

Wind powered electricity in the UK

This article looks at wind powered electricity in the UK, examining how its position in the UK energy mix has shifted from 2010 to 2019¹, and how wind capacity may change in the future.

Key points

- Total wind generating capacity increased by 19 GW from 5.4 GW in 2010 to 24 GW in 2019. This is the result of sizeable increases in capacity both onshore and offshore, which are up 10 GW and 8.5 GW respectively.
- In the last year, UK offshore wind capacity rose 1.6 GW following the opening of Hornsea One, Beatrice extension (partially operational in 2018) and East Anglia One (partially operational). Hornsea One is now the largest offshore wind farm in the world with an operational capacity of over 1.2 GW.
- In 2019, wind generators became the UK's second largest source of electricity, providing 64 TWh; almost one fifth of the UK's total generation. This was achieved by record onshore and offshore generation despite suboptimal conditions for wind, with 2019 reporting the lowest average wind speeds since 2012.
- Onshore generation exceeded offshore for every year 2010 to 2019, however the gap narrowed each year. In 2019 the difference was marginal with each providing 32 TWh of electricity and 9.9 per cent of the UK's total generation.
- Offshore sites are typically able to use more of their available capacity for generation, as wind speed and direction are more consistent offshore. This is measured by the load factor, the proportion of maximum generation achieved. Offshore load factors averaged 38 per cent versus 26 per cent for onshore from 2010 – 2019. In 2018, relative to the global averages, UK wind farms achieved greater load factors both onshore and offshore².
- Among OECD European countries, the UK's share of total wind generation grew almost every year from 2010 to 2017³. In 2018, the UK was the second largest generator of wind powered electricity in the group, behind Germany, with the third largest capacity; Germany and Spain being first and second.
- England was the largest generator of wind powered electricity of the four UK countries in 2019, providing 52 per cent of the UK's total wind generation. Scotland, Wales and Northern Ireland provided 35, 8.0 and 5.0 per cent respectively.

Growth of UK wind generation

Commercial wind farms comprising a series of wind turbines at a single site were introduced in the UK in 1991 with the opening of Delabole wind farm. The site consisted of ten 50m wind turbines with total capacity of 4 MW. Throughout the 1990s the pickup of wind-powered electricity generation was slow but momentum gradually grew. Government subsidy schemes introduced from the early 2000's as well as technological developments unlocked rapid growth. The subsidy schemes were the Renewables Obligation (RO, 2002-2017)⁴, Feed in Tariff scheme (FIT, 2010-2019)⁵ and Contracts for Difference (CfD, 2015-)⁶. Development of offshore wind began in 2001,

¹ Please note that all data for 2019 is provisional and may be subject to revisions.

² Offshore Wind Outlook 2019: www.iea.org/reports/offshore-wind-outlook-2019

³ Data beyond 2017 for all of Europe is currently unavailable from the IEA, the most up to date data can be found at: www.iea.org/data-and-statistics/data-tables?country=WORLD&energy=Electricity&year=2017

⁴ The RO closed for new generating capacity for large-scale and small-scale solar PV in March 2015 & 2016 respectively. It was then closed for onshore wind in May 2016 and for all other technologies in March 2017. Dates differ for Northern Ireland.

⁵ FIT closed for new generators in April 2019.

