GE Renewable Energy

CASE STUDY

GE RENEWABLE ENERGY AND ORE CATAPULT

Collaboration delivering real impact

Bringing the most powerful offshore wind turbine in the world to market, enabling accelerated deployment of offshore wind to meet the UK's net zero ambition, record low energy prices, unlocking billions in investment, thousands of green jobs, research, product and service development.

In August 2017, GE Renewable Energy and ORE Catapult set out to test and achieve certification for GE's next-generation offshore wind turbine, the 12MW Haliade-X, and its 107m wind turbine blade, developed by GE-owned LM Wind Power, at the Catapult's unique test and validation facilities in Blyth, Northumberland. In March 2018, GE announced its ambitious plans to bring the disruptive technology to market in just over two years, which they achieved thanks to the pivotal role of ORE Catapult, enabling supply of the turbine to the world's largest wind farm, Dogger Bank. Developments like Dogger Bank provide the necessary foundation from which the UK will strive to achieve Net Zero, creating momentum for a strong UK supply chain, thousands of jobs and paving the way for large-scale, indigenous manufacturing.

> "By using ORE Catapult's facilities and expertise, we will be in a better position to adapt our technology in a shortened time, reduce unplanned maintenance, increase availability and power output, while introducing new features to meet customers' demands."
> John Lavelle, president & CEO of GE's Offshore Wind business

Operations and Activities: Innovation at the forefront of the green energy revolution

ORE Catapult's unique world-leading test facilities (no other facilities could cater for technology at this scale) provide an essential part of the type certification process, as well as accelerated life testing of components, in particular bearings, invaluable for potential investors to understand the risks of their long-term investment. These factors were key in attracting GE Renewable Energy to the UK. The collaboration between ORE Catapult and GE includes:

- A five-year agreement for GE to utilise ORE Catapult's 15MW drive train and long blade test facilities at Blyth for enhancing existing and developing future offshore wind turbine technology;

• A £6m combined investment in ORE Catapult's unique Grid Emulation system, allowing next generation turbines to demonstrate compliance with international electrical network codes and integrate offshore wind into future energy systems, putting the UK in pole position on the global stage on grid compliance technology development;

• A £9m R&D collaboration, 'Stay Ashore', focusing on priorities that drive technology and supply chain improvements in offshore wind;

• £500k investment over four years in UK academia, specifically the universities of Sheffield and Warwick, who form the ORE Catapult Powertrain Research Hub, focusing on maturing technologies from innovative concepts into viable products and services, while in parallel developing experts in renewable energy who will be well positioned for careers in the UK energy sector;

• Engaging the UK supply chain through a series of 'innovation challenges' aimed at providing access and direct benefit to UK SMEs in the development and commercialisation of innovative products and services for the offshore wind industry in conjunction with ORE Catapult.

Outputs and Outcomes: Delivering huge UK benefit

Image credit: Dogger Bank Wind Farm (doggerbank.com)

"Turbine innovation has played a huge role in bringing down the cost of offshore wind, and these world-leading turbines will help us deliver renewable electricity at the lowest cost possible for millions of people across the UK"
Halfdan Brustad, vice president for Dogger Bank at Equinor

In late 2019, GE signed an agreement with Equinor and SSE Renewables to supply all 277 units of the upgraded Haliade-X 14MW turbine to the 3.6GW Dogger Bank Wind Farm, 130 km off the north-east coast of England, set to power around 5% of the UK's electricity demand. ORE Catapult was on the critical path to the successful completion of this agreement, as financing for the project was dependent on successful accelerated completion of the testing programme.

The Dogger Bank partners state that using GE's Haliade-X, the most powerful turbines certified to date, enabled them to reach record-low CfD prices for the project in 2019 – the lowest ever seen for a UK offshore wind farm. The projects will trigger approximately £9bn of capital investment into low carbon infrastructure between 2020 and 2026, delivering substantial economic benefits to the UK including 200 long term roles in the North East to work directly on operating and maintaining the wind farm and 3000 further roles in the UK from contracts announced so far.

In November 2020, a major milestone was reached with type certification achieved for the 107m blade and the Haliade-X, following the successful testing programme. Without ORE Catapult's contribution the technology would not have been certified in such a short timescale nor investor confidence gained so quickly. Following the success of this collaboration, in March 2021 GE announced investment in a new blade factory in Teesside, creating over 2000 direct and indirect jobs in the region. And, as a direct consequence of the success of the market entry of Haliade-X, Equinor announced their O&M base will be in the North East, less than 30 mins from Blyth, creating 200 direct jobs.

