

Offshore wind

operational report 2014



# Introduction

**With nearly five gigawatts (GW) of capacity due to be operational by the end of 2015, the UK continues to be the world leader in offshore wind power generation. With further cost reduction and continued investment, this figure is set to double to 10GW or more by 2020.**

2013 was a landmark year for the renewables sector as the government wrote the Energy Act into the statute book and confirmed strike prices for renewable energy technologies through the enduring Contracts for Difference (CfD) regime. The new policy has already identified projects that will benefit from the first round of investment contracts.

This has provided certainty to investors, sending a strong signal that offshore wind will continue to grow its contribution to the UK's energy mix. It has also focused developers' strategies on how to deliver the best value projects by the end of the decade.

This publication provides an overview of the operational offshore wind sector's continuing growth, presenting both new and previously published information on a range of measures covering both generation and transmission.

# Health and Safety

**It is essential for offshore windfarms to be constructed, operated and maintained in a way that minimises risks to those working on them. We work with industry to ensure that health and safety remains a top priority.**

We continue to sponsor RenewableUK's Health and Safety annual award, which this year was won by Centrica Energy for its Generation Safe initiative, designed to promote best practice throughout the supply chain.

In response to a series of HSE incidents, Centrica decided to overhaul their current approach to H&S and instead work on creating a 'one team' culture by changing mind sets, attitudes and organisational behaviours. They held one-day Generation Safe events, involving over 1,000 attendees, including joint venture partners, contractors, sub-contractors and major suppliers like Siemens.

Applying their learning from elsewhere, they held workshops, bespoke inductions and fortnightly bulletins which had a direct correlation with the quality and quantity of safety observations. Through their hard work they have ensured that H&S is now an integral part of each employee's values and ethics.

A project team comprising Forewind, SeaRoc and Universal Foundation Norway was named as runner up for its "human free" meteorological mast installation on the Dogger Bank in the North Sea approximately 125km from the nearest landfall.

In 2013, 6,830 FTEs were directly employed in the offshore wind sector, more than double the 3,151 in 2010



COURTESY OF SIEMENS

In March 2014 the UK had 1,450 offshore wind turbines either installed or in construction



Generation across the portfolio reached an unprecedented 11.5TWh in 2013



# In the news

**In April 2013 the world's largest offshore windfarm, London Array, opened in the Thames estuary. At 630MW, the site is over 100MW larger than its nearest rival. London Array comprises 175 Siemens 3.6MW turbines with a swept area of 120m in diameter.**

Speaking at the windfarm's inauguration on 4 July, Prime Minister David Cameron said "This is a great day for Kent and a great day for Britain. London Array has been built by some of the bravest seamen, the most talented engineers and hardest workers. It will bring benefits to Kent for years to come."

**Five projects have been awarded financial investment decision enabling (FIDeR) contracts by the government under Contract for Difference (CfD) provisions within the 2013 Energy Act.**

With an aggregate capacity of nearly 3.2GW the projects will follow the last of those receiving support under the current renewable obligation certificate (ROC) regime, due to be phased out by 2017. The five projects are Beatrice (664MW in the outer Moray Firth), Burbo Bank extension (258MW in Liverpool Bay), Dudgeon (402MW in the Greater Wash), the 1,200MW Hornsea Project 1 in the North Sea off the Yorkshire coast and the Walney extension (660MW in the East Irish Sea).

These contracts are vital to give investors the confidence they need to pay the up-front costs associated with major infrastructure projects at this scale. Together the projects will help provide a secure, affordable supply of electricity and support skilled jobs, boosting growth, supply-chains and businesses across the country.



This is a great day for Kent and a great day for Britain. London Array has been built by some of the bravest seamen, the most talented engineers and hardest workers. It will bring benefits to Kent for years to come.

**PRIME MINISTER DAVID CAMERON**



# UK offshore wind assets

**Asset base circa £12 bn**

CORRECT AS OF  
31 MARCH 2014



**Offshore turbines**

Operating 1,115  
In construction 335  
Total 1,450



**Offshore substations**

15  
5  
20



**Onshore substations**

20  
5  
25



**Export cables**

44  
9  
53



**Offshore masts**

23  
3  
26

# Generation overview

**Generation figures reported to The Crown Estate reveal that offshore windfarms installed in the UK generated 11.5 terawatt-hours (TWh) in 2013. This amounts to a record 3.3 per cent of UK electricity demand and satisfies the equivalent demand of 2.7 million homes, equating to approximately 10 per cent of all UK households.**

Put another way, this would be sufficient power to run the London Underground for 10 years.

The trend of strong growth in UK offshore wind generation continued in 2013 with year on year growth of 53 per cent, consistent with average annual growth over the past 10 years of 55 per cent (Figure 1).

Counting the output only from windfarms fully operational at the start of 2013 we found that the UK fleet delivered a 37.7 per cent capacity factor for the year as a whole, the highest portfolio average ever achieved.\*

The operations team at Walney 2 windfarm achieved the highest annual capacity factor recorded to date of any offshore windfarm in the UK, at 47 per cent. Another figure of note was the average capacity factor across the UK's offshore wind portfolio in December 2013 at 55 per cent.

Four windfarms – London Array, Greater Gabbard, Sheringham Shoal and Thanet – accounted for half of all production in 2013. The remaining 20 (smaller) windfarms provided the other 50 per cent. London Array

was the first offshore windfarm in the world to achieve an annual output of more than 2TWh in a single year, approximately 17 per cent of the UK's 2013 generation from offshore wind, this despite not having been fully commissioned until April.

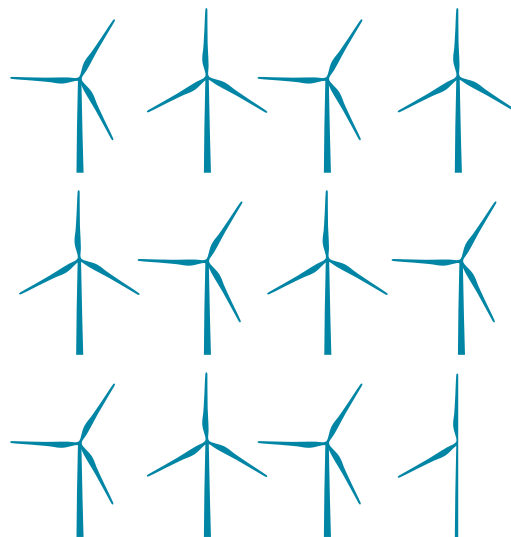
Given the strong performance of many windfarms during 2013, we estimate that as many as eight UK windfarms could exceed a 40 per cent capacity factor in 2014, with up to seven of those having been commissioned since 2012.

At the beginning of May 2014 there were 24 operational offshore windfarms, 2 partially operational and a further 2 under construction with an aggregate capacity of more than 5GW (Figure 2).



The UK is the number one country in the world for investment in offshore wind, supporting green jobs and growth as well as strengthening our energy security. We have already attracted over £30bn worth of investment in renewable technologies since 2010. Our ambitious electricity market reforms provide investors with the long-term certainty they need.

