

Offshore Wind Report

2022



Introduction



Gus Jaspert
Managing Director, Marine

It's just over 20 years since The Crown Estate explored options for its first ever commercial offshore wind farm lease. North Hoyle, off the North Wales coast, became operational in 2003 with the installation of 30 turbines, each with 2 MW capacity.

It's hard not to be impressed by how far we've come since those early days. Last year the world's largest wind farm, Hornsea 2, entered full operation. By the end of 2022, the average turbine capacity of sites under construction had reached 9MW. There are now 50 wind farms in UK waters which are either operating or under construction, with another seven that have secured a Contract for Difference (CfD). Millions of homes are now being powered by offshore wind, with more to come from a significant pipeline of projects. This includes up to 8GW of additional capacity to come from the Round 4 projects that signed Agreements for Lease (AfL) with The Crown Estate in early 2023.

Internationally, the UK continues to be at the forefront of offshore wind and is one of the most attractive places to invest in the world. In 2022, UK offshore wind capacity accounted for 24% of global capacity, second only to China, as we continue to push hard to meet the Government's target of 50GW of offshore wind capacity by 2030.

These are remarkable numbers. They reflect a huge amount of work and an appetite to accept some risk and uncertainty along the way.

45TWh

Amount of electricity produced by UK offshore wind in 2022

+40%

UK offshore wind generated enough electricity in 2022 to supply the needs of 41% (11.5m) of UK homes

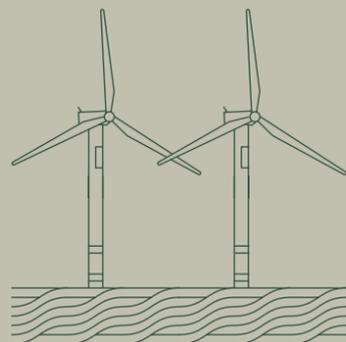
14%

Proportion of total UK electricity generated by offshore wind in 2022

17m tonnes

Avoided CO₂¹

¹ How this is calculated can be found at the [end of the report](#).



None of this would have been possible without collaboration, partnership, investment and innovation across an extraordinarily diverse group of partners and industries.

As we look ahead, The Crown Estate will continue to invest in our Offshore Wind Evidence and Change Programme, made up of 27 partners working together to propel forward the growth of the sector at pace in a sustainable way. We will continue to grow our data and expertise, including the Marine Data Exchange, the world's largest database of offshore marine industry survey data, research and evidence. We will support the ambitions of both government and industry to develop capacity in the waters off Northern Ireland and will back complex and emerging technologies such as floating wind. Later this year, we will launch the UK's first major leasing round for floating wind in the Celtic Sea, off the coasts of Wales and South West England.

Our work doesn't stop there. We know that the seabed is critical to meeting all three generational challenges of energy security, climate change and biodiversity loss, supporting a vast array of natural habitats and vital industries such as renewable energy, telecoms, aggregates and fishing.

As a result, the seabed is facing a moment of transition as it becomes increasingly busy with more demands on it than ever before. We have to do more in the next decade than we have in the last two, whilst crucially supporting a thriving natural world and enabling the development of new sectors such as hydrogen and carbon capture.

We recognise a new approach is needed if we're to address these multiple priorities and maintain the UK's world leading position. That's why, over the coming year, we will continue to build on our track record to bring together the best minds, data and technologies to build an holistic view of the whole of the seabed and how it can be optimised for the benefit of the nation and the natural world.

None of this will be easy, but this report for the UK, with thanks to Crown Estate Scotland for their contribution, demonstrates the success of the last twenty-plus years and what can be achieved together and for the benefit of generations to come. The opportunity before us is extraordinary.

We look forward to working with you on this exciting journey.



Gus Jaspert
Managing Director, Marine

Figure 1: UK electricity generation mix 2022 with 2021 comparison¹

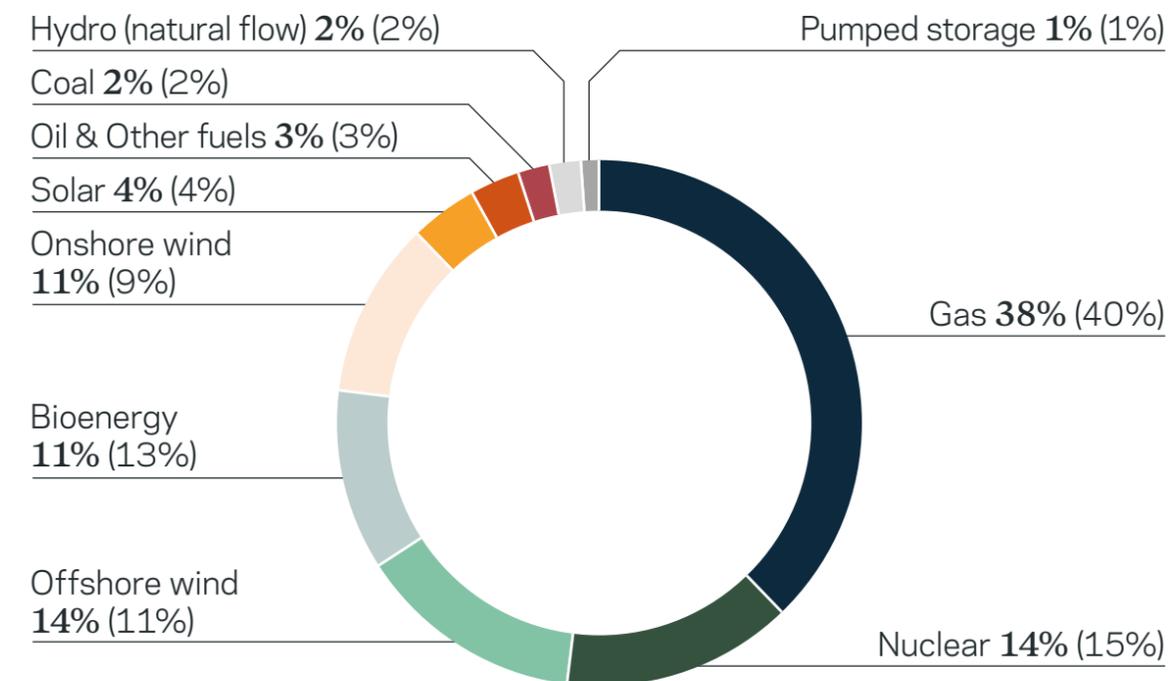
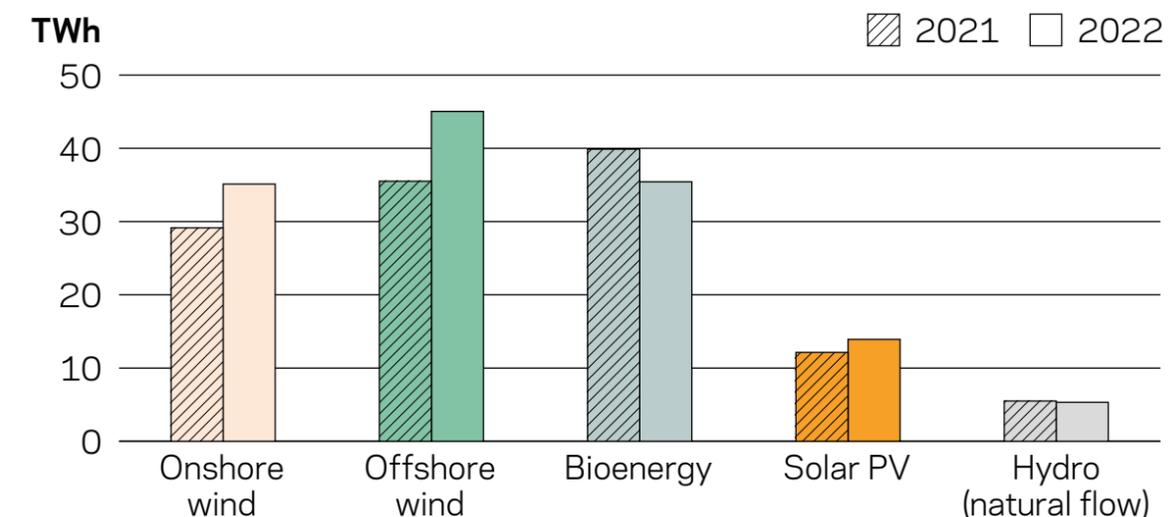


Figure 2: Renewable energy generated by fuel type¹



1. Department for Energy Security and Net Zero (DESNZ)

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Why we produce this report

This report is produced annually by The Crown Estate to provide a picture of the UK offshore wind industry, using our own and publicly available data.

The Crown Estate

The Crown Estate is a national landowner with a diverse £16bn portfolio. Throughout everything we do, we seek to create environmental, social and economic value, both now and for the long term. We manage the seabed and half the foreshore around England, Wales and Northern Ireland. We therefore play a significant role in unlocking renewable energy for millions of homes through sectors such as offshore wind and creating opportunities for new technologies, like Carbon Capture, Usage and Storage (CCUS) and hydrogen to deliver the UK's energy security transition.

Our portfolio also includes urban centres and development opportunities; one of the largest rural holdings in the country; places to work, shop and experience in central London; and the world-renowned Windsor Great Park. We are a unique business established by an Act of Parliament, occupying a space between the public and private sector. We are tasked with growing the value of the portfolio for the nation and returning all of our net profit to HM Treasury for the benefit of the UK taxpayer. This has totalled £3bn over the last ten years.



Crown Estate Scotland

Crown Estate Scotland is a public corporation which manages a range of property, including the seabed, to deliver lasting, valuable benefits to Scotland and its people. Our revenue profits are paid to the Scottish Government for use in public spending. Part of our role is awarding the rights to build and operate renewable energy projects in Scottish waters, and we are committed both to supporting the development of Scotland's blue economy and the Scottish Government's target of reaching net zero emissions by 2045. To learn more about the work we do and the causes we support, visit crownestatescotland.com.



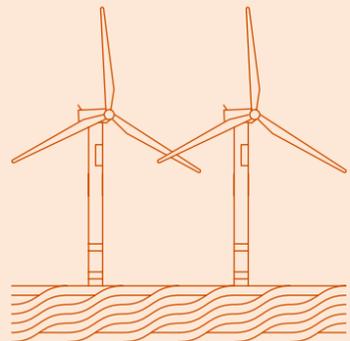
Acknowledgements

In order to provide a UK wide picture of offshore wind, Crown Estate Scotland has provided statistics for this report and there are features on the performance and development of the Scottish offshore wind portfolio.

Our thanks to all those who have provided content, in particular: Balfour Beatty; Ben Barden Photography; Celia Anderson (RWE); Dan Bolt; Diamond Transmission Partners; Equitix; Frontier Power; Grayling; Kirsty Andrews; Molly Gifford; Offshore Wind Industry Council (OWIC); Ofgem; Ørsted; Principle Power; Renewable UK; Rhiannon Phillips (Ofgem); RWE; Skye Francis; SSE; World Forum Offshore Wind

Offshore wind farm overview

The UK's offshore wind sector continues to be a world leader and a UK success story. For our part, we continue to be focused on how we can support the accelerated deployment of offshore wind alongside a thriving natural world. This includes investing in data, evidence and expertise that can de-risk investment through overcoming common challenges and reducing barriers, alongside an agile approach to leasing.



50

There are 50 wind farms in UK waters (operating and under construction)

Gwynt y Môr
offshore wind farm



In 2022, the UK commissioned its largest capacity to date in a single year. Hornsea 2 and Moray East, totalling 2.3GW¹, became fully operational, adding 20% of new capacity to the second largest offshore wind market in the world. Total operational capacity in the UK now stands at 13.7GW, that's 45% of the European offshore wind total and 24% of the global offshore wind total.

The UK's under construction pipeline is healthy, at 6.7GW, which is almost half of the operational portfolio's capacity. With a total of 50 offshore wind farms, the combined capacity of operational and under construction projects was 20.3GW at the end of 2022.

The major change to the offshore wind pipeline during 2022 was an uplift of 7GW in the capacity

that secured government support following the Contracts for Difference (CfD) Allocation Round 4. This is an increase from near zero in 2021. Record low strike prices of £37.35/MWh² were even lower than onshore wind and solar, which was a key development. The UK was ranked first for offshore wind, based on investment attractiveness in EY's Renewable Energy Attractiveness Index by the end of 2022. However, there are growing pressures on the UK's significant cost reduction track record, including supply chain pressures, inflationary cost increases, interest rate rises and increasing project finance costs. These are the fallout of some of the global macro headwinds facing the industry, adding pressure to projects and capital costs. This calls for an ever greater effort across stakeholders and partners to help the industry succeed.

Figure 3: Average size of UK offshore wind farms



1 Figures exclude Triton Knoll (857MW) commissioning as it was included in 2021 figures, and the partial operational capacity at Seagreen Phase 1 (not yet fully commissioned)
 2 In 2012 prices.

Figure 4: Increase in global offshore wind operating capacity

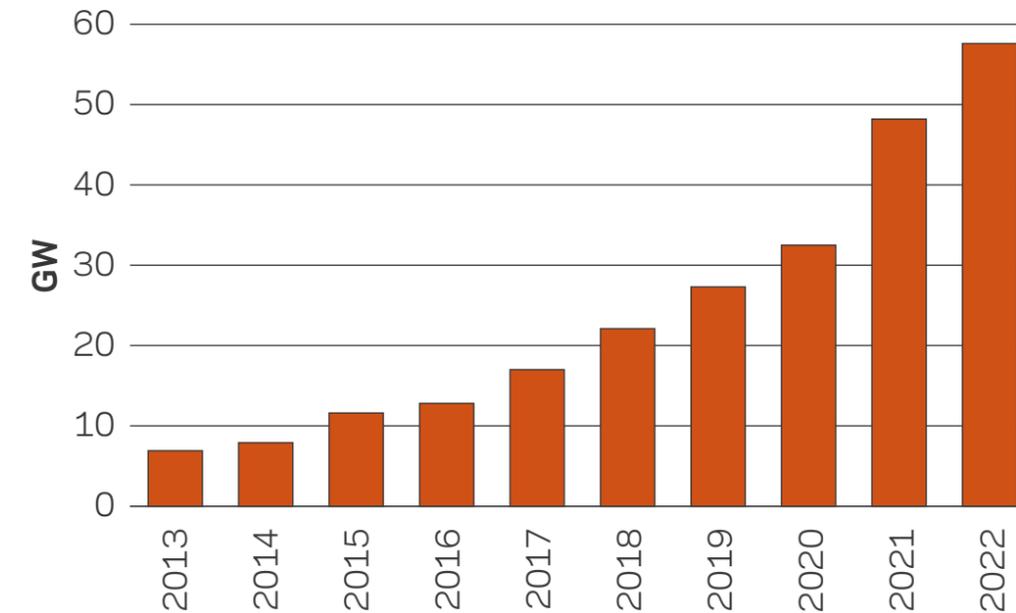
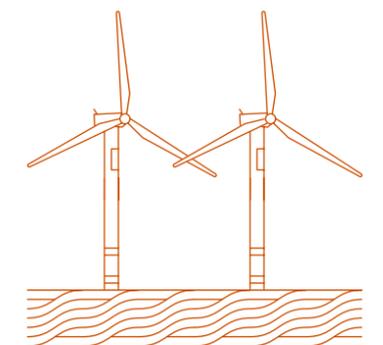
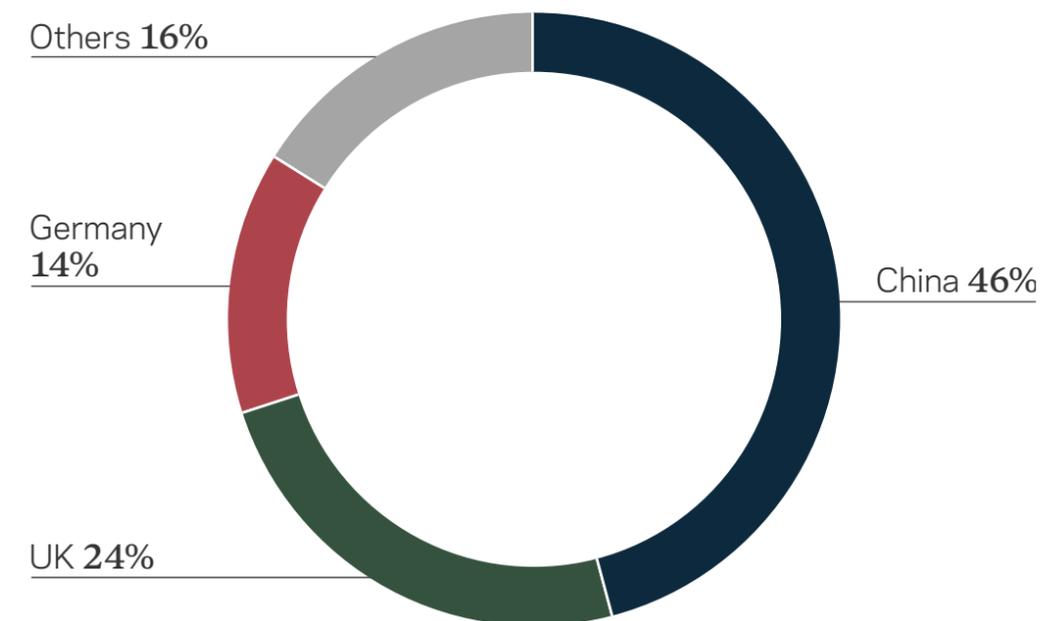


Figure 5: Global offshore wind operating capacity in 2022



24%

of global offshore wind operating capacity is in the UK

During spring 2022, the Government set out its British Energy Security Strategy, which raised the ambition from 40GW to 50GW of capacity by 2030, including 1GW of floating capacity. At the end of 2022, the UK had commissioned 28% of what it needs to achieve the 50GW target. As witnessed in 2022, turbine and project sizes are increasing, along with the sophistication of construction techniques. This will help increase the efficiency and speed of future commissioning. You can read more about the pre-construction development of projects on [page 32](#).

