BRIEFING

Offshore wind energy in Europe

SUMMARY

Offshore wind is a highly promising renewable energy source (RES) that could make a major contribution to global and European efforts to decarbonise the economy by 2050 and keep global warming to around 1.5°C above pre-industrial levels, as set out in the Paris Climate Change Agreement. The European Commission expects the EU to produce at least 240 gigawatts (GW) of global offshore wind power capacity by 2050, while international organisations specialising in the energy field are even more optimistic about the prospects of this energy source. Europe accounts for 80 % of global offshore wind capacity and is the dominant region in terms of technologies and manufacturing. Offshore wind accounts for 210 000 jobs in Europe (over half of all jobs in wind energy), and this number should increase further with greater investment.

Wind is the only offshore RES that is currently deployable on a commercial scale and there is vast untapped potential in the world's oceans and seas, even if only some potential sites can be developed. Offshore wind has a higher capacity and more consistent output than other variable RES, with the International Energy Agency describing it as a unique 'variable baseload' technology that could help to integrate the decarbonised energy systems of the future. A major constraint on offshore wind has been the difficulty of building fixed constructions in depths greater than 60 metres. Floating bases for offshore wind turbines could then prove to be a game changing technology, allowing much wider exploitation of wind resources. Many of the leading projects for commercialising these floating technologies are based in Europe. Hybrid projects linking offshore wind to other uses – such as hydrogen production or battery storage – represent another important avenue for offshore wind to contribute more widely to our energy systems.

The Commission is expected to adopt a new strategy for offshore RES in 2020, proposing further EU action to scale up deployment of offshore wind and invest in its underlying technologies. Some EU Member States have set their own indicative targets for offshore wind deployment by 2030, accompanied by a range of support schemes. The European Parliament has been supportive of offshore wind energy, in particular the potential for a North Sea offshore grid (energy hub).

In this Briefing

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Challenges and advantages

The Paris Climate Change Agreement, to which the EU and its Member States are all signatories, seeks to maintain global warming at well below 2°C, and much closer to 1.5°C, above pre-industrial levels. To achieve this ambitious goal, a vast expansion of renewable energy deployment will be required on a truly global scale. This has prompted policymakers and scientists to search for reliable and clean sources of renewable energy with huge potential and multiple uses that are also technologically and commercially feasible to exploit. Offshore wind ticks all of these boxes and could therefore play a major role in the world's clean energy transition. It is a renewable energy source (RES) where the EU has both the technological lead and currently offers the largest market, which means offshore wind has a particularly promising role to play in the EU's efforts to achieve net zero emissions by 2050. The European Commission estimates that between 240 and 450 GW of offshore wind power is necessary globally by 2050 to keep temperature rises below 1.5°C. As electrification increases to account for at least half of the global energy mix by 2050, the Commission estimates that 30 % of future global electricity demand could then be supplied by offshore wind.

The first offshore wind farm was installed in Denmark in 1991, but it is only over the past decade that the market has really taken off. Technological progress and significant cost reductions have transformed offshore wind into a safe and commercially viable form of clean power generation. Offshore wind projects can be slower to get going than their onshore equivalents. Wind farms have to be located in the territorial waters (14 nautical miles) or exclusive economic zones (200 nautical miles) of their host country. They must go through a complicated approval process, including environmental impact assessments that consider their effect on marine habitats, migrating birds, etc. Wind turbines must avoid other human infrastructure at sea (e.g. cables for electricity and telecoms, and gas pipelines) and not interfere with major shipping routes. Offshore wind turbines are also more costly than their onshore equivalents to set up and connect to onshore electricity grids. Yet in the longer run, offshore wind has numerous advantages over onshore wind: a much bigger fleet of wind turbines is possible at sea; wind power generated offshore has a higher and more consistent output than on land; and offshore projects are less likely to run into objections from citizens concerned about the impact of wind turbines on their immediate living environment. Most offshore wind turbines in shallow waters rest on fairly simple monopile foundations, while more complex (and expensive) gravity or jacket foundations are used in deeper waters.[1] There are considerable synergies with the offshore oil and gas industry, which provided much of the initial technology used to develop offshore wind. The main challenge for offshore technologies is the cost and difficulty of building solid foundations at water depths greater than 50 to 60 metres, greatly limiting the choice of potential locations. The development of floating foundations could therefore prove to be a game changing technology that can scale up global deployment of offshore wind.