**ED DAVEY,**  
Energy and Climate Change Secretary

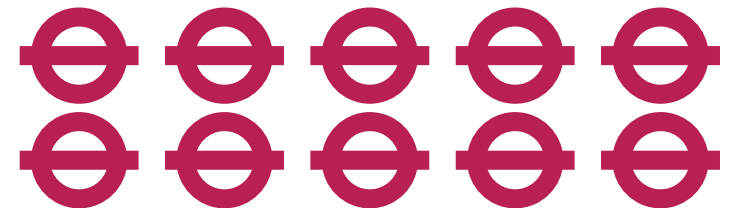


**In 2013, offshore windfarms installed in Britain generated 11.5 terawatt-hours**

**This satisfies the equivalent demand of 2.7 million homes, equating to approximately 10 per cent of all UK households**

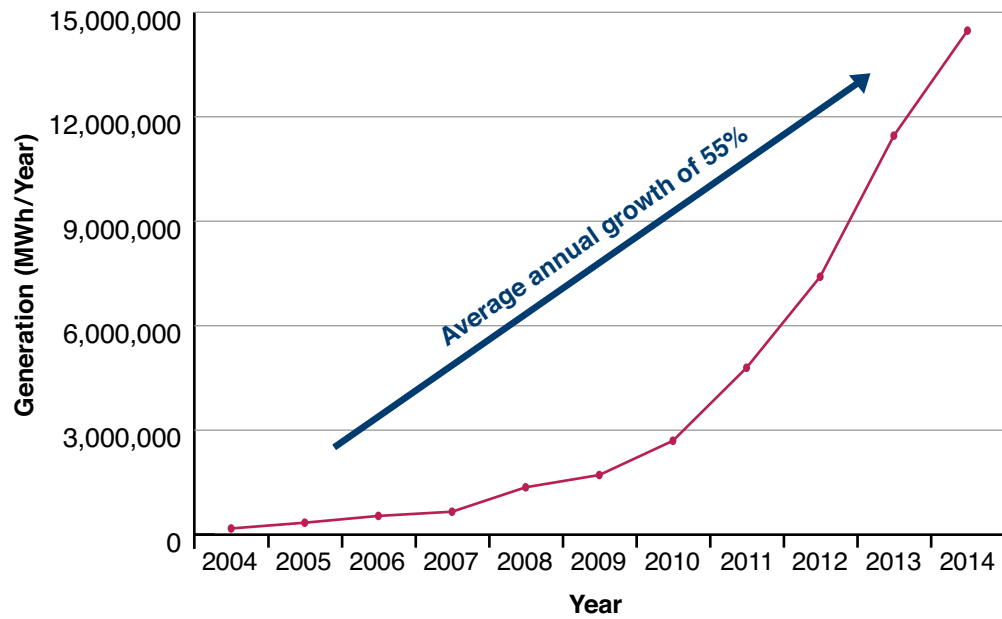


**Put another way, this would be sufficient power to run the London Underground for 10 years**



\* The capacity factor is calculated without reference to availability – (actual generation/nameplate capacity X 24 X 365) X 100 per cent

**FIGURE 1: Total generation trend**



**FIGURE 2: UK offshore windfarm status: May 2014**

Summary project status	Total no. sites	Total MW
Fully operational	24	3,650
Partially operational/under construction	2	965
Under construction	2	429
Contracted, construction to commence	1	49.5
Consented not yet reached final investment decision (FID)	8	4,876
<b>GRAND TOTAL</b>	<b>37</b>	<b>9,969.5</b>

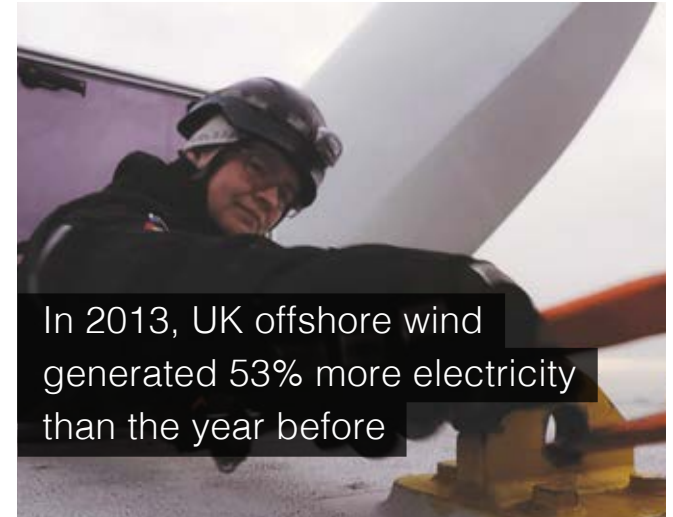




Wind power supplied more than 10% of Britain's total electricity demand in December 2013



On 23 February, 2014 wind accounted for 17% of electricity demand on that day



In 2013, UK offshore wind generated 53% more electricity than the year before

## Energy trends

**According to government statistics, renewable energy accounted for a record 14.8 per cent of electricity generation in 2013, up from 11.3 per cent in 2012, much of which was driven by the expansion of offshore wind capacity as well as onshore windfarms and bioenergy.**

Wind and solar power generation in particular rose by 41.7 per cent from 20.8TWh in 2012 to 29.4TWh in 2013, thanks to increased capacity and higher than average wind speeds.

Based on generation returns from industry, our figures confirm that offshore windfarms produced 11.5TWh in 2013, a whopping 53 per cent increase on 2012's 7.5TWh production.

National Grid data also reveals that wind power is playing an increasingly important role in the UK electricity mix, helped by the above average wind conditions experienced during the winter months.

A number of records were broken in December 2013 as wind power supplied 10 per cent of the UK's total electricity demand for homes, businesses and factories for the first time, breaking the previous record set just two months earlier.

In the early months of 2014, the UK's fleet has continued to perform at record levels. In February, wind power supplied a new record 11 per cent of UK electricity demand, enough to power more than six and a half million homes. On 23 February, wind accounted for 17 per cent of demand on that day.

## Moving beyond 5MW

**Westermost Rough offshore windfarm is set to become the first commercial windfarm in the world to install turbines larger than 5MW in capacity.**

Developer DONG Energy has decided to use 35 Siemens' next-generation 6MW turbines at their latest windfarm to be constructed near the Humber Estuary.

This represents a major leap forward in the technological development of the industry as it seeks to reduce the cost of energy and improve the yield of offshore windfarms, whilst at the same time reducing their environmental footprint.

In March 2014, Siemens made a landmark announcement that it plans to start manufacturing the next-generation 6MW turbines, including the 75m blades, from a new blade and turbine facility in Hull. Both units are expected to be fully operational by 2017.



# SPARTA – measuring performance of the UK’s wind turbine fleet

**Working with the Offshore Renewable Energy (ORE) Catapult and DNV GL, we have launched an £850,000 project to help developers measure and improve the performance of their operational windfarms.**

The SPARTA (System Performance, Availability and Reliability Trend Analysis) project will involve participating developers submitting operational windfarm data at a system (rather than component) level in order to create an anonymous database. The database will benchmark 69 availability, maintenance and performance characteristics including system availability, repair interventions, crew transfers and meteorological conditions.

Monthly reporting and longer term trend analysis will help companies identify the measures they need to take to boost availability, reliability and performance (Figure 3). The project aims to contribute towards cutting the cost of electricity generated from

offshore wind and, through improved reliability, to reduce the need for repairs and therefore enhancing health and safety performance.