The average turbine size for projects commissioned in 2022 was 9MW, an increase of almost five times the size of the first commercial offshore turbines installed twenty years ago. The UK fleet is coming of age and some of the earlier sites are

reaching their twentieth anniversary. This presents a step change for the UK. Whilst we need to keep a razor-sharp focus on new development to achieve the UK's net zero target by 2050, we also need to maintain a strong focus on life extension to sustain low carbon generation on the UK seabed.

Milestones achieved in 2022:

- Hornsea 2 (1.4GW) – the world's largest offshore wind farm entered full operation (enough to power 1.4m homes)
- Seagreen Phase 1 (1.1GW) in Scotland achieved first generation
- Moray East became fully operational and during 2022 became Scotland's largest operating offshore wind farm (953MW)
- Dogger Bank A (1.2GW) started offshore construction in March 2022

Figure 6: UK offshore wind grid connected¹ (change from previous year)

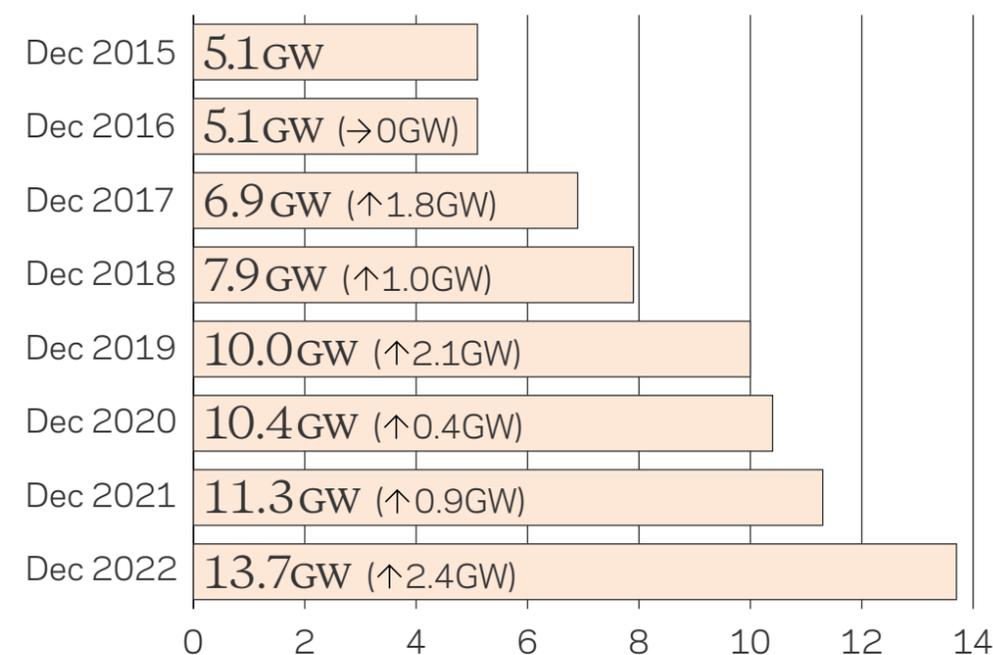


Figure 7: UK offshore wind assets as at 31 December 2022



	GW	Offshore turbines	Offshore substations	Export cables	Offshore met masts	Wind farms
Operational:	13.7	2,652	39	87	10	44
Under construction:²	6.7	545	8	13	0	6
Total:	20.4	3,197	47	100	10	50

1 Grid connected capacity stated refers to the capacity connected to the grid from fully operational and partially operating sites (those under construction but already exporting power at December 2022)

2 Sites having reached Final Investment Decision and those under construction, including where first power is achieved, but not yet fully operational.

Figure 8: Asset activity in 2022

Wind farms starting onshore construction

- Dogger Bank C
- Moray West
- Sofia

Wind farms starting offshore construction

- Dogger Bank A

Wind farms under construction

- Dogger Bank A
- Dogger Bank B
- Dogger Bank C
- Neart na Gaoithe
- Seagreen Phase 1
- Sofia

Wind farms achieving first power

- Seagreen Phase 1

Wind farms becoming fully operational

- Hornsea 2
- Moray East

Figure 9: UK offshore wind project pipeline as at 31 December 2022

Operational: Total capacity of wind farms that have been fully commissioned.

	Capacity MW ¹	
01	Barrow	90
02	Beatrice ²	588
03	Blyth Demonstration (Phase 1)	42
04	Burbo Bank	90
05	Burbo Bank Extension	259
06	Dudgeon	402
07	East Anglia ONE	714
08	European Offshore Wind Deployment Centre ²	97
09	Galloper	353
10	Greater Gabbard	504
11	Gunfleet Sands Demonstration	12
12	Gunfleet Sands I	108
13	Gunfleet Sands II	65
14	Gwynt y Môr	576
15	Hornsea 1	1,218
16	Hornsea 2	1,386
17	Humber Gateway	219
18	Hywind Scotland ²	30
19	Inner Dowsing	97
20	Kentish Flats	90

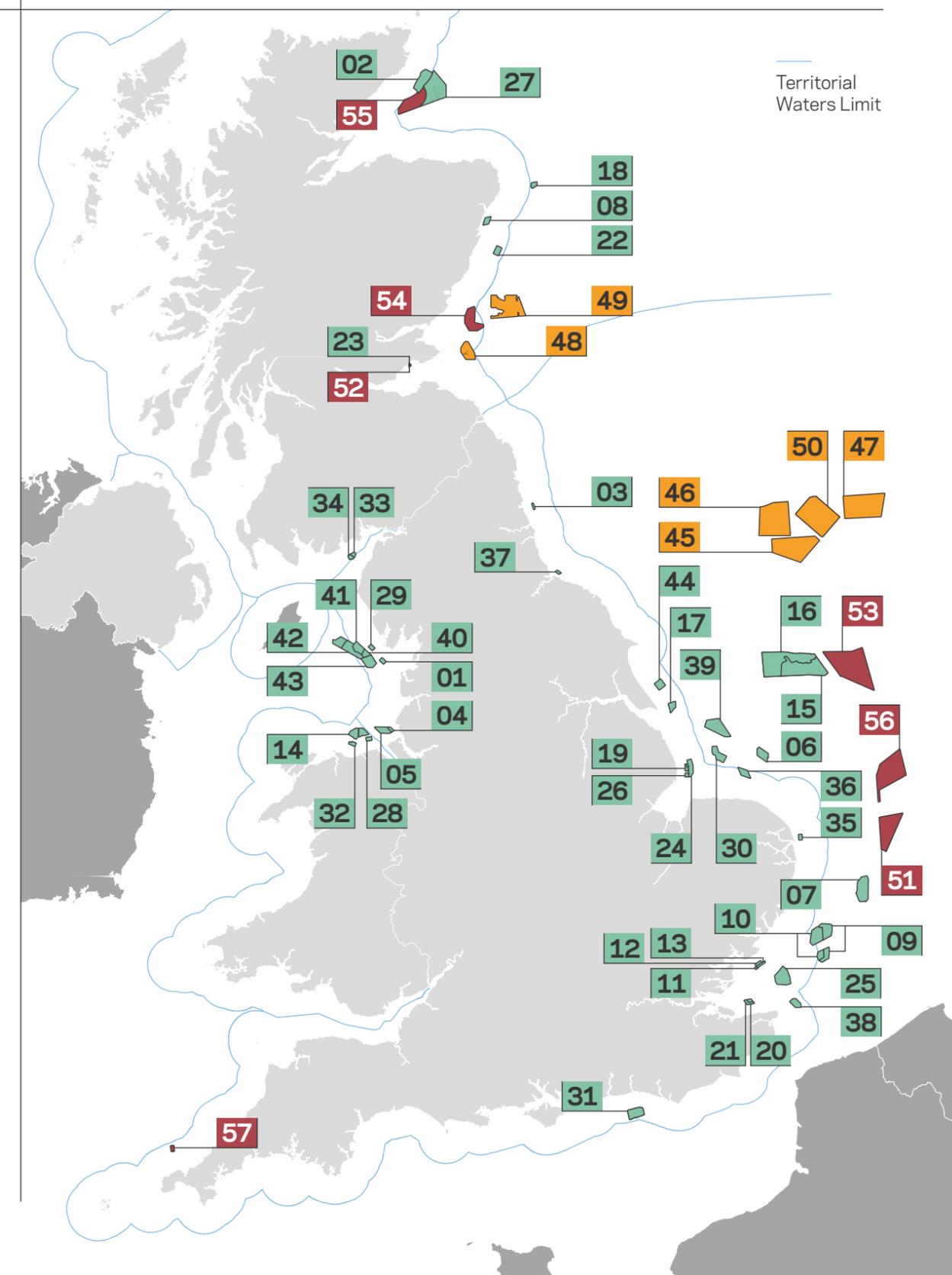
	Capacity MW ¹	
21	Kentish Flats Extension	50
22	Kincardine ²	50
23	Levenmouth Demonstration ²	7
24	Lincs	270
25	London Array	630
26	Lynn	97
27	Moray East ²	953
28	North Hoyle	60
29	Ormonde	150
30	Race Bank	573
31	Rampion	400
32	Rhyl Flats	90
33	Robin Rigg East ²	84
34	Robin Rigg West ²	90
35	Scroby Sands	60
36	Sheringham Shoal	317
37	Teesside	62
38	Thanet	300
39	Triton Knoll	857
40	Walney 1	184
41	Walney 2	184
42	Walney Extension	659
43	West of Duddon Sands	389
44	Westermost Rough	210
Total	13,666	

Under construction: Total capacity of wind farms that have commenced offshore construction but are not yet fully operational, or the developer has confirmed a Final Investment Decision.

	Up to capacity MW ¹	
45	Dogger Bank A	1,235
46	Dogger Bank B	1,235
47	Dogger Bank C	1,200
48	Nearr na Gaoithe ²	448
49	Seagreen Phase 1 ²	1,140
50	Sofia Offshore Wind Farm	1,400
Total	6,658	

Government support on offer: Total capacity of wind farms that have secured a Contract for Difference.

	Up to capacity MW ¹	
51	East Anglia THREE	1,480
52	Forthwind ²	12
53	Hornsea 3	3,000
54	Inch Cape ²	1,008
55	Moray West ²	882
56	Norfolk Boreas	1,800
57	Wave Hub	30
Total	8,212	

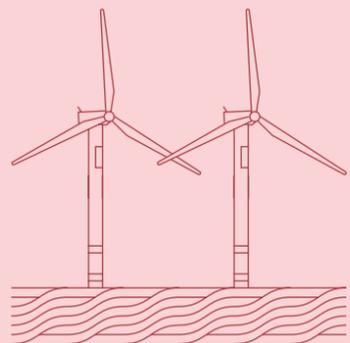


To find out where future development sites are – please see Figure 33 on page 34

1 Capacities noted are rounded to the nearest whole MW. 2 Asset managed by Crown Estate Scotland.

Offshore wind farm performance

Gwynt y Môr
offshore wind farm



45TWh

Wind farm output has increased sixfold over the last ten years

England and Wales capacity factor

Figure 10 shows the evolution of the capacity factor and the power output of offshore wind farms in England and Wales, between 2005 and 2022.

The capacity factor indicates how fully a plant's capacity is used, and varies year on year, depending on the wind conditions. There is a clear upwards trend, reflecting the improvement in turbine technology and better wind conditions further offshore where wind farms are now being

built, as opposed to earlier wind farms which were much closer to shore.

The wind speed in 2022 was lower than the long term average, giving a fleet capacity factor of 38%, with newer sites typically 5-10% higher than this.

Despite this drop in performance, the power output is the highest ever, thanks to the increasing number of operating wind turbines.

Figure 10: Capacity factor - England and Wales

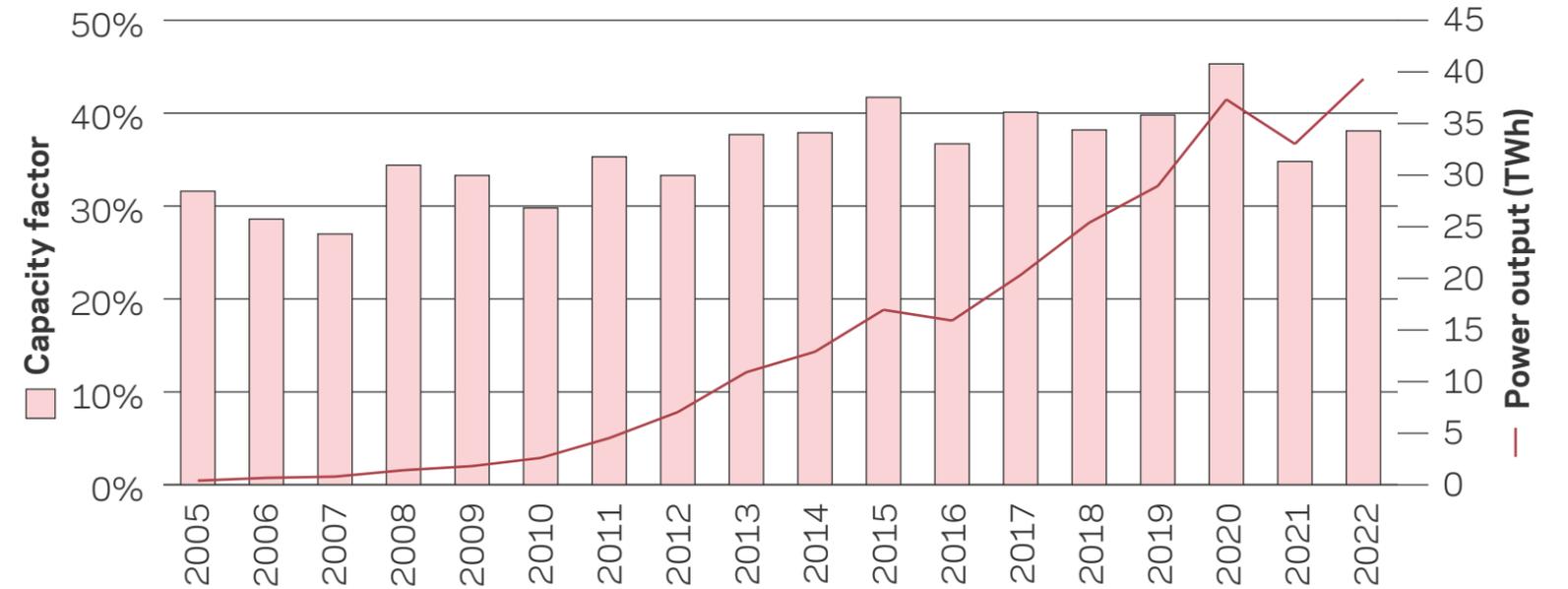
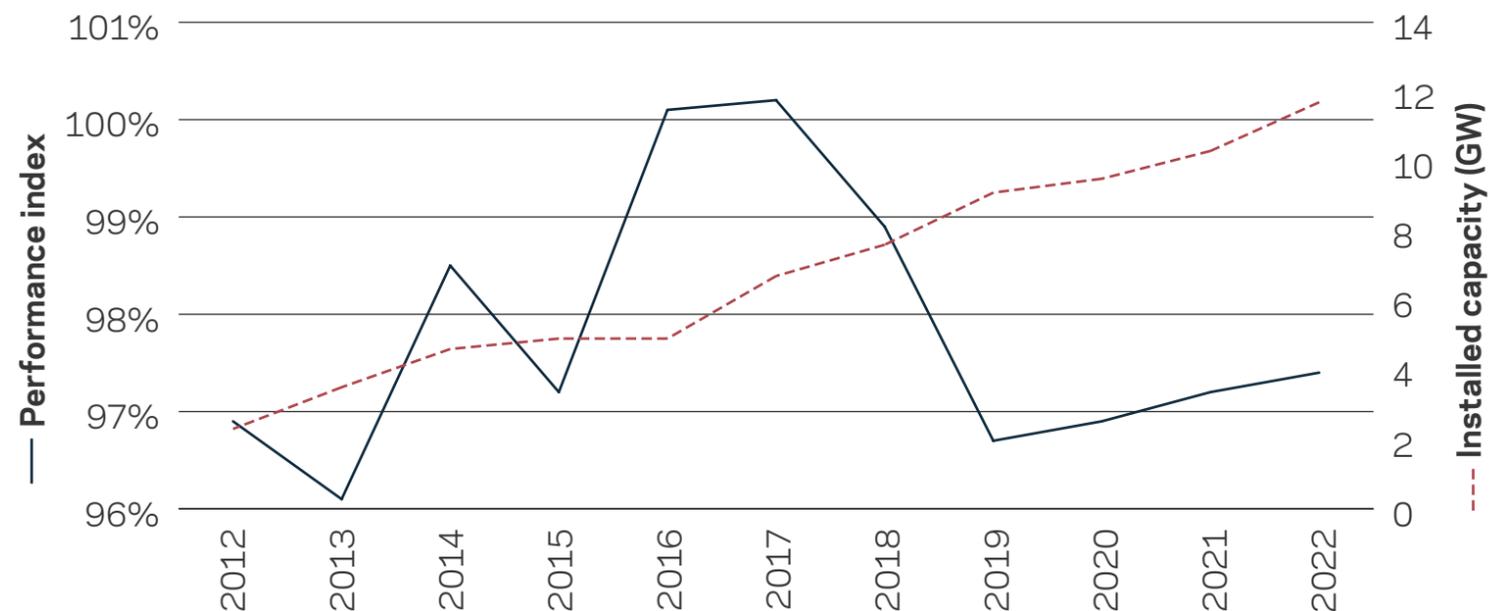


Figure 11: Fleet Performance Index - England and Wales



England and Wales Fleet Performance Index

The Fleet Performance Index compares metered electricity output against the expected output adjusted for actual wind speed during that period. It gives a direct measure of the performance of the offshore wind farm fleet in England and Wales, without any adjustment for outages.

