

Offshore Wind

Regenerating Regions - Investment
and Innovation in the UK

November 2017



RenewableUK

RenewableUK is the not-for-profit trade association representing the onshore and offshore wind, wave and tidal energy industries and their supply chains, with over 400 member companies based throughout the county, from large multinationals to small businesses.

All information in this document is provided by RenewableUK and has been sourced from either Offshore Wind Week partners or publicly available information. This information is correct as of October 2017

Front cover photo credit: Innogy

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Foreword



This year, we found out that Britain has backed a winner. Offshore wind has fallen in cost by nearly 50% in just two and a half years. In achieving this, the industry has rewritten the rules for how to deliver cost reductions in energy through innovation and new business models. The industry is shaking up existing markets and creating vital new opportunities for powering our country, creating more skilled jobs in our vibrant supply chain and successfully exporting to markets across the globe. What has been achieved is extraordinary and it is truly a British success-story, one driven by trailblazers across the UK who are fuelling growth, bringing investment and regeneration to local communities, especially in coastal areas.

I have been lucky enough to see at first hand the development of this sector over the last decade, witnessing how small companies have grown into international players. I have also watched household names changing the very core of their business strategy by diversifying into renewables, and many parts of the country becoming known for their expertise in offshore wind. From the Humber taking its place as a global powerhouse for offshore wind, to the North East of England leading the world in cable technology expertise; from blade manufacture taking place on the Isle of Wight to innovation in Blyth and investment in fabrication facilities in Scotland, UK-based companies are driving the renewable energy revolution and bringing real industrial and economic benefit to our country.

2017 has been an exciting year and a reminder of what innovative industry can achieve with sustained Government support. With the Clean Growth Strategy and the announcement of further auctions for Contracts for Difference, the Government has sent a strong signal that it wants offshore wind to continue delivering large-scale, low-carbon infrastructure – growing a competitive local supply chain across the country. Industry is further working hard with Government to deliver an ambitious sector deal which will place offshore wind at the heart of the energy system of the future. Investment in offshore wind is helping to transform economies and communities across the UK, and this publication showcases some of the firms and projects driving this transformation.

Hugh McNeal

CEO of RenewableUK

Introduction



Photo credit: ORE Catapult

Offshore wind is an essential part of the UK's current energy mix and a vital force for powering its future economy. It generates 5% of UK electricity, enough to power over 4 million homes, and is expected to generate 10% by 2020. By 2030, it has the potential to supply over a third of the UK's power needs. As the largest offshore wind market globally, the UK attracts large amounts of investment which enables a growing domestic supply chain and ensures that the UK reaps the benefits of its role as a global leader in offshore wind.

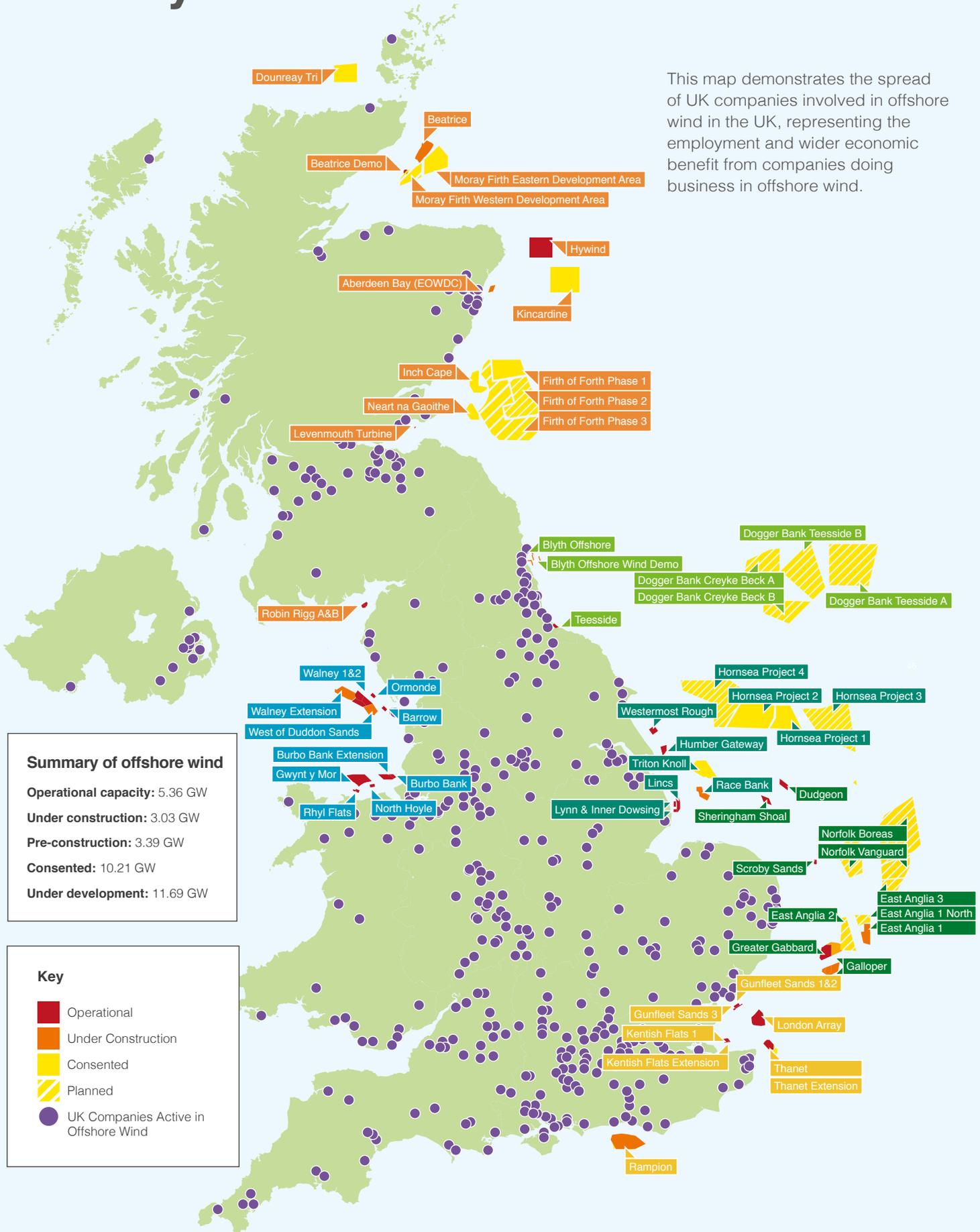
2017 has been a milestone year for the offshore wind industry. The results of the Contracts for Difference auction in September saw three offshore wind farms awarded with contracts to generate a capacity of 3.2GW by 2023, enough energy to power more than 3.3 million homes. Strike prices for several of these projects are now as low as £57.50 per megawatt hour for capacity delivered in 2023, nearly 50% lower than prices at the last auction in 2015.

As this publication makes clear, the industry is fuelling vital investment in manufacturing and the wider domestic supply chain to build vibrant economies and support thousands of skilled jobs. The industry is further on track to meet the goal of at least 50% UK content for the lifetime spend of new offshore wind farms, ensuring the maximisation of economic value for manufacturing, construction and long-term operations of offshore wind farms in the UK. Alongside supply chain activity in the UK, companies are also taking advantage of opportunities to export components, services and knowledge across the world; including China, the USA, Taiwan, Denmark, The Netherlands, France and India.

Further to this, innovation in the offshore wind sector is happening at extreme pace; developers are expecting to install 15MW turbines in the future, nearly double the capacity of the largest models currently installed at 8MW. Transmission cables using 66kV high voltage technology instead of 33kV are currently being installed in UK offshore wind farms, enabling increasing power transmission back to shore from these new large-scale wind turbines, and new types of foundation technology being developed will drive further cost reductions. Innovation by the industry is happening rapidly, promising wider investment opportunities and lower costs in the UK's energy future.

Summary of Offshore Wind Activity in the UK

This map demonstrates the spread of UK companies involved in offshore wind in the UK, representing the employment and wider economic benefit from companies doing business in offshore wind.



Summary of offshore wind

Operational capacity: 5.36 GW

Under construction: 3.03 GW

Pre-construction: 3.39 GW

Consented: 10.21 GW

Under development: 11.69 GW

Key

- Operational
- Under Construction
- Consented
- Planned
- UK Companies Active in Offshore Wind



Offshore Wind in the East of England

The East of England currently has enough offshore wind installed (1176 megawatts) to power over 982,629 homes with a total of 3 windfarms operational, 3 under construction and a further 5 wind farms currently being planned.

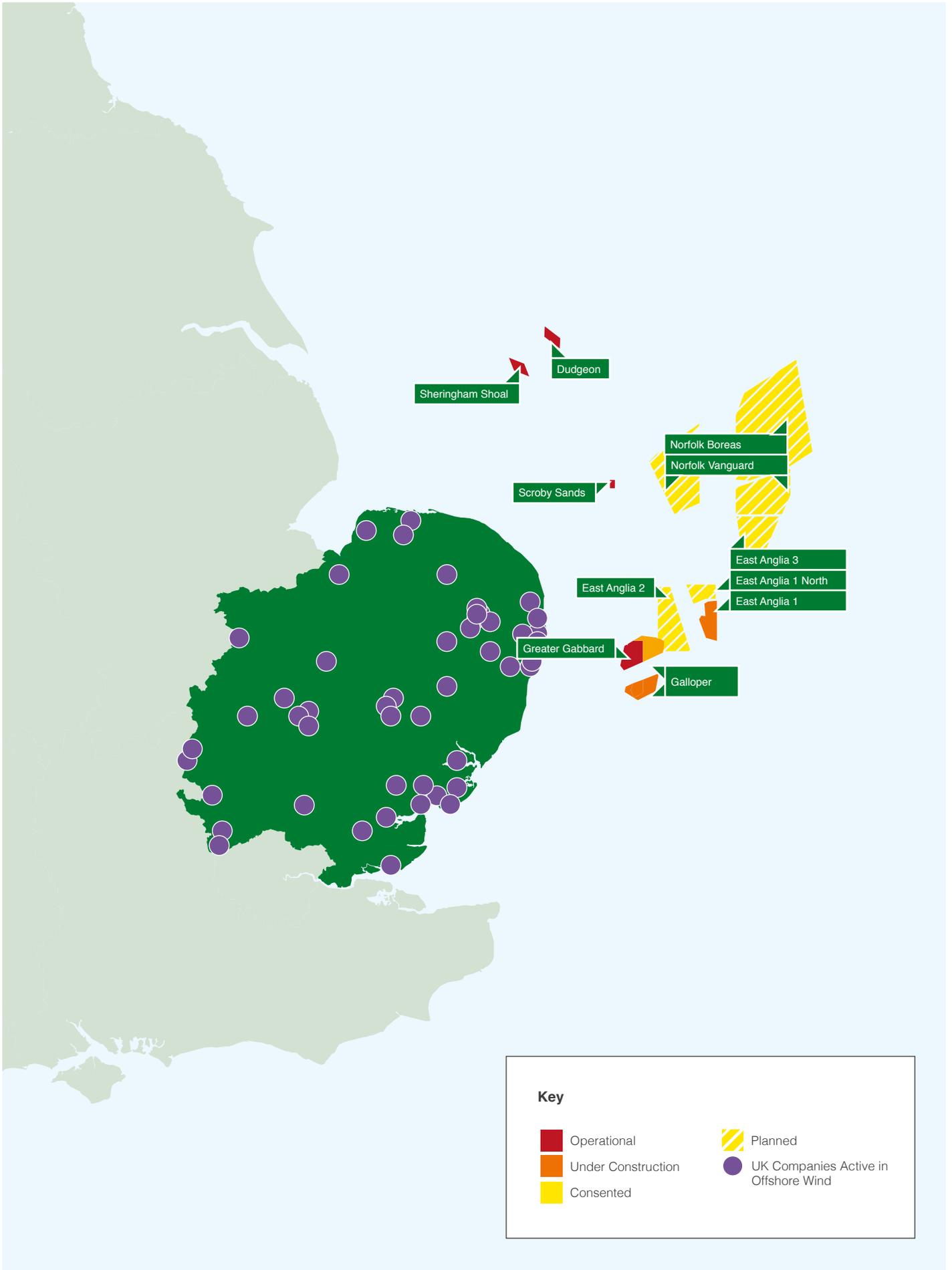
Offshore wind in the East of England has resulted in a hub of activity for the region. The region is at the centre of the UK's offshore wind industry and is ideally placed to serve existing offshore wind farms, those that are under construction and those that are to be built. The region is home to companies across the supply chain, from those who are based at OrbisEnergy, the specialist innovation and incubation centre at Ness Point in Lowestoft, to larger companies such as Seajacks and CWind who have their headquarters in the East of England.

