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The UK's Approach to Climate Change as Seen in Offshore Wind Power Generation

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1. Introduction

In June 2019, the United Kingdom made news by enacting a "net zero" law aimed at reducing carbon dioxide emissions to zero. Interest in the UK's initiatives vis-à-vis climate change is growing, in part because the nation will serve as the president of the 26th United Nations Climate Change Conference (COP26) in 2021. And against this backdrop, there are rising expectations for offshore wind power generation as a source of low-carbon energy for the UK, a nation surrounded by the sea. The UK has the world's largest installed offshore wind power capacity, but how did it achieve this? This article summarizes the latest trends in the UK's offshore wind power generation and present the systems behind them. In particular, the Contracts for Difference Feed-in Tariff (CfD-FIT) is highlighted,looking back at the UK's offshore wind power market's development. I will also consider how the circumstances surrounding offshore wind power in the UK will change in light of the initial steps being taken by floating offshore wind and finalization of the UK's departure from the European Union (Brexit).

2. A current picture of offshore wind power generation in the UK

In 2019, the amount of electricity generated in the UK by renewable energy moved ahead of that generated by fossil fuels for the first time, and the share of renewables in the nation's energy mix grew to 40%.[1] Offshore wind power accounting for 24% of the nation's power generation from renewables,[2] and thus it could be described as a key source of next-generation low-carbon energy in the UK as a maritime nation. According to statistics of the European Wind Energy Association (WindEurope), the installed capacity of offshore wind power in Europe in 2019 exceeded 3.6 GW.[3] The UK newly installed 1.7 GW, or nearly 50%

[1] GOV.UK, UK Energy Statistics, Q3 2019, Retrieve from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/853580/Press_Notice_Q3_2019.pdf
[2] GOV. UK, Digest of UK Energy Statistics(DUKES) 2019 Chapter 6: Renewable sources of energy, Retrieve from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/840014/Chapter_6.pdf
[3] Wind Europe, Offshore wind in Europe – key trends and statistics 2019, Retrieved from https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Offshore-Statistics-2019.pdf

of this total, surpassing the second-ranked nation of Germany (1.1 GW) and far surpassing the third-ranked nation of Denmark (374 MW).[4] The number of offshore megaprojects currently operating in the UK is the largest in the world at seven. Among them are the London Array wind farm, whose installed capacity exceeds 600 MW, and the Walney Extension wind farm. There is also Hornsea Project One, which will become one of the world's largest offshore wind power stations with an installed capacity of 1.2 GW and which began supplying electricity in February 2019. Hornsea Project Two, which is an extension of this project, is scheduled to be completed in 2022. Additionally, construction of the Dogger Bank wind farm, slated to become the world's largest, began in January 2020. Scheduled to begin supplying electricity in 2023, Dogger Bank's installed capacity will reach 3.6 GW, enough to cover the electricity needs of some 4.5 million households. With such achievements, the UK is a driver of offshore wind power in not only Europe but also the world.

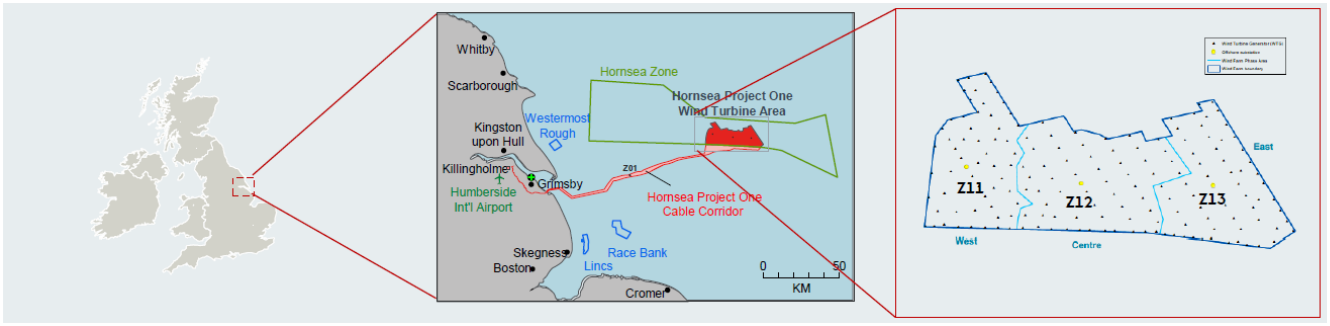

Figure 1: Hornsea Project One's planned sea area (from material prepared by Ørsted)