The analysis only includes fully operational wind farms and excludes the construction period. The analysis includes the whole system of the wind farm and its associated transmission/export of electricity back to shore.

The expected power output is derived from satellite measurements and theoretical power

curves. This indirect calculation carries a notable uncertainty but gives an indication of the technical availability of offshore wind farms.

Events that may have a noticeable impact include export and array cable failures, as well as substation maintenance.

In 2022 the Fleet Performance Index was 97.4%.

Over the last few years, the fleet has been notably impacted by some export cable failures on large wind farms, and array cable maintenance across several assets, affecting overall performance.

England and Wales wind variability

Figure 12 shows the impact on energy production due to monthly wind speed variation in England and Wales. Zero on each graph represents the long-term average for each month.

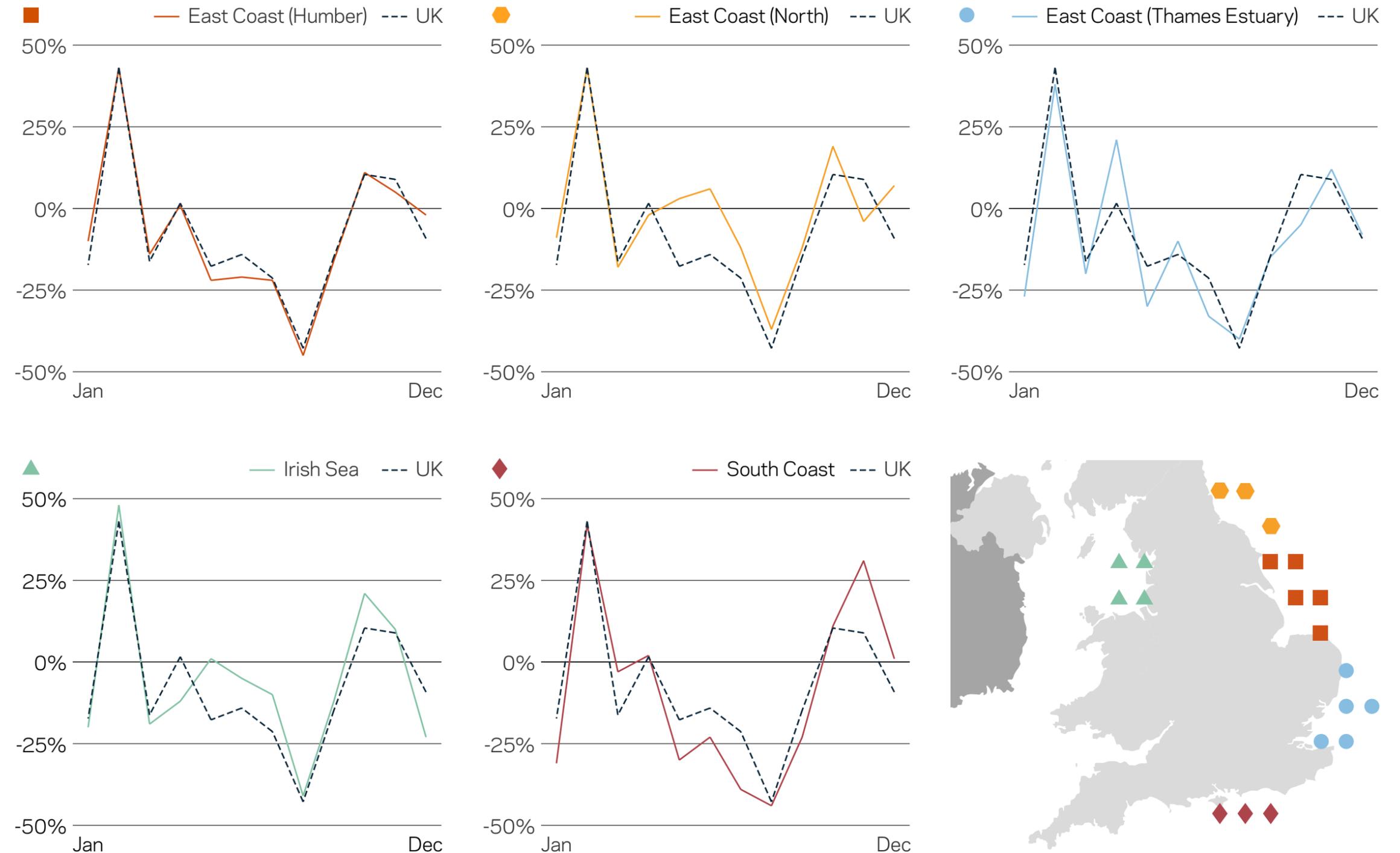
The overall energy deviation at the end of 2022 was 8% below the long-term average.

February was exceptionally windy, but overall, 2022 was less windy than average. The summer was particularly calm, with a high-pressure system lingering over the British Isles for several weeks, leading to one of the worst heat waves in decades. Offshore wind production in August 2022 was more than 40% below expectations.

The UK has the advantage of benefiting from different wind conditions along its coast, thanks to its size and position. It is worth noting that during the 2022 summer months, the Irish Sea and North East regions fared notably better than the others. By spreading offshore wind farms around the coast, the effects of extreme weather events may sometimes be attenuated, albeit not enough to compensate fully for the variability of wind generation. Doing so requires either backup generation units, as is the case today, or some form of large capacity energy storage.

Details on capacity factors and wind variability in Scotland can be found on [page 13](#).

Figure 12: Monthly energy deviation due to wind speed in 2022



Offshore generation

Figure 13 compares the output of the biggest producing wind farms in 2022 compared to production in 2021. Eight wind farms generated more than half of the UK's total offshore wind power in 2022. Hornsea 1, with a capacity of 1.2GW, generated more than 10% of the UK's offshore wind output.

Figure 13: Percentage of electricity generated by UK assets in 2022 (position change from 2021)

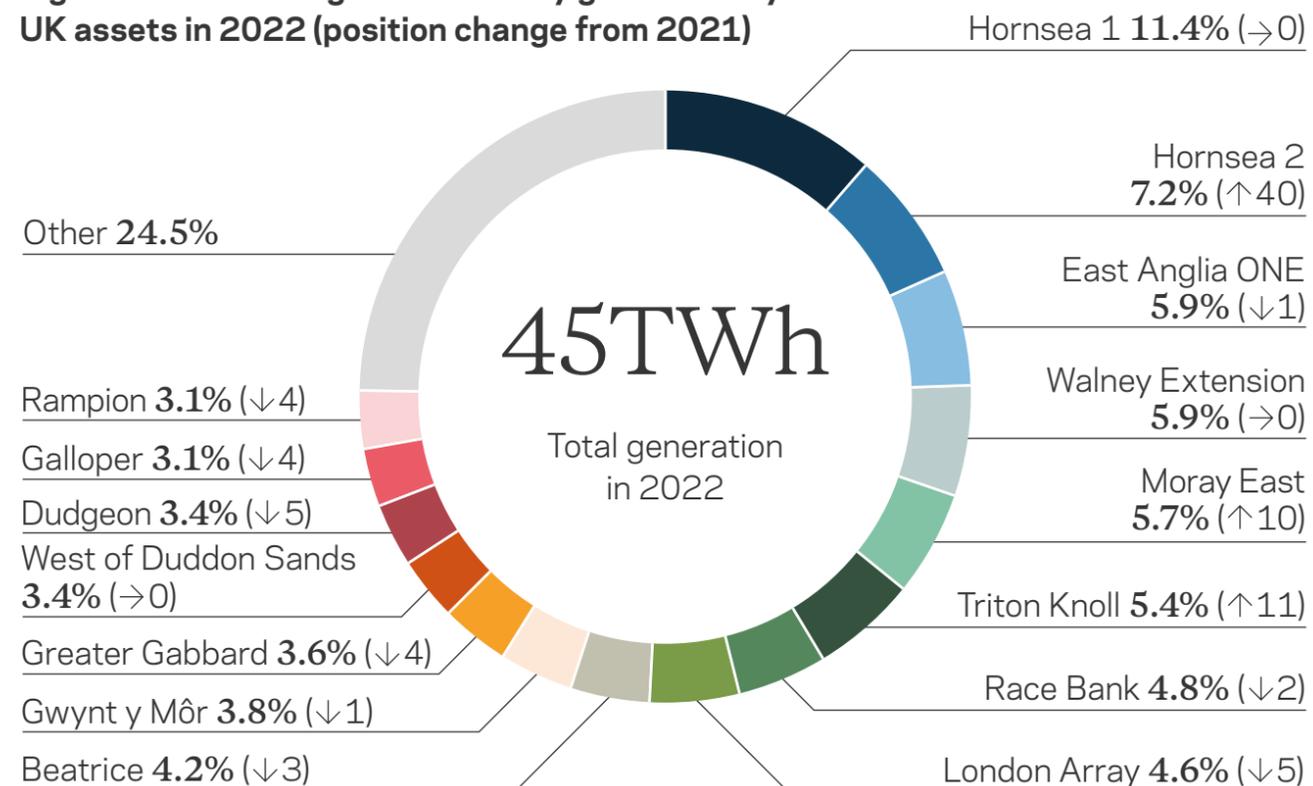
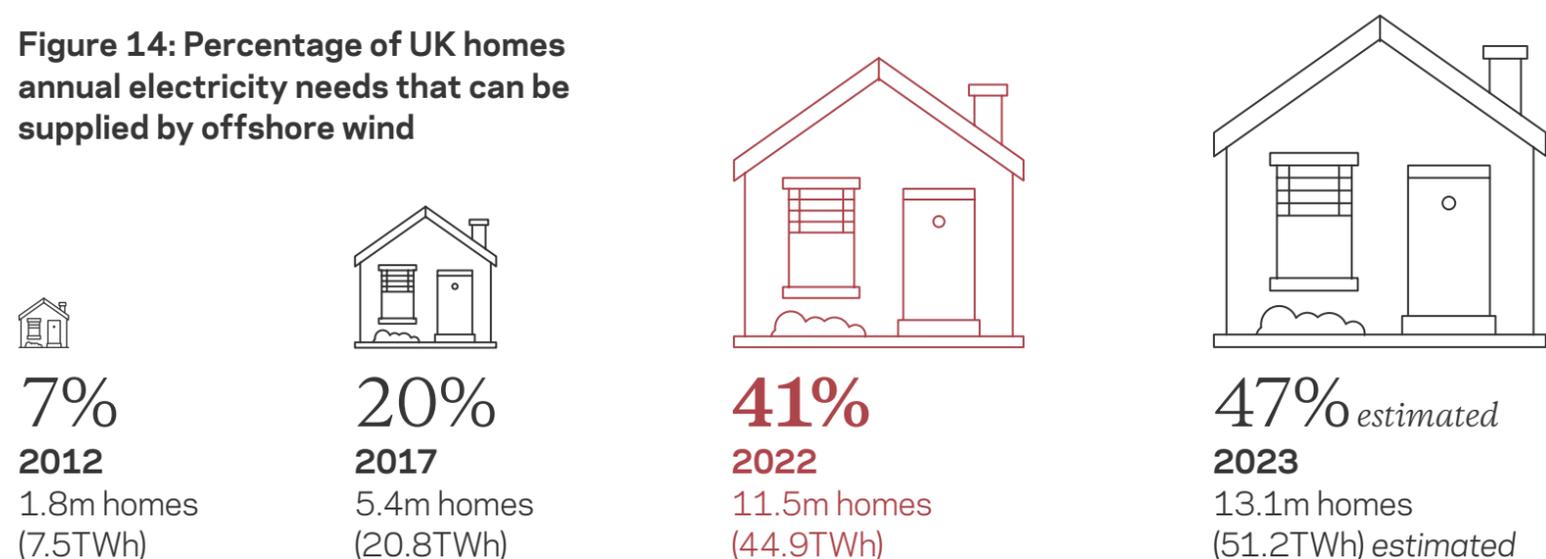


Figure 14: Percentage of UK homes annual electricity needs that can be supplied by offshore wind



UK offshore wind generated **45TWh** last year. That's enough to supply the electricity needs of **11.5m homes**.

Performance in Scotland Portfolio managed by Crown Estate Scotland

Moray East offshore wind farm completed commissioning works in April 2022, with the development achieving its full contracted output. With an installed capacity of 953MW, Moray East is Scotland's second largest offshore wind farm.

The Seagreen (Phase 1) project achieved first power in August 2022 and by October, its turbine installation hit the halfway mark, with 57 out of the 114 turbines in place. Construction work is expected to be completed in 2023. When fully operational, the wind farm will be the largest in Scotland and capable of generating around 5,000GWh of renewable energy annually.

Construction of the Neart na Gaoithe offshore wind farm continued during 2022 with installation of the turbine jacket foundations - a significant milestone for the project. The first turbines are planned to be operational in mid-2023, with completion of the entire wind farm scheduled for 2024.

The Moray West offshore wind farm has now called upon its option and is in lease, with construction expected to begin in Q2 2023 and first power estimated for 2024.

Grid capacity is a continuing challenge for the Scottish portfolio; lack of capacity often leads large volumes of wind energy in Scotland to be constrained off. The offshore wind sector continues to work with grid stakeholders to resolve issues and strengthen the grid in the coming years.

Scottish capacity factor

Figure 15 depicts the evolution of the capacity factor and power output of Scottish offshore wind farms between 2010 and 2022. When Beatrice wind farm became fully operational in 2019, Scotland's offshore wind capacity increased markedly. In 2020, Hywind Scotland set a record for the highest annual average capacity factor for a UK offshore wind farm with 57.1%.

As with the rest of the UK, average wind speed was exceptionally low in 2021, resulting in a 20% decrease from the previous year, with a capacity factor of only 33%, compared to 42% in 2020. In 2022, power output recovered significantly, owing primarily to the addition of Moray East capacity. The average capacity factor over the last 5 years in Scotland was 37%.

