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POLICY BRIEF

UK OFFSHORE WIND

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DISCLAIMER

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TABLE OF CONTENTS

SUMMARY AND KEY MESSAGES

The UK has made enormous progress in the deployment of offshore wind energy, which supplied 14% of the country's electricity in 2020. However, the sector now faces a series of challenges in scaling up capacity to meet the Government's new target of 50GW of offshore wind by 2030 – close to four times current levels – in just eight years. This scaling up has taken on a new urgency with energy prices at current levels, and the challenge of reducing the UK's dependence on imported gas.

The rollout of offshore wind in the UK has so far been a major policy success. The UK's experience in this area to date can help in the development of future policies and can provide lessons for renewables policy in the rest of Europe and elsewhere. This briefing examines the role of government policy in the growth of UK offshore wind to date, and the challenges facing the sector out to 2030 as it seeks to achieve unprecedented further growth.

THE EFFECTIVENESS OF POLICIES TO DATE

We identify the following key developments and policy approaches that have enabled the UK to achieve rapid growth in offshore wind energy:

Fixed prices provide effective incentives for investment. Contracts for difference (CfDs), which guarantee revenues for offshore wind generators, have proved vital to supporting investment in new offshore wind capacity. Several design features of CfDs have contributed to the policy's success:

1. The use of auctions has led to competition driving down costs.

2. The guaranteed revenue per MWh provided through the CfDs reduces investment risks associated with renewable electricity projects, further contributing to cost reduction. This has, by one estimate, lowered the cost of capital from about 6% to 3%.

3. The contracts are governed by private law, with a counterparty at arm's length from government. This increases investor confidence by reducing the risk of political interference in the delivery of CfDs.

4. Auctions are held at regular, predefined intervals, giving renewable energy developers a clear timeline to prepare bids to supply capacity. Between 2015 and 2022, CfD auctions were held at roughly two year intervals. The Government will now start annual auctions from March 2023 to enable an accelerated rollout.

5. Two-way CfD contracts are a hedge against price fluctuations in both directions. As a result, renewable energy projects generate revenue to the government when electricity prices are higher than the strike price, as they are at present. This enhances their political acceptability.

6. By dividing CfD funding into different pots for different technologies, a diverse portfolio of low-carbon generation has been incentivised.

While the UK approach to delivering CfDs looks set to evolve as part of ongoing electricity market reforms, the system will likely remain an essential instrument for delivering the required capacity growth.

Other policies have also contributed to the success of the programme.

Carbon pricing can be an effective means of supporting investment.

Carbon pricing acts as a financial disincentive for fossil fuel power which in turn makes low-carbon electricity generation more competitive. The UK's carbon price support (CPS) scheme led to the rapid decline of coal generation and helped signal a shift of investment towards renewables.

Electricity markets need to be designed to perform efficiently in a renewables-dominated system. Most electricity markets in Europe were created to deliver dispatchable fossil-fuel generation. This presents a challenge for increasing the share of renewable generation because the functioning of electricity markets strongly influences which technologies are deployed. Reforms undertaken in the UK almost a decade ago supported a rapid expansion of offshore wind and other renewables, but further changes will be needed in future to continue deploying renewables at pace.

FUTURE CHALLENGES

Despite its successes to date, the UK's ambitious goals for renewable energy expansion face several important challenges.

Permitting. Currently, it can take up to four years to approve the development of an offshore wind farm in the UK. The Government now plans to update planning rules to cut the approval time down to one year, and to streamline environmental assessments for offshore wind projects.

Increased grid capacity and flexibility plus storage. At a national level, electricity transmission infrastructure will need to be expanded to accommodate increased electricity flows, particularly between northern and southern regions of the UK, and to deal with more variable supply in an energy system dominated by renewables. Alongside this, the growth of energy storage and demand-side response will provide important grid-balancing services, helping reduce the costs of electricity supply. Increased interconnection with electricity markets elsewhere in Europe can play a valuable role.

Skills. The UK will need to invest in and retain a skilled workforce. There are opportunities to leverage skills from adjacent sectors - including offshore oil and gas, subsea, automotive and aerospace - to support the growth of offshore wind. The UK Government has committed to supporting the transition of North Sea workers to green jobs as part of the North Sea Transition Deal it agreed with the oil and gas industry in 2021. However this plan lacks specific detail on the nature or pace of the transition. The Government has also recognised the threat that the skills shortage poses to achieving renewable energy deployment targets and, in 2021, established the Green Jobs Taskforce with the goal of supporting the creation of two million jobs by 2030.

Supply chain capacity. The UK lags behind other countries in terms of its domestic turbine manufacturing capacity and has historically relied on imported turbine components. However, the UK has recently begun to see investment in domestic wind turbine manufacturing and, in early 2021, the Government invested in two new offshore wind ports to be constructed in the Humber region and Teesside. It is yet to be seen whether the UK's most recent target for offshore wind deployment will lead to significant new investment in UK turbine manufacturing.

Electricity Market Arrangements will need to be modified to function effectively with a predominance of very low marginal cost capacity on the system, and to address the problems currently being caused by marginal cost pricing with high gas prices. Some reform was undertaken about a decade ago but more will be needed in future.

INTRODUCTION

The UK is a world leader in the deployment of wind energy and has achieved remarkable growth in offshore wind generation during the last decade. Between 2009 and 2020 electricity generation from domestic offshore wind energy increased by a factor of 23 – from 688MW of capacity producing 1.75 TWh (0.5% total UK electricity generation) to more than 11GW of capacity producing 40.68 TWh (14% to total UK electricity generated in 2020).[1,2] By the autumn of 2022, the UK had around 14 GW of offshore wind capacity in operation.[3]

As the Government embarks on a process of modernising the power sector, offshore wind can deliver a win-win-win outcome in the form of reduced emissions, enhanced energy security and lower prices for consumers. These objectives have taken on a renewed urgency within the last year as energy prices continue to rise due to volatility in natural gas markets, placing an enormous financial burden on consumers. And while offshore wind capacity being planned today will not be deployed in time to alleviate the immediate energy crisis, **the technology will nonetheless play a role in preventing future price shocks while contributing to increasing the share of the UK's energy mix which is indigenous, and displacing gas power.**

Key to achieving this vision is the creation of a political and economic climate that supports the deployment of renewables. UK energy policies have played a significant role in the expansion of UK offshore wind capacity during the last decade. Today, unprecedented levels of political support and private capital are driving the expansion of UK offshore wind energy and continued rapid growth of the sector seems readily achievable.