10 windfarm operators are participating in the pilot phase of SPARTA, namely Centrica, ScottishPower, SSE, EDF, RWE Innogy, Statoil, Statkraft, Vattenfall, DONG and E.ON. The system is scheduled to go live in Summer 2014 when the first live data will be submitted.

The project will initially run a pilot phase until 2015, after which full-scale implementation is planned. Although SPARTA is being launched in the UK, it is open to non-UK projects from which applications are invited.

The scheme was inspired by the offshore oil industry’s long established Offshore Reliability Database known as OREDA, which has helped operators to deliver performance improvements for more than 30 years.

## FIGURE 3: Availability, reliability and performance as adopted by SPARTA

### Availability

Expressed as a percentage, the proportion of time that a windfarm or wind turbine is actually generating electricity when it is technically capable of producing electricity. For example, turbine availability captures time measured against the time the turbine was generating or could have generated if the environmental conditions were right and/or balance of plant was available and there were no curtailment limitations.

### Reliability

The frequency of system failure and period of time taken to effect repairs and/or replacements reported as mean time between repairs/replacements. Repairs include preventive maintenance.

### Performance

Total number of hours that turbines are generating electricity and the cumulative generation for each windfarm both on and offshore. Performance is also reported in terms of the O&M strategy including number of crew transfer vessels and number of vessel transfers.



# Improved understanding of windiness

## Generation variability due to windiness

The Crown Estate maintains a database of historical wind speeds around the UK which includes measured wind speeds from offshore met masts and modelled wind speeds from advanced reanalysis data models. These wind speeds, combined with the generation outputs from operators, allows The Crown Estate to forecast and track performance across each offshore windfarm in the UK. Actual output of a windfarm is primarily dependent on the wind speeds and the availability of the asset to generate power. By monitoring the wind speeds around each site, The Crown Estate can identify periods of under or over performance and determine the causes of the differences. The Crown Estate starts with an estimated average performance (red line in Figure 4) for the whole portfolio (or even a single windfarm). This red line

represents the average historical performance of offshore windfarms around the UK. Next, each wind farm is individually adjusted to account for the windiness of each period (i.e. lower performance for wind speeds below average and higher performance for wind speeds above average). This adjustment is represented in blue to the left. Windier than average months like October or December cause output to be higher than expected whereas months like July show expected output to be lower than expected.

planned maintenance or repair works undertaken at the windfarm. By identifying periods of under performance, like in April or November, The Crown Estate can monitor any trends in the industry that are affecting windfarm output and promote measures, like SPARTA, that will help to improve future performance (Figure 5).

## Monthly windfarm generation for an individual windfarm

Once windfarm performance is adjusted for wind speeds, any deviation from the expected can be attributed to

## Generation variation between east and west coast windfarms

At any given time, wind speeds vary around the UK which means that windfarms in one area may not be experiencing the same wind speeds as windfarms in another area. By capturing this wind speed variation across the UK, wind generation as a whole can reduce the amount of variability in overall output (Figure 6).

FIGURE 4: Generation variability due to windiness

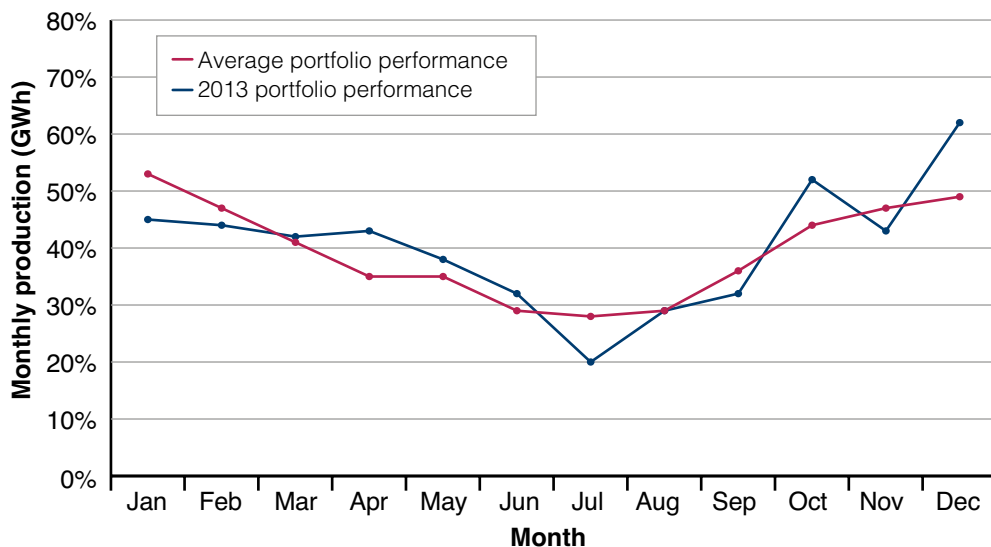
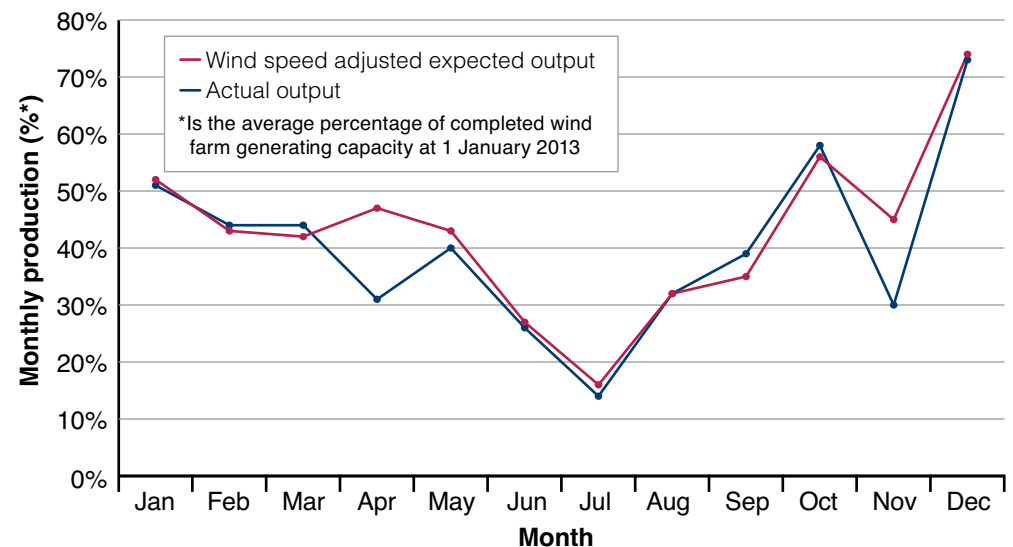