Great Yarmouth has recently been selected to be the site of Statoil's Operations Centre for the Dudgeon Offshore Wind Farm. Similarly, the Port of Lowestoft will act as the offshore construction coordination base for Galloper Wind Farm. With current and upcoming activity, the East of England is sure to benefit from offshore wind in the coming years.



Photo credit: Innogy

Wind farms	Owner/Operator	Capacity (MW)	
Operational	Scroby Sands	E.ON	60
	Greater Gabbard	Innogy Renewables UK Ltd, SSE Renewables	504
	Sheringham Shoal	Statoil, Statkraft, Green Investment Group	210
	Dudgeon	Statoil, Statkraft, Masdar	402
Under Construction	East Anglia ONE	ScottishPower Renewables	714
	Galloper	Innogy Renewables UK, Green Investment Group, Siemens, Macquarie, Sumitomo Corporation	336
Planned	East Anglia ONE North	ScottishPower Renewables	800
	East Anglia TWO	ScottishPower Renewables	900
	East Anglia THREE	ScottishPower Renewables	1200
	Norfolk Boreas	Vattenfall	1800
	Norfolk Vanguard	Vattenfall	1800





Case Studies

3sun Group Great Yarmouth

3sun Group was founded in 2007 and first began work in the offshore wind sector in 2008. 3sun Group provide multi-skilled technicians who undertake a number of services such as installation, inspection and operations and maintenance. Other services that the group provide include engineering, project management and training services. At present, the group has approximately 400 employees, the majority of whom work in various roles to support the offshore wind sector.

3sun Group has provided technicians to over 90% of the UK's current offshore wind capacity- from older 2.3MW turbines to the latest 6MW and 8MW turbines. 2017 has seen them awarded with other considerable contracts from key customers, such as the provision of installation services to MHI Vestas for the 400 MW Rampion offshore wind farm and the pre-assembly of turbine towers for the 336MW Galloper offshore wind farm for Siemens. As well as their significant work in the UK, the company is also active in Denmark, Germany, The Netherlands, France and Belgium.

CWind Chelmsford

CWind provides vessels, technicians, engineering design/analysis support and training throughout the entire lifecycle of a wind farm. Since their launch in 2009, CWind has worked on over 40 wind farms and command a fleet of 16 crew transfer vessels. As part of the Global Marine Group (GMG), CWind has access to three regional UK bases, including Grimsby and the Port of Blyth, as well as Portland, Dorset. These hubs facilitate vessel mobilisation and deployment, as well as cable management and storage capability. CWind has recently expanded their services to include cable installation and repair capabilities, and 2017 has already seen them completing back-to-back power cable repairs for the Isles of Scilly, and a repair in the North Sea. CWind will also be providing all cable pull-in services for 66 offshore wind turbines and one offshore substation at Merkur Offshore Wind Farm, located in the German North Sea.

Fred Olsen Windcarrier Lowestoft

Fred Olsen Windcarrier was founded in 2009 and provides services such as turbine transportation and installation, crew transfer vessels and operations and maintenance to the offshore wind sector. They employ 200 people, all of whom work in offshore wind, and have won contracts for a host of large-scale projects in the UK such as the Hornsea Project One, Wiking Offshore Wind Farm, Dogger Bank, Gunfleet Sands and Galloper, for which Fred Olsen Windcarrier provide jack-up services, and Scroby Sands, Walney 1 and 2 and West of Duddon Sands, for which they supply crew transfer vessels. They have also won contracts for several offshore wind farms in Germany, Norway, Belgium, Denmark and the US.

Seajacks Great Yarmouth

Seajacks is a UK-based operator of purpose-built offshore wind turbine installation vessels. The company owns and operates 5 self-propelled vessels including the world's largest jack-up vessel, the 'Seajacks Scylla', which started work 2016. Seajacks employs over 250 people. As well as direct jobs, the company estimates they inject approximately £3 million per year into local businesses. Since 2009, Seajacks has installed over 1400MW of turbines in UK waters and overseas. 2017 has seen Seajacks awarded with contracts for its Kraken vessel to support work on the substation at the German 359MW Wiking Offshore wind farm and its Scylla vessel to transport and install jacket foundations for Scottish Power's East Anglia ONE Wind Farm, a contract which will create 75 new jobs. Alongside this, the Seajacks Scylla vessel is currently installing 87 8MW and 7MW turbines at the Walney Extension Project in the Irish Sea.

Gardline Great Yarmouth

Great Yarmouth based Gardline delivers geophysical, geotechnical and environmental surveys to the offshore renewables industry. The company employs 1000 people worldwide and operates a fleet of survey vessels on projects from the shoreline to full ocean depth. In August 2017, Gardline was acquired by the Boskalis Group. Gardline has been active in the European marine renewables market for over 15 years, and in the USA since 2016. In the Eastern region of the UK, Gardline has delivered services to the Greater Gabbard, Dudgeon, East Anglia and Galloper Offshore Wind Farms.

Recently, Gardline was awarded contracts by Scottish Power Renewables to undertake pre-construction UXO, geophysical and benthic surveys across the East Anglia ONE, ONE North and TWO Offshore Wind Farm sites. Fieldwork commenced in May and will continue until late 2017 utilising vessels from the Gardline fleet

Proserv Great Yarmouth

Proserv was created in 2011 from the merging of 5 separate companies, and today employ more than 1400 people across 11 countries. They carry out a range of services within offshore wind farm planning, commissioning, operations and maintenance - from survey services to structural installation positioning, condition monitoring, general offshore maintenance and provision of offshore technicians and personnel. In 2016, Proserv were awarded contracts for offshore wind farm installation at the Veja Mate Windfarm and Wiking Offshore Windfarm in Germany.

Galloper Wind Farm

Galloper Wind Farm is a 336MW offshore wind farm project, currently being constructed 30km off the coast of Suffolk. The project will be fully operational in 2018.

Photo credit: Innogy

View Point: from Toby Edmonds, Project Director, Galloper Wind Farm

"The Southern North Sea offers wind farm operators the perfect conditions for developing - shallow waters, a series of deep water ports and ideal weather conditions.

"Opportunities for contracts in construction, installation and then operations and maintenance on future wind farms stretch for decades ahead, promising huge opportunities for businesses in the coastal communities.

"The east coast also offers the expertise of 50 years' offshore experience in oil & gas and a growing supply chain of innovative, flexible and ambitious businesses.

"Construction of the Galloper Wind Farm is on schedule, largely due to the support of some of these companies working with the Galloper team, as well as the ports at Great Yarmouth and Lowestoft, where turbine towers are built and construction activity is managed and Harwich, chosen as the base for all Galloper's operations and maintenance for the next 25 years.

"I'm delighted that, as a project, Galloper will ultimately utilise three major ports along the east of England. The project, similar to others like it, is bringing new jobs, experience, aspirations, and skills for new generations of offshore wind workers, to the area. These communities are part of the project that is taking shape right now, off their beaches, and will soon be generating enough power for 336,000 homes."

Key project stats

Enough power for 336000 homes

700 jobs during construction

90 long-term jobs once operational

Project partners: Innogy SE, UK Green Investment Group, Macquarie Capital, Siemens Financial Services

Preferred bidders announced for Harwich renewables base

- Three preferred bidders announced in deals totalling over £7 million to build the Galloper Operations & Maintenance base and associated infrastructure
- State-of-the-art, purpose-built base

Earlier this year three companies were announced as the preferred bidders for the Galloper Operations & Maintenance (O&M) base in deals totalling over £7 million. All of the winning bidders are UK based with two of the contracts being awarded to East Coast firms. The agreements are for the construction of the Galloper offshore wind farm O&M base and its associated infrastructure at Harwich International Port.

The preferred bidders have been confirmed as Ipswich based R G Carter for the construction of the O&M building; Ipswich based Jackson Civil Engineering Group, for the construction of the access road; and Farrans Construction, for the fabrication and installation of the pontoon.

A planning application is currently being progressed for the O&M building and infrastructure; if successful and the development is given the green light, the three construction contracts will become live.

Galloper Operations & Maintenance Manager, Sean Chenery said:

"The O&M base will be the hub for all of the activity to maintain and operate the wind farm over its 23 year life. Therefore these contracts and the construction of the base would signify the beginning of a major long-term investment and jobs boost for the area."

James Wilson, Director and General Manager at R G Carter which has been established in Essex for nearly 40 years and employs 45 people, said:

"R G Carter is delighted to have been given the opportunity to be a part of this innovative project. This facility will not only benefit the local community but will also involve substantial investment into the local economy for years to come."

[1] Energy predicted to be generated by the proposal is derived using wind speeds monitored in the local area and correlating to suitable reanalysis weather data providing longer term data. The calculations are based on an installed capacity of up to 336MW. The energy capture predicted and hence derived homes equivalent or emissions savings figures may change as further data are gathered. Equivalent homes supplied is based on an annual electricity consumption per home of 4500 kWh. This figure is supported by recent domestic electricity consumption data available from The Digest of UK Energy Statistics and household figures from the UK Statistics Authority.



East Anglia ONE

East Anglia ONE is the first of 4 offshore windfarms ScottishPower Renewables is planning to build in the southern North Sea. Due to be completed in 2020, East Anglia ONE's 102 turbines will be able to generate enough electricity to power up to 600,000¹ homes

ScottishPower Renewables is leading the way with a target of spending 50% of the £2.5billion project in the UK over the lifetime of the windfarm. Major contracts to date include crane manufacture by Granada Cranes in Aberdeen, a £10m contract supporting 75 jobs; jacket foundation installation by Great Yarmouth-based marine engineering company Seajacks, supporting 75 local jobs; wind turbine manufacture by Siemens in Hull, supporting 1,000 jobs.

Port Investments

The Port of Lowestoft will serve as the operations and maintenance hub for East Anglia ONE for 30 years as part of an agreement worth £25million. ScottishPower Renewables have also co-invested £5million in preparing Great Yarmouth Port for offshore windfarm construction activity, securing its long-term potential.

Economic Growth: ScottishPower Renewables is committed to maximising the investment and economic opportunities for communities close to its projects. East Anglia ONE will sustain up to 3,000 jobs at the peak construction for the project and up to 100 skilled long-term jobs for the 30 year expected lifespan of the windfarm.

In a report issued by industry analyst Barbour ABI and Construction Products Association, East Anglia ONE has been credited for elevating the region into the leading position for construction contracts.

Supplier Event March 2017

In partnership with the East of England Energy Group, ScottishPower Renewables hosted a supply chain event for East Anglia ONE in March. Major contractors demonstrated over

200 opportunities to 700 local delegates to get involved with the project. For example, Siemens and VBMS confirmed the opportunity to tender for Crew Transfer Vessels, Prysmian presented the opportunity for transport and logistics, and VBMS required local transport vessels and marine support to assist with the installation of inter array cables.

Various suppliers, such as Lamprell and Van Oord, also highlighted the need to use local apartments, hotels and taxi services in the region – bringing huge financial benefits to the hospitality sector in East Anglia.

ScottishPower Renewables has also received planning approval for the East Anglia THREE offshore windfarm with an output capacity of up to 1,200 megawatts (MW).

The planning consent will allow for the installation of larger and more efficient 'next generation' turbines, up to a tip height of 247 metres and ScottishPower Renewables believes that next generation

technology will help to ensure that offshore wind is one of the cheapest forms of low carbon electricity.