However, this success was not a foregone conclusion. Only five years ago, investment in the UK renewable energy sector appeared to be in decline[4] following government cuts to green policies, and the UK ranked behind most other European nations in developing renewable energy capacity.[5]

The rapid expansion of UK offshore wind capacity has been accompanied by wind energy technologies having fallen in cost much faster than predicted[6] (Figure 1). Clearing prices (also referred to as "strike prices") for UK offshore wind projects - that is the guaranteed price per MWh awarded to wind developers through the UK's Contracts for Difference (CfD) scheme - have dropped by more than two thirds since the first

1 Figures derived from BEIS. (2022). Supplementary data for Annex O (Feb 2022): Energy & Emissions Projections. Retrieved 26 July 2022 from https://www.gov.uk/government/publications/energy-and-emissions-projections-net-zero-strategy-baseline-partial-interim-update-december-2021

2 2022 offshore wind capacity data from Renewable UK. Retrieved 8 August 2022 from https://www.renewableuk.com/page/UKWEDhome/Wind-Energy-Statistics.htm

3 Buljan. A. (2022 September). BREAKING: UK Puts Massive Amount of New Offshore Wind Capacity on Fast Track. OffshoreWIND.biz https://www.offshorewind.biz/2022/09/26/breaking-uk-puts-massive-amount-of-new-offshore-wind-capacity-on-fast-track/

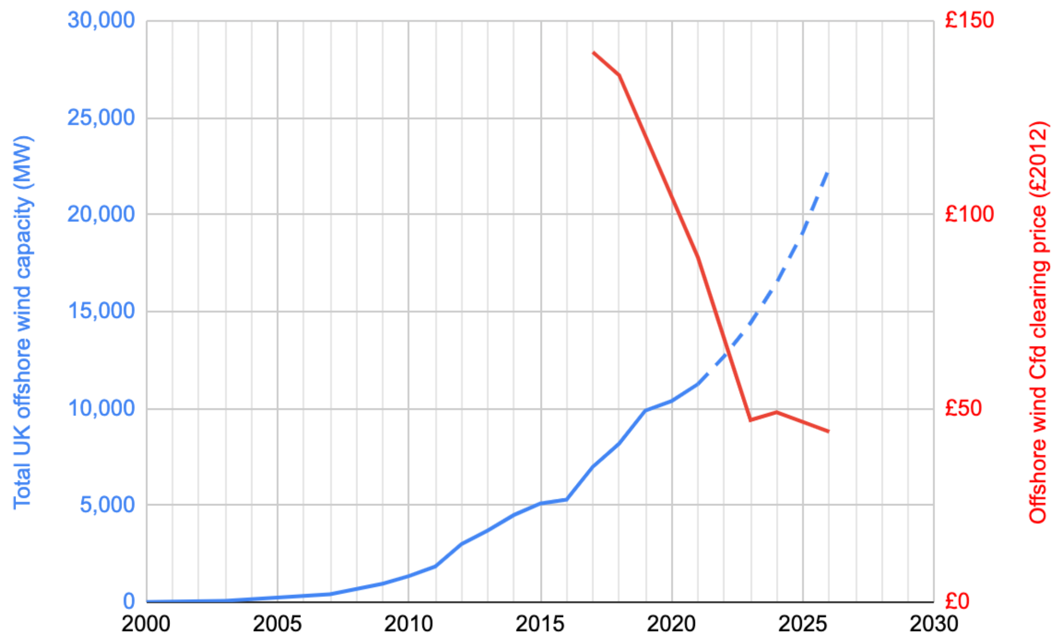
4 Vaughan A. (2017 January). Renewables investment in UK will fall 95% over next three years – study. The Guardian https://www.theguardian.com/environment/2017/jan/04/renewables-investment-uk-fall-95-percent-three-years-study-subsidy-cuts-emissions-targets

5 MarketLine. (2018). UK lags behind the rest of the EU in renewable energy consumption. Power Technology Retrieved 31 July 2022 from https://www.power-technology.com/comment/uk-lags-behind-rest-eu-renewable-energy-consumption/

6 Milborrow, D. (2021). WindEconomics: Cost of wind falling faster than predicted. Windpower Monthly https://www.windpowermonthly.com/article/1718149/windeconomics-cost-wind-falling-faster-predicted

CfDs were awarded in 2015.[7] The 2022 CfD auction saw projects starting in 2026/27 awarded supply contracts at a clearing price of £37.35/MWh.[8]

FIGURE 1: HISTORIC AND PROJECTED OFFSHORE WIND ENERGY CAPACITY IN THE UK AND CFD CLEARING PRICES BY PROJECT START YEAR.



Historic and projected UK offshore wind capacity (blue), and CfD clearing prices for allocation rounds one to four (red) according to project start year.

Sources: historical offshore wind capacity from irena.org. Projected offshore wind capacity (dotted lines) based on official UK targets from gov.uk.

Under plans announced by the UK Prime Minister earlier this year, domestic offshore wind power capacity is targeted to grow to 50 GW by 2030[9], almost five times existing capacity, and 20GW more than was planned just two years ago. Installing close to 40GW of additional offshore wind in just eight years is a highly ambitious target as historically it has taken at least a decade to bring an offshore wind farm to commercial operation.[10]

This briefing examines the role of government policy in the growth of UK offshore wind to date, and the challenges facing the sector out to 2030 as it seeks to achieve unprecedented growth.

UK renewable energy policy dates back to the nineties[11], with the introduction of the Non-Fossil Fuel Obligation (NFFO) in 1990. The NFFO subsidised both nuclear and renewable power generation via an obligation on the country's newly privatised energy companies to purchase power from non-fossil generators at a premium

7 Based on offshore wind project clearing prices for CfD Allocation Rounds one and four.

8 BEIS. (2022). Contracts for Difference (CfD) Allocation Round 4: results. Retrieved 28 July 2022 from https://www.gov.uk/government/publications/contracts-for-difference-cfd-allocation-round-4-results

9 BEIS. (2022). British energy security strategy. Retrieved 27 July from https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy

10 Bourne, S. (n.d.). Can the UK achieve its 50 GW offshore wind target by 2030? DNV. https://www.dnv.com/article/can-the-uk-achieve-its-50-gw-offshore-wind-target-by-2030--224379

11 See Annex 1 for a more detailed discussion of UK renewable energy policy up to 2010

UK POLICIES AND THE GROWTH OF OFFSHORE WIND TO DATE

price. Over time, it became apparent that, while certain forms of renewable energy were more investable in the short term, a more diverse portfolio of low-carbon electricity generation would be needed to meet the UK's emissions reduction targets.

This led to the creation of the Renewables Obligation (RO) which replaced the NFFO in 2002. Rather than offering contracts to renewable energy generators, the RO set an obligation on energy suppliers to purchase and supply a certain amount of generated electricity from renewable sources. The amount of renewable electricity was certified by Renewables Obligation Certificates (ROCs). Suppliers negotiated their own contracts with renewable electricity generators, or bought ROCs on the secondary market.

RO funding was later divided into several bands with different technologies attracting different numbers of ROCs. This enabled early expansion of offshore wind energy, which grew by a factor of 22, from 60MW in 2003 to 1.34GW of total capacity by 2010.[12]

While RO helped establish the UK's commercial offshore energy industry, the rapid acceleration of offshore wind power installations in recent years can be largely attributed to a series of policy changes that took place from 2013 – the introduction of contracts for difference in particular – which are detailed in the sections that follow.

Well-designed contracts for difference have by far been the most important driver of growth in offshore wind energy. However, several other policies played an important supporting role in paving the way for this rapid growth. Together, these policies have enabled offshore wind to become a highly competitive source of electricity generation through:

- ◊ **supporting first-of-a-kind projects** through creating demand for early-stage renewable energy technologies by the RO;
- ◊ setting a **clear long-term policy direction** for the UK electricity sector and discouraging investment in carbon emitting forms of electricity generation (carbon price floor, and the 2015 coal-phaseout announcement);
- ◊ **incentivising the switch to low-carbon power generation** by ensuring fossil generators face greater carbon costs and steering investment towards renewables;
- ◊ structuring the electricity market in a way that **enables the transition to a low-carbon electricity system** (electricity market reform).

The remainder of this section examines the impact that contracts for difference, the capacity mechanism, and carbon price support have had on the development of offshore wind energy.