FIGURE 5: Monthly windfarm generation for an individual windfarm



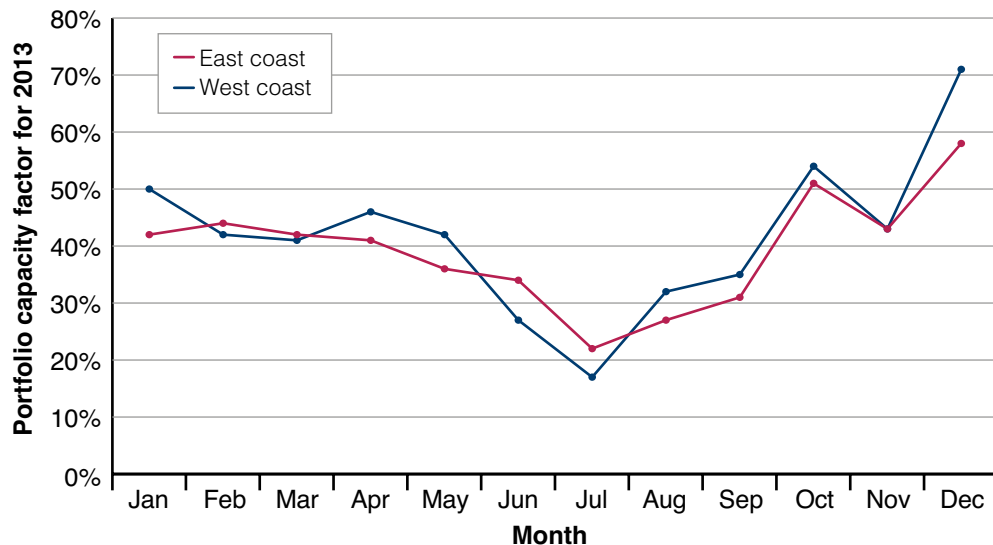
Whilst overall wind speeds were 22% ahead of average in December 2013, east coast wind speeds were 16% above average whilst west coast wind speeds were 30% above average

## Investment growth

A study by financial analysts Ernst & Young places the UK at the very top of the global list of countries in which to invest in offshore wind energy. Ernst & Young's Renewable Energy Country Attractiveness Index places the UK's offshore wind sector above Germany, which had previously held the top spot but is now in second place. China is third, Belgium fourth and Denmark fifth.

Evidence of growing investor interest, both in the windfarms themselves and in their associated infrastructure (the transmission assets), has been demonstrated by a number of significant transactions during the past twelve months.

FIGURE 6: Generation variation between east and west coast windfarms



2013

**MARCH 2013 Rhyl Flats**  
RWE sold 49.9 per cent of its interest in Rhyl Flats to the Green Investment Bank (24.95 per cent) and Greencoat UK Wind PLC (24.95 per cent)

**JULY 2013 Sheringham Shoal**  
Sale of offshore transmission assets to Blue Transmission Sheringham Shoal Ltd

**OCTOBER 2013 London Array**  
Refinancing agreement for Masdar Energy UK Ltd

**SEPTEMBER 2013 London Array**  
Sale of offshore transmission assets to Blue Transmission London Array Ltd

**NOVEMBER 2013 Greater Gabbard**  
Transfer of offshore transmission assets to Greater Gabbard OFTO Plc

**DECEMBER 2013 Gunfleet Sands 1 and 2**  
Marubeni signed agreement to sell 24.95 per cent of its stake in Gunfleet Sands wind farm to the Development Bank of Japan

**FEBRUARY 2014 London Array**  
DONG sold 50 per cent of its share in London Array to La Caisse de depot et placement du Quebec

2014

**Negotiations are underway regarding new investment in at least two further sites**

# Community engagement

This is a snapshot of community engagement projects across the operational wind portfolio. There are many other projects which these and other sites have supported.

## 01 Burbo Bank



The DONG Burbo Bank site works closely with the local RNLI bases in Birkenhead to support them with events.

## 02 Greater Gabbard



The Leiston and Sizewell Community Benefit Fund has been set up to

provide grants for local voluntary and community groups. Greater Gabbard also provides significant support for the local RNLI.

## 03 Gunfleet Sands I, II & III



Gunfleet Sands has a long standing relationship with some cultural

events in the Clacton area, including the Brightlingsea Free Music Festival, Brightlingsea in Bloom flower show and the Clacton Air Show.

## 04 London Array



At London Array, a University bursary scheme will, for a ten year period, provide

an annual bursary of £3,000 to one local student for 3 years towards the cost of tuition fees to study a course in a subject related to sustainable development, science or engineering. Nine apprentices have also been recruited and they are currently undergoing on the job training as wind turbine technicians.

## 05 North Hoyle



A community fund has been set up to assist local community projects.

This fund will continue throughout the operational life of the windfarm, with recent grants contributing to the purchase of specialist wheelchairs for the Rhyl Raptors Wheelchair Basketball Club and the funding of a counsellor for bereaved young people.

## 06 Ormonde



Ormonde contributes to funding of the Barrow Engineering Project which

provides secondary school students with an opportunity to actively engage with engineering. This project is supported by the Royal Academy of Engineering. Ormonde also sponsors various community events including the Love Barrow Awards.

## 07 Rhyl Flats



RWE have also set up a community fund which is ongoing throughout the

operational life of the windfarm. Recent grants have been made to Fareshare (a food share project tackling food poverty by collecting and distributing foodstuffs that are in date but surplus to requirements); a homeless shelter providing facilities for the homeless to cook for themselves, and a community garden.

## 08 Robin Rigg



E.ON has established a 10 year community fund, worth £50,000 per year, with over

30 grants issued to date. Some grants include community transportation; the installation of solar panels on various community buildings and the creation of the Salterbeck wildlife habitat. Robin Rigg also offers a free energy experience to schools in Dumfries, Galloway and Cumbria.

## 09 Scroby Sands



Scroby Sands Visitor Centre attracts over 35,000 visitors each year and

includes an education centre for younger visitors and school trips. There is also ad hoc sponsorship of community events including local RNLI and maritime festival.

### 10 Sheringham Shoal



The Sheringham Shoal Community Fund makes grants to local organisations.

Examples include the National Coastwatch Institution Mundesley; North Norfolk Surf Live Saving Club; and Wells Maltings Trust. A bursary scheme for engineering students aged 16 to 18 from low income families studying at one of three Norfolk colleges supports 20 students each academic year.

### 11 Teeside



A local community benefit fund has been established in partnership with Tees Valley Community Foundation and during its first year of operation around 40 local community groups and projects have been supported with financial assistance from the fund.