Figure 15: Capacity factor - Scotland

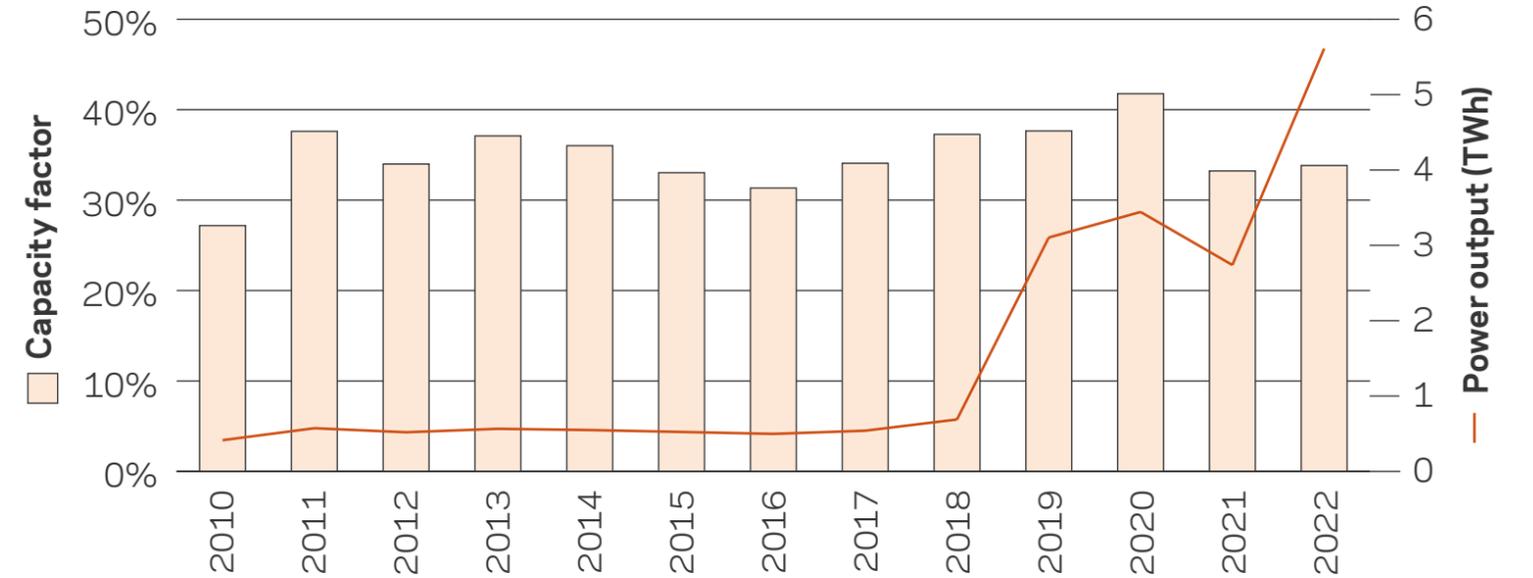
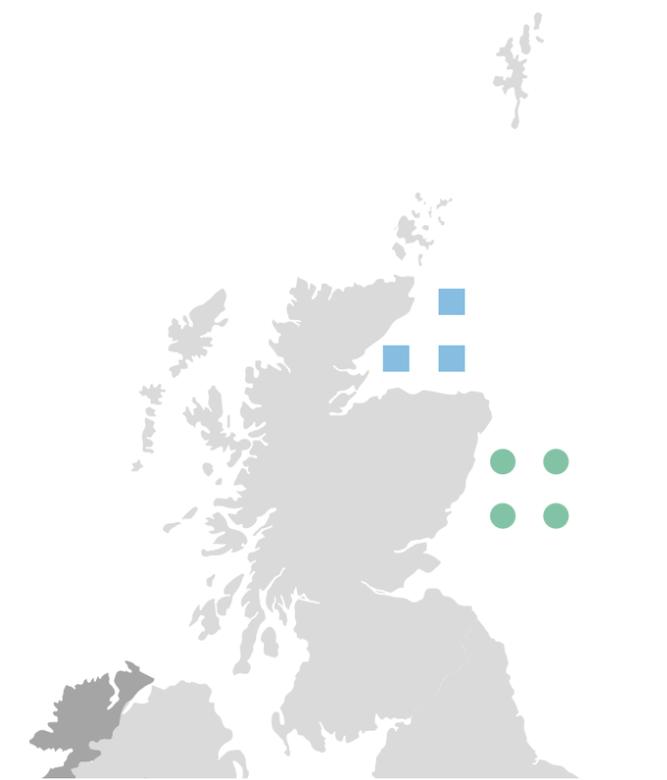
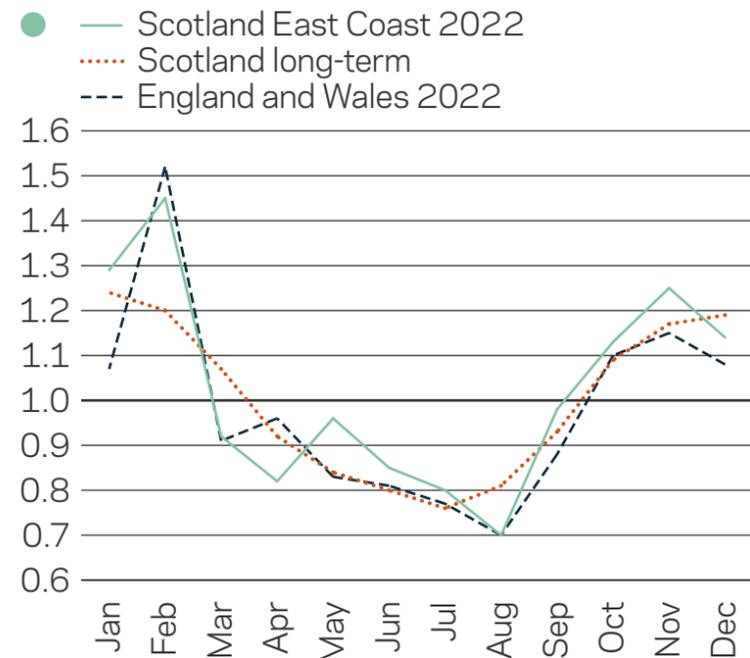
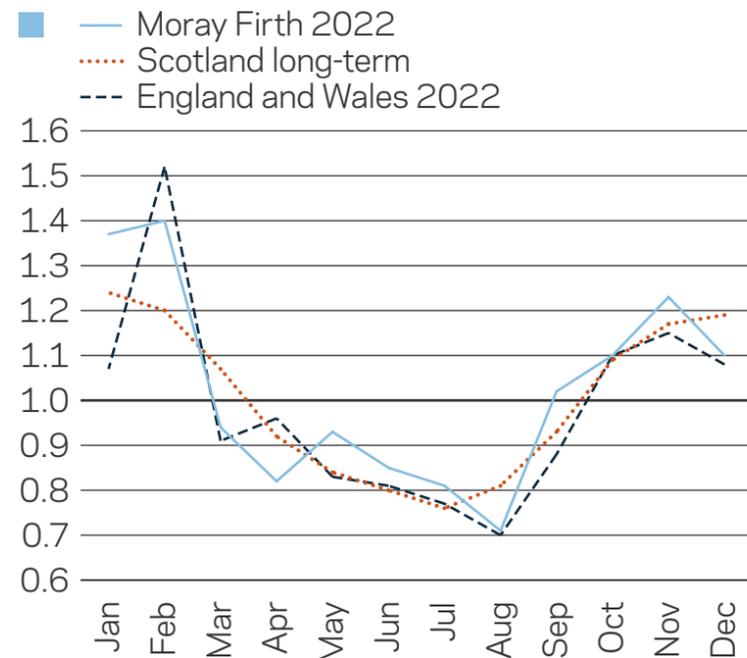


Figure 16: Monthly wind speed index in 2022



Scottish wind variability

Figure 16 illustrates Scotland's monthly wind speed indices based on the average of two regions, East Coast and Moray Firth. Wind speed trends for 2022 were similar for both regions, with the index demonstrating wind speeds in Scotland 2.3% above the long-term average. The graphs illustrate the variation across the UK: contrasting with Scotland, wind speeds in England and Wales were 2% lower than the long-term average. In 2021, milder, less windy weather resulted in record low wind speeds in Scotland, however this recovered in 2022 with wind speeds exceeding the long-term average for most of the year. Three storms were named in the one week in February 2022, the result of this exceptionally windy weather impacted the whole country, as demonstrated on the graphs.

Offshore Transmission Owner (OFTO) performance

Offshore Transmission Owner (OFTO) performance is important for the electricity generation of an offshore wind farm, as it provides the transmission connection to the onshore electricity network. Its availability is critical in ensuring electricity can get to consumers.

In this section, we take a look at how these assets have performed and cover performance data up to March 2022. Transmission system availability for OFTOs is published in the annual [NETS Performance report](#) by National Grid each September.



98.9%

The average
OFTO availability
for 2021/22



Offshore substation platform at Gwynt y Môr offshore wind farm

By the end of 2022, the OFTO network comprised 24 licensed OFTOs¹ supporting over 9.5GW of generating capacity, connected by 47 export cable circuits. These interface with either National Grid’s National Electricity Transmission System (NETS), or the lower voltage distribution networks owned and operated by Distribution Network Operators (DNO). OFTO ownership details are found on our [website](#).

OFTOs are incentivised through the regulatory framework to provide prescribed minimum levels of availability. The default is 98%, with specific targets established for each OFTO. The average availability for 2021-22 was above this at 98.89% and over the last five years, average availability was 98.94%.

There can be a variety of reasons for a drop in availability. These could include planned outages required for maintenance or modification of the assets, unplanned outages as a result of plant or equipment failure, i.e. circuit trips/faults, or outages requested by the DNO. Figure 18 shows the breakdown of system unavailability. Planned OFTO outages were the main cause of system unavailability with most occurring during the summer.

Annual availability data for each OFTO features in [figure 19](#), which can be found on the next page. This includes all outages that originate on an OFTO’s system but excludes outages that originate elsewhere, for example on a wind farm generator or DNO system. The OFTO availability incentive then adjusts the reported outage data to calculate incentivised performance for each OFTO.

OFTO life extension

At The Crown Estate we have continued our engagement with offshore wind generators, OFTOs and Ofgem on transmission asset and offshore wind life extension. We have been engaging with generators and OFTOs to understand the challenges they are facing and recognise the importance of timing for decisions as an essential factor in life extension being a viable option. We see life extension of these assets as critical to ensuring the UK can meet its net zero target by 2050 and look forward to seeing the outcome of Ofgem’s latest consultation on the End of Tender Revenue Stream, which can be expected in 2023.

Figure 17: OFTO availability trend

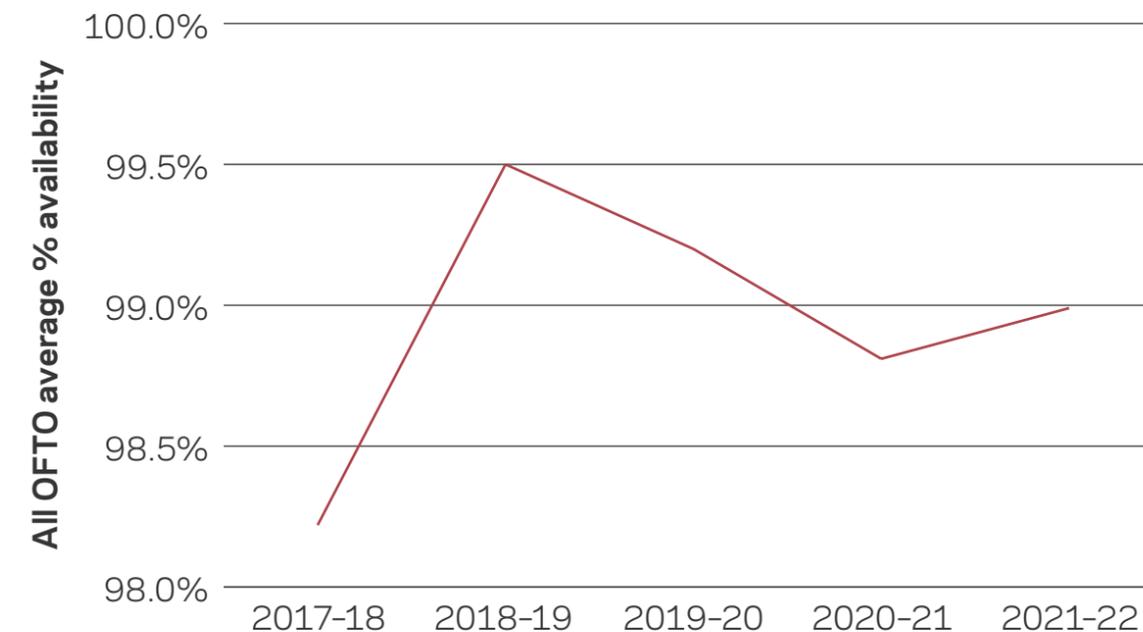
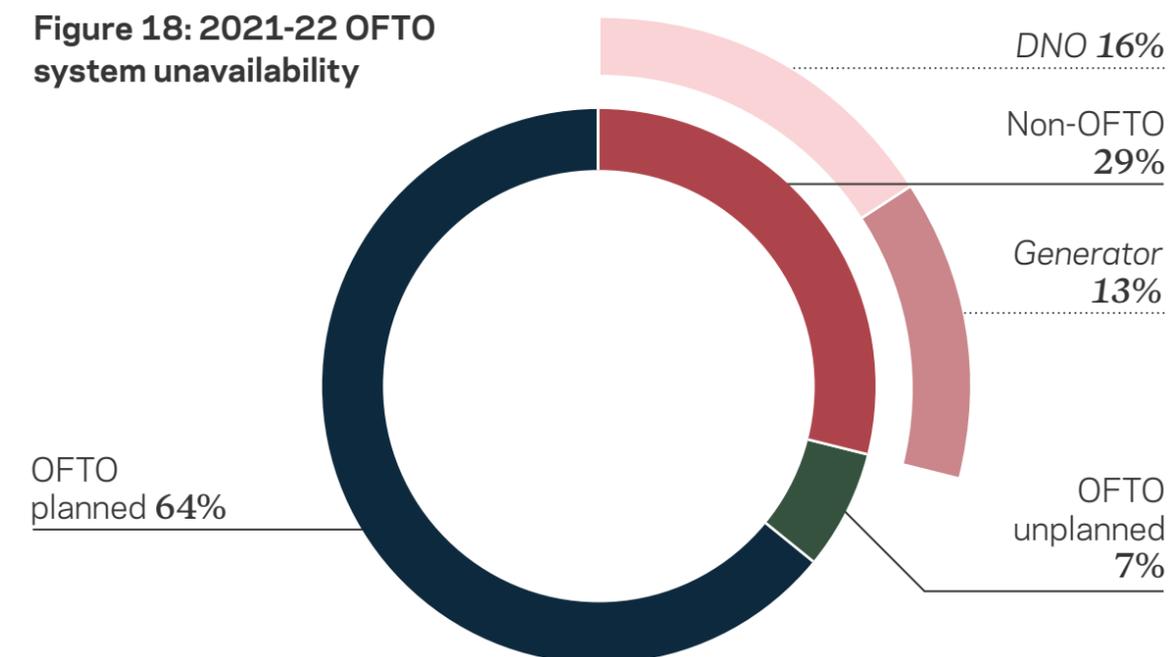


Figure 18: 2021-22 OFTO system unavailability

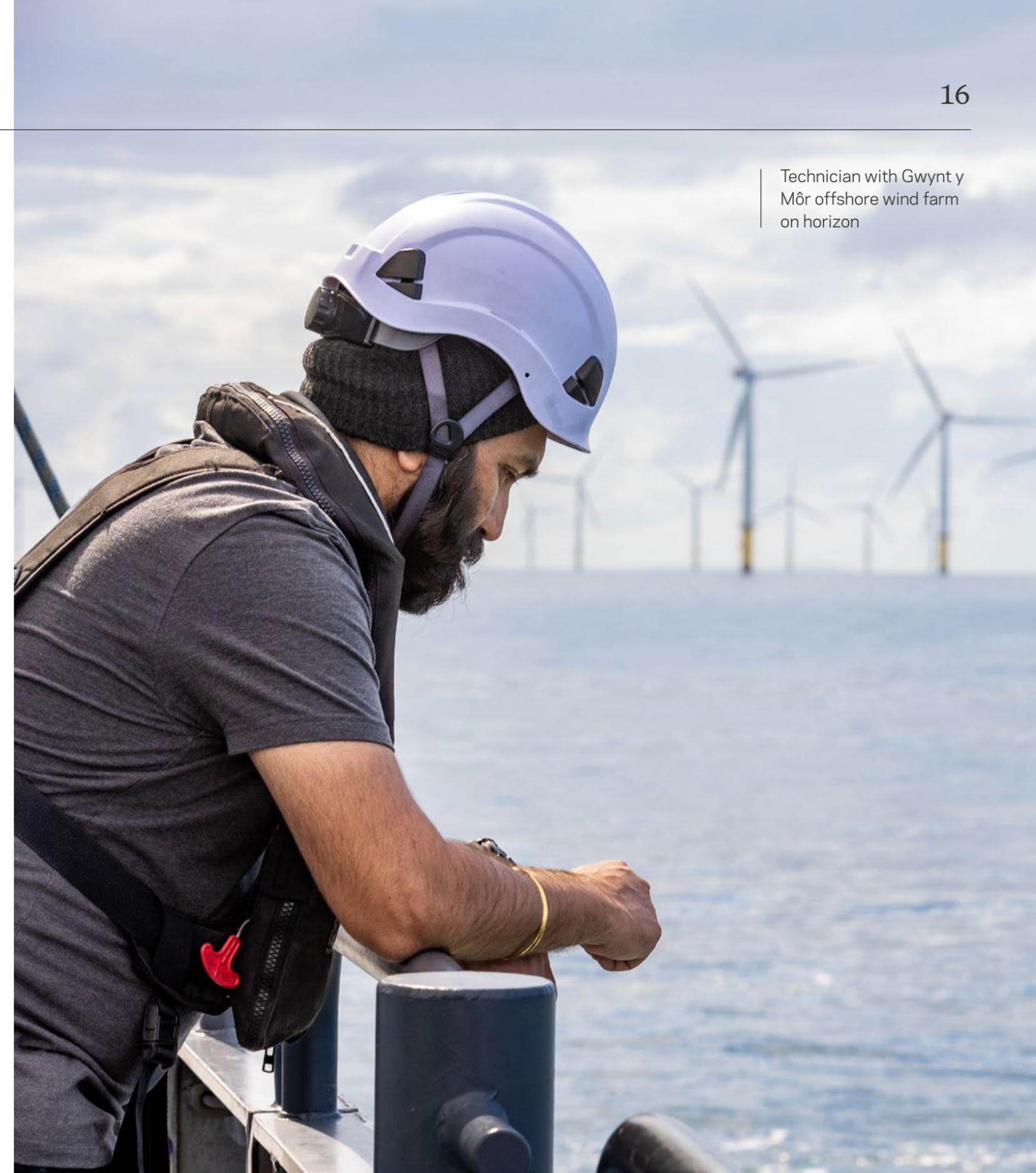


1 East Anglia ONE OFTO licence granted in December 2022 but is not included in the performance statistics for this section of the report.