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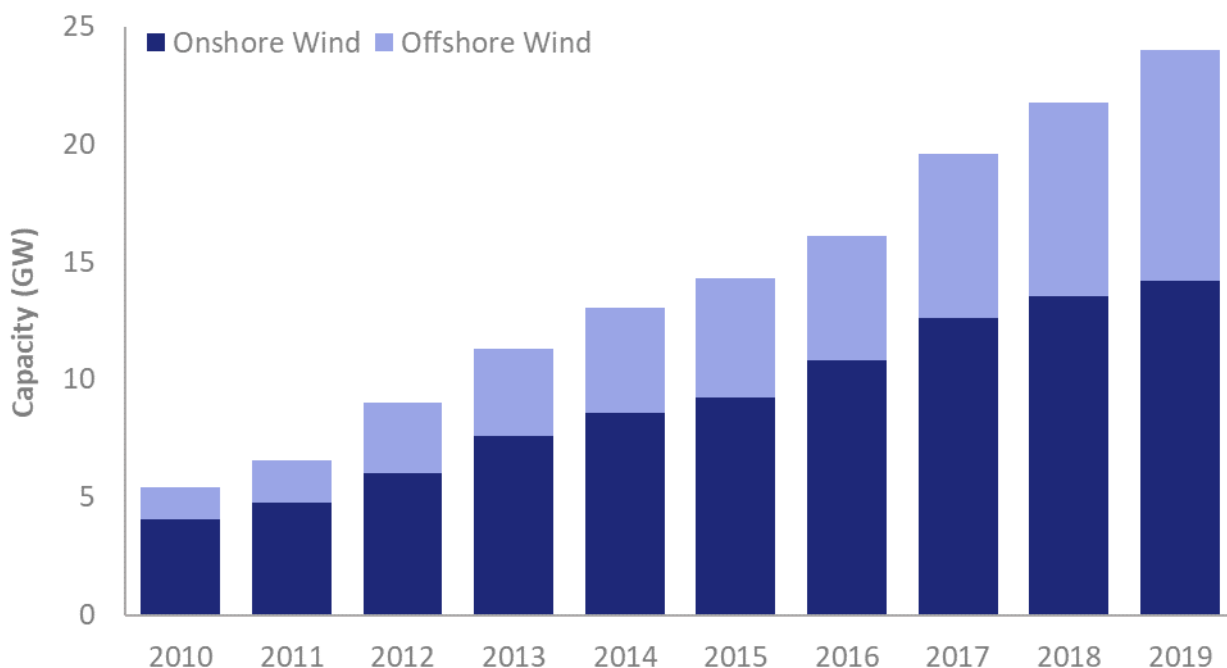
when the British Wind Energy Association and the Crown Estate selected a series of locations that offered potential for offshore wind farms. A portfolio of 17 offshore wind projects were granted permission and of these, 12 would eventually be developed. The wind farms became known as ‘Round 1’ wind farms. The first of these became operational in 2003 and the last in 2013.

From 2010 to the present, onshore and offshore wind capacity grew dramatically. For onshore wind, this includes large scale projects as well as smaller scale developments, supported by FiTs. For offshore wind, almost all projects are of a large scale.

Onshore and offshore wind in the UK

Charts 1 and 2 describe the UK’s onshore and offshore wind capacity and generation in the period from 2010 to 2019.

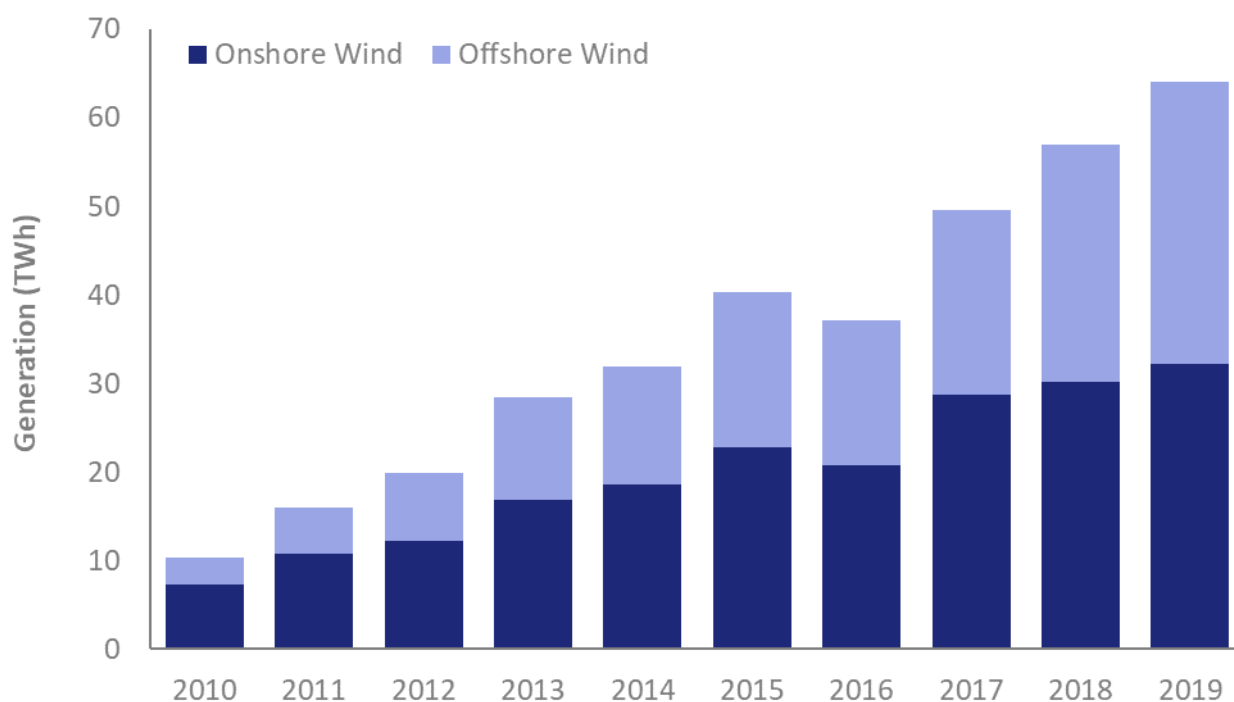
Chart 1. UK onshore/offshore wind capacity 2010 to 2019⁷