### 12 Thanet & Kentish Flats



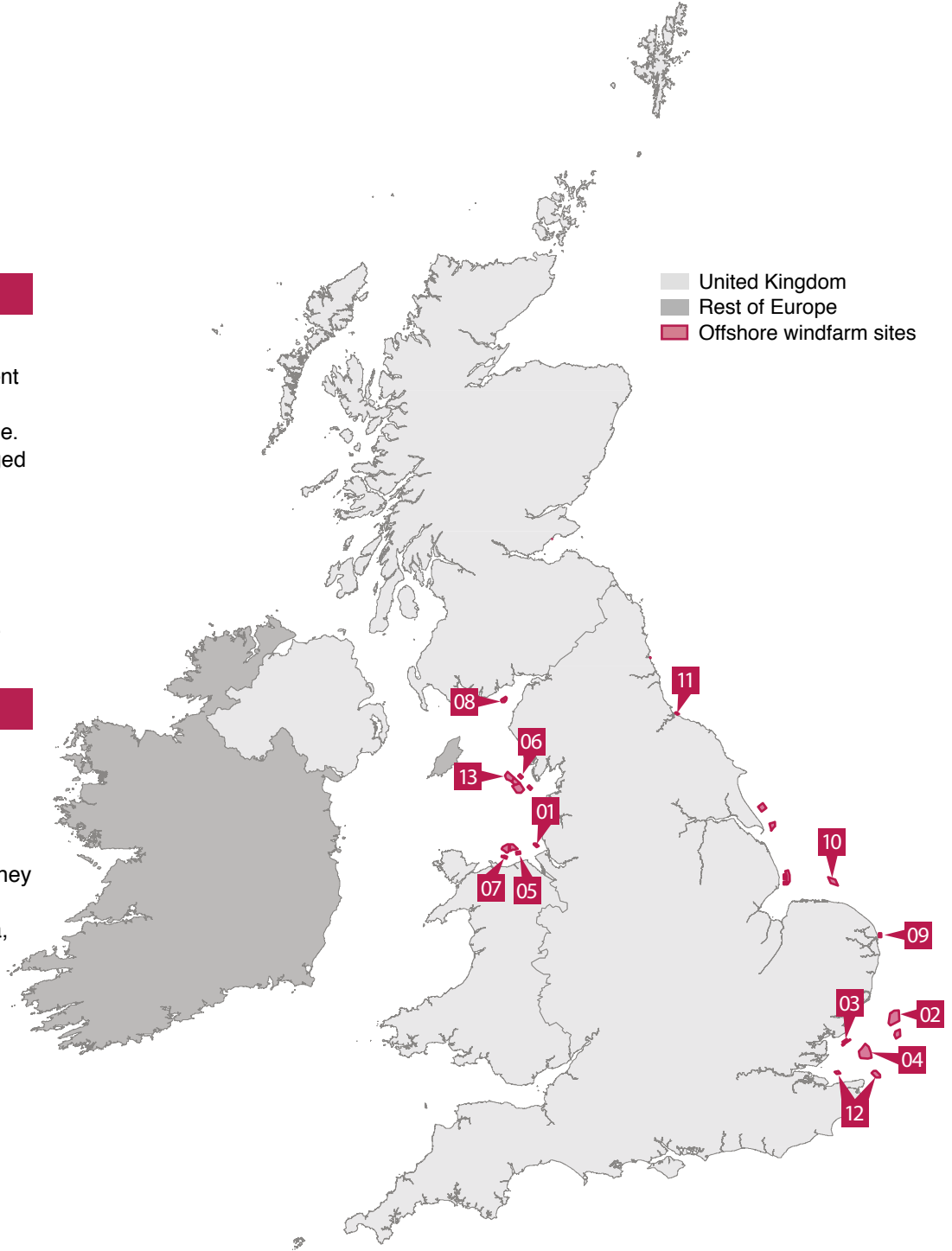
Helped fund the Marine Environment and Renewable Energy Programme.

The programme offers young people aged 10 to 15 the opportunity to connect with the marine and coastal environment. There are interactive sessions and learning activities for the children to complete. Any costs to participating schools are covered by the programme.

### 13 Walney 1 & 2



Walney Offshore Windfarms have, for the past two years, sponsored the local angling competition, the Walney Open. This event has helped attract people from Barrow and the local area, as well as people from across the UK, to come to Barrow in Furness.



# Employment

**The number of people employed by the UK's offshore wind industry is steadily rising, as the pipeline of projects under construction and in operation increases.**

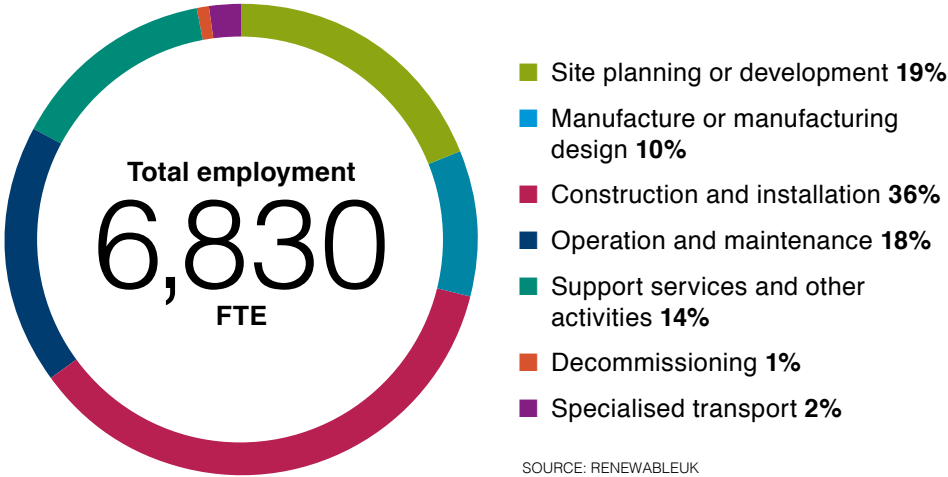
Roles include highly skilled engineering positions, manufacturing roles, consultancy, lawyers, surveyors and many more.

According to RenewableUK, the number of people employed directly in full-time jobs in the offshore wind sector more than doubled from 3,151 in 2010 to 6,830 in 2013.

More than one third of those 6,830 jobs are engaged in construction and installation, while more than 1,000 jobs are involved in operations and maintenance.

Ahead of the construction of Round 3 windfarms, the number of people working in planning and development almost tripled from about 450 in 2010 to 1,276 in 2013.

We expect to see continued growth of the sector over the coming years. For example, Siemens' new offshore wind turbine and blade manufacturing facility in Hull is expected to create up to 1,000 jobs directly, with additional employment during construction and indirectly through the supply chain over the longer term.



SOURCE: RENEWABLEUK

COURTESY OF RENEWABLEUK



# Case study: wind blows favourably for Seacat Services



Nobody is under any doubt about the pace of offshore wind energy innovation.

**IAN BAYLIS,**  
MD, Seacat Services



**Located on the Isle of Wight, offshore wind workboat company Seacat Services has responded to the growing market demand for purpose built charter vessels supporting the offshore wind industry. Founded in 2010 by husband and wife team Ian and Nia Baylis, the company has grown rapidly, operating six market leading twin-hulled vessels of between 21m and 24m with another three (one 24m and two 26m) on order and scheduled for delivery between September 2014 and March 2015.**

Able to operate up to 150nm offshore, the Seacat fleet is comprised of modern, high specification, multi-purpose

vessels which provide crew transfer, hydrographic survey, equipment transport, dive operation and other services. With a total work force of 50 including 41 highly skilled operatives, Seacat Services is set to grow another 18 strong by the time the fleet is up to full complement next year.

The firm's latest £10m contract for its three next generation workboats was placed with Isle of Wight based boat builder, South Boats, representing one of the largest single windfarm workboat orders ever placed by a charter service firm. Ian Baylis, Managing Director, Seacat Services, said, "Nobody is under any doubt about the pace of offshore wind energy

innovation. However, as increasing numbers of European offshore windfarms come online and get connected to the grid, it's imperative that there's a means through which these advanced electricity-generating operational assets can be effectively safeguarded, serviced and maintained. Our latest workboat order marks another important chapter in our longstanding commitment to the market and to UK manufacturing, job creation and sector growth."