Figure 19: Offshore Transmission Networks % annual system availability

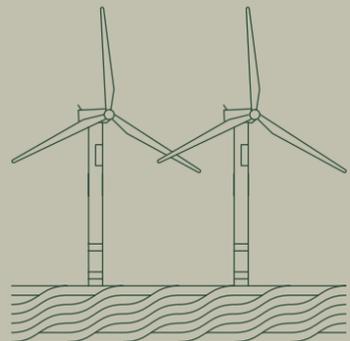
OFTO	2017-18	2018-19	2019-20	2020-21	2021-22
Barrow	99.99	100	100	100	100
Beatrice	N/A	N/A	N/A	N/A	99.16
Bubo Bank Extension	N/A	98.15	99.67	99.99	100
Dudgeon	N/A	100	99.31	99.83	99.92
Galloper	N/A	N/A	100	99.95	100
Greater Gabbard	99.61	99.82	99.78	99.78	99.98
Gunfleet Sands	99.81	99.97	100	99.66	100
Gwynt y Môr	100	99.93 ¹	96.10	86.31	87.62
Hornsea 1	N/A	N/A	N/A	100	99.93
Humber Gateway	100 ¹	100	99.83	99.76	98.73
Lincs	99.78	100	99.56	99.44	99.98
London Array	99.86 ¹	99.94	99.95 ¹	99.77	99.82
Ormonde	100	100	100	100	99.93
Race Bank	N/A	N/A	100	99.26	100
Rampion	N/A	N/A	N/A	N/A	100
Robin Rigg	100	100	99.87	99.95	100
Sheringham Shoal	99.23	99.40	100	100	99.69
Thanet	100	100	100	99.84	100
Walney 1	99.70	100	99.95	100	98.9
Walney 2	100	91.42	100	100	100
Walney Extension	N/A	N/A	N/A	99.97	100
West of Duddon Sands	99.45	100	100 ¹	99.50	99.19
Westermost Rough	100	99.73	100	100	99.93

¹ Figure has been updated because of an exceptional event, with agreement from Ofgem.



Technician with Gwynt y Môr offshore wind farm on horizon

Health, safety & wellbeing



Technicians at Rampion offshore wind farm



Technicians in Newhaven transferring to maintenance vessel

Figure 21: 2021 injury rates and frequency for countries with largest number of sites

UK
47 sites
1.7 LTIF ¹
3.79 TRIR ²

Germany
21 sites
4.28 LTIF ¹
7.5 TRIR ²

Denmark
19 sites
4 LTIF ¹
5.4 TRIR ²

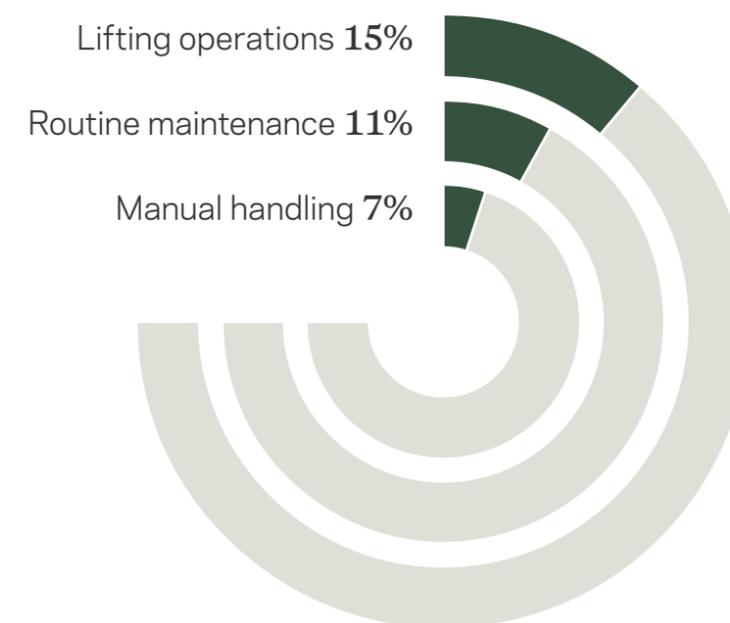
With several large-scale projects under construction adding to the growing offshore wind fleet, the industry's commitment to the importance of health, safety and wellbeing is more important than ever. From emergency response Ex Sancho in May 2022, to Dogger Bank's success at the **Renewable UK's Global Offshore Wind Awards**, held in October, to our conversations with operators who have developed initiatives such as wellbeing ambassadors, and introduced paperless reporting and regular safety days.

Here we have reported on health and safety data from G+, the global health and safety organisation for the offshore wind industry. The data used is

from their **2021 incident data report**. The data for 2022 is due to be published in summer 2023.

Figure 21 represents Health and safety performance data for the three G+ member countries with the largest number of sites. The UK remains the largest of these. The UK's LTIF¹ has increased by 13% and TRIR² by 26% since 2020 which is reflected in the number of incidents reported increasing by 14% with 535 reported for 2021. Globally, LTIF has decreased by 9% and TRIR by 13% compared to 2020. The global average LTIF for 2021 is 1.13 which is lower than the UK, but TRIR is significantly higher at 5.01.

Figure 20: UK top three work processes causing most incidents in 2021



1 Lost time injury frequency (LTIF) - The number of fatalities and lost work day injuries per million hours worked.
2 Total recordable injury rate (TRIR) - The number of fatalities, lost work day injuries, restricted work day injuries and medical treatment injuries per million hours worked.

Industry collaboration

The Ex Sancho: Offshore Wind Emergency exercise was a cutting edge test of health and safety and response protocols when tested against multiple scenarios. The exercise took place at Race Bank, Rampion, Triton Knoll & Westermost Rough wind farms and involved operators, coastguard, police and other government agencies. It was designed to test emergency services arrangements and procedures in response to scenarios occurring offshore, such as trespassers and challenging weather conditions. An exercise such as Ex Sancho provides valuable learning for all of us and is a welcome example of collaboration within industry.

Looking ahead

Although the UK is the G+ member with most capacity, with its LTIF and TRIR appearing healthier than other lead member countries, concerningly the UK's statistics have increased. Our LTIF is now above the global average and an issue that needs an industry-wide response, including a focus on the top work processes causing incidents in the UK, shown in figure 20 on the previous page. Lifting operations are the biggest single cause, followed by routine maintenance, then manual handling.

We will continue to keep health and safety at the top of our agenda in our conversations with our customers, as we seek to understand any trends or incidents affecting the industry.

Figure 22: UK incident consequence profile 2021

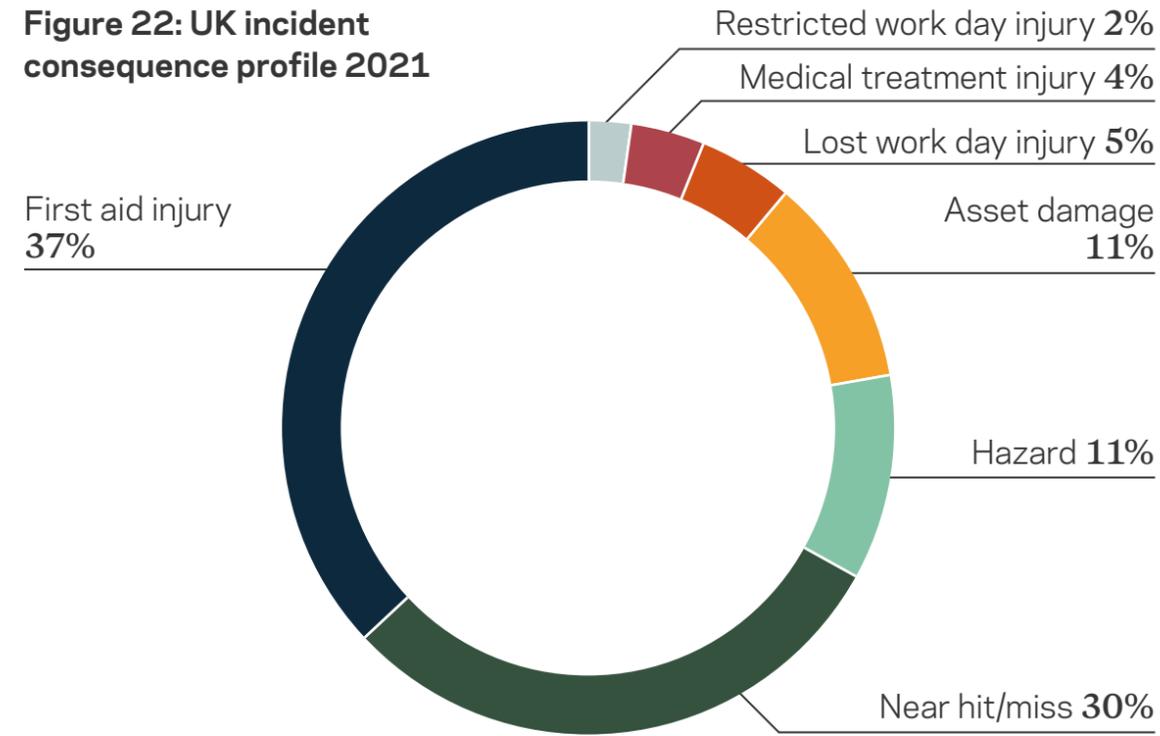
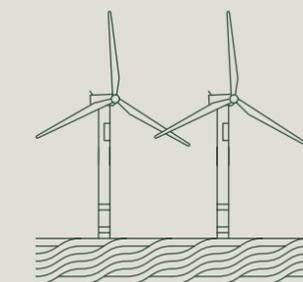


Figure 23: Global offshore wind industry recordable injuries (2020 v 2021)



“Dogger Bank is incredibly proud to have been recognised for their endeavours in “safety by design” by winning the inaugural Global Offshore Wind Health, Safety and Wellbeing Award. By looking at most common incidents from the G+ we incorporated design features to the assets and vessels to remove over a million lifting activities, replace manual handling for thousands of tonnes of material and minimise exposure to large falls to prevent future potential incidents.”

Andrew Saunders
PFO Manager, Dogger Bank
Offshore Wind



Diversity & skills



Technicians in nacelle
hub, Rampion offshore
wind farm

It is three years since the Offshore Wind Sector Deal set workforce and ethnicity targets and is starting to see some progress, shown in figure 24. Female employees now represent over 20% of the UK offshore wind workforce, reflecting an overall increase of 28% and an average increase of 1.5% per annum since the target was set. That might seem positive but the sector needs to move faster to meet the 2030 target and try to exceed it. In May 2022, the Offshore Wind Industry Council and the University of East Anglia announced a new joint research project, “Clearing the Pathway for Women in Wind”, which aims to tackle the gender imbalance in offshore wind and ensure more females enter the sector. The project is ongoing and the findings will be valuable in growing the sector’s career appeal.

Progress was made during 2022 on our Black, Asian and minority ethnic employee demographic, with an increase of 68% on the baseline of 3.7%. This could be due to better quality employee data collection across the industry. However, census data¹ reveals that in some areas, up to 18% of the population is made up of Black, Asian, Mixed or Other ethnic groups, challenging us to try and exceed the Sector Deal target and reflect population statistics.

The sector will soon have cause to celebrate achieving the UK’s target for apprentices making up 2.5% of the offshore wind workforce by 2030. By the end of 2022, apprentices made up 2.3% of the workforce, so the target is within grasp. The nurturing of talent is critical to the regeneration of our coastal communities and to help deliver the ambitious government legislative target for net zero.

Figure 24: Update on Offshore Wind Sector Deal workforce targets

Female employees

16%
Baseline (2019)

33%
Target (2030)
(40% if feasible)

20.5%
Progress (2022)

Black, Asian and minority ethnic employees

3.7%
Baseline (2019)²

9%
Target (2030)
(12% if feasible)

6.2%
Progress (2022)



Inside Rampion Offshore Visitor Centre

1 Black, Asian, Mixed or Other ethnic groups regional census data: England and Wales (2021) 18.3%.
2 2019 figure re-baselined in 2021 because of increased accuracy in data collection.



Left: Skye Francis, Offshore Operations Graduate, RWE.

Inset: Molly Gifford, Offshore Wind Turbine Technician Apprentice, RWE.

Collaboration and sharing of best practice are powerful tools in increasing diversity, equity and inclusion and in the summer of 2022 it was great to see the launch of the TIDE Taskforce (see boxed text).

At The Crown Estate, in our Marine Team, which works on offshore wind and management of the seabed, 47% of our team are female employees and 4% are Black, Asian and minority ethnic employees. We continue our own journey, working to increase diversity, equity and inclusion in our business. This includes building psychological trust in the importance of employee data and trust in how it is handled. If we don't understand whether under-represented groups are having a different experience in our business, it is more difficult to bring about change.

We have several Equity, Diversity and Inclusion (EDI) employee-led networks at The Crown Estate. Our gender network is just one of these, whose aim is to support gender equality and inclusivity. During 2022, the network launched a series of podcasts which featured Molly Gifford, an apprentice with RWE, and Skye Francis who is taking part in RWE's graduate programme. It was an insightful conversation which helped raise awareness of the possibilities for women seeking a career in the offshore wind industry.

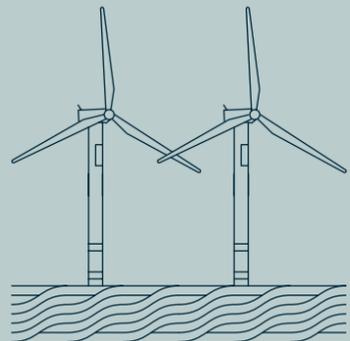
“Tackling Inclusion and Diversity in Energy (TIDE) Taskforce was established to drive forward EDI improvements across the energy sector. Led by Energy UK, Ofgem, the Energy Networks Association and Energy Institute in partnership, the Taskforce brings together leading experts to build on EDI insights and evidence to inform a programme of activities to support long-term industry-wide EDI changes. The Taskforce is focused on three priorities - insight gathering, sharing best practice and engaging with leaders. With over 30 organisations represented across the Taskforce, TIDE will act as a centralised industry body that will collate useful resources, events and best practice. A series of themed webinars is planned to run until August 2024, providing practical tools and cross-sector education opportunities. An online TIDE Hub will also be launched as part of the EDI conference in the summer of 2023, providing a one stop shop for EDI professionals in the energy industry.”

Celia Anderson

Skills Strategy Lead RWE Renewables Offshore and TIDE Chair

Offshore wind farm ownership

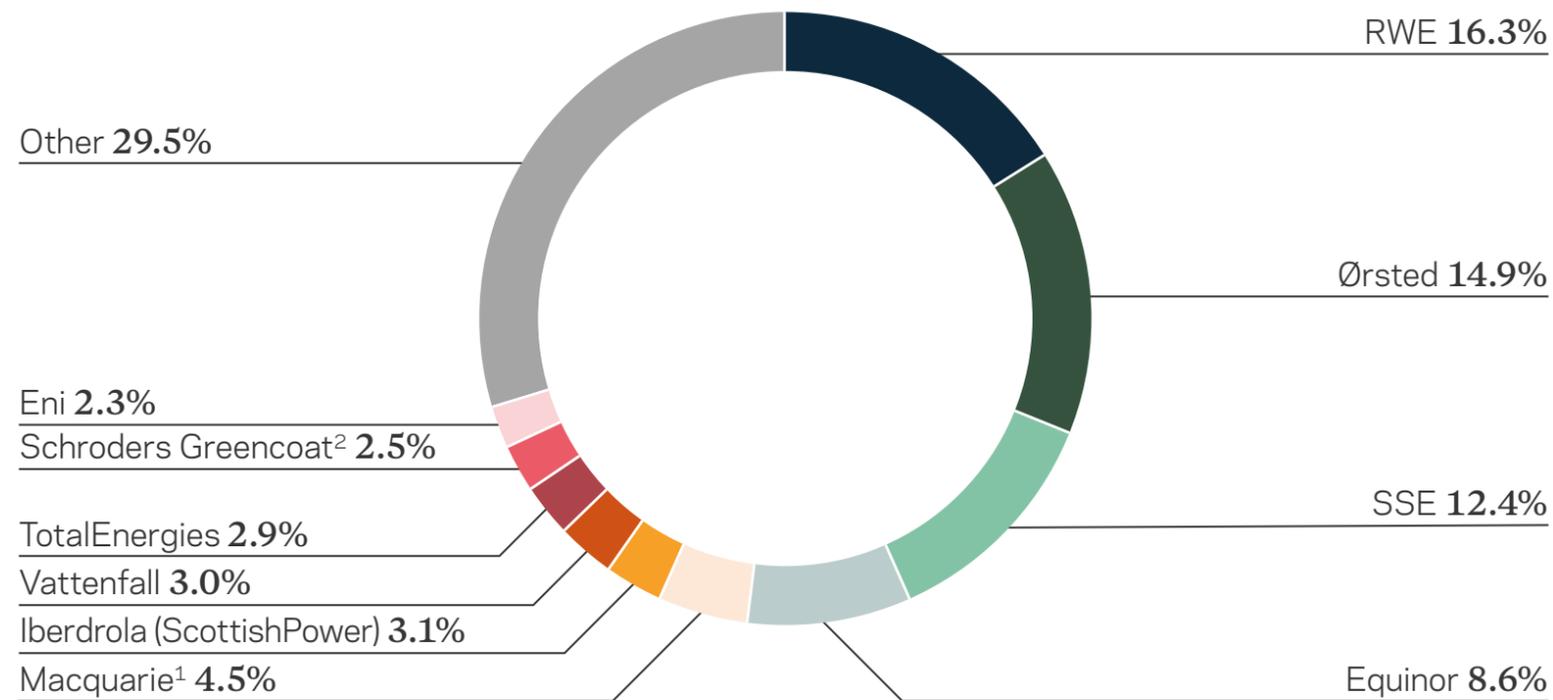
Rampion offshore
wind farm array



We track offshore wind farm ownership to identify key companies, industries and trends in offshore wind investment. Figure 25 shows companies with the greatest share of operating and under-construction offshore wind farms in 2022, and figure 26 summarises ownership by investor category. Utility companies continue to dominate with 59% share down from 63%, however financial investors' shares increased to 24%