Keith Anderson, CEO of ScottishPower Renewables, said: "Offshore wind has delivered on its promises from the outset. Our sector has met every technical and political challenge, grown the UK's supply chain, and improved the technology at a rapid pace to allow projects to be deployed in ever harsher conditions.

"With the support of a highly-skilled supply chain, East Anglia THREE will further enhance the UK's leading position in offshore wind. No other sector ticks all of the boxes in its ability to support the Government's plans for rebalancing the economy and promoting economic diversity through the Industrial Strategy.

¹Based on the following calculation: 714 MW (installed capacity) x 0.367 "offshore wind" average load factor (Digest of UK Energy Statistics) x 8,760 hours (hours per year)/3,900kwh (average domestic annual consumption) = 588,578 homes powered equivalent



Photo credit: Peel Ports HR



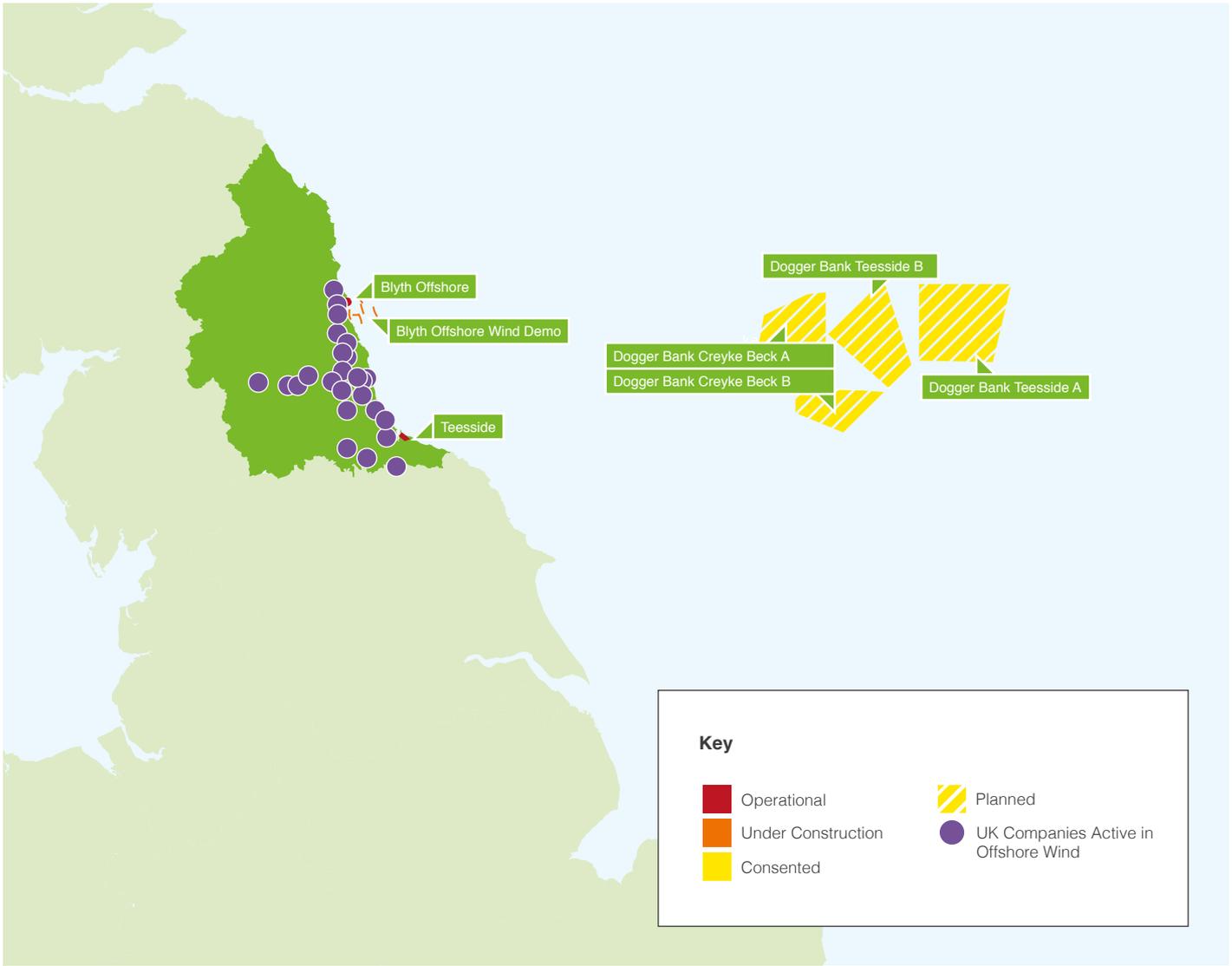
Offshore Wind in the North East

The North East of England has the potential to power over 4.1 million homes if the wind farms in the region are developed and deployed to their full capacity.

The region is the home to the UK's first offshore wind farm, Blyth Offshore Wind Farm and the Blyth Offshore Wind Demonstrator. The Blyth Offshore Wind Demonstrator is the world's first offshore wind farm to use 66kV technology which will demonstrate increased efficiency of the wind farm. In addition, the Offshore Renewable Energy (ORE) Catapult's testing site at Blyth is an innovation hub for the offshore wind industry and will shortly be welcoming the world's largest offshore wind blade, manufactured by LM Wind Power, who have chosen the facility to test their 88.4 metre blade.

The Round 3 Zone, Dogger Bank, has also received full consent and will consist of 4 offshore wind farms of up to 1.2GW, all of which will be at least 80 miles from shore. The wind farms in the Dogger Bank Zone will sit on the ancient Doggerland which had previously connected the United Kingdom to mainland Europe during the last Ice Age. The North East is also home to strong expertise in cable technology, with both JDR Cables and Tekmar based in this region.

Wind farms		Owner/Operator	Capacity (MW)
Operational	Blyth Offshore	E.ON	4
	Teesside	EDF Energy	62
Under construction	Blyth Offshore Wind Demonstrator	EDF Energy	40
	Blyth Offshore Wind Demonstration Project (Phase 2)	EDF Energy	30
Planned	Blyth Offshore Wind Demonstration Project (Phase 3)	EDF Energy	30
	Dogger Bank Teesside A	SSE Renewables, Statoil	1200
	Dogger Bank Teesside B	Innogy Renewables UK	1200
	Dogger Bank Creyke Beck A	SSE Renewables, Statoil	1200
	Dogger Bank Creyke Beck B	SSE Renewables, Statoil	1200



Case Studies

Tekmar Newton Aycliffe

Tekmar has been active in the offshore subsea sector for over 30 years and first entered the offshore wind market in 2007 through the development of a cable protection system for the Hooksiel demonstrator project in Germany. To date, the company has supplied over 5500 cable protection systems for over 55 projects, protecting 16.3GW of energy infrastructure across 7 countries, with contracts usually ranging from £1m to £8m. Approximately 110 out of the company's 130 employees work on offshore projects. Tekmar has recently opened a new 80 000 sq foot production facility and is now investing in a new R&D facility along with an engineering consultancy in London.

2017 has seen Tekmar awarded with 13 contracts to supply cable protection systems across the world, including global export contracts to supply the Binhai Phase II project in China and the Southwest Demonstrator in Korea.

Osbit Riding Mill

Osbit was founded in 2010 and is located in Northumberland, with a 1,140m² assembly facility at the Port of Blyth. The company delivers design, building and installation of back-deck and subsea equipment for the offshore wind industry. 2017 has seen Osbit winning a range of new contracts, such as the provision of a boat landing and access system for Ørsted's - formerly known as DONG Energy - Hornsea Project One, as well as work on Walney 3, the Burbo Bank Extension and Race Bank Offshore Wind Farm. With these recent contracts, 2017 has allowed Osbit to expand by 47% to now employ 53 people, most of whom work in offshore wind. Osbit has also supplied equipment to Dutch offshore contractors such as Van Oord and Tideway, and delivered a crew transfer vessel access system in June 2014 which is being used as part of the Fukushima Forward project, Japan's first offshore wind farm.



MPI Offshore Stokesley

MPI Offshore provides a range of services to the offshore wind industry, including the installation of foundations and turbines, consultancy, workboats, technicians and engineers.

The company has won several contracts for projects including Rampion and Dudgeon Offshore Wind Farms in the UK and Nordsee 1 and Sandbank Offshore Wind Farms in Germany.

In addition to installation and construction services, MPI Offshore and associated divisions within the group are also offering and performing offshore wind decommissioning and have developed a new innovative solution for repairing blade leading edge erosion offshore, offering a factory ship solution where the environment can be controlled and productivity increased.

Royal IHC Stocksfield

Royal IHC is a supplier of equipment, vessels and services for the offshore wind sector. This year, they are bringing a new remotely-operated trencher to market with the potential to reduce cable laying downtime in the offshore wind sector by 20% compared with current technology.

Supported by the team at the Offshore Renewable Energy (ORE) Catapult, Hi-Traq will transform the way that cables, designed to carry electricity from offshore wind farms to the grid, are laid.

JDR Cable Systems Hartlepool

JDR offer the design and manufacture of inter-array cables connecting offshore wind turbines.

JDR first entered the offshore wind market in 2006 following on from a contract with the Beatrice Demonstrator Project in Scotland. Since then the company has won multiple contracts with windfarms across the UK and Germany, with contracts in the range of £10m to £30m. Approximately 500 people are employed at the firm with 50% of the workforce working in offshore wind. In addition, the company runs an annual apprenticeship scheme.

In 2017, JDR has been awarded several large contracts: they will be designing and manufacturing 155km of 66kV array cables as well as handling cable management at each turbine at the East Anglia ONE offshore wind farm, and providing services for array cables at the Beatrice Offshore Wind farm in the Moray Firth. November 2016 also saw JDR awarded with a contract to supply subsea power cables for Ørsted's - formerly known as DONG Energy - Hornsea Project One Offshore Wind Farm, which at 242km of cables will be the largest array yet in the company's history.

DeepOcean Darlington

DeepOcean has been active in offshore wind since 2008, providing installation and protection of subsea power cables, seabed survey, site investigation, subsea inspection, maintenance and repair services. The company employs over 280 individuals in the UK, the majority of whom work on offshore wind projects. DeepOcean recently secured contracts to transport and install part of the array cables for Ørsted's - formerly known as DONG Energy - Hornsea Project One Offshore Wind Farm in 2016, and in 2017. Furthermore, the company has also won contracts to transport and install export cables for the East Anglia ONE Wind Farm and in the German sector of the North Sea cable transportation, installation and trenching for the Merkur Offshore Wind Farm.

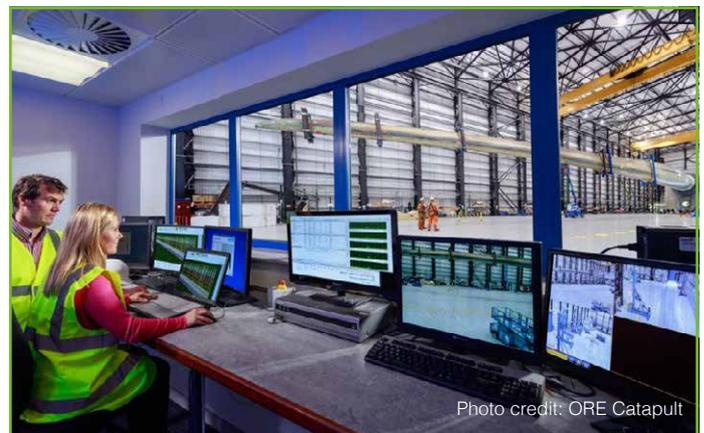


Photo credit: ORE Catapult

Offshore Renewable Energy Catapult Blyth

Established in 2013 by UK Government, the Offshore Renewable Energy (ORE) Catapult is a technology innovation and research centre with the aim of reducing the cost of offshore renewable energy, supporting the growth of the UK industry.

The site at Blyth is home to two blade test facilities, including the world's largest indoor blade test facility at 100m, a 15-megawatt power train test facility and a high voltage electrical lab which carried out the world's first accelerated lifetime testing of 66kV cabling.