An excellent example of a positive response to market demand, Seacat Services has already successfully completed contracts in UK, Danish and German waters and is currently operating internationally.

# Transmission

If a windfarm's transmission cable voltage exceeds 132kv the generation and transmission assets need to be owned separately. In practice this is achieved by means of a competitive tender process run by OFGEM whereby the transmission assets (export cables and substations) are sold to an Offshore Transmission Operator (OFTO). Would-be OFTOs bid for the purchase and management of the assets in return for which a management fee is paid by National Grid as National Electricity Transmission

System Operator for a 20 year term. So far three main players have emerged in the OFTO market; nine transactions are complete, four are currently under negotiation and another two have recently been tendered (Figure 7).

November 2012 at Walney 1. Overall the report reveals a strong and reliable performance by OFTOs, ensuring that power produced by windfarms is being delivered to land.

OFTOs recorded just one unplanned outage in the financial year 2012/13, according to National Grid figures (National Electricity Transmission System Performance Report 2012 – 2013). This one unplanned outage took place in

The report provides clear performance statistics for each operating OFTO (Figure 8 – there were only 6 during the period to 31 March 2013) and reports on the reasons for outages (Figure 9), the periods during which connectivity was lost and the impact on generation availability (not generation lost) in MWh.



Ofgem notes the strong operational performance achieved by OFTOs, as reported in the 2012/13 NETS Performance report. This highlights the robust incentives for licensees to maintain system availability under the OFTO availability incentive.

**STEVE BEEL**  
Associate Director Ofgem



**FIGURE 7: OFTO status as at 30 April, 2014**

Project Name	Capacity	Consortium
<b>OFTO Round: Transition 1</b>		
Barrow	90MW	Transmission Capital, IPP, Amber Infrastructure
Robin Rigg East & West	180MW	Transmission Capital, IPP, Amber Infrastructure
Gunfleet Sands 1 & 2	173MW	Transmission Capital, IPP, Amber Infrastructure
Ormonde	150MW	Transmission Capital, IPP, Amber Infrastructure
Walney 1	184MW	Blue Transmission
Walney 2	184MW	Blue Transmission
Sheringham Shoal	317MW	Blue Transmission
Greater Gabbard	504MW	Balfour Beatty Capital, Equitix, AMP Capital
Thanet	300MW	Balfour Beatty Capital (transfer incomplete)
<b>OFTO Round: Transition 2a</b>		
London Array 1	630MW	Blue Transmission
Lincs	270MW	Transmission Capital, IPP (transfer incomplete)
Gwynt Y Môr	576MW	Balfour Beatty Investment Limited, Equitix Ltd (transfer incomplete)
<b>OFTO Round: Transition 2b</b>		
West of Duddon Sands	389MW	To be determined
<b>OFTO Round: Enduring 1</b>		
Westermost Rough	210MW	Tender round commenced 26 February, 2014
Humber Gateway	219MW	Tender round commenced 26 February, 2014



**FIGURE 8: OFTO system availability percentage 1 April 2012 – 31 March 2013**

Project Name	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
TC Robin Rigg	100	100	100	94.48	100	100	100	100	100	100	100	100
TC Gunfleet Sands	100	100	100	98.55	100	100	100	100	100	100	100	100
TC Barrow	100	100	100	100	100	100	100	100	100	100	100	100
TC Ormonde	N/A	N/A	N/A	100	100	100	100	100	100	100	100	100
BT Walney 1	100	97.79	78.10	97.97	98.74	100	100	95.86	100	100	100	100
BT Walney 2	N/A	N/A	N/A	N/A	N/A	N/A	100	100	100	100	100	100

**FIGURE 9: Reported outages affecting Walney 1 April 2012 – 31 March 2013**

Outage date and time	Reason	Days, hours	MWh
<b>29 May 2012, 09:54</b> Planned outage to fix a snagging issue and fit surge arrestors to offshore transformers. Snagging issues pertain to problems known prior to transfer from the developer to the OFTO	OFTO	2 days 14 hours	2,546
<b>1 June 2012, 12:00</b> Planned outage to fix a snagging issue and fit surge arrestors to offshore transformers. Snagging issues pertain to problems known prior to transfer from the developer to the OFTO	OFTO	11 days 9 hours	11,184
<b>17 June 2012, 12:40</b> Planned outage to fix a snagging issue and fit surge arrestors to offshore transformers. Snagging issues pertain to problems known prior to transfer from the developer to the OFTO	OFTO	13 days 11 hours	13,256
<b>1 July 2012, 12:00</b> Planned outage to fix a snagging issue and fit surge arrestors to offshore transformers. Snagging issue pertain to problems known prior to transfer from the developer to the OFTO	OFTO	2 days 9 hours	2,339
<b>1 August 2012, 08:13</b> Planned outage to fix a snagging issue on an onshore circuit breaker	OFTO	9 hours	1,449
<b>2 November 2012, 08:06</b> Unplanned outage due to a lightning strike on a connected electrical system that tripped protection equipment	OFTO	1 day 6 hours	5,009
<b>TOTAL</b>			<b>35,783 MWh</b>



# Reanalysis data validation with UK offshore meteorological masts

Organisations like the European Centre for Medium-Range Weather Forecasts (ECMWF) and the National Aeronautics and Space Administration (NASA) maintain atmospheric data assimilation systems which record and analyse various data assimilation systems (e.g. Modern Era Retrospective-Analysis for Research and Applications or MERRA) atmospheric measurements from around the globe. These measurements are used to recreate an historical record of atmospheric conditions including wind speed and wind direction. These models are an important source

of meteorological information for use in wind resource analysis and operational monitoring for windfarms before and after construction. For example, using outputs from these models, developers and operators can improve their energy assessment predictions at a windfarm location, helping support the case for making an investment decision.

The Crown Estate collects meteorological information from each met mast installed offshore. This data records wind speed and wind direction over 10-minute periods.

Collectively, The Crown Estate holds meteorological data from over 20 different locations around the UK. With this data we have been able to analyse the data output from the models above with actual measurements taken at sea. This comparison has allowed us to undertake a broad validation study of the reanalysis models around the UK and has produced conclusions that will provide windfarm developers with more information during planning phases (Figures 10 and 11).

A formal paper is to be released in the summer of 2014 with presentation at industry conferences.