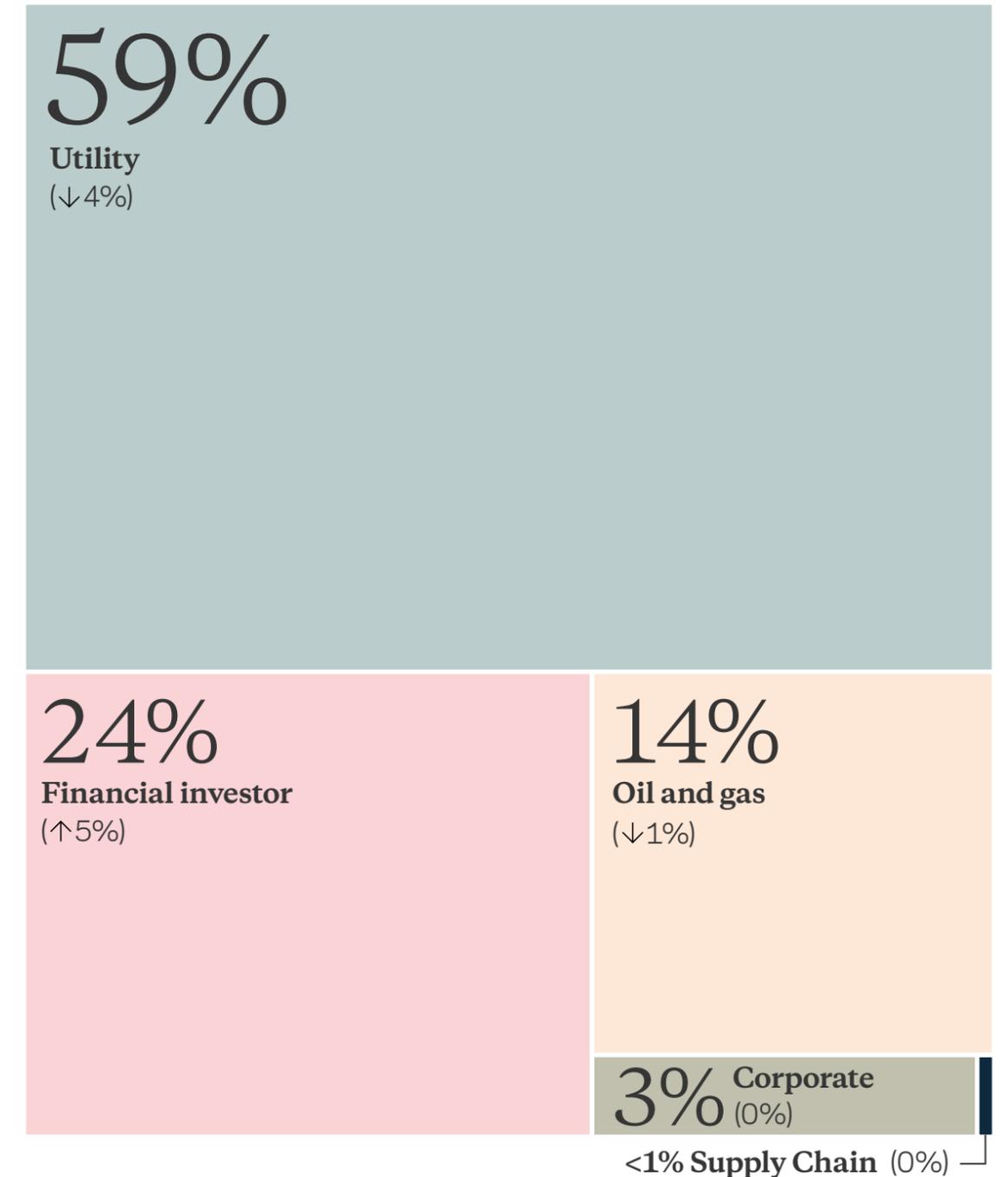
up from 19% in 2022. This reflects the sale of 50% of Hornsea 2 by Ørsted to Axa IM Alts and Crédit Agricole Assurances, and the entry of HitecVision into joint venture Vårgrønn AS with Eni to develop Dogger Bank A, B and C. A full breakdown of offshore wind farm ownership for operating and under construction sites can be found on our [website](#).

Figure 25: Operational and under construction wind farm ownership as a % of total capacity in 2022 by company



1 Green Investment Group (GIG), GIG Renewable Energy Fund, Macquarie European Infrastructure Fund, Macquarie Infrastructure and Real Assets.
2 Greencoat UK Wind, Greencoat Renewable Income LP.
3 Percentages rounded.

Figure 26: Capacity ownership by category in 2022 v 2021 (operational and under construction wind farms)³



Utility companies still dominate the ownership of projects at the development stage, as shown in figure 27. However, this has reduced to 70%, down from 89% in 2021, with the addition of Leasing Round 4 and ScotWind projects boosting the supply chain and oil and gas company share of the early-stage projects.

Notable transactions within the financial investor category included the sale of 50% of Hornsea 1 by Global Infrastructure Partners, and the new entry of Octopus Renewables Infrastructure Trust and Sky Fund into Lincs wind farm ownership. Figure 28 gives a further breakdown of financial investors in operating and under-construction offshore wind farms. Half of these investments are still held by renewable energy and infrastructure funds, but the proportion of direct investors with broader portfolios has increased, particularly investment managers with more diversified interests (16%), and other investors including insurance and financial services (12%).

Figure 27: Capacity ownership by category and lifecycle stage in 2022

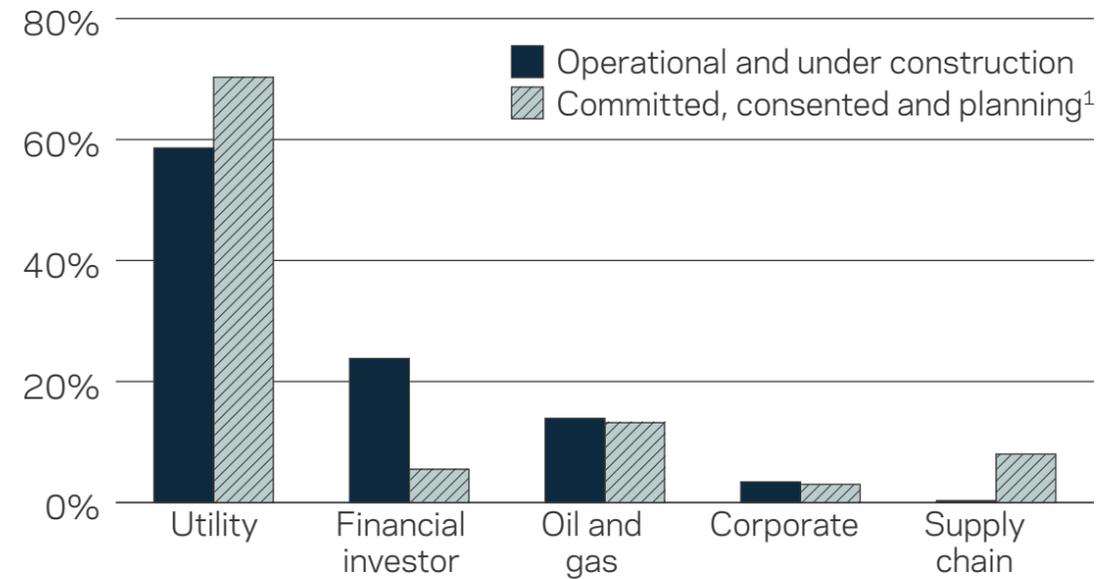
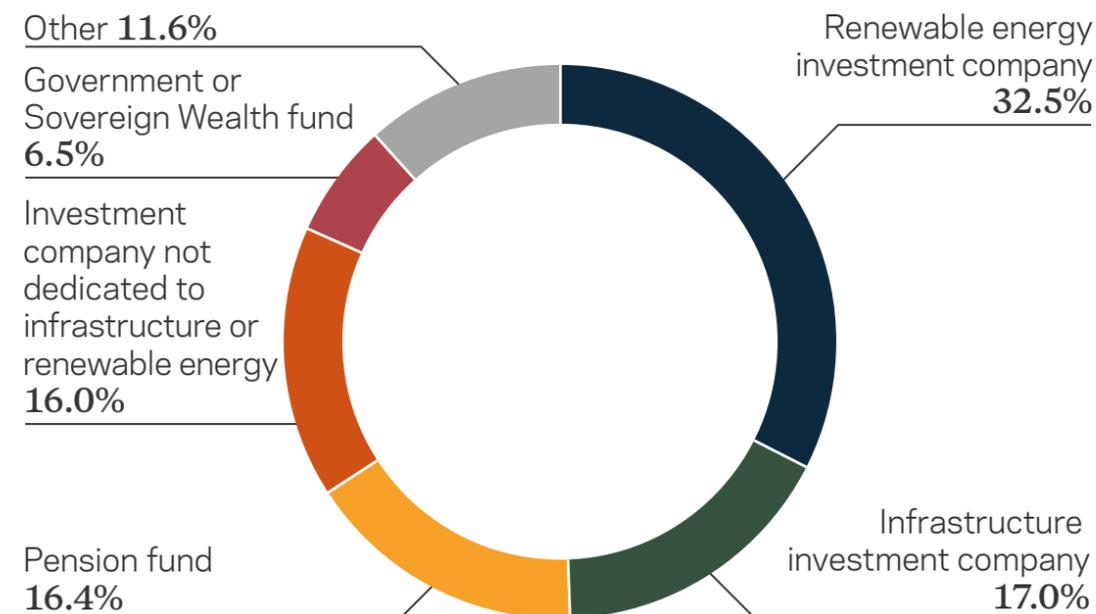


Figure 28: Financial investor capacity ownership (operational and under construction wind farms)

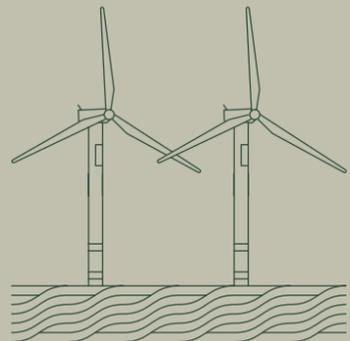


¹ Projects with formal property rights including ScotWind and Leasing Round 4.



Gwynt y Môr wind farm array and vessel

Investment & market



12%

of UK offshore wind
capacity changed
hands during 2022



Wind turbine rotor
at Rampion offshore
wind farm



In 2022 a total of 2.3GW of UK offshore wind capacity changed hands, spread across nine large transactions, reflecting a mature offshore wind investment market. That is 12% of all UK operating and under construction capacity changing hands in a year, shown in figure 29. Some 60% of those investments were in fully operational sites and the remaining 40% in under construction projects.

Figure 29: Transaction activities completed in 2022 in date order

Asset	Seller (share in the project before transaction)	Buyer (share in the project after transaction)	Value (£m)	Indicative timing
Dogger Bank C	SSE (50%) and Equinor (50%)	Eni (20%)	£136m	Feb-22
Lincs	Arjun Infrastructure Partners (7.75%)	Octopus Renewables Infrastructure Trust (7.75%)	Unknown	May-22
Hornsea 1	Global Infrastructure Partners (50%)	Equitix and The Renewables Infrastructure Group (12.5%)	Unknown	Jul-22
Hornsea 1	Global Infrastructure Partners (37.5%)	Greencoat UK Wind (12.5%)	£400m	Aug-22
Hornsea 2	Ørsted (100%)	AXA IM Alts (25%) and Crédit Agricole Assurances (25%)	£3,000m	Sept-22
Lincs	Macquarie European Infrastructure Fund (15.5%)	Octopus Renewables Infrastructure Trust (15.5%) and Sky Fund (7.75%)	Unknown	Sept-22
Hornsea 1	Global Infrastructure Partners (25%)	Equitix and The Renewables Infrastructure Group (25%)	Unknown	Oct-22
Dogger Bank A, Dogger Bank B, Dogger Bank C	Eni (20%)	Vårgrønn, a joint venture between Eni and HitecVision (20%)	Unknown	Oct-22
Hornsea 1	Global Infrastructure Partners (12.5%)	GLIL Infrastructure and Octopus on behalf of Nest (12.5%)	£400m	Nov-22



Transactions during 2022 led to RWE becoming the entity with the largest ownership share in the UK of operating and under-construction projects. Ørsted, previously the largest owner, moved into second place following a sale of half of their share of Hornsea 2. **Figure 25** provides a breakdown of ownership by company across all operating and under-construction sites. Whilst no longer the largest owner, Ørsted had its highest ever operating profit (EBITDA¹) in 2022 and in part, credits farm-downs of two assets, including Hornsea 2. Indeed, it was 2022's landmark transaction, with AXA IM Alts and Crédit Agricole Assurances acquiring a 50% interest from Ørsted in Hornsea 2 for c£3bn. Both investors cited the importance of the investment as part of their journey to decarbonisation.

Other entities, including Macquarie, announced planned sales of their stakes in eight offshore wind farms, although only shares in Lincs were sold before the end of 2022.

Octopus Energy² made a splash with its first investment in the UK offshore wind fleet by acquiring a stake in Lincs wind farm in June. A consortium of Octopus Energy, Nest and GLIL then partnered in November to acquire a 12.5% stake in Hornsea 1 for £400m from Global Infrastructure Partners.

Macro factors, including the war in Ukraine, continued to drive volatility in electricity prices. Although short term gains from selling into the market may be attractive, Contracts for Difference have continued to be the primary

bankable route to market for offshore wind. A diversified approach is increasingly adopted, with utilisation of Corporate Power Purchase Agreements (CPPAs) with high covenant strength corporates. Such a diversified route to market was demonstrated by the planned Moray West wind farm, in Scotland, which is due to reach Final Investment Decision during 2023. CPPAs are also important for corporate and institutional consumers in proving certification of clean energy in decarbonisation auditing and assurance processes. Some of the significant CPPAs agreed during 2022 are shown to the right.

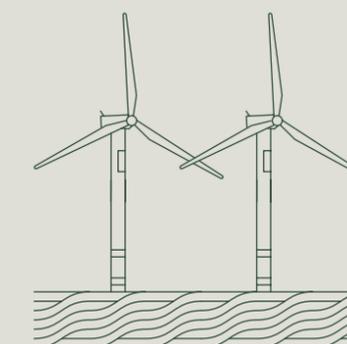
1 Earnings Before Interest, Taxes, Depreciation and Amortisation.
2 Octopus Energy is Britain's fourth-largest energy supplier.

Notable offshore wind CPPAs agreed during 2022:

Shell signs five-year CPPA with **Vattenfall** to offtake one third of the output from **Thanet wind farm**.

Google signs twelve-year CPPA with **ENGIE & EDPR** for 100MW of capacity from **Moray West Offshore Wind Farm** (a previous, 2021 deal was announced with Amazon for 350MW).

Octopus Energy signs a long term CPPA with power offtaker **Shell Energy Europe** for 20% of the energy from **Dogger Bank wind farms**, enough for around 24% of Octopus Energy's customers to be supplied with renewable energy.



Offshore Transmission Owner (OFTO) ownership

Offshore substation
platform at Rampion
offshore wind farm

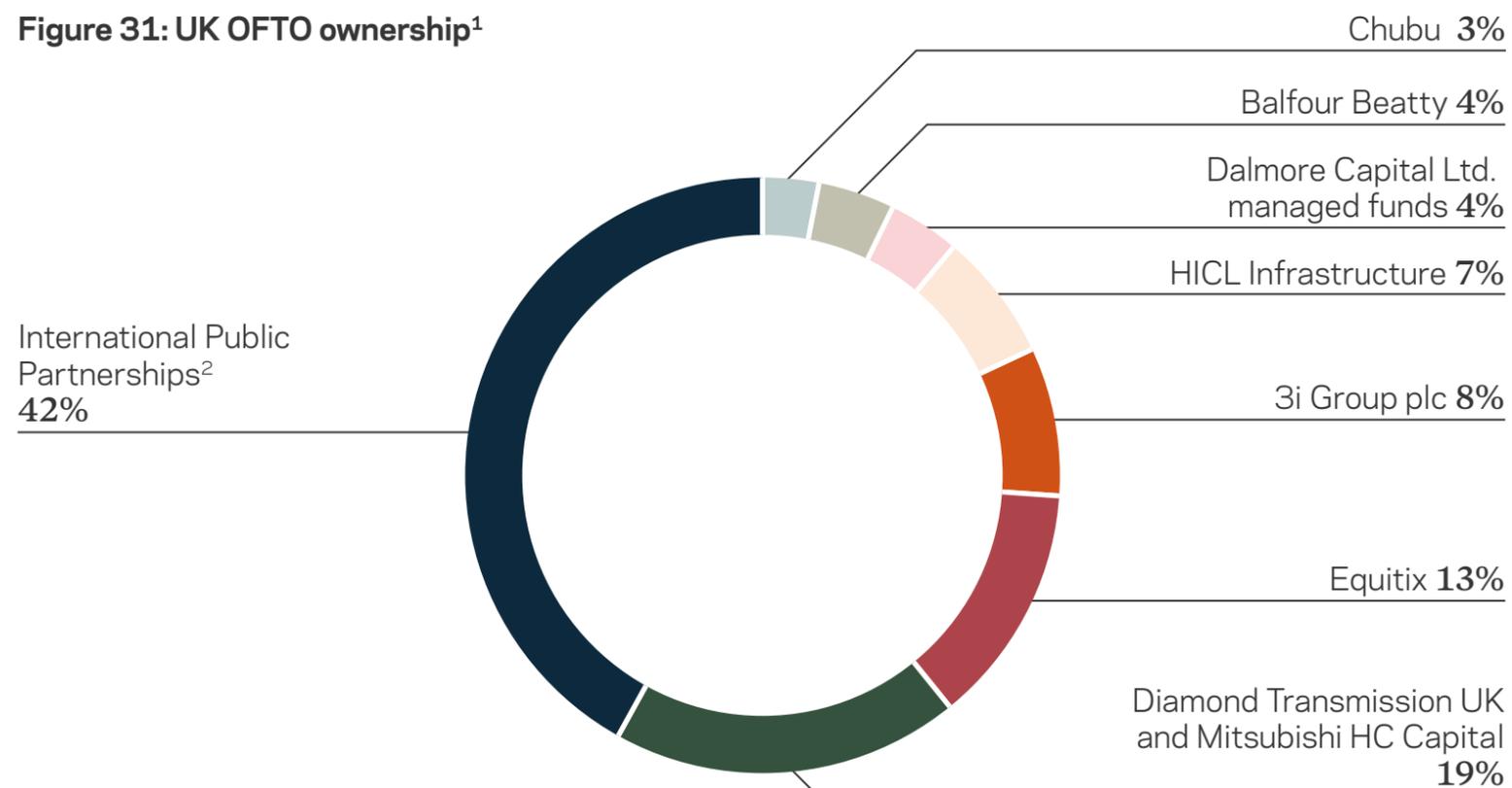


During 2022 only one major transmission divestment and OFTO licence grant took place, the previously delayed East Anglia ONE OFTO transfer (Tender Round 6). Activity is set to increase in 2023, with two Tender Round 7 and one Tender Round 8 licences due to be granted, see figure 30.