Evolving the Industrial Revolution: the power to connect in the 21st Century

In 1885, Queen Victoria famously sent the first transatlantic telegram to US President James Buchanan via subsea cable. Seventy-four years earlier, the first ever power-transmitting underwater cable had been installed in the Isar River in Bavaria. These two events, bookending a century of engineering firsts and industrial innovation, are the foundation of the subsea cable industry.

Today, that industry runs a global network of subsea infrastructure and power cables that stretches over half a million miles, keeping the lights on and enabling global communications. The UK already has four subsea cable interconnectors linking it to France, the Netherlands, and Ireland, with several more proposed or under development, including an ambitious subsea cable to link the UK and Iceland.

For the past 50 years, JDR has been at the heart of this essential industry, leading the way in the design and manufacture of subsea cables. Its subsea production umbilicals, including electrical, hydraulic and fibre optic designs, provide vital connections to offshore installations around the world, delivering power and control functions that support the production of oil and gas from the seabed.

JDR's bespoke power cables also have the power to connect the offshore wind and marine energy industries. Custom designed cables transfer

electrical energy from offshore wind turbines, tidal energy devices, or wave energy converters to the shore, bringing cleaner, sustainable energy supply to communities across Europe.

One of the first outcomes from renewed focus on innovation is a new 'wet design' 66kV cable, whose development, high-voltage and full-scale wet-age testing, cable splicing, joints and connectors were all fully qualified and type-tested in 2016.

The new 66kV cabling steps up the voltage from the 33kV intra-array standard cable voltage capacity, and enables power to be transmitted to and from larger turbines that are installed further offshore. This is essential as the wind industry starts to look beyond shallower waters to build its next generation of wind farms.

Another advantage of JDR's 'wet design' 66kV cable innovation is that it is ideally suited for dynamic floating offshore wind applications. The design offers significant weight and endurance benefits over conventional cables at this voltage level, which previously have incorporated a metallic barrier layer such a lead sheath extrusion. With leading developers already seeking to harness energy using floating offshore wind from Europe, the US and Japan, 66kV will be a key enabler to maximise energy generated from floating applications.

Elsewhere, JDR is working with Ørsted - formerly known as DONG Energy - on Hornsea Project One which, on completion, will be the world's largest offshore wind farm and the first to exceed 1 GW capacity. Located 120km off the Yorkshire coast, Hornsea Project One will meet the electricity needs of well over 1 million UK homes, supported by 242km of array cables designed and manufactured by JDR.

In collaboration with offshore cable installation specialist VBMS (part of Boskalis), JDR is also contracted to supply 20km of 66kV intra-array and export cables to Vattenfall's European Offshore Wind Deployment Centre (EOWDC). Located in Aberdeen Bay, the 92.4MW, 11-turbine development is Scotland's largest offshore wind test and demonstration facility.

When Queen Victoria sent her telegram, her reign had already seen mechanics, economies, cities and lives transformed first by steam power and then by electricity generated from fossil fuels. Today, subsea cables are playing a vital role in our future offshore energy infrastructure, where they are used for the development of competitive, clean and sustainable energy sources. The subsea cable innovations emerging now will be the vital connections that transform the world once more.





Offshore Wind in the North West, Wales and Northern Ireland

The North West and Wales currently has enough offshore wind installed (1,812 megawatts) to power over 1.5 million homes, with a total of 8 windfarms operational and 2 under construction.

The area is home to a hub of activity to help support the construction, operation and maintenance of existing offshore wind farms, as well as the supply of services and components to projects which are in development or being built in the UK and further afield.

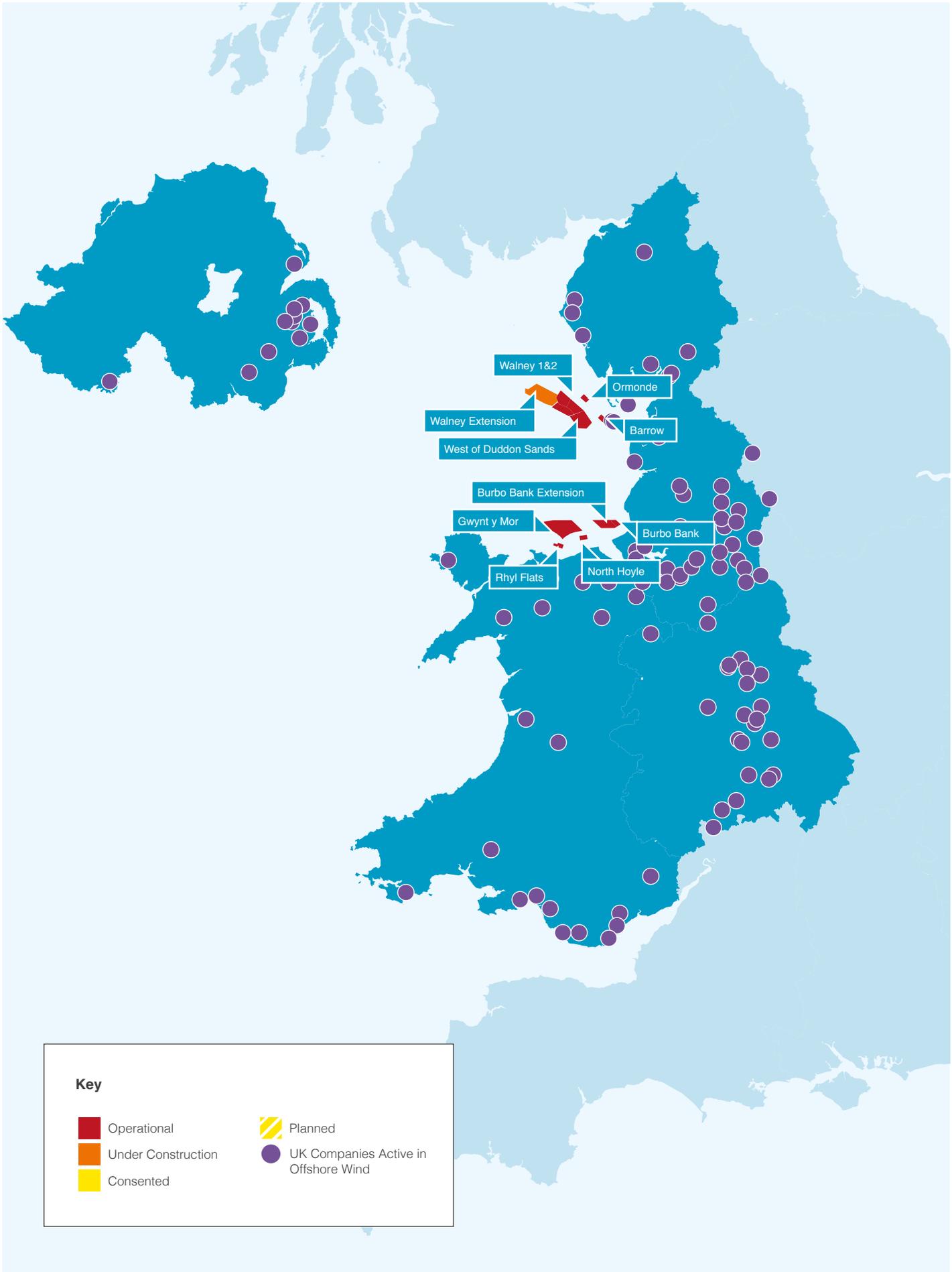
From large companies to smaller businesses, companies in the North West, Wales and Northern Ireland are taking advantage of the opportunities in offshore wind, both in the UK and around the world.

With a rich history in shipbuilding, Harland and Wolff have diversified to offshore renewables with contracts for the supply of foundations as well as large storage, assembly and load-out facilities. Most recently the company were contracted for the fabrication of suction bucket jacket foundations to Germany. The company has previously delivered projects and services for Humber Gateway, Robin Rigg, Ormonde and Bard 1 Offshore Wind Farms.

The North West is home to the world's largest offshore wind turbines with a capacity of 8 megawatts each (supplied by MHI Vestas Offshore Wind) at Ørsted's, Burbo Bank Extension Offshore Wind Farm.

The Port of Mostyn has acted as a wind farm construction port as well as an operations and maintenance base for North Hoyle, Rhyl Flats and Gwynt y Mor Offshore Wind Farms.

Wind farms	Owner/Operator	Capacity (MW)	
Operational	Barrow	Ørsted	90
	Burbo Bank	Ørsted	90
	Gwynt y Mor	Innogy Renewables UK Ltd, Green Investment Group, Stadwerke Munchen GmbH, Siemens AG	576
	North Hoyle	Innogy Renewables UK Ltd	60
	Ormonde	Vattenfall, AMF	150
	Rhyl Flats	Innogy Renewables UK Ltd	90
	Walney	Ørsted, SSE, Green Investment Group, Marubeni	367
	West of Duddon Sands	Ørsted, ScottishPower Renewables	389
Under construction	Burbo Bank Extension	Ørsted	258
	Walney Extension	Ørsted	660



Key

 Operational	 Planned
 Under Construction	 UK Companies Active in Offshore Wind
 Consented	

Case Studies

EDS Group Haslingden

2017 has been a busy year for EDS, as they have been delivering a contract to complete cable termination and jointing work at Rampion Offshore Wind Farm as well as a contract with VBMS to carry out cable termination and testing at the Blyth Offshore Wind Demonstration Project. This project is the first offshore wind project to use 66kV cable technology. EDS have also had their High Voltage(HV) Support Services contract extended by Vattenfall for a further 3 years. The contract will see EDS offering a wider range of services than previously, as well as taking in more sites.

In addition, the company has won a recent 3-year contract from Innogy to carry out operations and maintenance for the high voltage network at the 90 MW Rhyll Flats wind farm in North Wales, delivering planned maintenance as well as providing fault location services and emergency repairs if necessary.

Hutchinson Engineering Widnes

Hutchinson Engineering Ltd have completed work packages of secondary steel work for Dudgeon Offshore Wind Farm for Sif/Smulders, J-tube fabrication for Blyth Gravity Base Scheme for Bam Nuttall/Smulders and enabling works for the Beatrice & Aberdeen Offshore Wind Farms in the UK.

The company is now supplying tower and lifting frames, stillage beams and blade transport structures to MHI Vestas Offshore Wind for the Burbo Bank and Walney Projects.

Their most recent work includes cranes for the Beatrice substation and anode cage components for Hohe See Offshore Wind Farm in Germany. Hutchinson Engineering has plans to expand their quayside operation to facilitate larger scale fabrication and delivery, and currently employs over 130 people across their facilities located in Widnes & Garston.

Siemens Transmission & Distribution Manchester

Siemens Transmission and Distribution is based in Manchester. Its key focus is connecting grids and it has provided fully engineered offshore wind farm grid connection solutions which include the engineering, procurement, construction and installation of both the onshore and offshore transmission substations. The company has connected over 3.5GW+ of offshore wind and its most recent successes include the Triton Knoll Offshore Wind Farm (UK) and the Albatros Offshore Wind Farm (Germany), with Beatrice Offshore Wind (UK) Farm under construction.



James Fisher and Sons plc Barrow-in-Furness

James Fisher and Sons plc is a provider of specialist services to the marine sector both in the UK and world-wide. They employ over 1,700 people worldwide, with a large proportion of its UK personnel focused on offshore wind projects. The company regularly engages with their local workforce through providing apprenticeships, guidance and experience working in the offshore industry. James Fisher and Sons are currently providing marine co-ordination, OWMSTM marine management system, crew transfer vessels, vessel refuelling and emergency response services throughout the construction of Galloper Wind Farm. This contract is estimated to be worth more than £25 million and has facilitated the opening of a specialist marine operations office in the port of Lowestoft, resulting directly in the employment of local personnel.

HiDef Aerial Surveying Cleator Moor

HiDef was founded in 2005 and provides ultra-high resolution aerial digital video offshore wildlife surveys, complex statistical analysis, reporting and consultancy services. HiDef first ventured into offshore wind in 2008 where they surveyed all nine of the Round 3 offshore wind farm zones. The company currently employs 25 staff, all of whom are engaged in offshore wind.