FIGURE 10: Daily mast correlation with MERRA

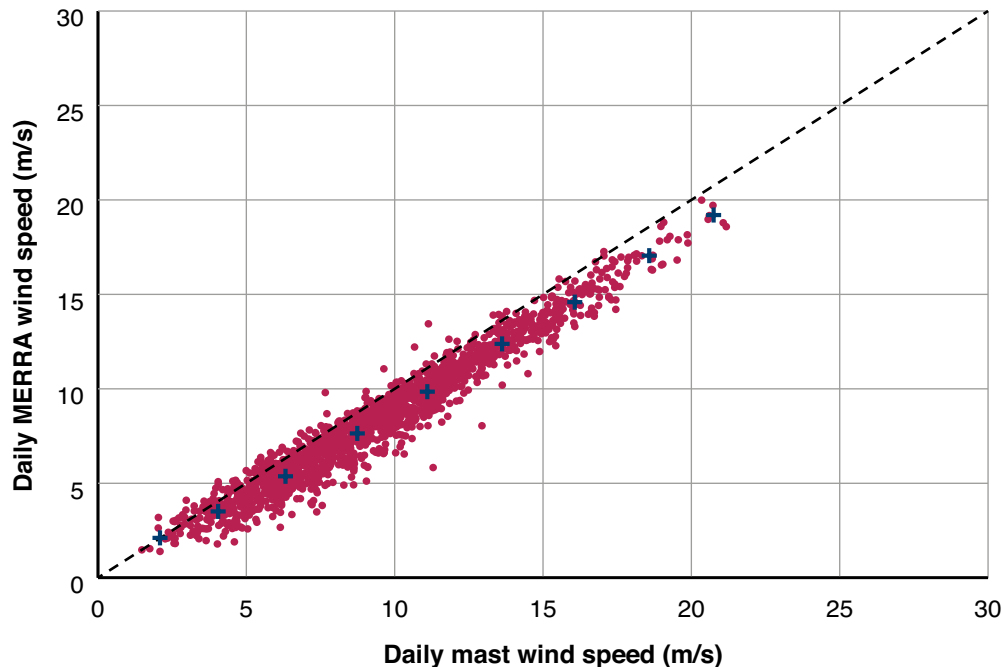
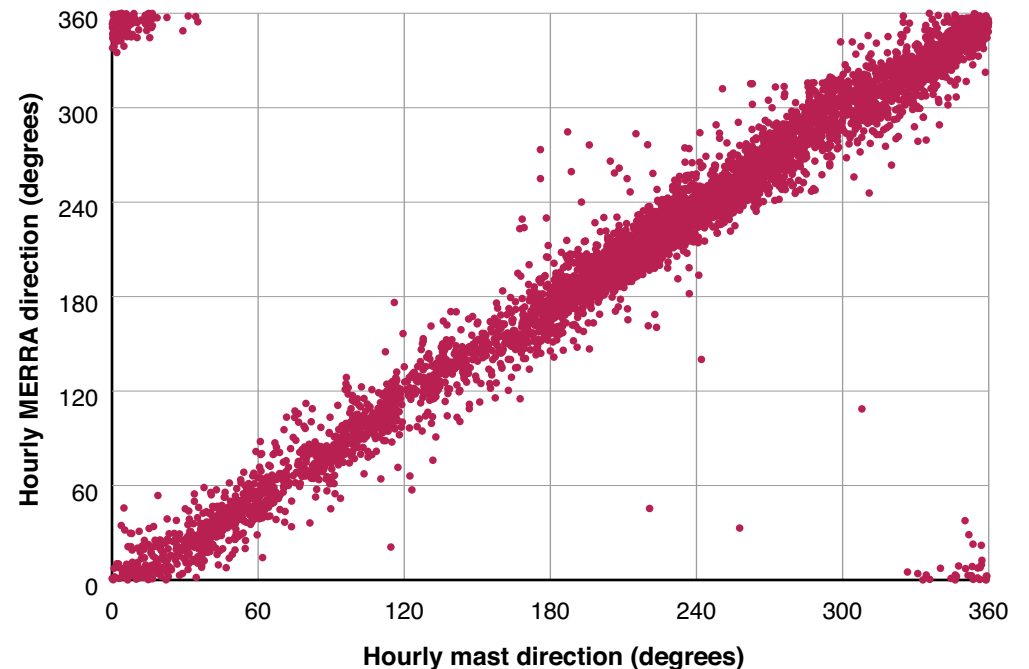


FIGURE 11: Hourly directional correlation with MERRA



Monthly windiness varied between -40% and +32% against our modelled long term average



COURTESY OF SIEMENS

Windiness was just 1% in excess of the long term average during 2013



1.51TWh – record monthly generation by UK offshore wind achieved in December 2013



# Sustainability

We estimate that the release of almost five million tonnes of carbon dioxide equivalent into the atmosphere was avoided in 2013 through the generation of low carbon energy from UK offshore wind projects compared with the alternative of fossil fuel generation.

As the number of low carbon energy projects continues to grow, so will the amount of greenhouse gas emissions avoided.

As well as protecting the environment, offshore windfarms offer a boost to local economies. Many developers support community funds and projects that aim to boost local employment, skills and culture.

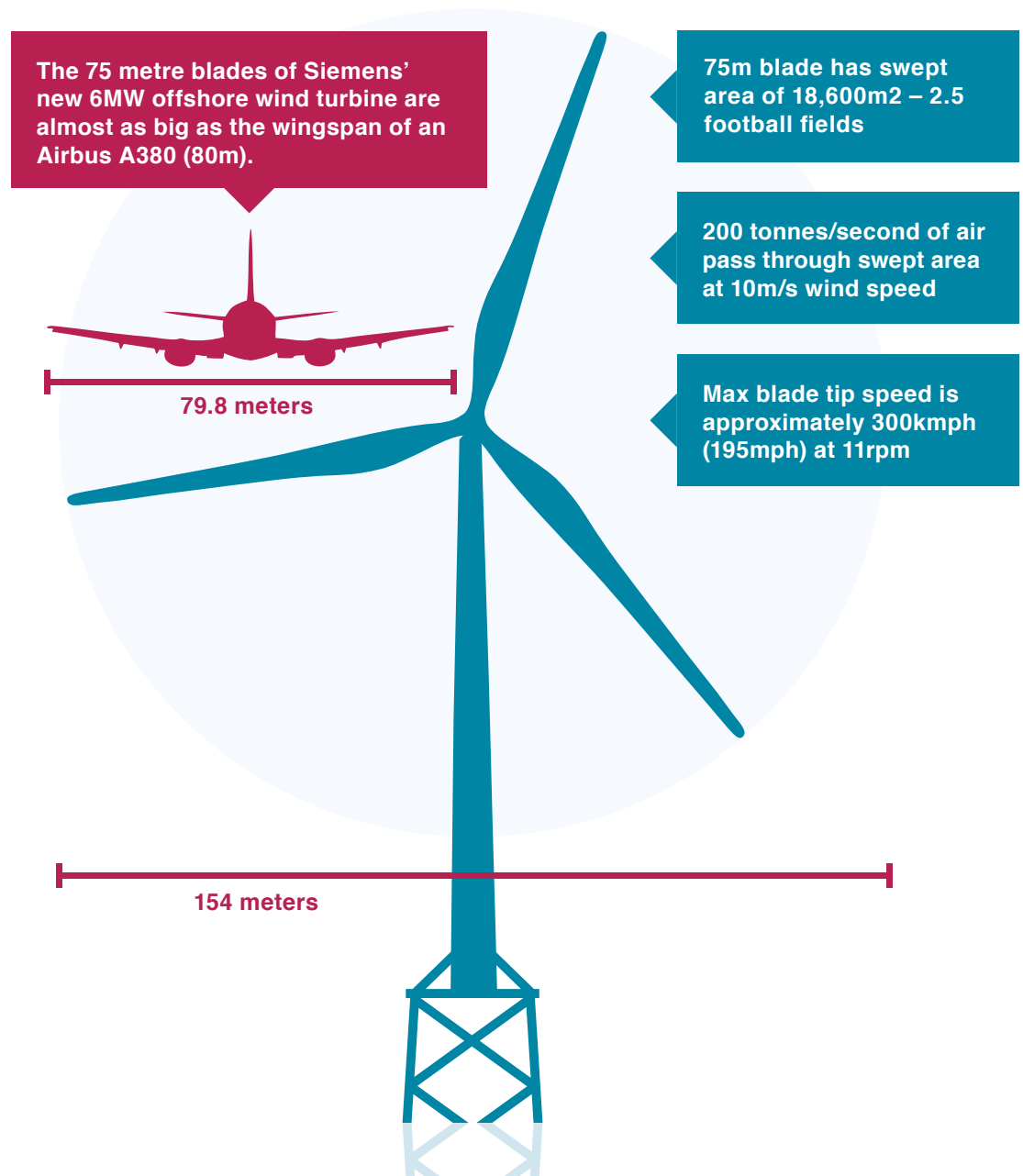
## Growing public support for offshore wind