12 DECC. (2010). Digest of United Kingdom energy statistics 2010. Retrieved 1 August 2022 from https://webarchive.nationalarchives.gov.uk/ukgwa/20101209110222/http:/www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx

CONTRACTS FOR DIFFERENCE

A central feature of reform was the establishment of Contracts for Difference (CfD). CfDs are contracts for low-carbon electricity supply awarded by a government backed counterparty, the Low Carbon Contracts Company[13] (LCCC) via a competitive bidding process. They pay the difference between the wholesale electricity price and a strike price set in the contract. They are thus designed to ensure stable prices for low-carbon electricity generation.[14]

Developers who participate in CfD auctions bid to supply low-carbon energy at the lowest price, with the winning bidders awarded contracts to supply electricity at a fixed price per MWh. The fixed price is indexed to inflation, though this is not a necessary feature of CfDs. Setting price by auction contrasts with Feed in Tariffs (FITs) where the contract pricing was set by the government.

CfDs have been the single largest driver of investment in offshore wind deployment since 2015.[15] Each successive auction has seen the capacity of offshore wind contracted significantly increase,[16] as can be seen in Figure 2, below. CfDs have also been instrumental in bringing down the cost of offshore wind projects and the cost per MWh has fallen substantially since 2015. In allocation round 1 (2015), the strike price stood at £114 - £119 per MWh but this had fallen to £37 per MWh in the fourth allocation round (2022).[17] Recent auction results indicate the costs of offshore wind have remained at similar levels, despite upward cost pressure, for example from rising materials costs.

13 The LCCC is a government-owned entity which independently administers CfD contracts

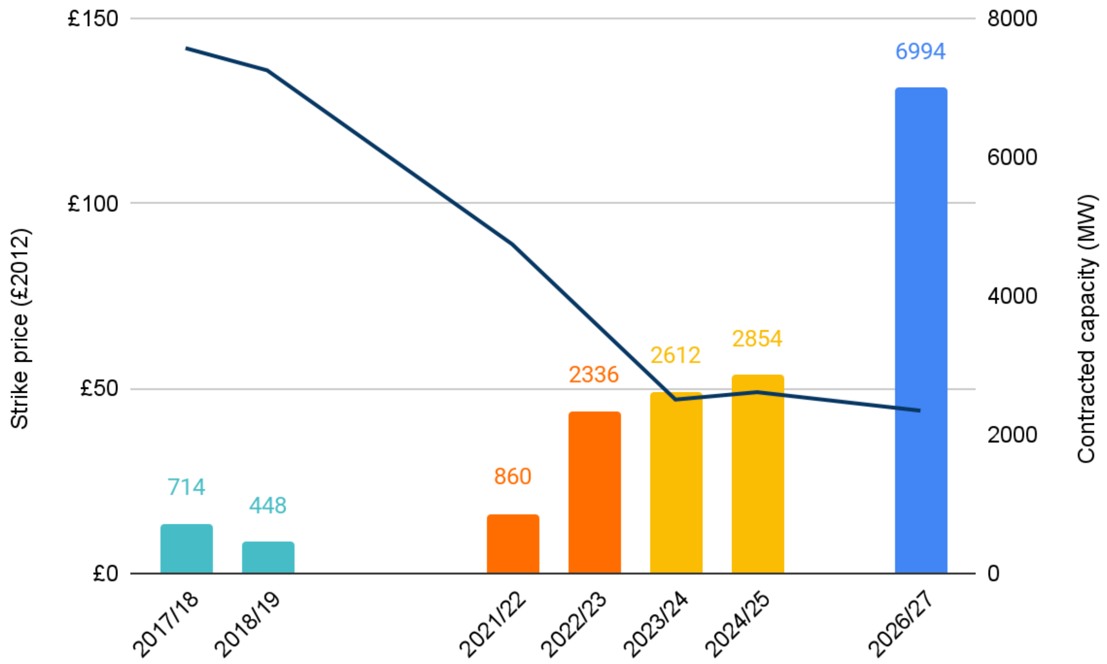
14 For further explanation of CfDs, visit https://www.blog.renewableuk.com/post/cfdexplainer

15 Grubb, M. (2022). Opinion: Renewables are cheaper than ever – so why are household energy bills only going up?. UCL News. Retrieved 8 August 2022 from https://www.ucl.ac.uk/news/2022/jan/opinion-renewables-are-cheaper-ever-so-why-are-household-energy-bills-only-going

16 In the most recent CfD auction (AR4), almost two thirds of the 11GW of contracted low-carbon capacity was awarded to offshore wind projects.

17 Strike prices shown in Figure 2 are in 2012 prices and so the overall real-terms cost reduction in offshore wind is more modest after accounting for inflation.

FIGURE 2: CFD RESULTS FOR ALLOCATION ROUNDS 1 TO 4 (HELD BETWEEN 2015 - 2022)



Strike prices (£2012) shown as solid line. Contracted capacity (MW) at each auction shown in columns - AR1 (teal), AR2 (orange), AR3 (yellow), and AR4 (blue).

Source: data from gov.uk

Several design features of CfDs have contributed to the policy's success:

1. The use of auction has led to competition driving down costs.

2. The guaranteed revenue per MWh provided through the CfDs reduces investment risks associated with renewable electricity projects. This has, by one estimate, lowered the cost of capital from about 6% to 3%.[18]

3. The LCCC's position as an arms length government entity with independent oversight increases investor confidence by reducing the possibility of political interference in the delivery of CfDs.

4. Auctions are held at regular, predefined intervals, giving renewable energy developers a clear timeline to prepare bids to supply capacity. Between 2015 and 2022, CfD auctions were held at roughly two-year intervals. The Government will now start annual auctions from March 2023 to enable an accelerated rollout of renewables.

5. Two-way CfD contracts are a hedge against price fluctuations that balances the interests of both the developer and the LCCC (acting on behalf of consumers). As a result, renewable energy projects

18 Grubb, M., & Newbery, D. (2018). UK electricity market reform and the energy transition: Emerging lessons. The Energy Journal, 39(6). https://www.eprg.group.cam.ac.uk/wp-content/uploads/2018/06/1817-Text.pdf

generate revenue to the government when electricity prices are higher than the clearing price, as they are at present.

6. By dividing CfD funding into different pots, the government has avoided pitting emerging technologies against mature ones, ensuring the UK maintains a diverse portfolio of low-carbon generation technologies.

However, as described in a later section of this paper, CfDs may not be all that is required to deliver the continued expansion of renewable energy needed to decarbonise the electricity system by 2035.

OFFSHORE WIND SUPPORT IN EUROPE

EU Member States have taken varying approaches to supporting offshore wind over the last decade. There appears to be a general trend towards contracts similar to the UK's CfD mechanism.