3. The UK's offshore wind power policies

In March 2019, the UK government announced the Offshore wind Sector Deal[5] through which it declared it would strengthen assistance to industry. Among other initiatives, it will invest as much as £250 million to build an offshore wind power supply chain, establish an Offshore Wind Growth Partnership to increase competitiveness, and increase spending for technical development to £7 billion by 2022. Moreover, during the UK general election of December 2019, the ruling Conservative Party pledged to raise the nation's offshore wind power target from the established 30GW to 40GW by 2030. The government subsequently decided to formally raise the target following the general election. Given that the UK's cumulative installed capacity was 9.9GW in 2019,[6] achieving this target will require a fourfold increase from the current level.

The UK's offshore wind power schemes were previously under the jurisdiction of the

[4] International Energy Agency, Offshore Wind Outlook 2019, published 25 October 2019.
[5] GOV.UK, Industrial Strategy Offshore Wind Sector Deal, published 7 March 2019.
[6] Ibid.

Department of Energy & Climate Change (DECC). However, the DECC was merged into the Department for Business, Energy and Industrial Strategy (BEIS) in 2016. The Offshore Wind Industry Council serves as a liaison between the government and industry and also formulates strategies and approves budgets for individual industrial sectors. Seabed leasing in the UK's territorial waters is handled by the Crown Estate, which is the management corporation for lands belonging to the British royal family. A lease must be received from the Crown Estate in order to construct an offshore wind power facility. The policy foundation for promoting the diffusion of offshore wind power was established under this system in the 2000s, and installation capacity has grown in stages ever since. The Crown Estate has sought bids for offshore wind power development sites on three occasions thus far, and it began soliciting for a fourth leasing round in October 2019.

Since 2002, the UK government has been promoting the introduction of renewable energy through a scheme called the Renewables Obligation (RO). It had previously combined the RO with a Feed-in Tariffs (FIT) scheme for small-scale power generation facilities (5MW or less) beginning in 2010, but this scheme ended in March 2019. On the other hand, in 2015, it began a shift toward a Contracts for Difference Feed-in Tariff (CfD-FIT) scheme based on a revision to the Energy Act 2013. The shift from the RO scheme was completed in September 2018. CfD-FIT is a measure that was proposed in the Electricity Market Reform of 2010 against a backdrop of the Climate Change Act of 2008 and increasing consumer burden.

4. A scheme to promote market-oriented renewable energy (CfD-FIT)

The CfD-FIT scheme resembles Feed-in Premium (FIP), in the sense that it compensates electricity producers for the difference between the minimum purchase price established by the government through bidding[7] (called the "strike price") and the wholesale price (in other words, the subsidy is added when the strike price is above the wholesale price and electricity producers refund the difference when it is below the wholesale price). On the other hand, FIP is a mechanism that adds subsidies[8] as premiums to wholesale electric power prices in the market. Its introduction has been advancing in recent years, most notably in Europe, as a renewable energy-promotion measure alternative to FIT schemes. Germany, which ranks behind the UK in terms of its installation of offshore wind power,

[7] In the UK, bidding is conducted not by individual power source but by dividing the entirety of renewable energy into two "pots" (Pot 1: established technologies; Pot 2: less-established technologies). Offshore wind power belongs to Pot 2.
[8] This refers to the sum obtained by subtracting avoidable expenditures (expenditures that electricity producers that are obligated to purchase electricity are exempted from paying under the renewable energy promotion scheme) is subtracted from the total purchased amount; levies that consumers pay to electricity producers are included. In the UK, the maximum amount of total subsidies to low-carbon power sources, including nuclear power, is established under the Levy Control Framework.