The successful GE/ORE Catapult partnership is set to continue, with a new blade test underway at ORE Catapult, testing the design that will be manufactured at the Teesside factory, and GE and ORE Catapult working towards certification of the turbine at the full 14MW, potentially extending the partnership by two years to 2024.

The Haliade-X LM 107.0 P blade in ORE Catapult's test facility, Blyth

"Validating a blade and composite structure with the size and complexity of the Haliade-X LM 107.0 P is a technological milestone never seen or tried before! We will continue learning and push the boundaries of what is possible, because that is in our DNA"
Hanif Mashal, VP Engineering, LM Wind Power

GE has also been instrumental in co-funding and commissioning ORE Catapult's state-of-the-art Grid Emulation System, eGrid, enhancing the regional and national mechanical and electrical systems testing infrastructure. eGrid allows equipment manufacturers to accurately replicate real-world operational conditions in a laboratory environment to further enhance turbine performance and reliability and meet grid compliance, a significant investment in UK capability by the manufacturer. As well as accelerating the Haliade-X route to market, eGrid has provided "an unparalleled upgrade in regional and national testing facilities" (Centrifuge Consulting, ERDF Summative Assessment, Oct 2020). To September 2020, 37 UK SMEs have brought new products to market following use of eGrid.

The collaboration also presents a significant opportunity to anchor real knowledge and Intellectual Property in the UK. Seventeen projects, as part of the 'Stay Ashore' programme, academic sponsorship and the Powertrain Research Hub, are underway. The collaboration provides a direct route to market for UK suppliers and innovative solutions, with UK supply chain companies already selected to develop new products and services for the Haliade-X supply chain, including:

- Echobolt, which is developing a new technology that promises to reduce manual working at offshore wind farms, slashing one of the industry's biggest maintenance costs by 80 per cent. The company expects to grow by an additional 10-20 employees in readiness for commercial roll-out.
- A subsequent collaboration between Echobolt and UK innovator BladeBUG, which pairs the six-legged BladeBUG inspect-and-repair robot for turbine blades and EchoBolt's ultrasonic bolt inspection device, allowing the robot to crawl turbine structures and test bolt integrity using ultrasonics.
- Development of a novel remote blade maintenance technique from Tethys Energy Services and Aerones. The system will be able to deliver advanced remote inspection, maintenance and repair tasks on offshore wind turbine blades up to five times faster than conventional rope access, drastically reducing turbine downtime. It is also more scalable and much safer to deploy, removing the need for personnel to work at height. Tethys hopes to grow its UK-based employees to 40 by 2024.

Prime Minister Boris Johnson gets to grips with the scale of the challenge and the opportunity, Blyth, December 2020

Longer term impacts: Lower energy costs, jobs, supply chain growth and exports

This relationship between ORE Catapult and a global market leader in equipment manufacture such as GE Renewable Energy is a key catalyst to further inward investment opportunities and attracting more offshore wind manufacturing capability to the UK.

The significant supply contract won by GE led directly to the announcement of the investment in the Teesside factory and the creation of thousands of new, high-value, sustainable jobs. It will, in turn, prompt its competitors to consider further investment, both capital and human resource, in their UK factories. Indeed, in response to GE's disruptive move, Siemens Gamesa announced a 14MW machine, which is expected to come to market in 2024.

Without ORE Catapult's contribution through expert validation knowledge and unique facilities, it is unlikely that such a seismic shift in technology development would have happened in such a short timescale. With current wind turbine platforms set to continue to grow rapidly in the next 5 to 10 years, our test facilities need investment to meet this growth and maintain our world-leading position and relevance to large industry, attracting major OEMs to develop their technology in the UK and unlocking world-leading research and product development.

Further ORE Catapult programmes, such as the Joule project in collaboration with HVM Catapult looking at feasibility for UK development of a 20MW+ turbine, and the investment in advanced blade manufacturing capability at ORE Catapult in Blyth, will enable us to deliver transformational manufacturing innovation, ensuring the UK becomes the global centre of excellence for offshore wind, attracting industry investment in both research and manufacturing and anchoring IP and manufacturing opportunities in the UK.

The unique collaboration between GE and ORE Catapult is leading to greater renewables capacity, lower electricity prices, increased market competition and a significant boost to investor confidence, enabling us to reduce our carbon emissions and achieve our Net Zero target by 2050.