Since 2012, Germany has operated a top-up support regime for offshore wind. The so-called market premium guarantees offshore wind operators a minimum price (the 'reference value') for electricity supplied to the grid. Unlike the UK's CfD, the premium is one way rather than two way. When electricity prices are high the operator is not required to pay the difference between the actual price and the reference value. This has led to large windfall profits for operators due to current high wholesale prices.[19] Moreover, since electricity prices are high and the costs of offshore wind have fallen, the tender process has become increasingly dominated by zero subsidy bids which has led to contracts for oversubscribed sites being awarded through a lottery process. The German Government recently proposed new legislation that would move to a CfD regime.[20]

Until 2017 the Netherlands operated a scheme in which bidders applied for a subsidy and permit. However, from 2018 the country awarded its first subsidy-free contract for an offshore wind farm.[21]

France completed the tender processes for its first offshore wind farms in 2011 which offered Feed In Tariffs (FITs) lasting for a period of 20 years.[22] However, in 2016 the French Government moved to a feed-in premium model which is a type of CfD.[23]

Between 2003 and 2018, Denmark subsidised offshore wind using a market premium system similar to that of Germany's.[24] In 2019 Denmark adopted an asymmetric CfD scheme with profits obtained split between the operator and the government.[25]

19 Allen & Overy. (2022). CFD regime for offshore wind in Germany. https://www.jdsupra.com/legalnews/cfd-regime-for-offshore-wind-in-germany-1077582/

20 Allen & Overy. (2022, May 26). CfD regime for offshore wind in Germany. https://www.allenovery.com/en-gb/global/news-and-insights/publications/cfd-regime-for-offshore-wind-in-germany

21 WInd Europe. (2018, March 20). World's first offshore wind farm without subsidies to be built in the Netherlands. https://windeurope.org/newsroom/press-releases/worlds-first-offshore-wind-farm-without-subsidies-to-be-built-in-the-netherlands/

22 EU Commissions. (2019). State aid: Commission approves support for six offshore wind farms in France. https://ec.europa.eu/commission/presscorner/d tail/PT/ip_19_4749

23 Ministère de la transition écologique et solidaire. (2017). Regulatory framework and support schemes for wind energy in France. https://energie-fr-de.eu/fr/manifestations/lecteur/conference-sur-les-mecanismes-de-soutien-pour-lenergie-eolienne-etat-des-lieux-et-perspectives.html?file=files/ofaenr/02-conferences/2017/171010_conference_eolienne_mecanismes_de_soutien/Presentations/02_Louis_Orta_MTES_DFBEW_OFATE.pdf

24 IRENA. 2013. Denmark. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2013/GWEC/GWEC_Denmark.pdf?la=en&hash=C14BEEC4FFEEBA20B2B1928582AA23931F092F48

25 OffshoreWIND.biz. (2019, November 15). Denmark Rolls Out New Subsidy Scheme for Offshore Wind. OffshoreWIND.biz. https://www.offshorewind.biz/2019/11/15/denmark-rolls-out-new-subsidy-scheme-for-offshore-wind/

THE CAPACITY MECHANISM

Introduced alongside CfDs, the capacity mechanism (CM), is the Government's primary means of ensuring security of supply for electricity in order to prevent blackouts (i.e., 'keeping the lights on'). It is used to contract dispatchable electricity generation capacity in advance which is not required under normal circumstances but can be called upon at short notice during periods of high stress in the electricity grid. The CM therefore acts as an insurance policy for managing the risk of variable generation from renewables and unplanned plant outages. At present, gas power makes up the vast majority of capacity contracted via the CM.[26]

As with CfDs, the LCCC awards CM contracts through competitive auctions that take place every year. Although the CM has no direct influence on the deployment of offshore wind, by ensuring grid stability, it has enabled far higher penetration of renewables into the electricity system than would otherwise have been possible.

ONSHORE WIND'S FALL FROM FAVOUR

In contrast to the experience of other countries, onshore wind faced major obstacles in the UK after the initial rush of NFFO-backed projects in the 1990s and early 2000s. Subsequent projects were held back in large part by local opposition to onshore wind developments. Opposition was based on concerns about the visual impact of wind turbines and the top-down planning strategies often employed by developers of early projects, which lacked proper engagement with local communities.[27]

In an attempt to win over rural communities, the Conservative party ruled out supporting onshore wind in their 2015 election manifesto. Following their election win, changes to the National Planning Policy Framework and the removal of subsidies for onshore wind projects established a de facto moratorium on new developments unless they had the full backing of local communities.[28] This led to a 97% decrease in the number of wind turbines that were granted planning permission in the period 2016-2021 compared to the period 2009-2014.[29]

The misfortune of onshore wind may have actually helped the success of offshore wind: reduced competition for funding among different low-carbon electricity sources, combined with the 2015 coal phaseout announcement, focussed resources on a more limited set of options. This allowed offshore wind to win funding in subsequent CfD rounds where it might otherwise have been outbid by onshore wind projects.

The economics of offshore wind power have since vastly improved and project developers have built up considerable experience around the associated technologies and business. Offshore wind farms also have certain advantages over onshore ones as the former can support larger turbines that generate power more cost efficiently, and benefit from more consistent wind speeds which support higher load factors,[30] meaning the same amount of electricity can be generated from fewer turbines.

26 See results for T-1 and T-4 Capacity Market Auctions: https://www.emrdeliverybody.com/CM/T12022.aspx, https://www.emrdeliverybody.com/CM/T42022.aspx

27 Jones, C. R., & Eiser, J. R. (2010). Understanding 'local' opposition to wind development in the UK: how big is a backyard?. Energy policy, 38(6), 3106-3117. https://eprints.whiterose.ac.uk/95729/2/WRRO_95729.pdf

28 Brown, P. (2022). "England is failing to capitalise on its onshore wind potential". The Guardian. https://www.theguardian.com/news/2022/jun/10/england-is-failing-to-capitalise-on-its-onshore-wind-potential

29 UWE Bristol. (2022). "National planning policy limiting creation of new onshore wind farms in England, research finds". Retrieved 8 August 2022 from https://info.uwe.ac.uk/news/uwenews/news.aspx?id=4220

30 Figures published by National Grid suggest the average onshore wind turbine produces around 2.5 to 3 megawatts (MW), in comparison to the offshore average of 3.6 MW. This is due to planning restrictions on the allowable height of onshore wind turbines. For further information, see https://www.nationalgrid.com/stories/energy-explained/onshore-vs-offshore-wind-energy

CARBON PRICE SUPPORT

In 2013 the UK Government also introduced Carbon Price Support (CPS) to provide a floor on the carbon price in power generation. This quickly led to coal being priced out of the electricity market and helped stimulate demand for low-carbon generation. The CPS is a carbon tax levied on electricity generators in addition to the ETS carbon price. In 2014, the CPS was set at £4.94/tCO_2e, rising to £18/tCO_2e in 2015 where it has remained since.[31] This significantly raised carbon costs for coal-fired power plants (and, to a lesser extent, gas-fired power plants).[32] Electricity generated from coal fell from 40% in 2013 to 3% in September 2019 as a result.[33]

31 Gissey, G. C., Guo, B., Newbery, D., Lipman, G., Montoya, L., Dodds, P., ... & Ekins, P. (2019). The value of international electricity trading. A project commissioned by Ofgem. https://www.ucl.ac.uk/news/2020/jan/british-carbon-tax-leads-93-drop-coal-fired-electricity