OFTO ownership is shown in figure 31 and more detail can be found on our [website](#). There were no

significant ownership movements during 2022. With OFTOs continuing to be operated by the main OFTO companies: Transmission Capital Partners, Balfour Beatty, Diamond Transmission and Equitix who are owned by infrastructure investment groups and venture capital companies. International Public Partnerships' overall UK OFTO ownership share exceeded the 40% mark as it was successful in the East Anglia ONE licence grant at the end of 2022.

Figure 31: UK OFTO ownership¹



1 Ownership has been rounded to the nearest whole percentage
 2 OFTOs operated by Transmission Capital Partners

Figure 30: Offshore transmission tenders

Ofgem is responsible for managing the competitive tender process through which offshore transmission licences are granted. Tenders listed below are currently in progress or recently completed:

Tender Round 6 <i>Launched October 2018</i>	Licences granted 2022 East Anglia ONE December 2022
Tender Round 7 <i>Launched November 2020</i>	Licences to be granted 2023 Triton Knoll Preferred bidder appointed October 2021 Moray East Preferred bidder to be appointed January 2022
Tender Round 8 <i>Launched July 2021</i>	Licences to be granted 2023 Hornsea 2 Preferred bidder appointed September 2022
Tender Round 9 <i>Launched January 2022</i>	Preferred Bidder to be appointed 2023 Seagreen Phase 1 ITT stage commenced January 2023
Tender Round 10 <i>Launched January 2023</i>	EPQ stage commenced 2023 Dogger Bank A ITT stage to commence Q3 2023 Neart na Gaoithe ITT stage to commence Q4 2023 Moray West ITT stage to commence Q2 2024

For more details on the tender rounds, projects and publications relating to the tender processes, please visit Ofgem's [website](#).

Offshore wind development

2022 was an extremely busy year for the future of offshore wind, with projects in the pipeline playing an integral part in enabling the UK to meet its renewable energy obligations.

In this section, we look at some of the key highlights from 2022 and signpost early 2023 developments, from Leasing Round 4 to plans for floating wind in the Celtic Sea.

We also include the latest updates from Crown Estate Scotland on ScotWind and their priorities for the future.



40%

of future offshore wind potential to be identified

| Turbine blade installation



Development Portfolio

The portfolio of offshore wind farms in development comprises projects under Agreement for Lease (AfL), where an option over an area of seabed is granted for offshore wind development. These include Round 3 projects yet to have entered lease, projects from the 2017 Extensions Round and projects under Round 4.

During the AfL period, key activity undertaken by developers includes securing a grid connection, environmental and technical surveys and assessments, consents, procuring contracts with the supply chain and securing finance prior to the start of construction and lease entry.

2022, and into 2023, has been busy with developers working hard to progress projects to an efficient programme to meet government targets in a challenging economic environment with a competitive supply chain. We are seeing the increasing need and benefit of adopting a collaborative and strategic approach across industry and government to address consenting issues, such as compensation measures under the Habitats Regulations¹. We also entered leases for areas of seabed to install artificial nesting structures for kittiwakes to enable compensation measures for specific wind farm consents.

Projects update

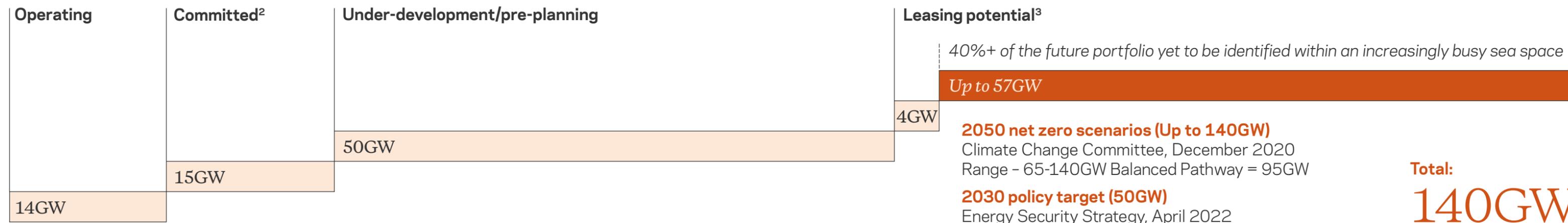
We welcomed new and existing offshore wind developers into AfL for six Round 4 projects at the start of 2023 (see [page 33](#)). Out of 15 Round 3 projects, six remain in AfL. Three of these projects, Hornsea 3, Norfolk Boreas and East Anglia THREE, were awarded a Contract for Difference (CfD). A Development Consent Order was awarded by the Secretary of State to Norfolk Vanguard. Legal challenges were launched to the Development Consent Orders of East Anglia ONE North and East Anglia TWO and a decision on consenting for Hornsea Four was delayed from 22 February to 12 July 2023. All projects aim to be operational by 2030.

Six projects are under AfL and are located adjacent to existing operational wind farms. Applications for consent were submitted for Awel y Môr, Sheringham Shoal and Dudgeon Extensions in 2022, with a decision on the former expected in September 2023 and the latter two projects, in January 2024. The remaining projects are at varying stages of application preparation and all projects aim to be operational by 2030.

Offshore Transmission Assets

Applications for cable routes are being progressed for Round 4 projects and we anticipate cross-border applications for cable routes, for example, Scottish wind farms connecting to the grid in England.

Figure 32: UK offshore wind development pipeline waterfall



1 Conservation of Habitats and Species Regulations 2017 (as amended), and the Conservation of Offshore Marine Habitats and Species Regulations 2017.

2 Projects under construction or that have government support on offer.

3 Potential supply to the national grid (Celtic Sea Floating Offshore Wind and Floating Wind Test and Demo).

Round 4 Leasing Round

In January 2023, we signed Agreements for Lease for six offshore wind projects under The Crown Estate's Round 4 leasing round. These projects, totalling c.8GW could begin to generate green electricity by the end of the decade and have the potential to generate enough renewable electricity for more than seven million homes.

Three of the six projects are located off the North Wales, Cumbria and Lancashire coasts, and three are located in the North Sea off the Yorkshire and Lincolnshire coasts (see [figure 33](#)).

Signing these agreements represents a significant moment in the UK's response to climate change and energy security, and further bolsters the country's thriving offshore wind industry, reinforcing its position as the second largest offshore wind energy generator in the world.

Round 4 follows three previous leasing rounds by The Crown Estate which, along with our investment in cutting-edge data and evidence and a commitment to increasing collaboration across sectors, has paved the way for the development of a world-class offshore wind market in the UK. The Crown Estate has awarded rights totalling 41GW. The offshore wind market is the largest source of renewable electricity in the UK, currently able to power over 40% of UK homes.

With agreements signed, developers can now further progress their plans for the projects which have the potential to make a major contribution to delivering sustainable, renewable energy for the UK, as well as the Government's target of 50GW of offshore wind capacity by 2030.

A pioneering approach to environmental habitats

Alongside the development of the projects, The Crown Estate will now lead a pioneering programme of work to oversee the development of strategic environmental compensation plans for two protected sites, ensuring that the health of the natural marine environment remains at the centre of development plans.

This is in response to a rigorous assessment of the potential impacts of offshore leasing Round 4 on the most valuable environmental habitats in the UK (the Offshore Wind Leasing Round 4 plan-level Habitats Regulations Assessment), and a commitment to ensure that environmental compensatory measures are put in place to offset the predicted impacts on two protected sites (the Dogger Bank Special Area of Conservation and the Flamborough and Filey Coast Special Protection Area).



Foundation
installation vessel

Figure 33: UK offshore wind development projects

Consented: Wind farms that have received consent but not yet secured a Contract for Difference.

Up to capacity MW		
01	Blyth Demonstration Phases 2 & 3 ¹	58
02	East Anglia ONE North ^{R3}	950
03	East Anglia TWO ^{R3}	980
04	Norfolk Vanguard East ^{R3}	1,800
05	Norfolk Vanguard West ^{R3}	500
06	Seagreen Phase 1a ^{R3,2}	500
Total		4,288

In planning: Wind farms for which a consent application has been submitted.

Up to capacity MW		
07	Awel y Môr ^{Ext}	576
08	Berwick Bank ^{R3,2}	4,100
09	Marr Bank ^{R3,2}	402
10	Dudgeon Extension ^{Ext}	99
11	Erebus Floating Wind Demo	2,700
12	Hornsea 4 ^{R3}	100
13	Pentland ²	317
14	Sheringham Shoal Extension ^{Ext}	8,294
Total		8,294

Pre-planning: Wind farms for which a consent application has not yet been submitted.

Up to capacity MW		
15	Arven (NE1) ^{SW,2}	1,800
16	Ayre (NE2) ^{SW,2}	1,008
17	Bellrock (E1-3) ^{SW,2}	1,200
18	Bowdun (E3) ^{SW,2}	1,008
19	Broadshore (NE6) ^{SW,2}	500
20	Buchan (NE8) ^{SW,2}	960
21	Caledonia (NE4) ^{SW,2}	1,000
22	CampionWind (E2-2) ^{SW,2}	2,000
23	Dogger Bank South (East) ^{R4}	1,500
24	Dogger Bank South (West) ^{R4}	1,500
25	Five Estuaries ^{Ext}	353
26	Havbredey (N2) ^{SW,2}	1,500
27	Machair Wind (W1) ^{SW,2}	2,000
28	Marram Wind (NE7) ^{SW,2}	3,000
29	Mona ^{R4}	1,500
30	Morecambe ^{R4}	480
31	Morgan ^{R4}	1,500
32	Morven (E1-2) ^{SW,2}	2,907
33	Muir Mhòr (E2-1) ^{SW,2}	798
34	North Falls ^{Ext}	504
35	Ossian (E1-1) ^{SW,2}	2,610
36	Outer Dowsing ^{R4}	1,500
37	Rampion 2 (Rampion Extension) ^{Ext}	400

Ext 2017 Extension project.
R3 Leasing Round 3 project.

Up to capacity MW		
38	Rampion 2 (Zone 6) ^{R3}	800
39	ScotWind (NE1) ^{SW,2}	500
40	Sealtainn (NE1) ^{SW,2}	500
41	Spiorad na Mara (N4) ^{SW,2}	840
42	Stromar (NE3) ^{SW,2}	1,000
43	Talisk (N3) ^{SW,2}	495
44	West of Orkney (N1) ^{SW,2}	2,000
Total		37,663

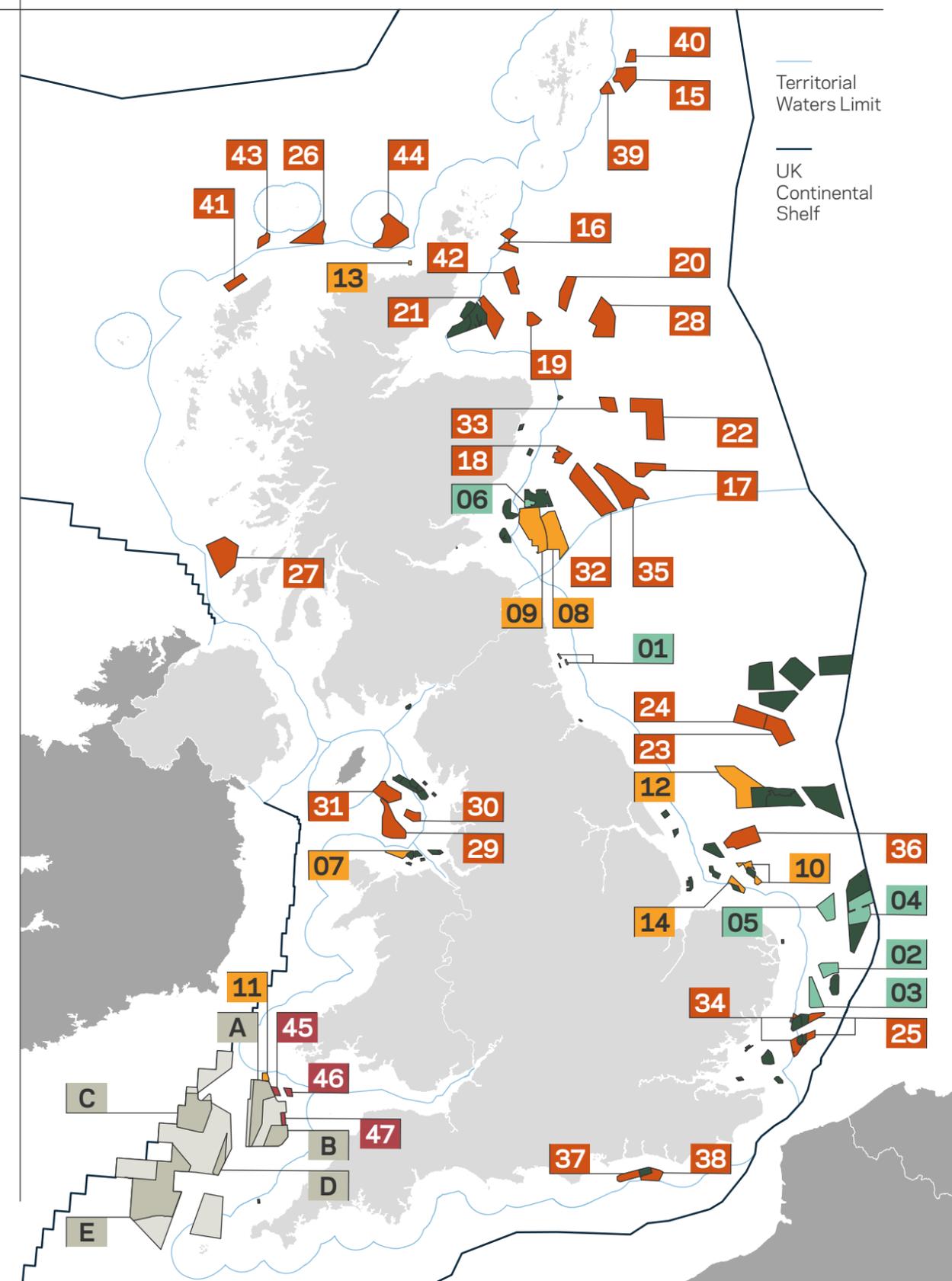
Future potential: Projects subject to plan-level Habitats Regulations Assessment (HRA).

Up to capacity MW		
45	Llŷr 1	100
46	Llŷr 2	100
47	White Cross	100
Total		300

Celtic Sea Floating Offshore Wind:

	Areas of Search
A to E	Refined Areas of Search
	Projects in operation or committed³

R4 Leasing Round 4 project.
SW ScotWind project (and plan area).



1 Capacity noted is rounded to the nearest whole MW.
2 Managed by Crown Estate Scotland.
3 Under construction or government support on offer.

Floating Wind in the Celtic Sea

The Celtic Sea off the coast of Wales and the South West of England represents the next frontier for the development of offshore energy in the UK. We aim to create a world-leading industry in the region. Our ambition is to develop a leasing strategy that delivers social, environmental and economic benefit.

Over the last 12 months, the global context has transformed. We have seen a step change in the focus and attention on the opportunity that exists in floating offshore wind, including in the Celtic Sea, and estimate the economic potential for significant GWs of floating capacity from the region. This will complement 0.7GW of operating fixed offshore wind already off the North Welsh coast, where a body of expertise is building up around Mostyn and a centre of technical learning at Coleg Llandrillo (Llandrillo College), in collaboration with the RWE apprenticeship scheme.

Floating offshore wind is an exciting new technology, and we are starting the development of this market with a leasing round for the first 4GW to be in operation between 2030 and 2035. This has the potential to offer real benefits to the region and the UK, but as with any innovation, joint working will be key to its long-term success. A number of smaller-scale Test & Demonstration projects could precede this commercial scale leasing and be in operation before 2030, providing vital lessons on how we best build and operate this new technology.

During 2022 we continued the detailed design of our Celtic Sea leasing programme, using the best data, evidence and extensive stakeholder engagement to identify the most promising locations for projects which also minimise impacts on the environment and others who make their livelihoods from the sea and our shorelines.

Through a series of webinars, workshops, discussions and market engagements, we have framed five Refined Areas of Search covering around 4,500km² of the sea. We will now need to work through any remaining

considerations before selecting individual areas for project development.