In 2010, the UK’s total wind capacity was 5.4 GW. Over the past 10 years, this capacity more than quadrupled to 24 GW, the result of substantial rises both onshore (up from 4.1 to 14.2 GW) and offshore (up from 1.3 to 9.8 GW). From 2010 to 2017, onshore wind capacity grew more rapidly relative to offshore. However, the trend reversed in 2018 and 2019 as the growth of onshore wind slowed and major offshore wind sites came online. Over the past two years, notable openings offshore include: Beatrice (0.6 GW), Walney extension (0.7 GW), East Anglia One (0.2 GW of its 0.7GW capacity is operational) and Hornsea One (1.2 GW). With an operational capacity of 1.2 GW, Hornsea One is currently the world’s largest offshore wind farm. The site covers an area of 407 km² (greater than the area of the Isle of Wight) and consists of 174 turbines, each standing at 190m. In 2019, over half of new UK renewable capacity came from offshore wind (+1.6 GW) with onshore wind also providing 21 per cent of the growth (+0.6 GW).

⁶ CfD continues to support both new offshore and onshore projects however not one technologies (those which are more established: Solar PV and Onshore wind) were not able to enter the auctions between 2015 and 2019.

⁷ Renewable electricity capacity and generation, March 2020 (Energy trends 6.1), www.gov.uk/government/statistics/energy-trends-section-6-renewables

Chart 2. UK onshore/offshore wind generation 2010 to 2019

In 2010, wind (both onshore and offshore) generated 10.3 TWh of electricity; 2.7 per cent of total UK generation. Excluding 2016, where average wind speeds were down 11 per cent on the year prior, the increases in onshore and offshore wind capacity have correlated to year on year records for generation. In 2019, generation totalled 64.1 TWh, over 6 times greater than the figure reported at the start of the decade.

Onshore generation has remained greater than offshore for every year 2010 – 2019, however the difference between them was only marginal in 2019 with each providing 32 TWh of electricity and 9.9 per cent of the UK's total generation. Table 1 shows onshore and offshore wind's share of annual electricity generation for the period 2010 – 2019. In Q3 and Q4 of 2019, offshore generation exceeded onshore for the first time. This was despite onshore wind's larger capacity (+4.4 GW) and is because offshore wind benefits from more consistent wind speeds and directions. Offshore generators are therefore typically able to use more of their available capacity for generation resulting in higher load factors (calculated as the total electricity generated as a proportion of total potential generation for a given capacity). From 2010 to 2019, load factors averaged 38 per cent for offshore generation compared to 26 per cent onshore.