32 The EUETS carbon price was at levels below €10/tCO_2 over the same period.

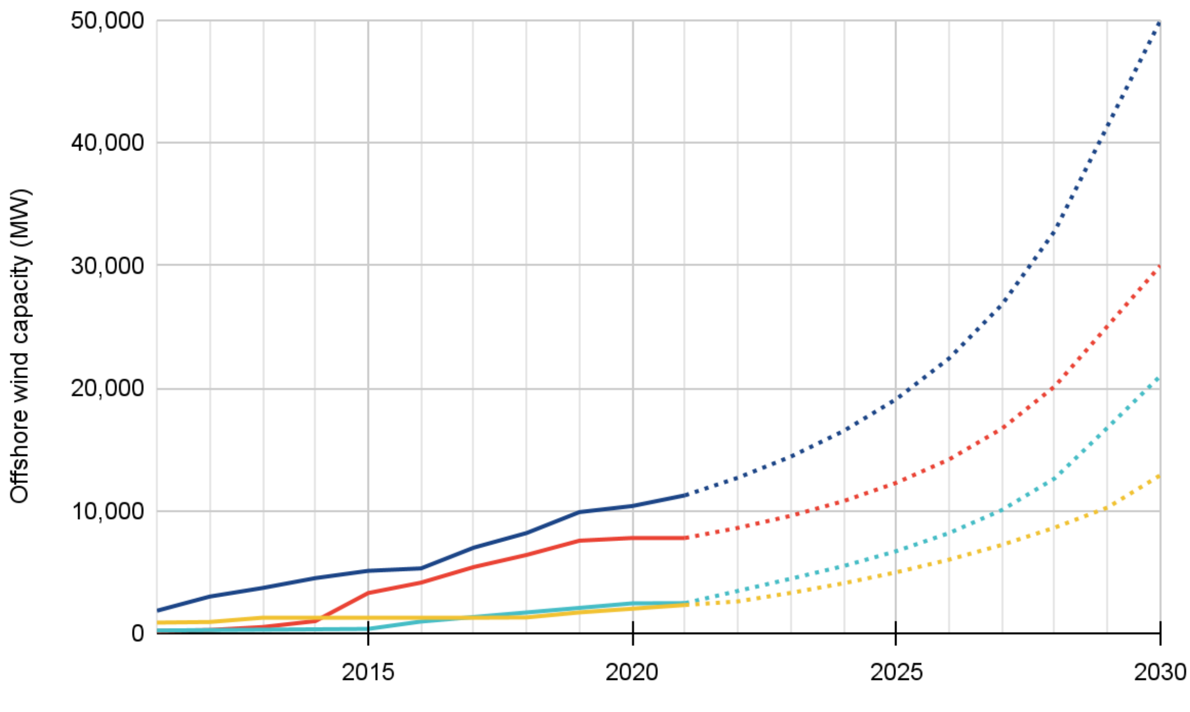
33 Gissey, G. C., Guo, B., Newbery, D., Lipman, G., Montoya, L., Dodds, P., ... & Ekins, P. (2019). The value of international electricity trading. A project commissioned by Ofgem. https://www.ucl.ac.uk/news/2020/jan/british-carbon-tax-leads-93-drop-coal-fired-electricity

THE FUTURE OF OFFSHORE WIND

In April 2022 the UK Government committed to increasing the pace of renewables deployment, raising its 2030 target for offshore wind capacity from 40GW to 50GW.[34] To put that in context, it has taken the UK a decade to increase offshore wind capacity from 1GW to 11GW and the rate of deployment would thus need to increase more than fourfold to add almost 40GW in additional capacity within eight years. As such, it is a highly ambitious target.

Nevertheless, the current pipeline of offshore wind projects suggests the UK can achieve its 50GW target[35] which at present exceeds those of other European countries by a considerable margin (Figure 2).

FIGURE 2: HISTORIC AND PROJECTED OFFSHORE WIND ENERGY CAPACITY IN THE UK, GERMANY, NETHERLANDS, AND DENMARK



Offshore wind capacity in the UK (dark blue), Germany (red), the Netherlands (turquoise), and Denmark (yellow). Dotted lines denote official capacity forward projections.

34 BEIS, 10 Downing Street. (2022). British energy security strategy. https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy

35 Buljan. A. (2022 September). BREAKING: UK Puts Massive Amount of New Offshore Wind Capacity on Fast Track. OffshoreWIND.biz https://www.offshorewind.biz/2022/09/26/breaking-uk-puts-massive-amount-of-new-offshore-wind-capacity-on-fast-track/

Sources: historical offshore wind capacity from irena.org, rvo.nl, and turbines.dk. Projected offshore wind capacity (dotted lines) based on official targets and estimates from gov.uk, government.nl, enerdata.net, and offshorewind.biz.

TABLE 1: OFFSHORE WIND ENERGY CAPACITY AS % OF TOTAL GENERATION CAPACITY IN THE UK, GERMANY, NETHERLANDS, AND DENMARK IN 2021

Country	Offshore wind (MW)	Total capacity (MW)	% offshore wind
United Kingdom	11,256	105,000	**10.72%**
Germany	7,774	223,138	**3.48%**
Netherlands	2,460	46,737	**5.26%**
Denmark	2,306	16,177	**14.25%**

Sources: BEIS, irena.org

As Table 1 shows, the UK is currently among the leading installers of offshore wind in Europe, both in terms of actual capacity and as a percentage of its overall electricity mix.

To realise its offshore wind energy target, the UK will need to overcome a series of challenges that limit the speed of renewables deployment. These include issues relating to permitting, skills shortages, supply chain capacity, and electricity grid infrastructure - each of which is briefly discussed below.

As part of its Review of Electricity Market Arrangements the Government is also considering how to redesign the electricity market to support continued growth of renewables, a topic briefly outlined at the end of this section.

PERMITTING

Permitting is the process of gaining local and/or national authority approval for the construction of wind farms at a given site. The process includes securing construction permits, performing environmental impact assessments, and obtaining planning consent. Currently, it can take up to four years to approve the development of an offshore wind farm in the UK. The Government now plans to update planning rules to cut the approval time down to one year, and to streamline environmental assessments for offshore wind projects.[36]

Permitting is an issue that also affects renewables deployment in the EU. The vast majority of Member States currently exceed the two-year limit for permitting processes set down in the 2018 Renewable Energy Directive - with some taking up to 10 years to approve projects.[37] However, there are now plans to reduce this to one year for projects located in certain areas.[38]

36 Ibid.

37 Ember. (2022). Ready, Set, Go: Europe's race for wind and solar https://ember-climate.org/insights/research/europes-race-for-wind-and-solar/

38 Abnet, K. (2022, May 9). EU plans one-year renewable energy permits for faster green shift. Reuters. https://www.reuters.com/business/sustainable-business/eu-plans-one-year-renewable-energy-permits-faster-green-shift-2022-05-09/

SKILLS SHORTAGES

To achieve 50GW of offshore wind capacity by 2030 the UK will need to invest in and retain a skilled workforce. The UK offshore wind industry is expected to employ close to 100,000 people by 2030[39] and competition for skills with overseas wind energy developers will only increase as other countries set ambitious plans for offshore wind development. Skills shortages threaten to create a bottleneck for renewable energy deployment which could limit the UK's ability to meet its targets.

There are opportunities to leverage skills from adjacent sectors - including offshore oil and gas, subsea, automotive and aerospace - to support the growth of offshore wind. As of 2019, there were 30,600 people employed directly in the UK's offshore oil and gas industry[40] and many are keen to retrain in offshore wind.[41] The UK Government has committed to supporting the transition of North Sea workers to green jobs as part of the North Sea Transition Deal it agreed with the oil and gas industry in 2021,[42] although this plan lacks specific detail on the nature or pace of the transition. The Government has also recognised the threat that the skills shortage poses to achieving renewable energy deployment targets and, in 2021, established the Green Jobs Taskforce with the goal of supporting the creation of two million net zero jobs by 2030.[43]

The EU is facing a similar shortage of workers to support its wind energy ambitions and is expected to employ some 450,000 people in the sector by 2030, 50% more than the current headcount.[44] Competition for skilled workers will likely increase in the coming years as investments in training programmes will take time to fill the skills gap.