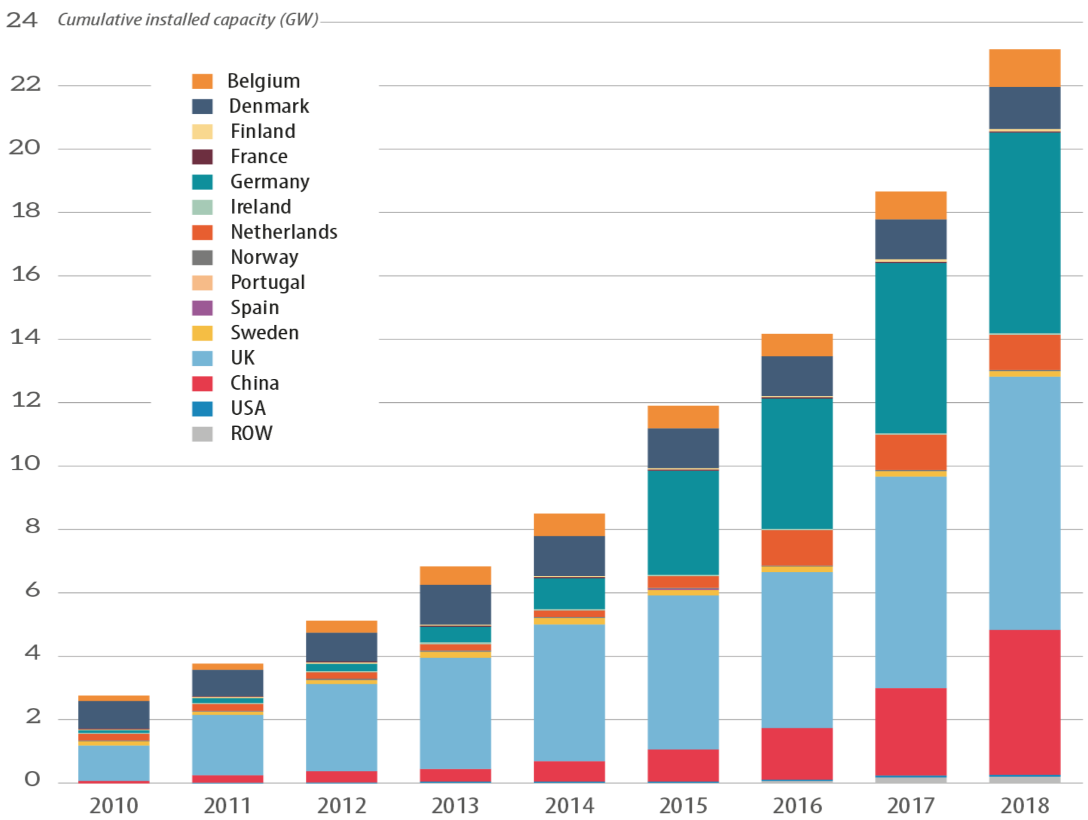
Global and European market outlook

Global market transformation

The past decade has seen exponential growth in the offshore wind sector. According to a recent industry report from the Global Wind Energy Council, offshore projects in 2019 accounted for 10 % of annual capacity additions in global wind energy, compared with only 1 % in 2009. Offshore wind now accounts for 5 % of global wind energy capacity and its relative share is increasing as individual offshore projects tend to dwarf onshore ones in size. Nevertheless, offshore wind generates only 0.3 % of global electricity production, so the potential for further growth is enormous. The International Energy Agency's outlook report on offshore wind argues that far more could be done to tap this technology's vast potential and rather unique status as a clean 'variable baseload' technology that can fully complement other energy sources and help to integrate energy systems more effectively. Offshore wind has a greater capacity factor and more stable output than either onshore wind or solar power. It can generate electricity at all hours of the day and produces more energy during the winter months when consumption needs are highest. This makes it complementary to solar photovoltaics (PV), which generate most energy during the summer but much less at other times. These features increase the system value of offshore wind in any decarbonisation scenario, and could help to reduce the system costs of the clean energy transition.

Whereas China dominates the global market for onshore wind (35 % of global capacity compared with 30 % for the 27 EU Member States plus the United Kingdom (UK), and 16 % for the United States (US)), the picture is very different for offshore wind, where almost 80 % of global capacity (23.1 GW) is located in Europe. The leading European markets are the UK (8 GW capacity) and Germany (6.4 GW), followed by Denmark (1.3 GW), Belgium (1.2 GW) and the Netherlands (1.1 GW).[2] Other EU countries planning to invest significantly in offshore wind include Ireland, France, Lithuania and Poland. Spain and Portugal could do the same if floating technologies become commercially feasible and allow the exploitation of deeper Atlantic waters. China is currently third in terms of global capacity (4.6 GW), but should soon become the market leader as several large offshore projects come on stream. However, offshore wind accounts for only 0.1 % of China's electricity production and its market share is due to decline after 2022 as central government subsidies end. Asia could nevertheless become the leading global market for offshore wind because of the rise of new players such as Japan, South Korea, Taiwan and Vietnam. These countries are all developing large offshore wind projects that should come on stream by the late 2020s or early 2030s. Meanwhile, the US is building 15 offshore wind installations on the Atlantic coast, to be ready by 2026. North America as a whole is a new market for offshore wind that is expected to reach 23 GW of capacity by 2030. Brazil, India, Mexico and Sri Lanka are among other countries that have ambitious plans for offshore wind that still require concrete financing decisions to be made.

Figure 1 – Cumulative installed capacity of offshore wind energy worldwide



Data source: JRC, Technology Market Report on Wind Energy, European Commission 2019.