Major clients include Ørsted, SSE Renewables, RES, Centrica, Forewind, National Grid, SLR Consulting, Hexicon, Highlands & Islands Energy, Oil & Gas UK, Marine Scotland Science, Scottish Natural Heritage, Natural England and JNCC, with contracts ranging between £10,000 and £2.4million.



Offshore Wind in Scotland

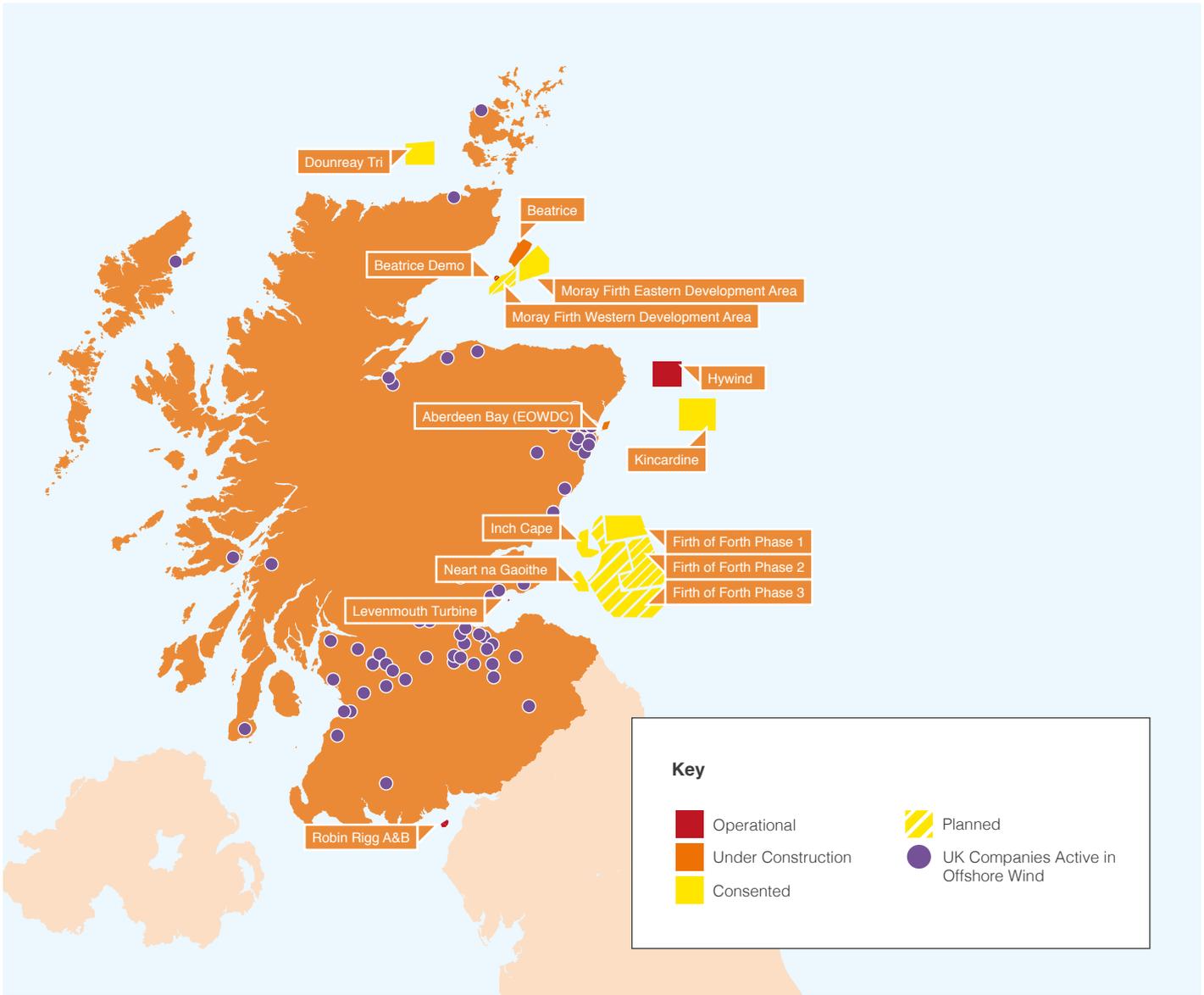
Scotland is home to a future potential of over 7.6GW of offshore wind capacity across 15 offshore wind farms, with the opportunity to power over 6.3 million homes.

Projects in Scotland are set to demonstrate the deployment of innovative solutions, from Siemens' Offshore Transformer Module at Beatrice Offshore Wind Farm to the exciting floating offshore wind developments at Hywind Scotland Pilot Park. The National Offshore Wind Turbine Test Facility at Hunterston is also located here, and is the UK's only onshore test facility for offshore wind turbines

As well as demonstrating future innovations to reduce cost across industry, Scotland has also seen significant investment from the Chinese developer, SDIC, at Beatrice Offshore Wind Farm and Inch Cape. 2017 has also seen EDPR's Moray East winning a Contract for Difference to generate 950MW of energy.

Scotland is home to a wealth of offshore expertise from companies such as Babcock Engineering and BiFab who have diversified from complementary sectors into offshore wind, as well as companies such as Atkins Global who are involved in the design and engineering of wind farms both in the UK and abroad.

Wind farms		Owner/Operator	Capacity (MW)
Operational	Robin Rigg	E.ON	174
	Beatrice Demonstrator	SSE Renewables, Talisman	10
	Levenmouth Turbine	ORE Catapult	7
	Hywind	Statoil, Masdar	30
Under construction	Beatrice	SSE Renewables, SDIC, Copenhagen Infrastructure Partners	588
	Aberdeen Bay (EOWDC)	Vattenfall	100
Consented	Near na Gaoithe	Mainstream Renewables	450
	Firth of Forth 1	SSE Renewables, Fluor	1050
	Moray East	EDPR	950
	Inch Cape	SDIC	750
	Kincardine	Atkins, Pilot Offshore Renewables	49.6
Planned	Dounreay Tri Demonstration Project	Hexicon	10
	Firth of Forth 2	SSE Renewables, Fluor	1800
	Firth of Forth 3	SSE Renewables, Fluor	800
	Moray Firth Western Development Area	EDPR	850



Case Studies

Offshore Renewable Energy (ORE) Catapult Glasgow

Established in 2013 by the UK Government, the Offshore Renewable Energy (ORE) Catapult is a technology innovation and research centre with the aim of reducing the cost of offshore renewable energy, supporting the growth of the industry and creating UK benefit.

ORE Catapult operates £1/4 billion of world leading test and demonstration facilities, with a total of 130 employees. In 2016/17, ORE Catapult supported 229 SMEs, won 29 competitive R&D projects and supported 51 companies to develop products through testing and validation services. In addition, ORE Catapult has worked on 35 international projects to develop opportunities for the UK supply chain including Europe, Asia, Australia, the USA and Canada.

BiFab Methil

Fife-based BiFab secured a £100 million contract to support the buildout of Beatrice Offshore Windfarm situated in the Outer Moray Firth. BiFab will be building 26 subsea jackets for the 84 turbine offshore wind farm, protecting 200 jobs. The contract will involve 22,500 tonnes of steel fabrication and will bring work to all 3 of BiFab's facilities; Burntisland, Arnish and final assembly and loadout from the Methil facility.

BiFab are also manufacturing 2 transformer platform jackets for Siemens as part of the Beatrice project. The jackets and piles weigh around 1,400 tonnes each and were due for delivery in July 2017.

In addition, BiFab has previously completed work for Ormonde; Greater Gabbard; Gwynt Y Mor; West of Duddon Sands Offshore Wind Farms in the UK and Alpha Ventus Offshore Wind Farm in Germany.



Ecosse Subsea Systems Banchory

Ecosse Subsea Systems (ESS) is a subsea technology, equipment hire and offshore engineering consultancy. The business was traditionally focused on oil and gas projects but in the last 5 years it has become a provider of services for the offshore wind industry.

2017 has so far been a busy year for ESS, as it has seen the company awarded with a seabed clearance project for the Beatrice Offshore Wind Farm located off the Caithness Coast, pre-cut trenching off the Moray Firth, as well as route preparation and pre-cut trenching on Kriegers Flak Offshore Wind Farm in Denmark. ESS has also recently been awarded seabed clearance work on Ørsted's - formerly known as DONG Energy - Hornsea Project One, the world's largest offshore wind farm. The company has further successfully completed the design and delivery of a 700-ton cable carousel for the storage of cables required for UK offshore wind farm projects, which was designed in Banchory and partially manufactured in County Durham.

Babcock International Rosyth

Babcock International delivers engineering services, technology and equipment to offshore wind projects in the UK. In 2016, Babcock was awarded a contract to construct two Offshore Transformer Modules (OTM™) destined for the Beatrice Offshore Windfarm in the Outer Moray Firth. The transformers are each suitable for 300MW when connected into the grid system via an onshore substation. The work will sustain at least 60 skilled jobs during the contract.

2016 also saw Babcock awarded with a multi-million-pound contract to construct the world's first reactive compensation station for Ørsted's - formerly known as DONG Energy - Hornsea Project One. The complex project, which will sustain around 100 jobs, involves Babcock manufacturing the five-deck station from its facilities in Rosyth, with support from a specialist local and UK supply chain.

In 2017, Babcock reached a key milestone when it achieved sailaway of a 2,000 tonne Offshore Sub Station (OSS) topside structure - for the Rampion Offshore Wind Farm - from its Rosyth site. The topside made the 500 nautical mile journey from the Rosyth facility to the Rampion site off the coast of Sussex, and has since been installed on the structure's jacket foundation. A key component of the wind farm, the OSS will transform the generated electricity from 33 kilovolts (kV) up to 150kV, reducing any loss of electrical power as it is transmitted to shore.

Inverlussa, Isle of Mull Argyll

Inverlussa Marine Services were awarded a 2 and a half year contract in April 2016 to provide offshore support during the construction phase of the 580 MW Race Bank Offshore Wind Farm. The work is carried out by the specially designed vessel Helen Mary, which was commissioned as part of a £3.5m investment to allow Inverlussa to expand into the renewables sector. Inverlussa now own and operate a fleet of 11 vessels and employ a total of 70 employees.



Maersk Training Aberdeen

Maersk Training started work in offshore wind in the UK in 2014, providing safety training and consultancy to a wide range of wind farms in the UK and employing around 30 people in the sector. They also deliver Advanced First Aid and Advanced Wind Turbine Rescue - projects through which Maersk Training are supporting the Global Wind Organisation with new training standards. In 2017, Maersk Training in Aberdeen launched an innovative Wind Turbine Generator to allow for rescue training from several areas in a wind turbine. Specific areas, such as the nacelle and the hub, have been designed to be able to replicate different turbines like Siemens, MHI Vestas and Nordex, allowing for technicians to train in highly realistic conditions.



Photo credit: Innogy

Beatrice Offshore Windfarm Limited

The £2.6bn Beatrice Offshore Windfarm Limited (BOWL), owned by SSE (40%), Copenhagen Infrastructure Partnership (35%) and Red Rock Power Limited (25%), is one of the largest ever private investments in Scottish infrastructure.

With an investment equivalent to nearly two Queensferry Crossings, the project, once completed in 2019, will have 84 offshore wind turbines able to generate enough electricity to power up to 450,000 homes.

Providing supply chain opportunities for UK companies and investing in local communities has been core to the development of Beatrice. The project is already delivering significant benefits locally, nationally and across the UK supporting more than 18,100 full time job years (according to economic modelling*) of which around 5,800 would be in Scotland. And, with the estimated addition of around £1.3bn of value to the UK GDP, the work to maximise the local supply chain will provide valuable employment and skills opportunities. Around £530m of the £1.3bn will be contributed to the Scottish economy.

“As a UK based energy company, SSE is proud to be investing in much needed energy infrastructure that helps to foster UK and Scottish supply chains for the offshore sector and has a positive impact on local lives and livelihoods.