adopted an FIP scheme in 2012. [9] This kind of market-oriented renewable energy-promotion scheme encourages producers to adjust their sales in response to price, and can be expected to lead to the introduction of renewable energy in accordance with power supply and demand. It also has the advantages of promoting market competition and reducing subsidies. [10] What effects has the UK's CfD-FIT scheme had on the offshore wind power market? The CfD-FIT allocation round is implemented every two years by National Grid, which is the government-designated grid operator, and in past auctions the strike price tended to be below the wholesale electric power price. Looking at the results of the third allocation round announced in September 2019, [11] record-low prices were recorded by several offshore wind power projects, and so-called zero-subsidy projects came into existence in the UK for the first time. A "zero-subsidy project" refers to a project that achieves profitability solely with electricity sales at the wholesale electric power price. This increase in the number of zero-subsidy projects is symbolic of intensifying competition among electricity producers and decreasing offshore wind power generation costs.

The dramatic decrease in cost can be said to be mainly the result of precise scheme development by the UK government. However, it can also be said that behind this were the continuous technical support and infrastructure development provided by the government that facilitated cost reductions in terms of, for example, lower construction costs and fewer man-hours attributable to the larger size of wind turbines. It is unlikely that significant cost reductions could have been achieved without them. Nonetheless, it must be noted that cost reductions were achieved more quickly than before as a result of CfD-FIT's introduction.

It is anticipated that projects relating to current bidding will commence operation in around 2023, and final investment decisions will be made then based on market conditions at that time. A zero-subsidy project means facing risks in the electric power market, and thus electricity producers might need to reduce their own risk through, for instance, power purchase agreements (PPA). On the other hand, it is thought that project risk can be

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[9] Three types of FIP scheme exist depending on the method of adding premiums (floating premium, fixed premium, and fixed premium with a cap and floor). The German FIP scheme's premiums are calculated based on the average monthly market price for each renewable energy power source, and therefore it is a floating premium-type FIP scheme with fixed monthly units.

[10] The differences between conventional Feed-in Tariff (FIT) schemes and FIP schemes are illustrated in "*Sogo Shigen Enerugi Chosa-kai Kihon Seisaku Bunka-kai Saisei-kano Enerugi Shuryoku Dengen-ka Seido Kaikaku Shoiinkai (Dai-ikkai) Shiryo 4*" (Subcommittee on System Reform for Renewable Energy as Main Power Source, Advisory Committee for Natural Resources and Energy (No. 1) Material 4)
https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/saiene_shuryoku/001/pdf/001_008.pdf (Last viewed on March 20, 2020)

[11] GOV.UK, Contracts for Difference (CfD) Allocation Round 3: results - published 20 September 2019, revised 11 October, Retrieve from
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/838914/cfd-ar3-results-corrected-111019.pdf

avoided to a certain extent by means of industry-government collaboration through the Sector Deal. The question of whether or not electricity producers will make a final decision on investment will be the focus of increasing attention in the future.

Table 1: CfD-FIT and offshore wind power

Scheme	Year of introduction	Purchase period	Bidding for new offshore wind power projects
CfD-FIT	2015	15 years	・ Twelve renewable energy projects were decided in the 3rd allocation round. Of them, six are offshore wind power projects. ・ The lowest strike price for offshore wind power projects (at 2012 prices) is £39.650/MWh (approx. €52.48/MWh) and the highest strike price is £41.611/MWh (approx. €55.08/MWh)[11]. ・ The offshore wind market price is forecasted to be between £48.13/MWh and £51.23/MWh[12].

5. Expectations for offshore wind power generation

Almost all existing offshore wind power stations employ the “bottom-fixed” method.[13] However, the areas suitable for this method are limited, as, for example, installation in deep ocean areas is difficult. On the other hand, “floating” offshore wind turbines that use floating structures are attracting attention, and demonstration tests toward their commercialization are taking place in Japan. It is thought that the full-scale commercialization of floating offshore wind turbines would permit the generation of electricity even in deep ocean areas and result in a dramatic increase in the installation of offshore wind turbines.