Table 1. Shares of total electricity generation 2010 – 2019.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Onshore	1.9%	2.9%	3.4%	4.7%	5.5%	6.7%	6.1%	8.5%	9.1%	9.9%
Offshore	0.8%	1.4%	2.1%	3.2%	4.0%	5.1%	4.8%	6.2%	8.0%	9.9%
Total	2.7%	4.3%	5.5%	7.9%	9.5%	11.9%	11.0%	14.7%	17.1%	19.8%

Wind speeds over the decade averaged at 8.5 knots. 2010 reported the lowest average wind speeds, at 7.8 knots, whilst 2015 reported the highest at 9.4 knots. Consequently, onshore and offshore load factors were also the lowest and highest in these years respectively. The drop in generation in 2016 is the result of 2015's record wind speeds followed by below average wind speeds in 2016. 2019 also reported wind speeds below average (at 8.2 knots), however the

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increase in capacity offset this leading to the record generation figures both onshore and offshore. Table 2 shows the onshore and offshore load factors for the period 2010 – 2019.

Table 2. Onshore and offshore load factors 2010 – 2019⁸

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Load factors										%
Onshore	21.8%	27.9%	25.8%	28.4%	26.2%	29.3%	23.6%	28.0%	26.4%	26.5%
Offshore	30.5%	37.0%	35.8%	39.1%	37.3%	41.5%	36.0%	38.9%	40.1%	40.5%
Wind speed										knots
Average	7.8	9.0	8.2	8.6	8.7	9.4	8.4	8.7	8.5	8.2

At the start of the decade, Scotland was the largest generator of wind powered electricity of the four UK countries, providing 48 per cent of the UK’s total. In 2013 England overtook Scotland to become the primary supplier of wind generated electricity in the UK. Generation in all four countries increased year on year with few exceptions; however compared to 2010, 2019’s shares of the UK’s total wind generation shifted. These are shown in charts 3 and 4.

Chart 3. Share of UK wind generation in 2010

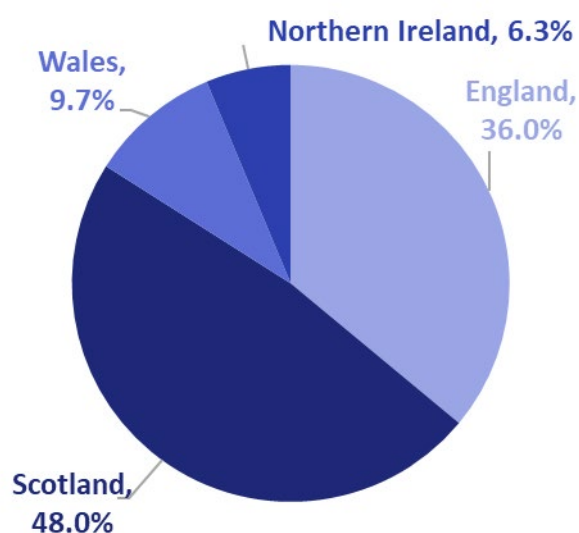
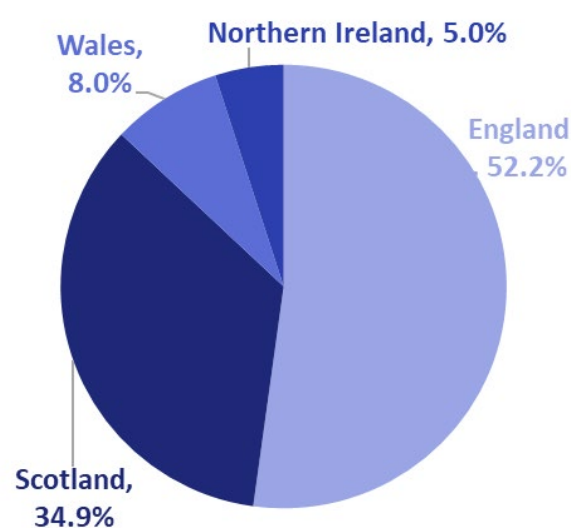


Chart 4. Share of UK wind generation in 2019



Onshore/offshore splits also differ. Whilst England provides the vast majority of the UK’s offshore wind, Scotland is the primary source of onshore generation. Wales maintains a broadly even generation onshore and offshore and Northern Ireland has only onshore capacity. The map at the end of the article shows UK’s onshore and offshore wind sites capacity in 2019.