“I’m pleased to report that construction of Beatrice is progressing well both onshore and offshore with 82 of the 86 pile locations completed, 24 jackets installed and export cable laying underway.”

Paul Cooley, SSE’s Director of Generation Development

Up in the north of Scotland, historic buildings at Wick Harbour are being redeveloped to create the operations and maintenance (O&M) base and up to 90 long term jobs. Originally designed by renowned Scottish engineer Thomas Telford in 1807 to support the herring industry, they will be brought back

to maritime use once sympathetically restored and ready for operational use in 2018.

BAM Nuttall, principal contractor of the O&M base works, have subcontracted GMR Henderson, who have their head office around the corner from the Telford buildings in Wick, for the demolition, preparatory works, renovation and restoration of the buildings.

Further south, Fife-based Burntisland Fabrications (BiFab) won two multi-million-pound contracts with Beatrice’s Tier 1 suppliers, Siemens and Seaway Heavy Lifting, to provide jackets for the project.

RJ McLeod, one of Scotland’s largest privately-owned civil engineering and building contractors is nearing completion of the civil construction of Beatrice’s Blackhillock substation near Keith in Moray.

Siemens will be supplying, installing and commissioning Beatrice’s 84 wind turbines with the majority of the turbine blades being built at their new manufacturing facility in Hull. The SSE Hunterston Offshore Wind Turbine Test Facility, located in North Ayrshire, has been an instrumental part of testing and operating Siemens turbines.

It’s not just the supply chain that is benefitting from Beatrice; the project also provides a total of £34m for community projects. £6m forms the Beatrice community fund managed by SSE’s Community Investment Team, and a further £28m will be provided by Beatrice over the lifetime of the wind farm to the Coastal Communities Fund.

Recent analysis completed by NEF Consulting, which assessed the social return on investment of the Beatrice community fund, found that for every £1 invested in community projects in the Highland and Moray regions, £3.21 is expected to be created in value for the communities. This means the £6m Beatrice fund, which supports the advancement of community projects in the Highland and Moray regions, could create nearly £20m of social value when fully distributed.



Photo credit: Øyvind Gravås/Statoil

Innovation in Scotland

Scotland is home to world-leading innovation in the offshore wind sector, with both the world's first floating offshore wind farm, Hywind Scotland, and the ORE Catapult Levenmouth Turbine - the world's largest open-access offshore wind turbine dedicated to research - located here.

Hywind Scotland Pilot Park

Hywind Scotland is the world's first floating offshore wind farm. Operated by Statoil in partnership with Masdar, it started delivering electricity to the grid in October 2017. At 30MW it will power approximately 20,000 households.

Located 25 kilometres offshore Peterhead in Aberdeenshire, Hywind can be used for water depths up to 800 metres. As such, it is a technology which is viable wherever sea depths are too great for conventional offshore wind power and their traditional bottom fixed installations. This opens up areas that have so far been inaccessible for offshore wind, allowing for new means of energy generation and a new global market.

Hywind consists of 5 floating wind turbines standing at 253 meters tall. The pilot farm covers around 4 square kilometres in water depths varying between 95-129 metres. The onshore operations and maintenance base for Hywind Scotland is located in Peterhead, while the operations centre is located in Great Yarmouth. Linked to the Hywind Scotland project Statoil and partner Masdar will also install Batwind, a 1MWh Lithium battery storage solution for offshore wind energy. Battery storage has the potential to mitigate intermittency and optimise output.

In recent years, there have been significant cost reductions in the offshore wind sector. Floating wind is expected to follow a similar downward trajectory over the next decade, making it cost competitive with other renewable energy sources.

Levenmouth turbine, Fife

A new product's route to market is often hampered by a lack of readily-available test and demonstration facilities, with wind farm owner/operators understandably reluctant to shut down their assets to test novel, unproven technology.

ORE Catapult operates the world's largest open-access offshore wind turbine dedicated to research. And after engaging almost 60 UK sensor SMEs, its CLOWT (Clone of the Levenmouth Offshore Wind Turbine) project will give the most promising an invaluable opportunity to demonstrate their sensors on the state-of-the-art 7MW machine. The Scottish Government-supported project is developing an exact digital simulation of the turbine, which will in future allow companies to develop innovative products using that data – and test them virtually, before expensive physical prototypes are developed.

Among the companies involved are Livingston firm Sensor-Works and Sheffield-based Tribosonics: developers of innovative vibration sensors and novel ultrasonic technologies, respectively. Other technologies being tested include tension monitors so small they fit inside individual bolts, and a high-voltage electrical noise monitor. A follow-up project, SMERT (SME Research and Testing), focusing on developing operations and maintenance technology and autonomous vehicles, will commence in late 2017.



Moray Offshore Windfarm (East) Limited

Delivering power for ca 1 million households, Moray East will deliver power at £57.50/MWhr – less than half the cost of offshore windfarms under construction today.

Moray Offshore Windfarm (East) Ltd is a 950MW project owned by EDPR (76.7pc) and ENGIE (23.3pc). Located in the outer Moray Firth 22km from shore at its closest point, the project will be constructed in deeper water - up to 57m – than most of the UK's existing offshore wind fleet. Deeper water working enables development farther from shore, where the wind resource is excellent. This has facilitated the development of a highly competitive project and is one of the elements which has allowed Moray East to lead the delivery of cost reduction.

Development of Moray East commenced in 2010, with the award of development rights for Zone 1 in the UK's 3rd round of offshore wind generation. The

zone was divided into two, the Eastern and Western development areas. At that time development in the west was constrained by existing activities (military and oil exploration). Those constraints have subsequently eased, allowing development of Moray West (850MW) to commence in 2016.

Moray East was awarded consent in 2014. It won a Contract for Difference (CfD) in the 2017 auction with a price of £57.50/MWhr (5.75p/kWhr) – delivering rapid cost reduction with a power price which is less than half that of comparable projects being built today, lower than new nuclear, and lower than existing onshore windfarms.

Moray Offshore Windfarm (East) Ltd is a 950MW project owned by EDPR (76.7pc) and ENGIE (23.3pc)



Photo credit: EDPR



Offshore Wind in the South of England

The South Coast is powering over 1 million homes from 6 windfarms. With the completion of Rampion Offshore Wind Farm, an additional 270,000 homes will be powered, bringing the total number of homes powered by offshore wind to over 1 million.

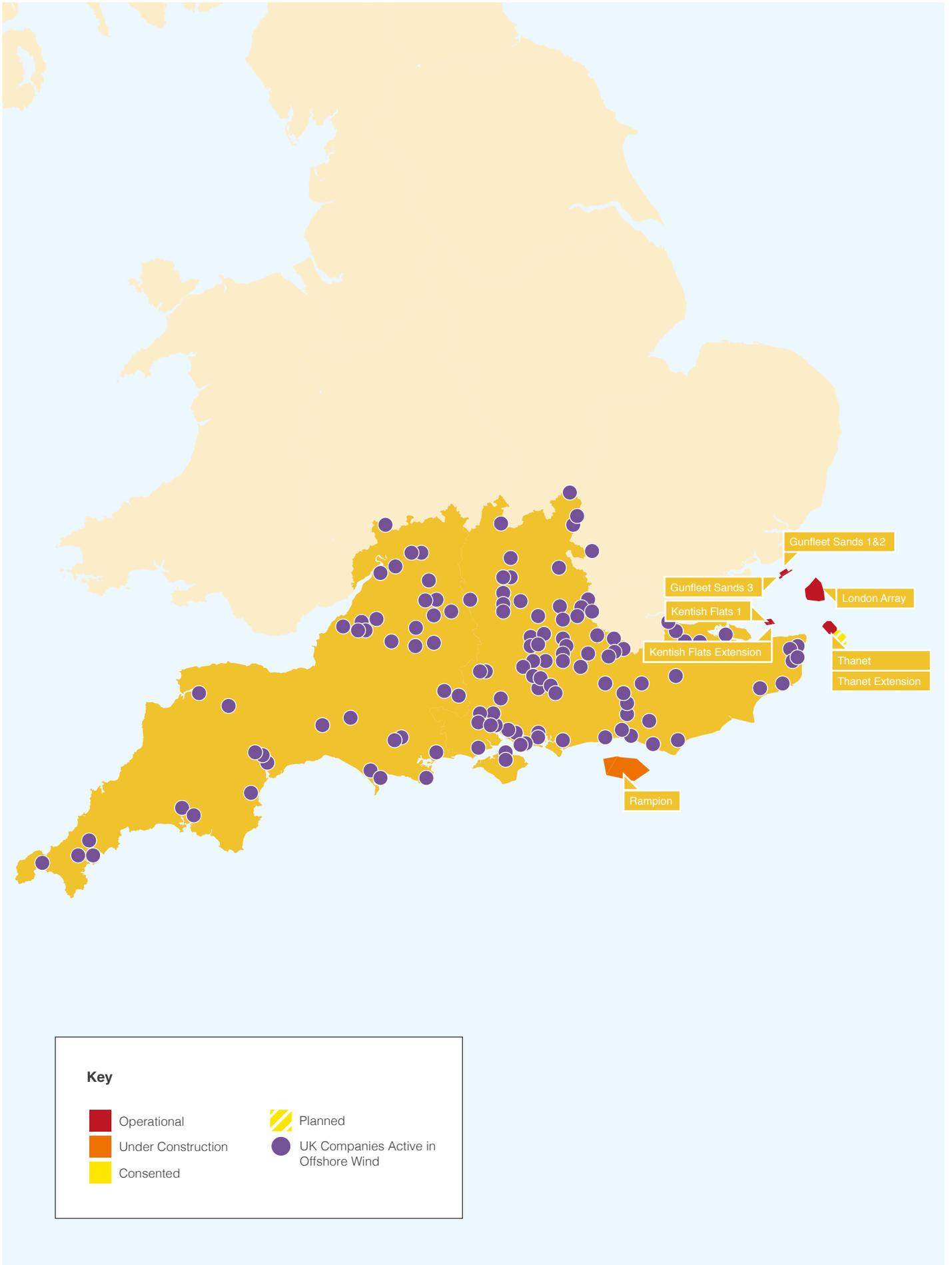
The Solent has an existing reputation of being a leader in the field of composites with companies now demonstrating and applying this expertise to offshore wind; from MHI Vestas Offshore Wind producing 80m blades from their facility on the Isle of Wight to Seacat Services and South Boats manufacturing vessels for offshore wind farms in the UK and abroad.

The South Coast has recently experienced significant investment on the Isle of Wight following on from MHI Vestas Offshore Wind's investment in a blade manufacturing facility. A recent economic impact assessment found that in 2016 MVOW's contribution to the economy of the United Kingdom (direct & indirect) in terms of total output is in excess of £500 million. In terms of total employment impact, it is more than 600 jobs.

Wind farms	Owner/Operator	Capacity (MW)	
Operational	Gunfleet Sands 1 & 2	Ørsted , Marubeni, Development Bank of Japan	173
	Gunfleet Sands 3	Ørsted	12
	Kentish Flats	Vattenfall	90
	Thanet	Vattenfall	340
	London Array	E.ON, Ørsted , Masdar, La Caisse	630
	Kentish Flats Extension	Vattenfall	50
Under construction	Rampion	E.ON, UK Green Investment Group, Enbridge	400
Planned	Thanet Extension	Vattenfall	340



Photo credit: Vattenfall





Case Studies

Atkins Epsom

Atkins has over 75 years of experience in delivering infrastructure projects. The company was established in Epsom which remains a key part of its offshore wind capability, and operates across the UK and around the world. Atkins is involved with the full lifecycle of offshore wind farms. Their major focus is in the design of wind farm facilities, including Wind Turbine Generator substructures and foundations, offshore substations and grid connection. Atkins is currently working on projects including the Beatrice Offshore Transformer Module (OTM™) for Siemens, Beatrice WTG jacket design for Seaway Heavy Lift (SHL) and Triton Knoll WTG and substation monopile designs for SSS-F (a Smulders and Sif partnership). Outside of the UK, Atkins is delivering work in south-east Asia and is aligned with the growing market in the USA. On July 3, 2017, SNC-Lavalin, a global professional services and project management company, acquired Atkins.