In the UK, the Hywind Scotland floating offshore wind power station began operating off the coast of Scotland in 2017. The station has a power supply capacity of 30MW. Other floating offshore wind power stations include the Windfloat Atlantic project off the coast of Portugal, which began operation in January 2020, as well as the Windfloat Atlantic Phase 2

[12] GOV.UK, CONTRACTS FOR DIFFERENCE SCHEME FOR RENEWABLE ELECTRICITY GENERATION Allocation Round 3: Allocation Framework, 2019. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/799074/Allocation_Round_3_Allocation_Framework__2019.pdf

[13] In general, this method involves generating electricity by installing a supporting structure on the seabed of a shallow sea area of no deeper than 50 meters and then fixing a wind turbine on top of it.

project, also off the coast of Portugal, and the Hywind Tampen project in Norway's North Sea, which are planned projects. The Celtic Sea to the south of Ireland is anticipated to be a suitable location for large-scale floating offshore wind power development in the UK that will rival the coast of Scotland. The Offshore Renewable Energy Catapult (OREC) issued a report at the end of January 2020 estimating that the economic effects of floating wind power in the Celtic Sea would be worth at least £680 million and generate more than 3,200 jobs.

Floating offshore wind power still faces challenges in terms of cost and technology compared to the conventional bottom-fixed foundation method. At present, economic efficiency is just barely being achieved in subsidies-based installations like Hywind Scotland and in the non-power sales market, such as power supply to seabed oil field and gas production facilities. Nonetheless, expectations are rising for floating offshore wind turbines. This is because European countries are aiming to achieve grid parity for floating offshore wind power (a state in which clean energy power generation cost falls below conventional energy power costs), and because competition in the discovery of market opportunities is heating up to the point that even major companies are joining in. In 2018, the UK government announced that it would provide £73.5 million in funding over five years to OREC to promote technology and innovation. Whether this will provide a boost toward achieving the UK's goals of "net zero" in 2050 and 40GW installation in 2030 is something that will continue to be watched.

Figure 2: Floating offshore wind power at Hywind Scotland

6. What Brexit means for offshore wind power

On January 31, 2020, the UK officially left the EU and entered a transition period that will last approximately eleven months. Although measures to correct related laws were implemented to correct flaws that will arise from non-compliance with EU laws at the time of separation, [14] the CfD-FIT scheme's operation is not affected by them. Additionally, the UK will remain in the EU market and the EU Customs Union and will continue to comply with the EU's energy-related laws during the transition period. However, it remains to be seen

[14] The Feed-in Tariffs and Contracts for Difference (Amendment) (EU Exit) Regulations 2018 (SI.2018/1092)

what will happen after the transition period. Attention is being focused above all on how negotiations for a trade agreement with the EU will play out.

WindEurope issued a report titled "Brexit and wind energy: the current state of play" on February 4, 2020, that presents a pessimistic view concerning the establishment of a free trade agreement during the short transition period. Moreover, there are concerns that a Brexit-cause split in the market and inefficiency generated by restrictions on the movement of people and materials may complicate progress in offshore wind power. For example, it may become more difficult to secure the engineers and other human resources that support wind farm operation when the currently existing freedom to cross international borders is abolished.

7. Looking ahead to "net zero" in 2050

In 2017, the UK put forth its "Clean Growth Strategy" as a national strategy and simultaneously achieved a reduction in greenhouse gas emissions and economic growth. The UK also drives the world in offshore wind power, one of the major renewable energies, by constructing and operating the world's largest wind farms one after another. In Maritime 2050, a long-term strategy for ocean industries announced by the UK government in January 2019, the government pledged institutional support to strengthen offshore ports and other infrastructure to promote the spread of wind power and other forms of offshore energy. [15] In 2020, the Paris Agreement has become operational under the United Nations Framework Convention on Climate Change (UNFCCC); the UK will serve as the president of COP26. A new energy white paper scheduled to be issued this year is expected to show the UK's high aspirations vis-à-vis climate change. The UK's Energy White Paper will be published within 2020, and will be closely watched for how it addresses offshore wind power—and particularly floating offshore wind power—as well as technical innovation in the reduction of management and repair costs using AI and robots, hydrogen production, and the like. As it stands at the crossroads that is Brexit, the spotlight is on how, as it faces an uncertain future, the UK will promote and accelerate offshore wind power incrementally toward its long-term vision and achieve "net zero" in 2050.

Acknowledgement

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[15] GOV.UK, Maritime 2050 Navigating the future, published 24 January 2019, Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/773178/maritime-2050.pdf