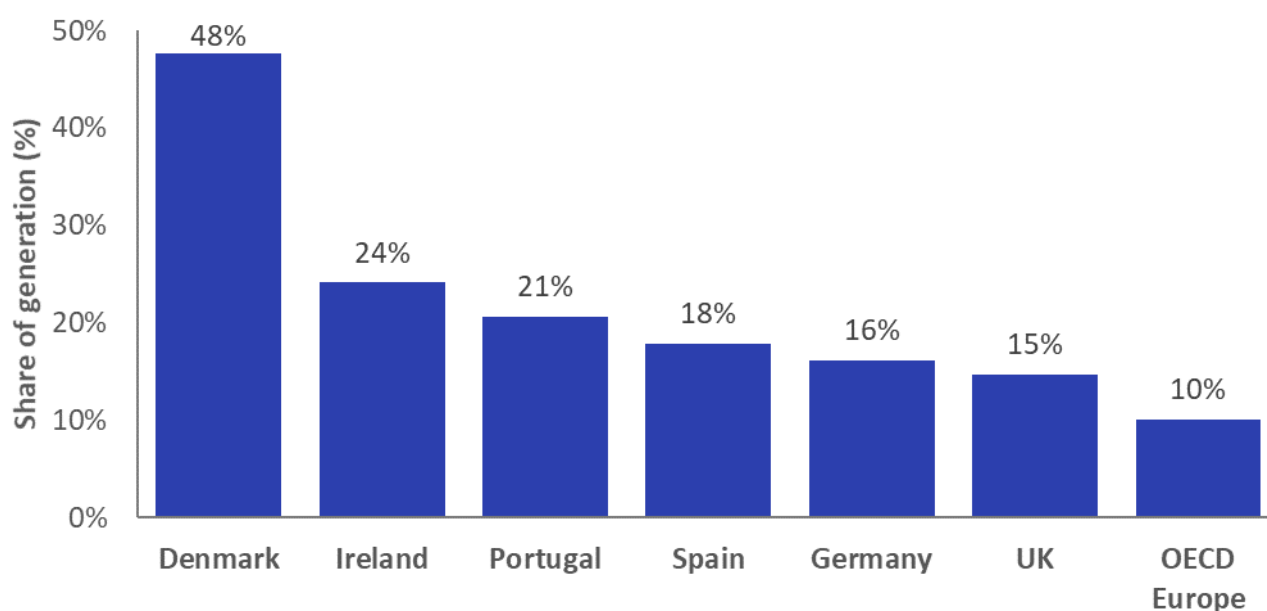
The rapid increase in generation from wind (and other renewable sources) over the decade helped fill the gap in generation left by the phase out of coal-fired electricity. In 2012 coal-fired generators supplied 133 TWh of electricity, which has drastically reduced to only 6.5 TWh in 2019, a record low.

⁸ Load factors are calculated using generation divided by mid-year capacity times 365 (days/year) times 24 (hours/day)

International comparison for UK for wind generation

The UK is one of the world leaders for wind generation, particularly for offshore wind, with the UK reporting the world's largest offshore wind capacity⁹. Hornsea One, Walney extension and London Array are currently the three largest offshore wind sites in the world. In terms of European comparisons, in 2017¹⁰ there were five countries reporting a higher share of their electricity production from wind, as shown in Chart 5. In 2018, the UK was the second largest generator of wind powered electricity in Europe (behind Germany) with the third largest capacity (with Germany and Spain first and second respectively). Excluding 2016, the UK's share of the OECD Europe's total wind generation has risen year on year from 2010 to 2017, reaching 13.3 per cent. One tenth of all electricity generated in OECD Europe was from wind technologies. The UK also benefits from favourable wind speeds, with 2018 reporting load factors for onshore and offshore wind of 26 and 40 per cent respectively, greater than the global averages of 25 and 33 per cent¹¹.

Chart 5: Wind share of total electricity generation - OECD Europe countries in 2017



2020 and beyond

In June 2019 the UK government passed legislation committing the UK to a 'net-zero' greenhouse gas emissions target by 2050. To achieve this goal, wind is expected to play an increasing role in the UK's electricity supply mix. The UK offshore sector deal in 2019 reported that subject to costs coming down, offshore wind could contribute up to 30 GW of generating capacity by 2030. This would more than treble its current operational capacity. Multiple GW of onshore and offshore capacity is currently under construction and due to become operational between 2020 and 2023 and an additional 5.8 GW of offshore and Remote Island onshore wind capacity has recently gained funding under the Contracts for Difference round 3 auction (2019). This will become operational between 2023 – 2025. A potential 7 GW have also been recently announced by the UK Government and the Crown Estate for new offshore projects to be developed in the waters around England and Wales.