SUPPLY CHAIN CAPACITY

Despite the considerable number of wind energy developers active in the UK - Ørsted, Vattenfall, SSE, Iberdrola, and Innogy - the UK lags behind other countries in terms of its domestic turbine manufacturing capacity and has historically relied on imported turbine components, typically from German, Danish and Dutch manufacturers that have well-established commercial offerings.[45] Siemens Gamesa and MHI Vestas are the two major manufacturers of wind turbine generators supplying to UK projects and, while GE Renewable Energy is now competing for market share with a new generation of large turbines, this is nonetheless a relatively small pool of suppliers.[46]

However, the UK has recently begun to see investment in domestic wind turbine manufacturing and, in early 2021, the Government invested £95 million in 2 new offshore wind ports to be constructed in the Humber

39 Memija, A. (2022). UK Offshore Wind Sector Expected to Employ Almost 100,000 People by 2030. OffshoreWIND.biz https://www.offshorewind.biz/2022/06/13/uk-offshore-wind-sector-expected-to-employ-almost-100000-people-by-2030/

40 Bills, G. (2021). A global skills shortage threatens UK offshore wind. Infrastructure Investor. https://www.infrastructureinvestor.com/a-global-skills-shortage-threatens-uk-offshore-wind/

41 Harrahill, K., Douglas, O. (2020). We want green energy jobs, say North Sea oil and gas workers – what they need to make the leap. The Conversation. https://theconversation.com/we-want-green-energy-jobs-say-north-sea-oil-and-gas-workers-what-they-need-to-make-the-leap-147612

42 Gov.uk. (2021). North Sea deal to protect jobs in green energy transition https://www.gov.uk/government/news/north-sea-deal-to-protect-jobs-in-green-energy-transition

43 BEIS. (2020). Energy white paper: Powering our net zero future. https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future/energy-white-paper-powering-our-net-zero-future-accessible-html-version

44 Jones, A. (2021, September 2). WindEurope launches educational hub to plug skills gap. Industry Europe. https://industryeurope.com/sectors/energy-utilities/windeurope-launches-educational-hub-to-plug-skills-gap/

45 Gross, R. and Heptonstall, P. (2010). Time to stop experimenting with UK renewable energy policy. https://www.imperial.ac.uk/media/imperial-college/research-centres-and-groups/icept/Time-to-stop-experimenting.pdf

46 Whitmarsh, M. (2019). The UK Offshore Wind Industry: Supply Chain Review https://cdn.ymaws.com/www.renewableuk.com/resource/resmgr/publications/supply_chain_review_31.01.20.pdf

region and Teesside.[47] The same year GE Renewable Energy announced plans for an offshore wind tubular rolling facility at Port of Nigg in Scotland.[48] Plans for a Teesside factory were, however, subsequently cancelled with the company citing insufficient orders to justify the facility's existence.[49] It is not yet apparent whether the UK's most recent target for offshore wind deployment will lead to significant new investment in UK turbine manufacturing.

GRID INFRASTRUCTURE AND STORAGE

Increased capacity and flexibility are needed both within the UK's transmission network and with adjacent electricity grids to cope with fluctuations in supply due to variable renewable generation.

With a growing number of renewable generation assets being connected to the electricity grid, additional transmission infrastructure will be needed in the UK to avoid generators competing for limited network capacity and the possibility of curtailment (where generators are paid to constrain their output). National Grid's Network Options Assessment estimates that up to £16bn of transmission investment will be required over the next two decades,[50] which will be paid for by electricity consumers. The timescales required to make the large transmission investments can, however, be much longer than renewables deployment requires, and this creates a challenge for the Network Operator which must anticipate the future rate of deployment and geographic distribution of renewable generation assets.

Under existing plans, UK interconnector capacity will more than double by 2025 from an existing capacity of 7.4 GW,[51] and is expected to reach 20 GW by 2030.[52] This will provide opportunities to export surplus electricity renewable generation, and import electricity during periods of high demand. These developments reduce the likelihood of curtailment and are therefore beneficial to renewable energy developers.

Electricity storage will also become increasingly necessary for balancing supply and demand in a decentralised electricity system. Between 2021 and 2022, the UK's pipeline of energy storage projects doubled to 32.1GW (as of March 2022 1.6 GW of energy storage was operational).[53] Battery storage is rapidly growing and National Grid ESO estimates that it will comprise the largest share (69%) of electricity storage capacity by 2050.[54,55]

Both interconnection and storage enable more efficient grid balancing and reduce the need to curtail renewable energy generation at times of low demand, giving confidence to renewable energy investors. Similarly, improvements in the UK's electricity transmission infrastructure can unlock investment in renewable generation at sites where development was previously limited by network constraints.

47 Gov.uk. (2021). Second wind for the Humber, Teesside and UK energy industry. https://www.gov.uk/government/news/second-wind-for-the-humber-teeside-and-uk-energy-industry

48 GE Group. (2022). The UK's Largest Offshore Wind Tower Manufacturing Facility to Be Built at Port of Nigg. https://gegroup.com/latest/nigg-offshore-wind-announcement

49 Mathis, W. (2022). GE Scraps Plan for Offshore Wind-Turbine Blade Factory in UK. Bloomberg. https://www.bloomberg.com/news/articles/2022-07-12/ge-scraps-plan-for-offshore-wind-turbine-blade-factory-in-uk

50 National Grid ESO. (n.d.). Modelled Constraint Costs 2020/21. https://www.nationalgrideso.com/document/194436/download

51 Ofgem. (n.d.). Interconnectors. Retrieved 8 August 2022 from https://www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/interconnectors

52 NationagridESO. (n.d.). Downloadable Future Energy Scenarios Resources. Retrieved 8 August 2022 from https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2021/documents

53 George, S. (2022, April 22). UK's energy storage pipeline doubles within a year, surpassing 32GW. edie. https://www.edie.net/uks-energy-storage-pipeline-doubles-within-a-year-surpassing-32gw/

54 National Grid ESO. (2022). Future Energy Scenarios 2022. https://www.nationalgrideso.com/document/263951/download

55 SMS. (2022). Battery energy storage continues rise as critical net zero technology. https://www.sms-plc.com/insights/battery-energy-storage-continues-rise-as-critical-net-zero-technology/

Developments in demand-side response (DSR) and smart metering technologies are also driving efficiency in grid utilisation through shifting electricity demand away from peak periods. This is necessary for managing demand as large segments of the economy undergo rapid electrification. Moreover, small scale distributed electricity storage, such as home and EV batteries, may also provide flexibility to the grid

REVIEW OF ELECTRICITY MARKET ARRANGEMENTS (REMA)

In mid-2022, with electricity prices still rising in the midst of a squeeze on incomes and living standards, the Government announced plans to overhaul the UK's marginal pricing system for electricity with the aim of decoupling electricity and gas prices.[56] At present, wholesale electricity prices are being set by the marginal costs of gas power generation, which have increased with gas prices. In contrast newer renewables are not making additional profits due to the operation of two-way CfDs.

The current marginal pricing system was developed at a time when electricity generation was dominated by coal and gas plants. However, with renewables comprising a growing portion of the electricity system, there are challenges for how market prices are formed. It has also been recognised that the current CfD model gives rise to price competition among renewable generators[57] and increasing renewable deployment may make offshore wind farms unprofitable once their CfD expires.

A range of options for reforming marginal pricing are under consideration by the Government[58], including:

Splitting renewable and non-renewable generation into entirely separate markets with different pricing structures allowing consumers (or energy companies acting on their behalf) to choose the amount of 'firm' power they want to purchase at a price premium.[59]

Developing a 'green power pool' to isolate renewables from the rest of the market and passing cost savings onto consumers.[60] This would provide some of the benefits of splitting the market but renewable power purchase agreements would only be available to commercial and industrial consumers that are willing to accept greater variability of supply in return for lower prices.