BVG Associates Swindon

BVG Associates were founded in 2006 and have worked in the offshore industry since then. They provide consultancy services on the technology, business and economics of the sector. The majority of BVG's work is in advising private clients investing in manufacturing, technology and renewable energy projects. Their clients include companies of all sizes from multinational corporations through to start-ups, for which they produce reports and deliver strategic advice for establishing offshore wind as a commercially, as well as environmentally, sustainable part of the energy mix. Alongside the UK, BVG Associates have clients in Europe, North America, South America, Asia and Australia.

MHI Vestas Offshore Wind Isle of Wight

MHI Vestas Offshore Wind is a joint venture between Vestas Wind Systems A/S 50% and Mitsubishi Heavy Industries (MHI) 50%. Established in April 2014, the company has grown from 110 staff in the UK to over 500 in 2017.

The company's focus is to design, manufacture, install and service wind turbines exclusively for the offshore wind industry. The company aims to create value through offshore wind power by driving capital and operating savings and increasing the power output of wind turbines. An innovative force in offshore wind since its inception in 2014, the company is guided by its founding principles of collaboration, trust, technology and commitment.

MVOW's contribution to accelerated cost reduction includes bringing leading technology such as the world record breaking V164-9.5MW to market and the delivery of industrial investment in the UK; from their own manufacturing, operation and maintenance facilities and their network of UK-based suppliers.

SeaRoc Group Chichester

SeaRoc Group has won a number of contracts for offshore wind farms across Europe utilising their SeaPlanner tool, a marine management and monitoring system. In 2017, SeaRoc Group was awarded a contract to provide its SeaPlanner system to support construction of the Merkur Offshore Wind Farm in Germany, as well as being selected by Ørsted, formerly known as DONG Energy, to support its UK portfolio of offshore wind projects. The group is also providing Health, Safety and Quality management for the East Anglia ONE Offshore Wind Farm under a 5 year contract, and holds contracts to support construction activity at Rampion Offshore Wind Farm off the south coast of England. 2017 has also seen SeaRoc Group grow its workforce significantly to increase development resources for their SeaPlanner system.

Vattenfall Kent

Vattenfall developed some of the UK's earliest offshore wind farms off of the Kent Coast. Vattenfall has worked hard to realise the potential economic and environmental benefits of these earlier sites; local staff are now fully trained and running the operations, more local suppliers are "match fit" for the industry and operation and maintenance base in Ramsgate houses the 70 plus staff who will operate and maintain Vattenfall's Kent Wind Farms over the remainder of their life. Vattenfall aims to ensure local and UK businesses benefit from the opportunities, from small local boats to larger national suppliers like Sembmarine SLP in Lowestoft. Vattenfall is now developing a proposal to extend Thanet Offshore Wind Farm. The extension would involve the addition of up to 34 turbines to the existing wind.

Red Penguin Fareham

Based in Fareham, Hampshire, Red Penguin provides specialist consulting and related support services for marine and subsea cable engineering. They deliver services in technical expertise, asset management, marine warranty surveying and preparedness planning and auditing to owners, developers, lenders, insurers and counsel across the whole project lifecycle of an offshore wind farm; from concept development, through design and construction to operations and maintenance. 2017 has seen Red Penguin awarded with contracts to support West of Duddon Sands Wind Farm and Walney 2 with technical expertise, as well as the successful delivery of a contract to provide marine warranty surveying for the Burbo Bank Extension. In the past, they have also worked on the Dogger Bank Teesside Offshore Wind Farms in the UK, and the Gode Wind Farm and DolWin2 offshore converter station in Germany.



Photo credit: MHI Vestas

MHI Vestas - Supply Chain Heroes

Supply heroes are more than just suppliers, they're valued partners and central to MHI Vestas Offshore Wind's industrial success.

Since our joint venture began in 2014, we have sought the most qualified partners throughout the UK to not only contribute their expertise but also to grow with us as we push the boundaries of offshore wind. These partnerships have helped MHI Vestas lower the cost of offshore wind energy and deliver increasing value with every project.

The landmark success of offshore wind in the UK is the result of a healthy, vibrant supply chain. And healthy supply chains are built with companies like 3sun. Partners with MHI Vestas since 2014, 3sun has proven their value and expertise time and time again. From all of the technicians who've gone offshore with our turbines to logistics coordinators like Heather Leadbetter, 3sun Group is, in every way, our 2017 supply hero.



Heather Leadbetter - Senior Renewables Coordinator, 3sun Group

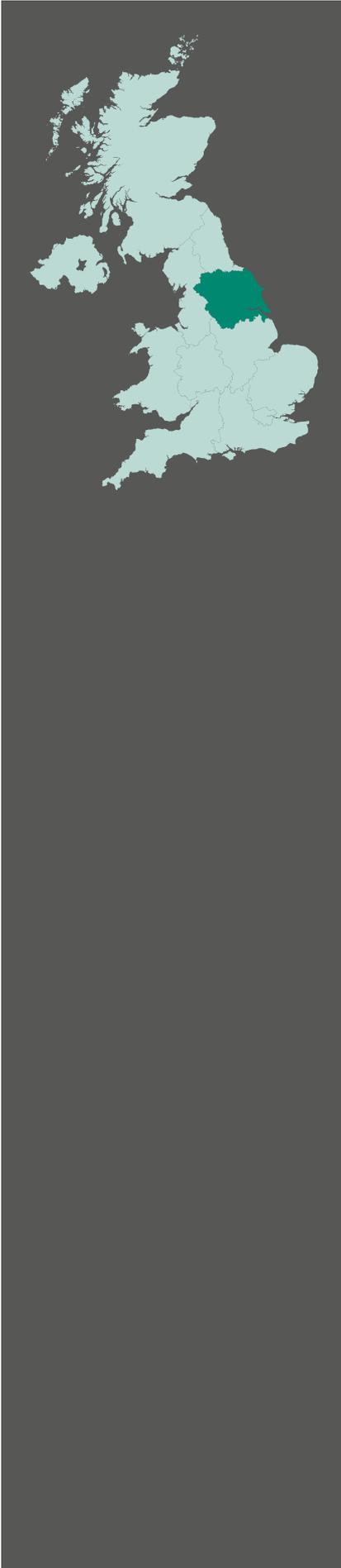
"My role involves overseeing the deployment and logistics of our skilled Wind Turbine Technicians. I've been leading the coordination of our Technicians on MHI Vestas Projects since the first M&E scope was awarded to us back in Sept 2014 for the V112-3.0 MW turbines at Humber Gateway Offshore Wind Farm.

Since then I've coordinated our team on Kentish Flats, Burbo Bank Extension, Rampion and Walney III Extension. I'm required to ensure our Technicians are fully trained and ready to undertake the work they've been mobilised for and ensure our PPE and Travel Departments have all the necessary arrangements in place for their assignment.

I'm also involved in the allocation of technicians to specific roles on the Projects in ensuring we are providing the best team build up we can.

We have a great team of technicians and Supervisors whom I've built an excellent working relationship with. I'm in contact with all of them day-to-day via phone and email and I try to attend site visits whenever possible to say hello and, of course, meet the MHI Vestas Site Team.

MHI Vestas is an absolute pleasure to work with; I find they are extremely organised in their planning which I greatly appreciate when it comes to planning in our rotations and labour for the projects. I never struggle with contacting a member of the site team with any issues/queries, whether it be the Site Administrator, Deputy Installation Manager or Project Manager, I've found them all to be extremely approachable and friendly. I hope I have the opportunity to work with MHI Vestas on many more projects in the future!"



Offshore Wind in Yorkshire and The Humber

Yorkshire and The Humber is home to a hub of regional activity which spans the whole lifecycle of an offshore wind farm. With 4 projects which have consent and a further 2 projects totalling 3.6GW yet to be developed, the area is truly at the heart of the offshore wind industry in the UK.

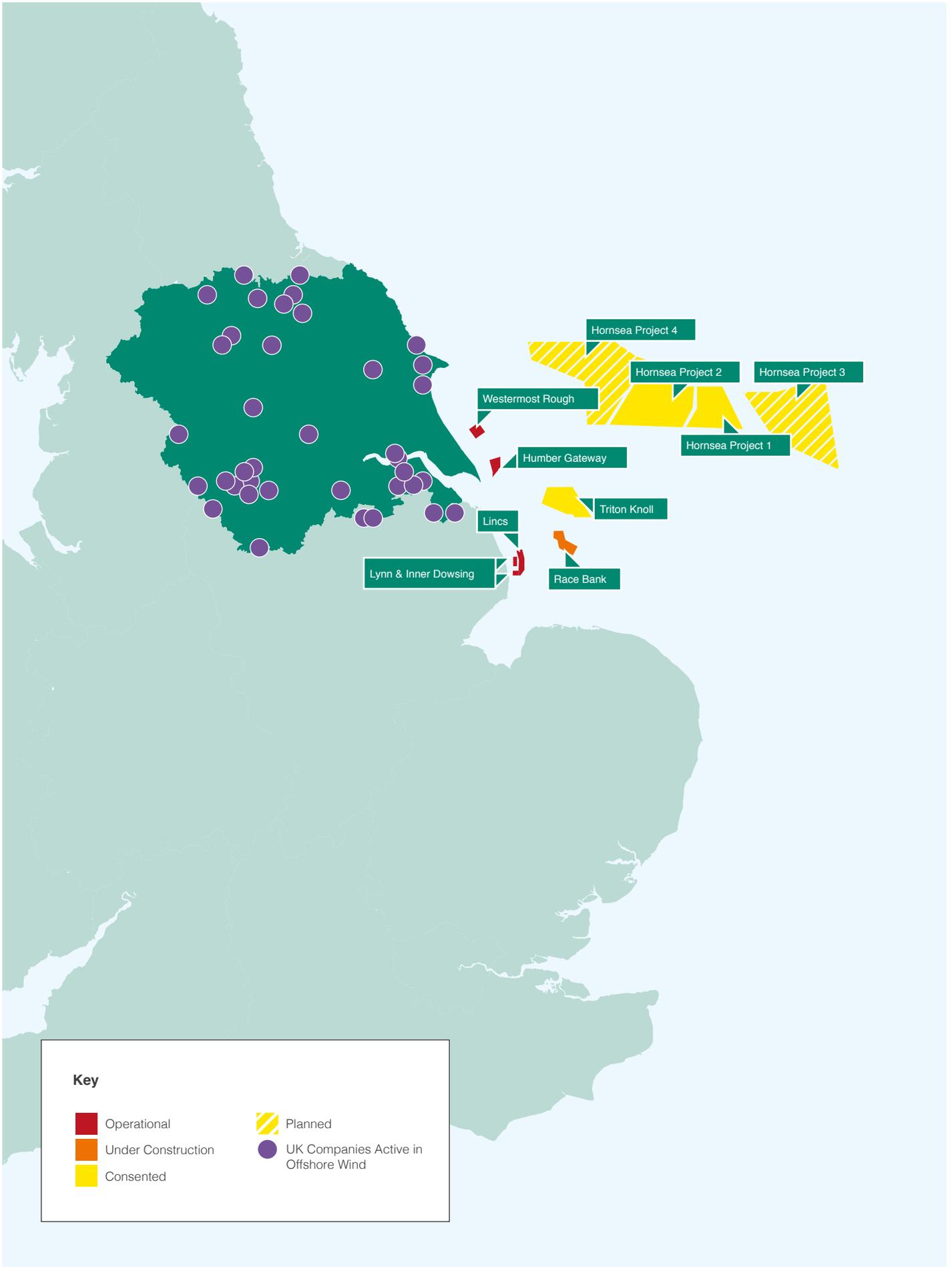
The Humber has experienced a buzz of activity around offshore wind; from Siemens' £160m pound investment at Alexandra Dock to the current operations and maintenance activity of existing offshore wind farms such as Ørsted's Hornsea Project One- the world's first offshore wind farm to exceed 1 gigawatt. The area has experienced significant investment which has revitalised the economy in the local area and resulted in a number of contract awards to UK companies doing business in offshore wind.