The global prospects for offshore wind are improving as the costs of production are falling rapidly. According to the International Energy Agency (IEA), the levelised costs of electricity (LCOE)[3] produced by offshore wind is now below US$140 per megawatt-hour (MWh) and is due to decline a further 40 % by 2040, making the technology competitive with other renewables (e.g. onshore wind and solar power) as well as natural gas. The average upfront cost of building a 1 GW offshore wind project, including transmission, was over US$4 billion in 2018, but is set to drop by more than 40 % over the next decade, driven by a 60 % reduction in the costs of turbines, foundations and their installation. The IEA study is sanguine about global investment prospects however: 'Offshore wind power capacity is set to increase by at least 15-fold worldwide by 2040, becoming a $1 trillion business. Under current investment plans and policies, the global offshore wind market is set to expand by 13 % per year, passing 20 GW of additions per year by 2030. This will require capital spending of $840 billion over the next two decades, almost matching that for natural gas-fired or coal-fired capacity. Achieving global climate and sustainability goals would require faster growth: capacity additions would need to approach 40 GW per year in the 2030s, pushing cumulative investment to over $1.2 trillion… Over the next two decades, its expansion could avoid between 5 billion and 7 billion tonnes of CO_2 emissions from the power sector globally, while also reducing air pollution and enhancing energy security by reducing reliance on imported fuels'.

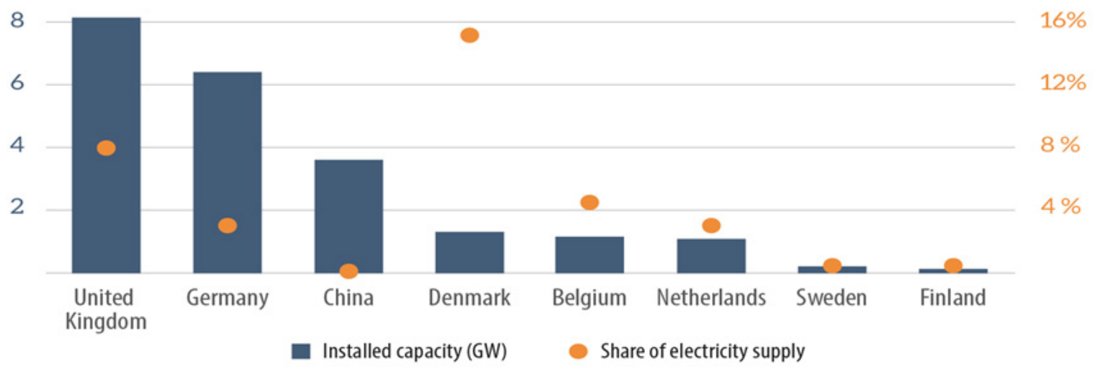
The International Renewable Energy Agency (IRENA) is confident about the prospects for wind energy. In a 2019 study on the future of wind, IRENA sets out a climate-resilient pathway compatible with the Paris Climate Agreement. This pathway envisages the global installed capacity of offshore wind increasing almost 10-fold by 2030 (to 228 GW), and continuing to rise until it nears 1 000 GW by 2050. This would require annual capacity additions of 45 GW (compared to only 4.5 GW added in 2018). Under this pathway, Asia would drive the capacity increase, becoming the world leader in offshore wind energy by 2050 (60 % of the market), followed by Europe (22 %) and North America (16 %). Improved technologies would lead to much higher capacity factors, thereby lowering costs and making offshore wind competitive with other renewables as well as fossil fuels. Yet this pathway hinges on large and sustained annual increases of 25 % in investment in offshore wind energy, and is considerably more optimistic about investment growth than the principal scenarios set out by the IEA (see below).

Prospects for Europe

Europe remains the global leader in offshore wind, with 80 % of total capacity and significant new investments planned by several Member States. Within the EU-28, offshore wind accounts for 10 % of total wind energy capacity and 23 % of annual capacity additions in 2018. According to figures from the European Investment Bank, 10 million households in the EU-28 are now served by offshore wind energy. Nevertheless, offshore wind in Europe is currently concentrated in a handful of countries with territorial waters in the North Sea: the UK (44 % share of capacity), Germany (34 %), Denmark (7 %), Belgium (6.4 %) and the Netherlands (6 %). In the UK and Belgium, offshore wind accounts for more than a third of total wind power. While a number of projects are looking to exploit wind power in the Atlantic and the Baltic Sea, there has been little interest so far in tapping the potential of offshore wind in the Mediterranean. According to a 2017 Wind Europe study, offshore wind is on track to meet 7 to 11 % of Europe's electricity demand by 2030, yet more could be done. Offshore wind could theoretically meet over 80 % of Europe's electricity needs if all reasonably priced locations were exploited (at an average cost of €65/MWh), while up to 25 % of Europe's energy needs could be met just by exploiting the most favourable offshore locations (at an average cost of €54/MWh).

Europe is unlikely to lose its leading role in the offshore wind sector any time soon. Under the IEA's **stated policies scenario** (based on existing government policies), the EU and UK combined will account for nearly 40 % of the global offshore market by 2040, and will increase their installed capacity to almost 130 GW. Offshore wind would then deliver 16 % of the region's electricity supply by 2040 (12 % by 2030). Under the IEA's more ambitious **sustainable development scenario**, EU offshore installed capacity increases by almost 40 % relative to the stated policies scenario, reaching 175 GW by 2040. Together with other renewables, nuclear power, and carbon capture, utilisation and storage, offshore wind would help to lift the low-carbon share of generation above 90 % in the EU in 2040. Under this scenario, offshore wind would account for 20 % of the EU's electricity supply in 2040 and rival onshore wind as the largest source of electricity generation. This will have benefits not only in terms of decarbonisation but also in maintaining European leadership in offshore technologies and securing employment in this high-skill sector. According to the European Commission's Blue Economy report 2020, employment in offshore wind has been growing and in 2018 accounted for 210 000 jobs in the EU plus the UK, 51 % of total employment in the wind energy sector. Most of these jobs are in manufacturing (60 %), while around a quarter are in operation and maintenance of wind farms. The report estimates that a 50 MW wind farm accounts for around 5 000 full time equivalent jobs during its lifetime.