We have also been taking steps to accelerate and de-risk the leasing process for developers, including committing to a multi-million pound programme of pre-consent surveys, carrying out the important Habitats Regulations Assessment alongside the spatial design, and working with National Grid ESO to develop a coordinated grid concept.

Our leasing process – which we expect to get underway in 2023 – will also have a strong

emphasis on requiring developers to support the necessary investment, for example, in ports infrastructure and supply chain, as well as demonstrating how their projects create wider social and environmental value. These factors, along with others, will determine who wins the rights to develop the first GW-scale floating offshore wind projects in the Celtic Sea.

For more on the progress of the Celtic Sea leasing round, visit our [website](#).



Floating wind turbine
at Kincardine

Looking to the future

Our seas are set to get busier over the coming decades, and work is underway in England and Wales designed to optimise sustainable use of the seabed and support co-existence. In England, a cross-government Marine Spatial Prioritisation Programme has been established to build understanding of future demands, maximise co-location, and optimise use of the marine space. In Wales, Welsh National Marine Plans set out Strategic Resource Areas and safeguarding policies for sectors of importance.

Recognising the urgent need for green, home-grown energy provision, The Crown Estate is committed to unlocking opportunities for offshore wind and we are looking ahead to how future leasing can support government policies on energy and climate change. Our independence allows us to take a long-term view for the design of leasing processes which can secure long term value, sustainably managing the seabed and the natural environment.

Our award-winning seabed mapping capability provides advanced analysis tools that utilise the most comprehensive database of seabed characteristics, uses and interests in the country. To improve on this system further, we are currently working on a Resource Identification & Optimisation tool (RIO) which enables data to be structured and prioritised to ensure all environmental, social, and cultural interests are fairly represented in line with stakeholder views. RIO provides a unique one-stop-shop of tools that

deliver the best evidence to support marine spatial planning now and into the future.

We fully support a more coordinated approach to planning and deployment of future offshore wind and electricity transmission infrastructure. We are collaborating with the Department for Energy Security and Net Zero on the Offshore Transmission Network Review (OTNR) to ensure a more coordinated approach for transmission connections for offshore wind generation. We recognise that our approach to leasing the seabed will need to

adapt to support the outcomes of the OTNR. We continue to invest in our data and evidence capability to de-risk consenting and accelerate development of offshore wind and transmission infrastructure and we are considering how we best put our own capital at work to remove market barriers and unblock supply chain constraints.

We are committed to supporting the transition to a net zero energy future and we will be reaching out to discuss future offshore wind leasing opportunities with the market during 2023.



Technician working in an offshore wind turbine

Offshore Wind Evidence and Change Programme

The Offshore Wind Evidence and Change Programme sits at the heart of sustainably and responsibly managing the seabed, whilst unlocking its vast potential to support a net zero energy future through the deployment of offshore wind. The past year has seen an additional £25 million investment from The Crown Estate to the Offshore Wind Evidence and Change Programme, bringing the total up to £50 million. This investment is combined with partner contributions to support research and collaboration to collate and share information that speeds up the consenting process whilst protecting wildlife and biodiversity.

This year we published the programme's second annual report which summarises a breakthrough year. It showcases a range of projects and partner voices from across the programme, including members of the Programme Steering Group spanning governments from all four nations, industry and environmental Non-Governmental Organisations.



**Offshore
Wind Evidence
+ Change
Programme**

Crown Estate Scotland Development

Crown Estate Scotland now has 26 option agreements for offshore wind farms in Scottish waters.

The Inch Cape and Moray West offshore wind farms both secured Contracts for Difference in 2022, and Moray West is expected to begin construction in 2023.

ScotWind leasing round

Of the current option agreements, 20 have emerged from ScotWind, with an intended installed capacity of 27.6GW.

Innovation has been a hallmark of the leasing round. Of those projects, 13 are based on floating technology and, as a result, Scotland now has the largest pipeline in the world of seabed agreements for commercial-scale floating wind (almost 5,000km²); several of the projects are also considering hydrogen as a possible offtake solution, in part due to grid constraints.

The diversity of ScotWind projects, the ongoing test and demonstration projects, and the introduction of Innovation and Targeted Oil & Gas (INTOG) means that Scotland has the potential to be a key development location for the global offshore wind market.

ScotWind is also expected to deliver an average of £1.4bn investment in Scotland per project built, and £1bn investment in Scotland per

gigawatt of capacity built, as a result of the innovative Supply Chain Development Statement (SCDS) process built into the leasing round. This process begins engagement with the supply chain at an early stage, and ensures that engagement continues to help all parties better understand and communicate expectations and opportunities.

Innovation and Targeted Oil & Gas (INTOG)

INTOG is a new seabed leasing opportunity for offshore wind farms, to help maximise value from commercial scale deployment and to reduce the carbon emissions associated with North Sea oil and gas production.

It will:

- Stimulate Scotland's offshore renewables innovation and associated supply chain
- Help new companies enter the renewable energy sector
- Progress the 'just transition' as set out in the North Sea Transition Deal (NSTD).

This leasing round is intended to support Scotland in its target of achieving net zero emissions by 2045.

INTOG has two distinct elements:

- Innovation (IN) which is for small scale innovation projects of 100MW or less
- Targeted Oil and Gas (TOG) which is specifically designed for offshore wind farms to connect to oil and gas installations and provide them with low carbon electricity.



Turbine blades stored at Port of Nigg, prior to installation

In March 2023 it was announced that 13 projects had been offered Exclusivity Agreements allowing them to start offshore wind development while the INTOG Sectoral Marine Plan is concluded.

Development priorities

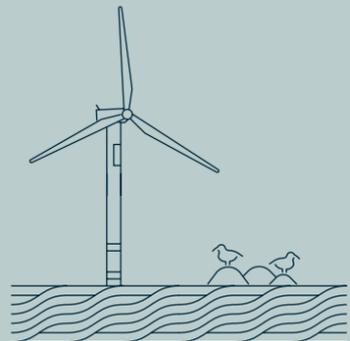
Crown Estate Scotland continues to support the strategic infrastructure planning, and socio-economic development, necessary to help Scotland maximise the benefits of offshore wind development – a commitment demonstrated by our continued support of the Scottish Offshore Wind Energy Council (SOWEC).

Our top priorities to help enable the offshore wind sector in the coming years have been identified as:

- Grid and hydrogen development for power export
- Delivering floating wind at gigawatt scale
- Solutions for the busy blue economy
- Pioneering models for supply chain collaboration
- Supporting Scotland's projects to be world-leading examples.

Data & evidence

We have been investing in marine data and evidence for over 20 years, to support sustainable marine development in our waters. This includes investment in our Resource Identification & Optimisation (RIO) tool which we discuss on [page 36](#).



260 TB

of survey data is now held on the Marine Data Exchange

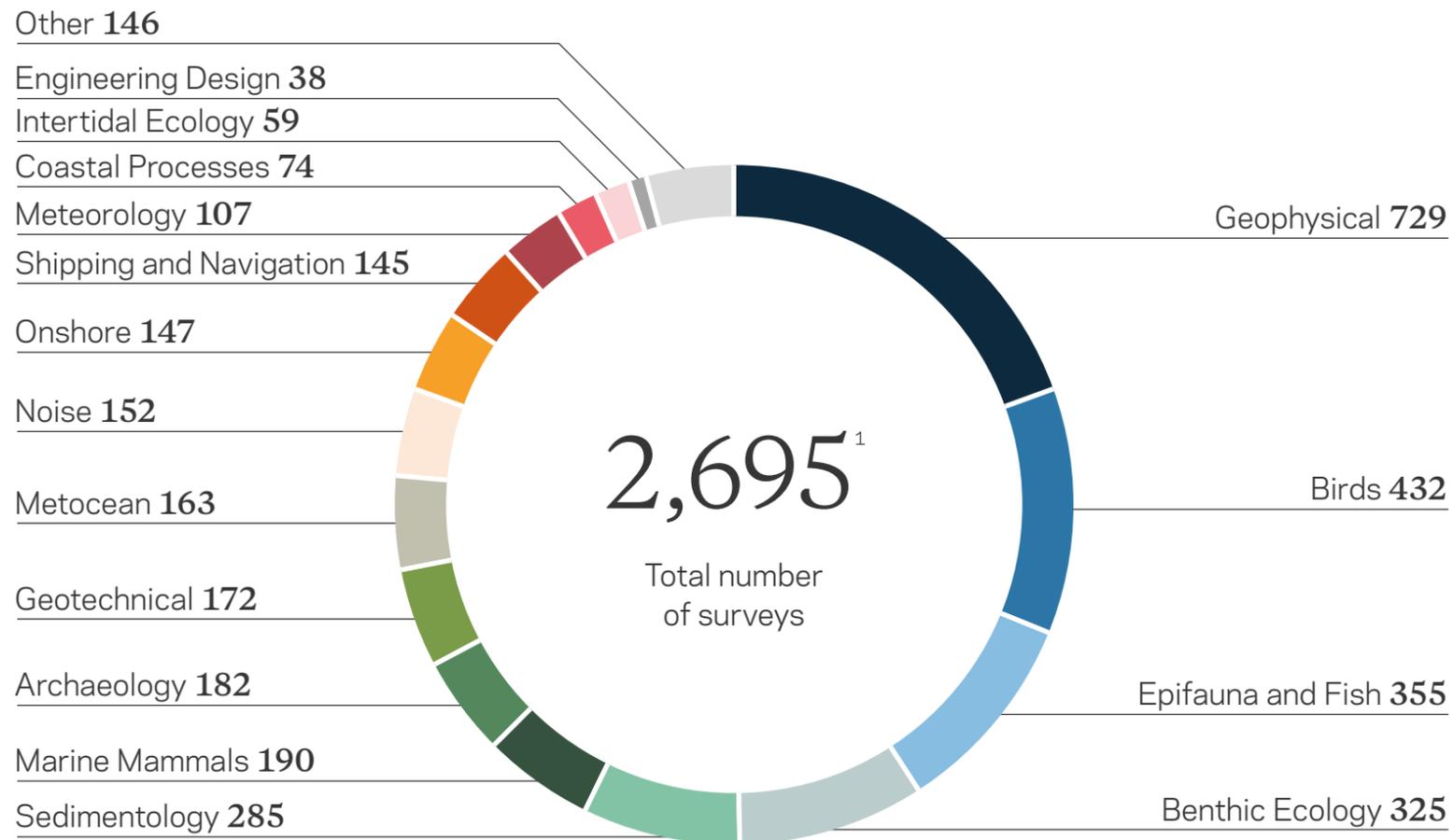


Pipe Reef - Dan Bolt. Winner of British Waters Living Together category of the 2023 Underwater Photographer of the Year.

With an increasingly busy seabed space and the dual crisis of climate change and habitat loss, it is critical that development decisions are based on sound data and evidence in order to maximise growth in secure, affordable green energy, whilst also protecting and restoring the UK's precious marine life.

The Marine Data Exchange (MDE) is a world-leading database of offshore industry survey data, research and evidence. By sharing our survey data collected during the lifecycle of an offshore wind project and investing in collaborative and innovative evidence programmes that address knowledge gaps, we help support the marine industry from feasibility through to decommissioning.

Figure 34: Type of survey data on MDE¹



¹ Many surveys are multi-disciplinary and tagged with more than one theme within the total number of surveys.



Snorkelling the smalls
– Kirsty Andrews.
Commended in the
British Waters Living
Together category of
the 2023 Underwater
Photographer of the Year.

As marine sectors expand, so does the spatial footprint of survey data collected by offshore industries. The breadth of high-quality and freely available marine industry data that is accessible on the MDE can help inform management and monitoring programmes put in place as part of the UK Marine Strategy (2012), which aims to achieve good environmental status (GES) in British Seas.

Published on the MDE in November 2022, the **Marine Industry Report** outlines the potential use of marine industry data for marine assessment and reporting. It concludes that future industry data pilot studies have the potential to make strides towards understanding the environmental status of the UK's marine environment, particularly surrounding natural capital approaches.

In one of our latest joint efforts to help the UK achieve net zero by 2050, we have convened with key stakeholders from across the UK to work on a shared mission to better understand and overcome the cumulative environmental impacts of offshore wind, and its effects on users of the sea and onshore communities. See our **Offshore Wind Evidence and Change Programme** for more information, as well as our report in collaboration with the Department for Business Energy, and Industrial Strategy (BEIS) and Crown Estate Scotland [here](#).

Figure 35: Survey data coverage on the Marine Data Exchange

260 TB

Of data held on the MDE

2,695

Total surveys

19,149

Downloads

60%

Made publicly available

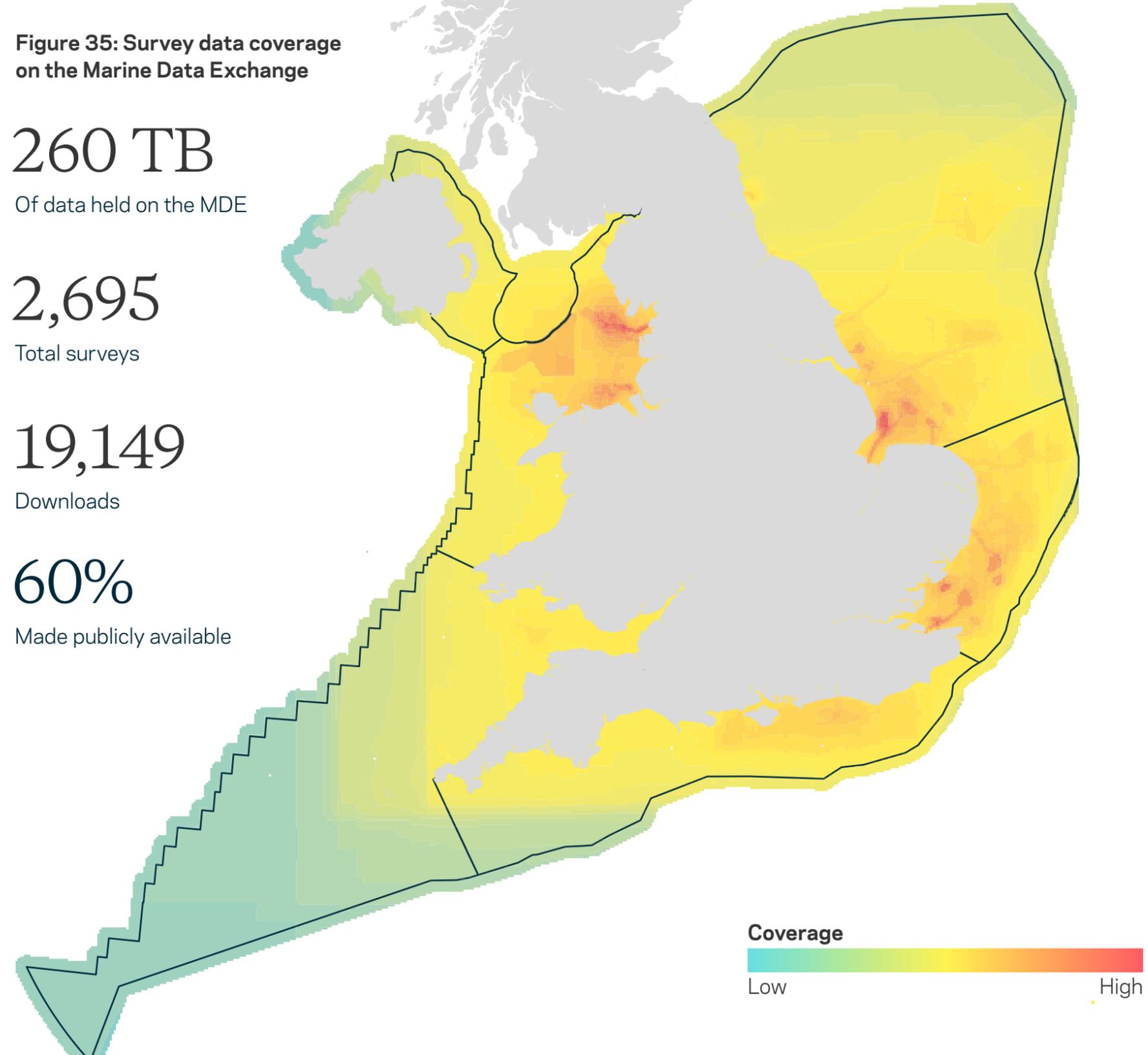


Figure 36

161 
Marine mammal surveys 2002-2022

Of those surveys...

42% 
Boat based

26% 
Aerial based

14% 
Desk based

9% 
Acoustic

8% 
Vantage based

1% 
Tagging based

Carbon dioxide displacement due to renewable energy

Displaced CO₂: Represents the carbon dioxide that would have been emitted by traditional power stations to generate electricity, in the absence of renewable energy.

A study of greenhouse gas emissions of the UK electricity system by R.C. Thomson (2014)¹ demonstrated that wind power displaces coal – and gas-fired power stations, and that partial loading of fossil-fuelled power stations has an efficiency penalty of 11%.

The CO₂ displaced by offshore wind can be calculated by using BEIS emissions statistics for “all fossil fuels” and subtracting 11% to account for the induced efficiency penalty.

The Crown Estate uses this method to measure the benefit of offshore wind.

Displaced CO₂ in 2022: 17,253,969 tonnes²

¹ *Carbon and Energy Payback of Variable Renewable Generation*, Rachel Camilla Thomson (2014)

² Provisional figure based on 2021 emissions data from BEIS

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