The Humber is also home to Triton Knoll and Hornsea Two, both of which have successfully won contracts to provide clean electricity. Looking to the future, UK based companies will be able to take advantage of a strong pipeline of projects, with project teams from Triton Knoll and the Hornsea Projects already engaging with supply chain to highlight the opportunities to come.



Photo credit: Siemens Gamesa

Wind farms		Owner/Operator	Capacity (MW)
Operational	Humber Gateway	E.ON	219
	Lincs	Centrica, Ørsted, Siemens Project Ventures	270
	Lynn & Inner Dowsing	Centrica	194
	Westermost Rough	Ørsted, Marubeni, Green Investment Group	210
Under construction	Race Bank	Ørsted	580
Consented	Triton Knoll	Innogy Renewables UK Ltd	860
	Hornsea Project One	Ørsted	1218
	Hornsea Project Two	Ørsted	1386
Planned	Hornsea Project Three	Ørsted	2400
	Hornsea Project Four	Ørsted	1200





Case Studies

Specialist Marine Consultants (SMC) Filey, North Yorkshire

SMC was founded in 2006 and is located in Hunmanby, North Yorkshire. The company started working in the offshore industry in 2008 and now employs 15 people and 112 contractors, all of whom work in offshore wind. SMC provides marine consultancy and coordination services as well as vessel inspection, quality inspection and technicians. SMC has won £35 million of contracts for Walney Offshore Wind Farm 1 and 2 as well as Walney Extension, Beatrice Offshore Wind Farm, Galloper Wind Farm and Race Bank in the UK, and Gode Wind and Veja Mate offshore wind farms in Germany. They are also working with Ørsted in Taiwan and with GE Wind in China.

Ørsted – the new name for DONG Energy

DONG Energy's transformation and recent divestment of their oil and gas business has led to a change of name. DONG, short for Danish Oil and Natural Gas, is no longer an accurate description of a company which invests in renewable energy. On November 6th, DONG Energy changed its name to Ørsted, after the Danish scientist Hans Christian Ørsted. In 1820 he discovered electromagnetism, which helped lay the foundation for the power production today.

Ørsted's largest offshore wind fleet is located in the UK, with projects in coastal communities such as the Humber, Barrow, Brightlingsea, Ramsgate and Liverpool. In September, the UK Government awarded Ørsted a contract to build the Hornsea Project Two wind farm, with a capacity of 1,386 MW. Once operational, Hornsea Project Two will be able to meet the electricity needs of over 1.3 million homes per year – delivering more low carbon energy to the UK whilst continuing Ørsted's further investment in the UK offshore wind pipeline.

Siemens Gamesa Renewable Energy Alexandra Dock, Hull

Siemens have invested £160m in the Green Port Hull facility, which forms part of a £310m combined investment from Siemens and ABP, resulting in the creation of around 1000 jobs in the UK. The 54 hectare site at Green Port Hull includes:

1. Project execution site at Alexandra Dock
2. Blade manufacturing facility at Alexandra Dock
3. Logistics and distribution centre to support service activity

After committing to the project in 2014, the factory was inaugurated by Secretary of State, Greg Clark, at the end of 2016 and is currently ramping up production towards the target of 450 blades per annum.

Recruitment of the new team has been a major success story. Siemens Gamesa received over 26,000 applications for the available posts, and 96% of the new recruits are from the Hull/Humber area. The benefits of having a purpose-built facility on the East Coast are a key factor in the significantly reduced costs which offshore projects are delivering.

GEV Wind Power Hessle, East Riding of Yorkshire

GEV Wind Power are a turbine maintenance company specialising in blade inspection and repair. In 2017, GEV have completed more than 60 individual projects across 4 continents. They were recently awarded a contract to complete a full range of rope access led maintenance services at Block Island, America's first offshore wind farm off the East coast of Rhode Island. At a peak in 2017, they had 116 technicians employed with 1 offshore campaign alone utilising more than 50 highly skilled rope access technicians. GEV have recently developed the new technology Ventura Habitat, which allows technicians to control the environment surrounding the blade and therefore enables complex repairs to be undertaken more easily.



Rix Shipping Port of Hull

Rix Shipping was founded in 1873 and started working in the offshore wind industry in 2012. The company employs more than 500 people, with 60 of these working in offshore wind. Rix Shipping specialise in providing managed services to the offshore wind industry, supplying strategic assets and services for all aspects of wind farm construction and maintenance, from sea and ground level up. They have won contracts for Beatrice Offshore Wind Farm, Dudgeon, Gwynt Y Mor, Humber Gateway, Race Bank, and Rampion amongst many others. Five out of six Rix Sea Shuttle crew transfer vessels will keep operating during the winter as they are contracted to work on offshore wind projects in the UK. The Rix Leopard and the Rix Lion are both contracted to the Dudgeon Offshore Wind Farm 32km off the Cromer coast. Rix Lynx is working on Beatrice, Rix Panther and Rix Tiger is working off the Sussex coast at the Rampion Wind Farm, and the Rix Cheetah has just completed works out of Grimsby.



Triton Knoll

Photo credit: MHI Vestas

View Point: from James Cotter, Project Director, Triton Knoll Offshore Wind Farm

“From the outset, Triton Knoll has worked collaboratively with its supply chain partners, to ensure that the business case we submitted to the CfD auction can and will be delivered, effectively from the point of having won a CfD.

“In recent years, the offshore wind sector has been consistently driving down costs, with the pace of cost-reduction not just continuing, but accelerating. For Triton Knoll to go a step further in this latest auction, we took a decision early on to bring our key contractors on board as an integral part of our team, and adopted a bottom-up, supplier-led approach. This meant we could identify the challenges and opportunities, then work together towards new, deliverable solutions. Our supply chain consists of many, very clever people, and we firmly believe the key to maximising value from our projects is in bringing those people together around a table at an early stage, and identifying innovative solutions.”

Background

Triton Knoll Wind Farm is a circa 860MW offshore wind farm project, currently preparing for construction 32km off the Lincolnshire coast, and is wholly-owned by Innogy SE. In September 2017, Triton Knoll was awarded a Contract for Difference. The project is now progressing towards a financial investment decision, planned in 2018 with full onshore construction starting shortly after, and offshore construction now likely to start in 2019. First energy generation could be as early as Q1 2021, with the project expecting to begin commissioning in 2021.

The offshore wind farm project expects to trigger a capital expenditure investment of around £2billion into much needed UK energy infrastructure, supporting up to 3000 UK jobs during construction, over 170 long term sustainable jobs during operations, enabling the delivery of some of the lowest cost energy generation for UK consumers.

Value by design

The offshore wind industry is delivering more value in terms of UK GVA and export opportunities than ever before, thanks to an increasingly mature knowledge-base and experience of the assets and their operations, the challenge of competition through the auction process, and the fast pace of innovation across the technology.

Triton Knoll will be one of the first offshore wind farms in the world to install and operate MHI Vestas’ V164-9.5 MW turbines, described as the largest and most efficient turbines currently on the world market. Setting the record for

energy production from a single turbine (216MWh in 24hrs), just 90 of these turbines will be capable of generating enough energy for the equivalent of over 800,000 UK homes.

Each turbine will sit on a single monopile foundation and transition piece, designed by UK firm Atkins. The designs are highly innovative, using advanced technology and engineering to reduce materials and production costs, and hence delivering promised value for consumers.

Onshore, Triton Knoll has taken full advantage of expertise, innovation and technology, in collaboration with its contractors, to achieve more megawatts down the wire; it has designed-out elements of the infrastructure thanks to advanced power flow modelling; and has minimised infrastructure at both our onshore and offshore substations.

Through collaboration, technology and expertise, the offshore industry, like Triton Knoll, is delivering more value every day.

A Snapshot of Triton Knoll statistics

The project will be located approximately 32km off the Lincolnshire coast and 50km off the coast of North Norfolk. It has consent to install almost 60 kilometres of onshore underground export cable, and a new substation near Bicker Fen.

Likely overall capital expenditure investment in much needed UK energy infrastructure – around £2billion

Likely overall UK content – at least 50% (full project lifecycle cost)

Potential jobs supported – up to 3000 UK Jobs during construction

No. of turbines – 90 MHI Vestas V164-9.5 MW

Installed generating capacity – circa 860MW

Homes equivalent – an expected minimum of 800,000

Size of turbines (height) – Approximate tip height of V164-9.5 MW turbine - 187 m (NB; consent granted for maximum installed blade tip height up to 220m)



Photo credit: Ørsted
(This image is not from
Hornsea Project One)

Ørsted – Hornsea Project One

DONG Energy's transformation and recent divestment of their oil and gas business has led to a change of name. DONG, originally short for Danish Oil and Natural Gas, is no longer an accurate description of a company which invests in renewable energy. On November 6th 2017, DONG Energy changed its name to Ørsted, after the Danish scientist Hans Christian Ørsted. In 1820 he discovered electromagnetism, which helped lay the foundation for the way power is produced today.

Hornsea Project One is Ørsted's largest offshore wind farm under construction and will be located 120km off the Yorkshire coast, spanning a huge area of approximately 407km². Once operational, it will become the largest offshore wind farm in the world and the first to exceed 1GW in capacity.

Hornsea Project One will have a capacity of 1.2GW, generated by 174 7MW wind turbines – each one taller than the Gherkin building in London. This means that it will be able to provide enough power for well over 1 million UK homes.

The project is scheduled to be operational in 2020 – with onshore construction having started in early 2016 and offshore construction due to begin in 2018.

Not only will Hornsea Project One provide low-cost, clean energy to the UK, it will also deliver high quality jobs and more value to the UK's offshore wind supply chain.

In July 2015, it was announced that the turbine blades would be manufactured by Siemens from their recently opened blade factory in Hull. In December 2015, a £25 million contract for construction of the onshore substation was also awarded to UK firm Balfour Beatty.

Hartlepool-based JDR cables will provide 242km of array cables, the largest contract in JDR's history, whilst J. Murphy & Sons Limited (Murphy), headquartered in London, will lay over 350,000m of onshore cable along a 38km route, connecting to the national grid at a new onshore substation being built by Balfour Beatty in North Killingholme.

In November 2016, Ørsted announced that DeepOcean, a Darlington based firm, will transport and install the array cables. This contract has safeguarded 150 jobs in Darlington and the surrounding area as well as enabling DeepOcean to offer significant opportunities to the UK supply chain.

In December 2016, Ørsted also announced a multimillion pound contract with Rochdale-based firm Granada

to provide all 174 davit cranes for the project. Later that month, Ørsted announced another multimillion pound investment in CS Wind's tower factory in Campbeltown, Scotland. The factory will supply offshore towers for Hornsea Project One.

In January 2017, a contract for 96 transition pieces was signed with Bladt Industries with an agreement that 56 of these will be manufactured in the Offshore Structures Britain (OSB) facility in Teesside. The remaining 20 transition pieces were awarded to Steelwind, with Teesside based Wilton Engineering providing a significant part of the scope including outfitting, coating and load-out. The award will create jobs and further opportunities throughout the local supply chain.

Ørsted is committed to investing in the UK and the Humber region. We have now invested over £6 billion in the UK through the development of our offshore wind projects.

Through the construction and delivery of Hornsea Project One, Ørsted will be facilitating the further development of a competitive and world-leading offshore wind supply chain in the UK, and continuing to work with businesses across the UK on our journey to a low-carbon future.



Our vision is for renewable energy to play a leading role in powering the UK.

RenewableUK is the country's leading renewable energy trade association, specialising in onshore wind, offshore wind, and wave & tidal energy. Formed in 1978, we have a large established corporate membership, ranging from small independent companies to large international corporations and manufacturers.

Our aim is to ensure increasing amounts of renewable electricity are generated sustainably by projects deployed across the UK, and to support our members win business in renewable markets in the UK and around the world. Our priority is to make sure that RenewableUK members are at the heart of delivering this opportunity. To do this we provide them with the highest possible quality services and information, supporting them in any way we can to do more business more effectively.

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