Figure 2 – Offshore wind installed capacity and share of electricity supply by country, 2018



Data source: IEA, Offshore Wind Outlook - Special Report, International Energy Agency, November 2019.

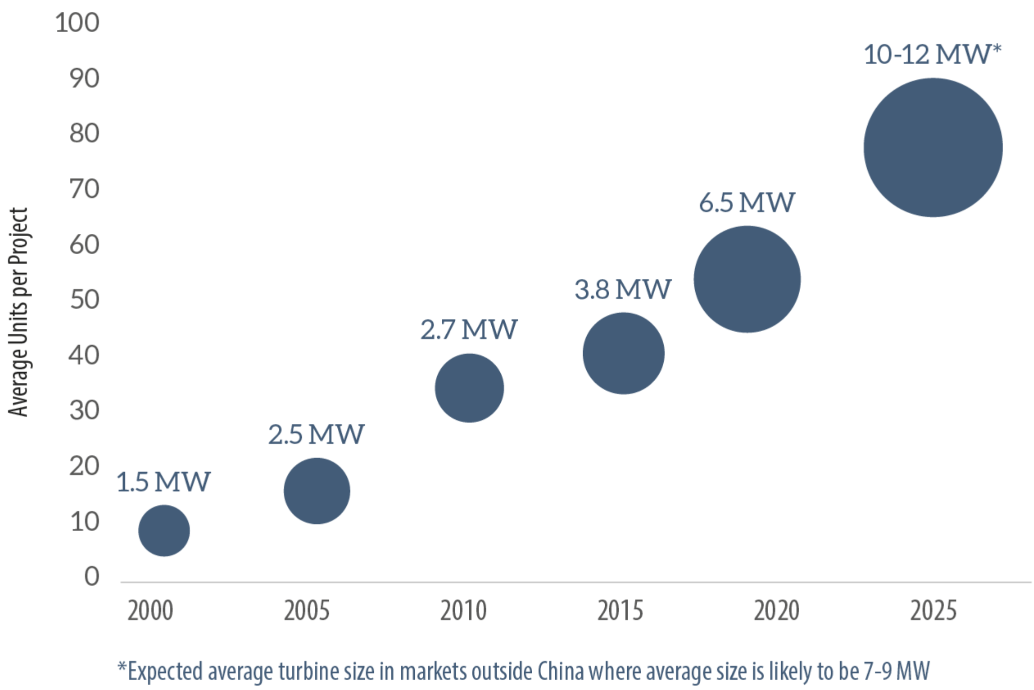
The reason offshore wind has such potential for job creation in Europe is that EU companies have a dominant technological and manufacturing position in the European market. As more countries around the world seek to develop offshore wind, this provides promising new export avenues for European industry. According to a Joint Research Centre technology market report, three EU companies account for 98 % of the market share for wind turbines in Europe: Siemens-Gamesa (69 %), MHI Vestas (24 %), and Envion (5 %).[4] European manufacturers also dominate the global market for foundations, electricity substations, offshore cables and installation vessels. Yet continued European dominance in this sector is not a given. The Chinese market is almost entirely (95 %) in the hands of Chinese companies, which may seek to offer their technologies and production capacity to the most promising Asian and Latin American markets. The 1920 Jones Act regulating maritime navigation means that offshore wind projects in the US must entrust US companies with full production of the installation vessels needed to set up wind turbines. As discussed in a 2015 study for the European Parliament's Committee on Industry, Research and Energy (ITRE), the Jones Act and other protectionist measures in the US increase the cost and complexity of the global supply chains required for renewable technologies, and have the effect of discouraging imports from Europe. China is already dominant in a few components of the offshore wind market that require economies of scale, such as wind turbine blades. It will require considerable ingenuity for the EU to maintain its technological lead and market dominance in the offshore wind sector, given the expected future size of the Asian market and the ability of China to succeed in global manufacturing. China already dominates manufacturing of solar PV panels and has a large share of the global market for onshore wind.

Technological developments and clean energy potential

Floating technologies

A major game changer for offshore wind would be the commercial development of floating technologies, allowing large wind turbines to be deployed in waters deeper than 50-60 metres, where it remains technically impractical and commercially unviable to build fixed foundations. According to a policy paper from Wind Europe, floating technologies would allow wind turbines in a vastly increased number of locations where the wind blows more strongly and consistently than in locations closer to shore. Wind Europe considers that turbine construction in deeper waters is less likely to face objections from citizens than either onshore projects or offshore projects located close to shore. In any case, floating technologies could greatly scale up the capacity of offshore wind, especially if accompanied by continued advances in turbine size allowing for greater energy capture. Floating technologies make it more likely that Japan and the US will fully exploit their offshore wind potential, since most of it is located in deeper waters. It would also make European countries bordering the Atlantic (e.g. Spain, France and Portugal) more likely to consider major investment in offshore wind. Floating foundations could therefore have a transformative impact on the European market, where 80 % of offshore potential lies in waters deeper than 60 metres.