⁹ www.gov.uk/government/publications/offshore-wind-sector-deal/offshore-wind-sector-deal

¹⁰ Data beyond 2017 for all OECD Europe is currently unavailable from the IEA, the most up to date data can be found at: www.iea.org/data-and-statistics/data-tables?country=WORLD&energy=Electricity&year=2017

¹¹ BEIS calculation based on 'IEA Renewables 2019': www.iea.org/reports/renewables-2019

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Since 2015, significant reductions in the strike price for offshore wind farms have been experienced in each CfD allocation round. In allocation round 1 (2015), the strike price ranged from 114 to 119 £/MWh. This dropped to 40 to 42 £/MWh¹² in the round 3 allocations (2019) as the technology matured. Technological developments are expected to further reduce offshore and onshore wind costs, including larger turbines and advances in foundation and installation technology to allow offshore wind farms to be built in deeper waters. These developments will help increase the potential for wind generation and support the UK in reducing its greenhouse gas emissions.

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References

Digest of UK Energy Statistics 2019 (DUKES); available on BEIS's energy statistics website at:

www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

Capacity of, and electricity generated from, renewable sources (Energy Trends 6.1):

www.gov.uk/government/statistics/energy-trends-section-6-renewables

Energy Trends: Weather:

www.gov.uk/government/statistics/energy-trends-section-7-weather

Renewable energy in Scotland, Wales, Northern Ireland and the regions of England in 2018 – Energy Trends September 2019, page 46

<https://www.gov.uk/government/publications/energy-trends-september-2019-special-feature-articles>

¹² Prices given in 2012 figures.