Locational wholesale pricing to encourage market participants to operate in ways that support grid balancing and enable more efficient use of the electricity network. This could have a significant influence on the development of grid storage.

Moving from pay-as-clear wholesale pricing (where all generators receive the price of the highest bid) to pay-as-bid pricing where participants receive the price of their bid.

Separating the market, as outlined above, results in a trade-off between low prices and consistency of supply which in turn promotes grid flexibility. However, the UK is in uncharted territory as both models are untested and its experience is likely to inform decisions taken by governments in Europe in the years ahead.

56 BEIS. (2022). Review of Electricity Market Arrangements: Consultation document. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1098100/review-electricity-market-arrangements.pdf

57 Such problems can arise when multiple sources of renewable energy are seeking to supply limited consumer demand (for example, when the wind is blowing and the sun is shining). Consequently the overall market price of electricity falls during those periods, leading to a reduction in the revenues for wind farms without CfDs.

58 Ibid.

59 Keay and Robinson. (2017). The Decarbonised Electricity System of the Future: The 'Two Market' Approach, Energy Insight.

60 Grubb and Drummond. (2018). UK Industrial Electricity Prices: Competitiveness In A Low Carbon World. https://www.ucl.ac.uk/bartlett/sustainable/sites/bartlett/files/uk_industrial_electricity_prices_-_competitiveness_in_a_low_carbon_world.pdf

FLOATING WIND POWER

The UK Government has pledged to create 5GW of floating offshore wind[61] - raised from a previous target of 1GW - as part of its ambition for 50GW of offshore wind by 2030. Floating offshore wind technology allows turbines to be sited farther out to sea, where wind resources are typically more abundant, and in places where seabed conditions are poorly suited to fixed foundation turbines.

Adopting a twin track fixed and floating wind deployment strategy may also enable more rapid growth of offshore wind as fewer sites become available to lease in shallow waters. Analysis by DNV suggests that the levelized cost of energy (LCOE) for floating wind will reduce by around 59% by 2030 although it will remain somewhat more expensive than fixed foundation offshore wind for the foreseeable future.[62]

Floating wind technology is still in its infancy with little operational data or experience to draw from. Consequently, the UK's 5GW target represents a considerable leap of faith in the technology. Proving the technology works well is not the only challenge to this target. The skills shortage and need for additional transmission infrastructure to connect new offshore wind sites, as discussed earlier in this paper, will require enormous investments from an industry whose entire value chain is already under strain.[63]

61 BEIS. (2022). British energy security strategy. Retrieved 27 July from https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy

62 Bourne, S. (n.d.). Can the UK achieve its 50 GW offshore wind target by 2030?. DNV. https://www.dnv.com/article/can-the-uk-achieve-its-50-gw-offshore-wind-target-by-2030--224379

63 Ibid.

SUMMARY OF LESSONS LEARNED

Responding to the ongoing energy crisis remains a priority for policymakers both the UK and the EU, particularly as the continent heads towards winter. Ongoing volatility in natural gas markets is expected to push up electricity prices for several years[64] and this has prompted more aggressive expansion of renewable energy technologies in the UK and internationally as governments attempt to reduce their energy dependence.

The EU is now preparing new measures to accelerate the rollout of renewable energy technologies across Member States, many of which are lagging on their renewable energy targets. When it comes to offshore wind energy, the UK's experience can provide valuable lessons in policy delivery.

The key developments that have enabled the UK to achieve rapid growth in offshore wind energy are as follows:

STABLE REVENUES (OR GUARANTEED MINIMUM PAYMENTS) ARE AMONG THE STRONGEST INCENTIVES FOR RENEWABLE ENERGY INVESTMENT

Guaranteeing revenues to offshore wind generators is an approach that is common among countries that have successfully expanded their offshore wind capacity, both in Europe and internationally. CfDs and Feed-In-Tariffs (FITs) are both well-established models for doing just that because they provide a predictable and long-term source of revenue which vastly reduces investment risks associated with renewable energy projects. FITs that set prices years in advance can, however, lead to renewables developers being overcompensated. In contrast, CfDs allocated by auction can be used to share price risks fairly between the consumer and the generator. The UK was among the first countries to adopt a two-way CfDs model and, although this approach looks set to evolve as part of ongoing reforms, it is nonetheless an essential instrument for delivering renewables growth.

CARBON PRICING CAN BE AN EFFECTIVE MEANS OF SUPPORTING INVESTMENT TOWARDS RENEWABLE ENERGY

Carbon pricing acts as a financial disincentive for fossil fuel power which in turn makes low-carbon electricity generation more competitive. The UK's carbon price support scheme effectively doubled the carbon price for power generation when first introduced which led to the rapid decline of coal generation and shifted investment towards renewables. The price floor created by the CPS also reduced the risk to renewable energy investments if ETS prices fall in future. Although EU ETS prices have risen in recent years, price floors remain an effective signal to investors in renewable energy.[65]

64 Guénette, J. and Khadan, J. (2022). The energy shock could sap global growth for years. Worldbank.org. Retrieved 28 July 2022 from https://blogs.worldbank.org/developmenttalk/energy-shock-could-sap-global-growth-years

65 Whitmore, A. (n.d.). 3. Carbon price floors and ceilings. On Climate Change Policy. https://onclimatechangepolicydotorg.wordpress.com/carbon-pricing/price-floors-and-ceilings/

THE IMPORTANCE OF MAINTAINING A PORTFOLIO OF TECHNOLOGIES

Supporting a diverse and sustainable portfolio of renewable generation technologies can lead to more cost-effective decarbonisation compared to deploying only the cheapest forms. While onshore wind is less expensive than offshore wind power, the latter benefits from being highly scalable thanks to relatively low barriers to development. The higher cost of offshore wind can thus be offset by a more rapid shift away from costly fossil fuel power generation.

A diverse portfolio of renewable technologies is also more robust in the face of unexpected changes in costs or disruption to supply chains. In creating a balanced generation portfolio, governments should adopt clear requirements for the sustainability of renewable technologies to avoid creating incentives for activities that damage natural ecosystems, particularly in the case of hydropower and biomass-based energy sources.

Many EU Member States have achieved high rates of solar PV and onshore wind installations. Reaching 2030 targets with the same strategy may, however, prove challenging as areas suitable for development become scarce. Supporting a broader set of renewable energy technologies is likely to prove more cost-effective in the long-term.

ELECTRICITY MARKETS NEED TO BE EQUIPPED TO PERFORM EFFICIENTLY IN A RENEWABLES-DOMINATED SYSTEM

Most electricity markets in Europe were created to deliver dispatchable fossil-fuel generation and this has created an inherent bias in favour of incumbent fossil fuel-based electricity generation technologies. This presents a challenge for increasing the share of renewable generation because the functioning of electricity markets strongly influences which technologies are deployed. A fundamentally different market structure is required to support the continued growth of offshore wind and maintain efficient pricing in a renewables-system dominated with variable output. The UK is now undergoing a second iteration of major electricity market reforms in the space of decade and this process will be informative for developments in other electricity markets.

INCREASED GRID FLEXIBILITY IS REQUIRED TO SUSTAIN THE GROWTH OF RENEWABLES

Timely investments in electricity transmission and storage infrastructure are critical to sustaining the large-scale deployment of renewables and providing grid-balancing services which help reduce overall costs of electricity supply.

Grid infrastructure will need to be expanded to accommodate increasing offshore wind capacity. This not only means connecting new offshore wind farms to the grid, thereby widening its geographical extent, but also reinforcing existing networks to enable electricity to be transmitted to where it is needed.