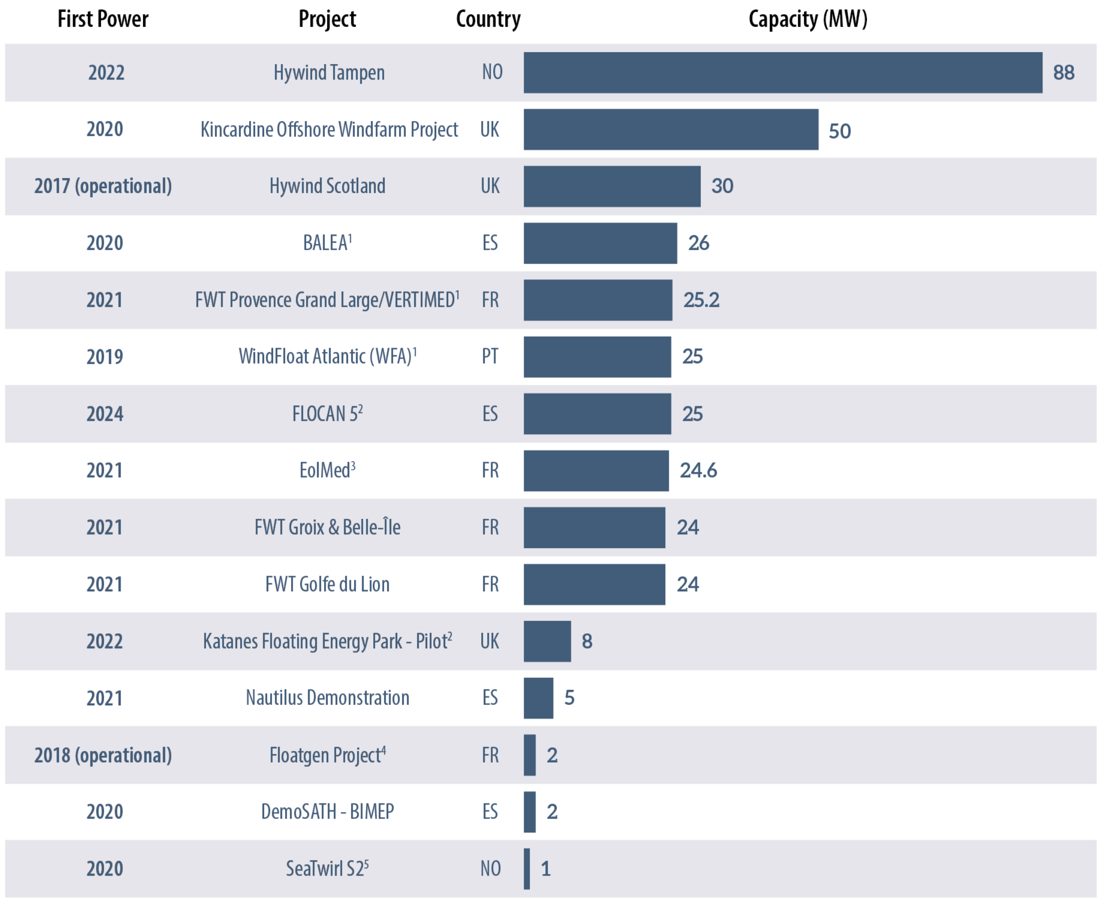
Figure 3 – Evolution of offshore wind turbine and project size



Data source: GWEC, Global Offshore Wind Energy Report, Global Wind Energy Council, August 2020.

Many floating offshore projects are still in their demonstration or pre-commercial stages, yet the first floating wind farm on a small commercial scale was launched in the EU in 2017. **Hywind Scotland** has a generating capacity of 30 MW and is located in the North Sea. A joint venture of Equinor (the Norwegian state energy company) and Masdar (an energy company in the United Arab Emirates), it now supplies electricity to mainland Scotland. In 2018 the **Floatgen** demonstration project was launched in France to test the potential for floating technologies in the Atlantic Ocean. The success of Floatgen means that a public tender in France is expected in 2021 to start producing offshore wind energy using floating technologies. Further demonstration and pre-commercial floating offshore projects are expected in Spain, France, Norway and the UK. Two projects by Equinor seek to generate energy from floating technologies on a larger commercial scale. Hywind Tampen (88 MW capacity) is designed to power offshore oil and gas platforms in Norway and is due to start operations in 2022. A floating wind farm off the Canary Islands could become the largest project in size (200 MW capacity) and supply clean electricity to these remote islands as early as 2024. Several floating offshore projects have received EU funding, some under the NER300 programme for innovative low carbon technology. Equinor believes that floating wind has the potential to power

Figure 4 – European floating offshore wind farms (announced and operational)



[1] Funded by the EC's NER300 programme
[2] Combined wind-wave generator. Project will be further developed to 47MW
[3] Co-financed by the European Investment Bank
[4] Funded by the EC's FP7 programme
[5] Received a €2.48 million grant from the European Innovation Council's SME instrument

Data source: JRC, Technology Market Report on Wind Energy, European Commission, 2019.