UK Onshore and Offshore Wind Capacity

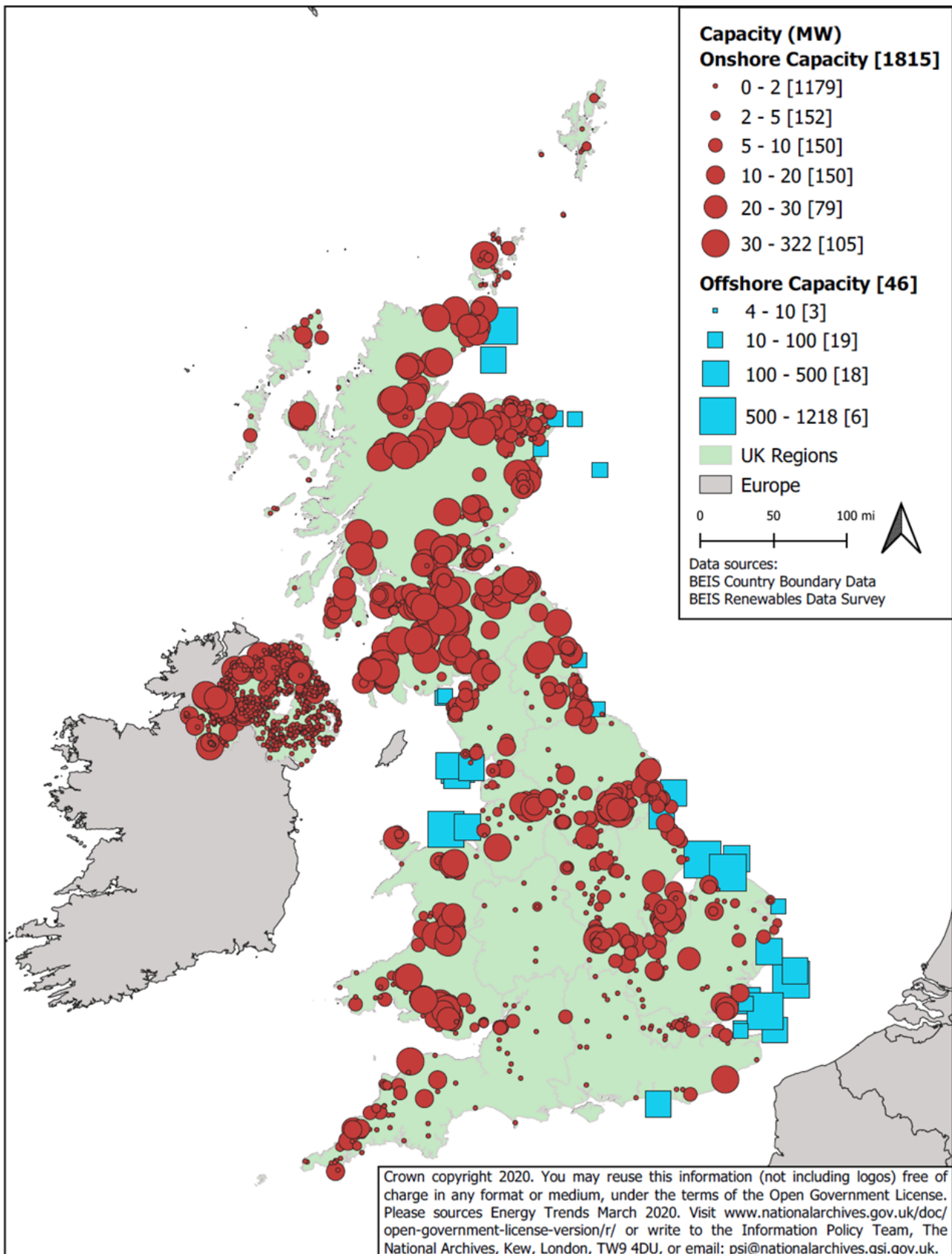


Table 3. Regional data wind data 2010 to 2019

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Cumulative Installed Capacity										
Onshore Wind										
<i>England</i>	865	1,023	1,316	1,840	2,188	2,439	2,819	3,059	3,078	3,125
<i>Scotland</i>	2,486	2,898	3,765	4,589	5,079	5,398	6,298	7,338	7,936	8,327
<i>Wales</i>	388	429	494	576	607	644	829	1,018	1,137	1,279
<i>Northern Ireland</i>	341	409	460	581	697	731	886	1,182	1,404	1,453
Total	4,080	4,758	6,035	7,586	8,573	9,212	10,832	12,597	13,554	14,183
Offshore Wind										
<i>England</i>	1,001	1,498	2,655	3,313	3,726	4,180	4,380	6,016	6,869	8,085
<i>Scotland</i>	190	190	190	190	197	187	187	246	623	981
<i>Wales</i>	150	150	150	193	578	726	726	726	724	726
<i>Northern Ireland</i>	-	-	-	-	-	-	-	-	-	-
Total	1,341	1,838	2,995	3,696	4,501	5,094	5,293	6,988	8,217	9,792
Total	5,422	6,597	9,031	11,282	13,074	14,306	16,126	19,585	21,770	23,975
Generation										
Onshore Wind										
<i>England</i>	-	2,156	2,478	3,829	4,640	6,043	5,715	7,501	7,279	7,088
<i>Scotland</i>	-	6,653	7,752	10,564	11,131	13,339	11,891	16,306	17,627	19,022
<i>Wales</i>	-	1,004	972	1,187	1,325	1,610	1,410	2,395	2,314	2,912
<i>Northern Ireland</i>	-	1,002	1,042	1,345	1,458	1,860	1,733	2,515	2,997	3,183
Total	7,226	10,814	12,244	16,925	18,555	22,852	20,749	28,717	30,217	32,205
Offshore Wind										
<i>England</i>	-	4,091	6,588	10,403	11,870	14,933	13,892	17,870	23,118	26,377
<i>Scotland</i>	-	604	540	587	569	539	502	614	1,371	3,329
<i>Wales</i>	-	455	475	482	966	1,951	2,012	2,431	2,198	2,223
<i>Northern Ireland</i>	-	-	-	-	-	-	-	-	-	-
Total	3,060	5,149	7,603	11,472	13,405	17,423	16,406	20,916	26,687	31,929
Total	10,286	15,963	19,847	28,397	31,959	40,275	37,155	49,633	56,904	64,134
Total UK generation	382,068	367,982	363,873	358,284	338,096	338,875	339,191	338,172	332,893	323,708