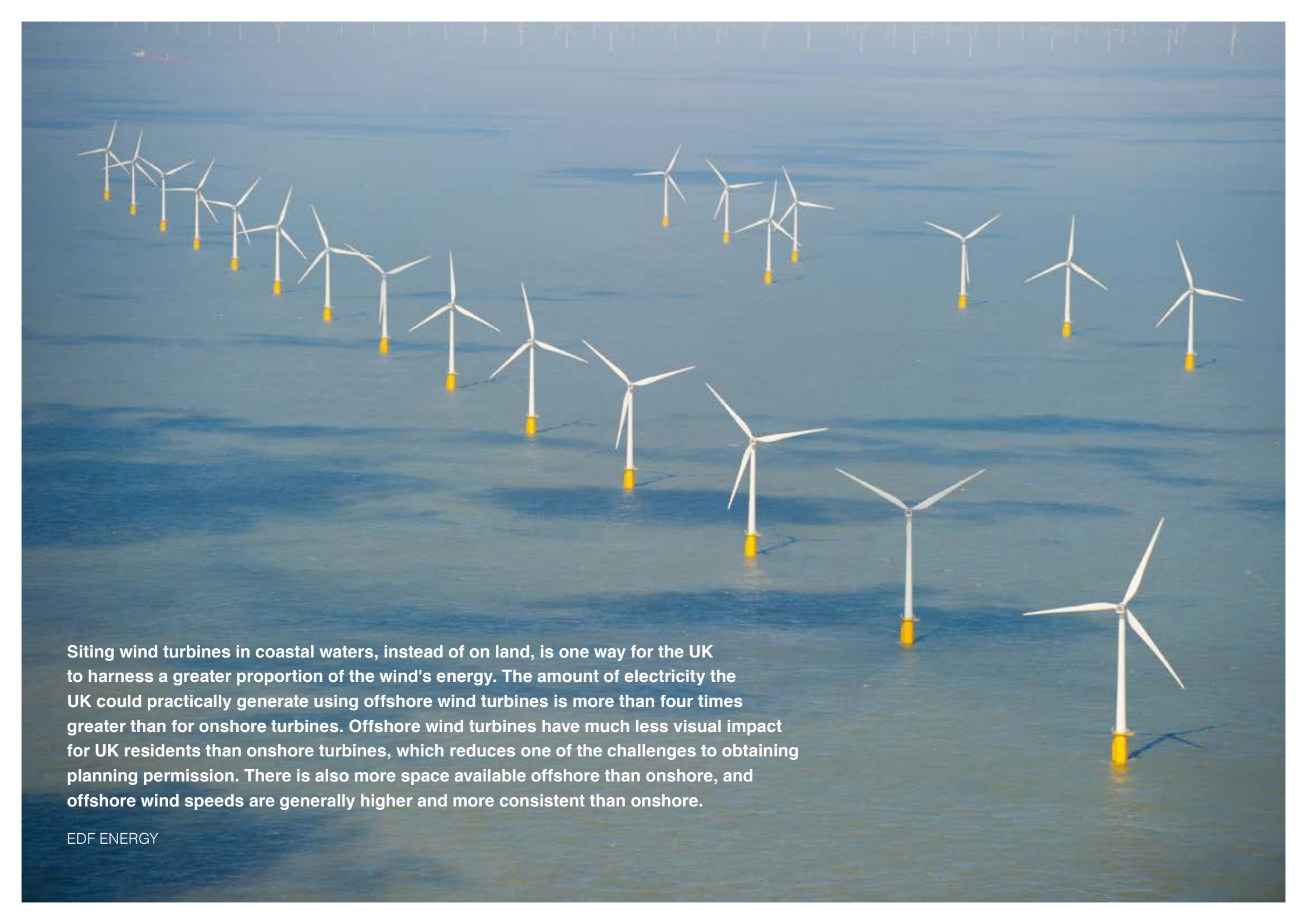
A 2013 government commissioned survey found that 76 per cent of all adults support offshore windfarms. Amongst those aged 16 to 24 years old, the figure increased to 85 per cent.

The poll, by Ipsos MORI, also found that 58 per cent of adults think offshore wind has a positive impact on the UK economy. Again, this rises to 70 per cent amongst the younger generation.

When asked which technology would help tackle climate change more than three quarters of those aged 16 to 24 years old cited offshore wind compared to 60 per cent of all adults.

## Siemens 6MW



An aerial photograph of an offshore wind farm. The image shows a large number of white wind turbines with three blades each, mounted on yellow-painted concrete or steel foundations. The turbines are arranged in a somewhat grid-like pattern across a vast expanse of blue water. The perspective is from a high angle, looking down at the turbines. The water is a deep blue, and the sky is a lighter blue, suggesting a clear day. The overall scene is a vast, open area of water with the turbines scattered across it.

**Siting wind turbines in coastal waters, instead of on land, is one way for the UK to harness a greater proportion of the wind's energy. The amount of electricity the UK could practically generate using offshore wind turbines is more than four times greater than for onshore turbines. Offshore wind turbines have much less visual impact for UK residents than onshore turbines, which reduces one of the challenges to obtaining planning permission. There is also more space available offshore than onshore, and offshore wind speeds are generally higher and more consistent than onshore.**

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Correct as of May 2014

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**The Crown Estate is an independent commercial business created by Act of Parliament. We invest in and manage some of the UK's most iconic assets, including the seabed: managing it effectively and sustainably, balancing different interests and delivering best value over the long-term.**

This gives us a unique role to play in developing and helping sustain the UK's energy supply and infrastructure, by working in partnership with a wide range of organisations that have interests in the seabed.

These include wind, wave and tidal power, carbon capture and storage, gas storage, marine aggregates and minerals, cables and pipelines.

We are active asset managers, applying our experience, skills and understanding to deliver optimum returns, create opportunities for ourselves and our partners, and provide a quality service to our customers.

Aware of our monopoly position and the impact of our activities, we are careful to comply with competition laws, co-exist with the wider marine community, and be open and transparent in our dealings.

Because of who we are, we are able to see the bigger picture, making best use of the seabed, and supporting and investing in sustainable development for the long-term benefit of the whole of the UK, now and in the future.