12 million homes in Europe by 2030, when it should be competitive with other forms of energy. Outside Europe, the most promising markets for floating wind technologies are Japan, South Korea, Taiwan and the US. Japan has four demonstration projects in progress and several more are planned.

Hybrid projects

Most decarbonisation scenarios envisage offshore wind playing a significant role in cutting greenhouse gas emissions, especially in light of the sustained cost reductions and technological developments allowing exploitation of wind resources in deeper waters. Not only does offshore wind have significant potential for electricity generation, it could also serve other vital purposes such as hydrogen production and powering batteries for energy storage. The IEA study is particularly optimistic about the prospects of using offshore wind to produce hydrogen, a fuel with considerable potential for use in energy-intensive industries where decarbonisation is most difficult, and perhaps a valuable form of energy storage in future. The EU hydrogen strategy (July 2020) makes it clear that this fuel lies at the heart of the EU's efforts to decarbonise its energy supply. Using offshore wind to produce hydrogen has significant advantages over using electricity from the grid, by avoiding the need for costly transmission infrastructure and ensuring the underlying source of power to produce hydrogen is clean. The IEA estimates that offshore wind could save 60 to 80 % on the costs of electricity input to produce hydrogen. Offshore wind has a high and steady capacity and can make full use of the electrolysers used to produce hydrogen (giving value for money), especially when compared to other variable renewables such as onshore wind and solar power. In addition, using a share of offshore wind energy to produce hydrogen or for battery storage has the advantage of limiting the amount of offshore wind power that needs to be integrated with the onshore grid. This means less electricity grid infrastructure is necessary and there will be fewer curtailments of offshore wind power whenever electricity supply greatly exceeds demand.

Advances in 'hybrid projects' involving offshore wind could be the key to unlocking its full energy potential. According to the IRENA study, some of the largest hybrid projects involving offshore wind are based in China. However, other significant hybrid projects are based in Europe. GE Renewable Energy and Max Bögl Wind AG are developing a 13.6 MW wind farm combined with a 16 MW pumped hydro plant in Germany's Swabian-Franconian Forest. In Scotland, the world's first hybrid project – Batwind – has been using electricity generated by Hygen Scotland (pioneering floating technologies) to supply battery storage of 1-1.3 MWh since 2018. That same year, MHI-Vestas and EDP completed Spain's first hybrid 3.3 MW wind and solar project. In 2019, Denmark's Ørsted announced pioneering efforts to develop green hydrogen projects produced by offshore wind power as part of its bid for the Holland Coast South 3 and 4 projects in the Netherlands.

Environmental concerns

Although offshore wind has the advantage of not interfering directly with people's living environment (unlike solar panels or onshore wind turbines), offshore wind projects can nevertheless generate numerous objections on environmental grounds. Some argue that offshore wind turbines are a major interference with the natural environment and a threat to the fish and mammals that thrive in the oceans, as well as to migrating birds. Others argue that the threat to the environment is minimal or at least manageable, and needs to balanced alongside the benefits of reducing greenhouse gas emissions and air pollutants. In support of this view, studies have shown that monopile foundations for wind turbines can attract marine life by acting as natural reefs. The World Wide Fund for Nature (WWF) commissioned a literature review on the benefits and drawbacks of offshore wind installations. This review notes there are considerable gaps in our knowledge about the environmental impacts of wind turbines, due in part to limited data on the baseline scenario (i.e. the existing state of the marine environment in the oceans). Better data is needed on species distribution and abundance over the annual cycle, as well as on the migration routes of birds, fish and marine mammals. The WWF review notes there are already ways to reduce the impact of construction noise (e.g. through 'soft start' construction activities or 'pingers' to keep marine life away from construction sites) and more should be explored. While offshore wind installations can serve as artificial reefs that attract even more marine life than natural reefs, care must be taken to ensure that this does not lead to species distortion or act as a stepping stone for invasive species. The WWF review finds that wind turbines pose major risks to some vulnerable bird species, including migrating ones. Offshore wind turbines should not be built where they can damage vulnerable species by affecting their traditional breeding and feeding grounds, or by interfering with their migration paths. Policymakers should also consider the benefits of human food or animal feed production in the vicinity of wind turbines (e.g. mussel farms in the North Sea). A recent external study produced for the European Parliament looked at the impact of offshore wind on European fisheries. The study notes the potential for a sharp increase in spatial conflict over the next five years as fisheries and offshore wind seek to exploit the same area. The study proposes various mitigation measures that could be put in place to reduce the potential for such conflict.