Consideration also needs be given to the sustainability of each type of renewable energy. For example, the use of biomass lacks scalability, may have associated lifecycle emissions, may risk unsustainable sourcing, may reabsorb carbon over a long timescale and can result in land use changes that reduce the effectiveness of natural carbon sinks.

Similarly, energy storage is important for short-term grid balancing. The UK has an ambitious pipeline of electricity storage projects.

ANNEX 1: MAJOR UK RENEWABLES POLICIES 1990 - 2010

In 2000 the UK's first offshore wind turbines began generating electricity off the coast of Blyth in Northumberland.[66] At that time, environmental concerns had already been receiving considerable attention from UK policymakers but were not yet a central driver of energy policy.

The earliest legislation to promote renewable energy in the UK came in the form of the Non Fossil Fuel Obligation (NFFO). Introduced in 1990, the NFFO subsidised both nuclear and renewable power generation via an obligation on the country's newly privatised energy companies to purchase power from non-fossil generators at a premium price.[67]

However, early NFFO rounds lumped different forms of renewable energy under the same funding pots, creating an inherent bias towards the cheapest forms of renewable energy generation as developers could cherry-pick projects that would yield the greatest returns. While a number of onshore wind projects were awarded subsidies through the NFFO, the scheme lacked a facility to support emergent technologies, including offshore wind which has higher associated costs and risks.[68]

In 1997, the Labour Government came to power with a manifesto pledge to supply 10% of the UK's electricity from renewables by 2010, replacing the previous government's target of achieving 1,500 MW of new renewable energy capacity by the year 2000. At that time, a major barrier to developing renewable energy projects was planning consent.[69] The rush to build onshore wind projects in the early years of the NFFO with relatively little input from local stakeholders sowed the seeds of a community-led backlash against onshore wind farms[70] - a source of tension which continues to the present day.

THE RENEWABLES OBLIGATION (2002 - 2017)

The Renewables Obligation (RO), which replaced the NFFO in 2002, sought to apply lessons from its predecessor. Rather than offering contracts to renewable energy generators, it set an obligation on energy suppliers to purchase and supply a certain amount of generated electricity from renewable sources. This allowed suppliers to negotiate their own contracts for renewable electricity and avoided the government being seen to 'pick winners'.

However, the RO also created new risks for generators, who no longer had certainty around the price or quantity of electricity that they would be able to sell. Furthermore, it capped the price of eligible technologies at 6–7p/kWh, in effect limiting participation to more mature technologies. To overcome the latter issue, the then government introduced a capital subsidies bidding mechanism to support emerging technologies and between 2002-2005 £102 million in capital grants were awarded to offshore wind energy projects.[71]

The RO has been modified numerous times since its inception. In 2004 and 2006 the scheme was expanded to include forms of renewable energy generation which were not previously covered. And in 2009, the

66 BVG Associates. (n.d.). UK offshore wind history. Retrieved 31 July 2022 from https://guidetoanoffshorewindfarm.com/offshore-wind-history

67 Gross, R. and Heptonstall, P. (2010). Time to stop experimenting with UK renewable energy policy. https://www.imperial.ac.uk/media/imperial-college/research-centres-and-groups/icept/Time-to-stop-experimenting.pdf

68 Mitchell, C., Connor, P. (2004). Renewable energy policy in the UK 1990–2003. Energy Policy (32). http://aoatools.aua.gr/pilotec/files/bibliography/EP_renewablesUK_mitchell-3820549121/EP_renewablesUK_mitchell.pdf

69 Kettle, R. (1999). Promoting Renewable Energy: Experience with the NFFO. UK Department of trade and Industry. https://www.oecd.org/unitedkingdom/2046731.pdf

70 Gross, R. and Heptonstall, P. (2010). Time to stop experimenting with UK renewable energy policy. https://www.imperial.ac.uk/media/imperial-college/research-centres-and-groups/icept/Time-to-stop-experimenting.pdf

71 Mitchell, C., Connor, P. (2004). Renewable energy policy in the UK 1990–2003. Energy Policy (32). http://aoatools.aua.gr/pilotec/files/bibliography/EP_renewablesUK_mitchell-3820549121/EP_renewablesUK_mitchell.pdf. Note: £20m was also awarded to solar photovoltaic projects and £5m to wave and tidal projects over the same period.

Government introduced banding into the RO which enabled higher-cost renewable technologies to earn more RO credits per unit of electricity than lower-cost technologies.[72] This raised RO support for offshore wind and other nascent renewable technologies enabling them to play a more prominent role in the scheme.

Despite its drawbacks, the RO had the desired effect of creating momentum behind renewable energy development. Between 2003 and 2010, offshore wind capacity grew from 60MW to a little over 1GW.[73] However, this achievement came at a cost. In its early years, the RO secured renewable electricity at a higher rate of subsidy per unit of electricity than elsewhere in Europe but without achieving a higher installation rate.[74] Indeed, the RO was criticised for creating an extra burden on household energy bills in the short-term,[75] yet it also supported technologies that would ultimately become a source of low-cost energy.

FEED-IN TARIFFS (2010 - 2019)

Driven in large part by its commitment to achieving 10% of gross electricity consumption from renewables by 2010, in April 2010 the Government introduced the Feed-In Tariff (FIT) scheme which was designed to encourage deployment of small-scale (5MW or less) electricity generation. The scheme provided fixed payments per MWh to small renewable installations for both electricity generation and export to the grid. It led to 3,567MW of small scale renewable capacity being installed during the first five years of the scheme[76], most of which was solar photovoltaic (PV) with a modest amount of (onshore) wind generation.

The popularity of FIT led to the scheme becoming a victim of its own success and the government slashed tariffs to a fraction of their original levels[77] within two years of its launch in a bid to reduce the financial burden of the scheme. A 2015 review of FITs by DECC acknowledged that “original projections failed to foresee the rapid uptake of domestic solar PV, due to the unexpectedly large reductions in module costs”.[78] The scheme was eventually wound down in 2019.

72 Gross, R. and Heptonstall, P. (2010). Time to stop experimenting with UK renewable energy policy. https://www.imperial.ac.uk/media/imperial-college/research-centres-and-groups/icept/Time-to-stop-experimenting.pdf

73 DECC. (2010). Digest of United Kingdom energy statistics 2010. Retrieved 1 August 2022 from https://webarchive.nationalarchives.gov.uk/ukgwa/20101209110222/http:/www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx

74 IEA. (2008). Deploying Renewables: Principles for effective Policies. 101 https://iea.blob.core.windows.net/assets/5a1c2e9f-8016-4528-b692-05604324b306/DeployingRenewables2008.pdf

75 Daily Mail Reporter. (2008, July 29). Climate change policies are costing families an extra £50 on annual electric bills. Daily Mail. https://webcache.googleusercontent.com/search?q=cache:IrPIxKI4xVMJ:https://www.dailymail.co.uk/news/article-1039727/Climate-change-policies-costing-families-extra-50-annual-electric-bills.html&cd=1&hl=en&ct=clnk&gl=uk

76 DECC. (2015). Performance and Impact of the Feed-in Tariff Scheme: Review of Evidence https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/456181/FIT_Evidence_Review.pdf

77 Which?. (2022). What was the feed-in tariff? Retrieved 2 August 2022 from https://www.which.co.uk/reviews/feed-in-tariffs/article/feed-in-tariffs/what-was-the-feed-in-tariff-aAsa36S95iJy

78 DECC. (2015). Performance and Impact of the Feed-in Tariff Scheme: Review of Evidence https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/456181/FIT_Evidence_Review.pdf

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