Towards a European strategy

EU-level initiatives

As part of its European Green Deal (December 2019), the European Commission announced that it would prepare an EU strategy for offshore wind in 2020. This was later broadened into an EU offshore renewable energy strategy expected to be adopted in late 2020. Wind power is likely to be at the very core of this new EU strategy because it is the only offshore RES that is currently deployed on a commercial basis. Other promising offshore technologies include wave, tidal and floating photovoltaic energy. However, for now such technologies remain mostly at the stages of research, development and demonstration. The Commission put the roadmap for its offshore renewables strategy out to public consultation between 16 July and 24 September 2020, and received feedback from a range of stakeholders and individuals. In contrast with studies produced by international organisations specialising in the energy field (see above), the Commission's roadmap seems more pessimistic about the state of offshore renewable energy, noting that the 'current offshore wind and renewable development pace is far too slow and constrained to meet the needed massive scale up to ensure climate neutrality by 2050. There are major obstacles to its wider and efficient deployment... [and] only a step change in regional cooperation between the Member States and European coordination will allow leveraging the EU's offshore renewables to the necessary capacity by 2050 in cost efficient, sustainable and cohesive ways ... without a strategic approach across European and national policy as well as financial instruments to step up and steer the long term sustainable development of offshore energy, the EU risks losing its current technological and industrial leadership in this field, and failing to grasp its related post Covid-19 recovery sustainable growth and inclusive jobs potential. We could even have Member States or regions developing in a sustainable way offshore energy, while others do not capitalise on its potential or exploit it in an environmentally harmful way'.

Nevertheless, the Commission anticipates that 250 GW of cumulated offshore wind capacity will be deployed in the EU by 2050. Unlike existing capacity, which is concentrated in the North Sea, the new capacity will also extend to the Baltic Sea, the Black Sea, the Mediterranean and the Atlantic. The offshore renewable strategy envisages a legislative revision of the 2013 EU regulation on trans-European energy networks (TEN-E), which will improve its applicability to cross-border offshore infrastructure that serves a hybrid purpose. Considerable synergies are also likely to be found between the offshore renewables strategy and EU strategies on hydrogen and sector coupling.

Offshore projects are eligible for EU funding on numerous grounds, including as cross-border energy infrastructure, research and innovation projects, action to boost regional development (especially in maritime areas), and financial support for promising European industries. Most EU funds are distributed either directly by the Commission or via Member State authorities. In addition, offshore wind projects are usually eligible for low interest loans from the European Investment Bank (EIB), whose lending focus has shifted heavily towards projects with a climate action component, including the promotion of RES. Examples include a loan of €250 million to build an offshore wind farm in Belgium, financed jointly by the Commission and the EIB under the European Fund for Strategic Investments. As part of its ordinary project funding, the EIB recently provided a €450 million credit line to build an offshore wind farm in France.

Intergovernmental action

North Seas Energy Cooperation (NSEC) is an intergovernmental agreement established in 2016, bringing together nine European countries (Belgium, Denmark, France, Germany, Ireland, Luxembourg, Netherlands, Norway and Sweden) with the aim of improving conditions for the development of offshore wind in the North Sea. NSEC prioritises four main work areas: maritime spatial planning; development and regulation of offshore grids; finance for offshore wind projects; and standards, technical rules and regulations for offshore wind. NSEC seeks to meet the EU's long-term strategy of delivering 240-450 GW of offshore wind in 2050, and works closely with the European Commission, which is heavily involved in its meetings. In July 2020, NSEC adopted a joint statement calling for a European enabling framework for offshore wind energy that considers how to tackle existing barriers to cross-border and hybrid projects. NSEC also calls for guidance for EU and EEA countries on how to implement projects, ensure adequate electricity market arrangements, and secure sufficient EU financing to meet these objectives.

While the UK signed the original NSEC agreement and participated in its earlier meetings, a political and legal decision was taken to terminate the UK's membership of the NSEC at the same time as its EU membership ended on 31 January 2020. The NSEC has since adopted a new administrative structure and a three-year work plan that focuses on developing concrete offshore 'hybrid' wind and grid projects with a strong cross-border dimension and the potential to reduce the costs and space of offshore developments. Despite its departure from the NSEC, the UK is still involved in two of the three selected hybrid projects: Wind Connector (UK-Netherlands) and Nautilus Hybrid Interconnector (UK-Belgium). The third and largest hybrid project is a North Sea Wind Power Hub that can connect multiple wind farms in a hub-and-spoke configuration.[5] In this way, electricity flows from offshore wind farms are easier for the onshore grid to manage and limit the need for curtailment, while greatly reducing the number of connection lines that need to be built. The proposed power hub is directly linked to the EU's single electricity market and therefore UK participation is not envisaged. Nevertheless, the UK remains the world's largest market for offshore wind and has the greatest potential capacity in Europe (see below), so UK participation could add both scale and expertise to projects where EU partners are involved. At the same time, the contours of the future energy relationship between the UK and the EU remain unclear, with the UK government consistently expressing its desire to detach itself from the EU single market.

National approaches

European countries have set differing goals for increasing the share of offshore wind in their energy mix. The UK has set a target of 30 GW of wind capacity by 2030 (compared with 10 GW at present), in order for offshore wind to meet around 40 % of its electricity needs.[6] Meanwhile, France is aiming for 2.3 GW capacity by 2023 and thereafter to increase capacity annually by around 1 GW. Denmark has set a goal of 6 GW operating capacity by 2030. The Netherlands has set an offshore wind generation target of more than 49 terawatt-hours (TWh), which implies a total installed capacity of 11.5 GW by 2030. Eleven EU Member States plus the UK envisage offshore wind energy in their financial support schemes for RES. Most RES support schemes are technologically neutral, so as not to violate EU state aid rules that prohibit the selectively beneficial treatment of individual companies, as well as to ensure more market-based pricing that will eventually lead to lower costs for consumers. Nevertheless, the 2018 revised EU Renewable Energy Directive broadens the possibility for technology specific tenders, including for offshore wind, in recognition of the specific characteristics of different RES and their varied availability across Member States. The provisions of the revised Renewable Energy Directive will take full effect across the EU from July 2021.

Nine EU countries with RES support schemes that cover offshore wind (Denmark, Germany, Ireland, Greece, France, Italy, the Netherlands, Poland and Finland) have opted for tender-based feed-in premiums (FIPs), whereas Belgium and Sweden grant tradeable green certificates (TGCs). In practice though, five of these countries have never allocated FIPs to offshore wind (Ireland, Greece, Italy, Poland and Finland), while Sweden does not have any offshore projects that benefit from TGCs. The length of guaranteed financial support for FIPs also varies: 20 years in Germany, 15 years in the Netherlands, and only 12 years in Denmark. In all these EU countries as well as in the UK (which has adopted a Contracts for Difference approach since 2015), the auction price of offshore projects has been falling, making the technology more competitive with other renewables as well as some fossil fuels. Two public tenders in 2017 and 2018 saw a total of seven zero-subsidy bids awarded in Germany. The Netherlands also secured a zero-subsidy bid in 2018. While there are common factors behind the falling costs of offshore wind (financing, technology, grid connections, etc.), the fact that

Germany and the Netherlands have pioneered zero subsidy bids is also closely linked to their preferred exploitation of nearer shore sites. According to the JRC-EU-Times model outlined in the JRC study, it is the UK that has by far the greatest energy potential from offshore wind (1 000 GW). Germany and the Netherlands have a potential closer to 100 GW and are due to fully exploit this in the coming decades, while Portugal has a similar level but will only exploit around a half of it. France has more than 300 GW of unused potential, while Denmark and Ireland have over 200 GW each, with all three countries planning to invest significantly in offshore wind projects. Some other EU countries possess very high offshore wind potential but have not made concrete plans to invest in this technology on a commercial basis (e.g. Spain, Finland and Sweden).

Position of the European Parliament

The European Parliament is generally supportive of offshore wind energy and sees this as a promising renewable technology. Parliament's resolutions of 21 May 2013 on renewable energy in the European internal energy market and of 5 February 2014 on a 2030 framework for climate and energy policies both emphasise the systemic importance of developing a North Sea offshore grid. The resolution of 2 July 2013 on blue growth calls for an integrated approach to the development of marine energy resources, by exploiting synergies between offshore wind energy and other forms of renewable marine energy. It reiterates support for a North Sea offshore grid and calls for a precise regulatory framework for this infrastructure from the Commission.

The resolution of 15 December 2015 on achieving the 10 % electricity interconnection target enters into more detail on the question and acknowledges that 'offshore wind in the North Sea region has the potential to generate over 8 % of Europe's power supply by 2030'. It also notes that 'coordination of the planning and building of a regional offshore grid infrastructure, market access and reserve sharing in the North Sea region could lead to cost savings of €5-13 billion per year by 2030 through a better integrated regional market' and calls on the Commission and the Member States to lend strong political support and endorse the North Sea offshore grid as 'a key step' in building an effective energy Union.

The resolution of 15 January 2020 on the European Green Deal welcomes the Commission's announcement of an offshore wind strategy. Parliament will have a further opportunity to provide its position in the context of the Commission's forthcoming EU strategy on offshore renewables.

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ENDNOTES

[1] There are three main types of offshore foundations. Monopiles are used in depths of 15 metres or less. These are fairly simple structures, made up of a thick steel cylinder that is anchored directly to the sea bed. They are buried up to 30 metres under the sea bed to support the tower. Gravity foundations are generally used in deeper waters of 30 metres or less. These involve a large concrete or steel platform with a diameter of approximately 15 metres and a weight of approximately 1 000 tonnes, and require the ground to be prepared beforehand. Jacket foundations or other complex anchoring structures are required at depths greater than 30 to 35 metres. Jackets are foundations with a lattice framework that feature three or four sea bed anchoring points, which increases the levels of safety when anchoring the towers. The top of the jackets features a transition piece that is connected to the turbine shaft, while three or four legs are anchored to the sea bed with piles.

[2] As a share of overall electricity consumption, offshore wind plays the biggest role in Denmark (15 %) and the UK (8 %), and a more limited role (3 to 5 %) in Belgium, Germany and the Netherlands.

[3] The levelised cost of electricity (LCOE) is an estimate of the cost of producing electricity by means of a given project, after considering the economic life of the plant and all costs incurred in its construction, operation and maintenance. The LCOE takes into account fuel costs, which are not relevant for wind power but necessary when comparing it with fossil fuels.

[4] Siemens-Gamesa is the result of a merger in April 2017 of two of the largest market players in Europe. The only non-EU company currently on the European wind turbine market is the US company General Electric, which supplied just 5 % of new capacity in 2018.

[5] The Danish parliament recently agreed on a similar project to create two 'energy islands' in the Baltic and North Seas, which would act as hubs and connect several offshore wind farms.

[6] UK Prime Minister Boris Johnson recently committed to increase this target to 40 MW by 2030, and incorporate a sub-target of 1 MW for floating wind projects by 2030.

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