

# Impact Report

Business review 2015/16



We work with  
**Innovate UK**

**CATAPULT**  
Offshore Renewable Energy

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“Innovate UK is building a world-class network of Catapults to transform the UK’s capability for innovation and help drive economic growth. There are boundless opportunities for business and academics to engage with the Catapults. They help sectors translate innovative ideas from concept to commercialisation and develop connectivity between businesses, new technologies and funding.”

**Dr Ruth McKernan CBE**  
Chief Executive, Innovate UK

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# Foreword

**When the UK Government set up the first Catapult Centres in 2013, they set out a long-term strategy to deliver sustainable, economic growth in the UK through the development of strategically important sectors by accelerating innovation, collaboration and commercialisation, building and developing existing capability into world-leading industries.**

Since then, the programme has expanded, both with the growth of the original Centres and creation of several new Catapults in key industries with the potential to deliver enormous, long-term social and economic benefits.

In the intervening three years, the Offshore Renewable Energy Catapult has become recognised as the UK's flagship technology innovation and research centre for advancing wind, wave and tidal energy.

We are working closely with partners from across industry and academia, and using our world-leading test and demonstration

facilities to develop new ways of working and prove, de-risk and develop promising new technologies.

This is directly helping to reduce the cost of offshore renewable energy, supporting the growth of the industry and delivering significant economic benefit.

This impact report highlights some of our key activity in 2015/16, and sets out how we will continue to drive forward this vital sector to deliver affordable, secure, low carbon energy whilst creating thousands of jobs across the industry and supply chain and establishing capability that will deliver UK exports for decades to come.

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“The Offshore Renewable Energy Catapult has become recognised as the UK's flagship technology innovation and research centre for advancing offshore wind, wave and tidal energy.”

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**Colin Hood**  
Chairman, ORE Catapult

# Our Impact

in 2015/16

**50** Companies

whose product development we've supported through our testing and validation services

**151** SMEs

we have supported

**Global Reach**

**18** Countries

we have worked with to develop opportunities for the UK supply chain



**126**

projects with academia

**204**

industry collaborations

**£4.9m**

invested in procuring capital equipment, materials and engineering and consulting services from our supply chain

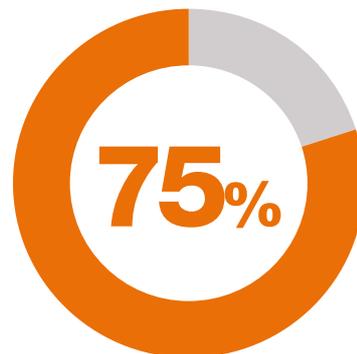
**23**

competitively won R&D projects

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# Operating £1/4bn

of world-leading test and demonstration facilities in support of UK innovation



Year-on-year uplift in competitive R&D revenue



## World Firsts

First benchmarking platform for offshore wind turbines

Operating largest indoor blade test facility

World's largest open access offshore wind turbine dedicated to research

First accelerated testing of 66KV cable

Return on Investment

# 1:3:21

For every £1 of core grant invested we have leveraged £3 of additional research funding driving £21 of activity

# £6.2m

invested in building team of leading engineering and research specialists

# £5.7m

invested in collaborative projects and programmes in 2015/16

# Executive Summary



**Andrew Jamieson**  
CEO, ORE Catapult

Across all our areas of operation, we have worked hard to make a tangible difference to this rapidly maturing industry. In this report, we look at how our people and programmes have helped scores of businesses, including 151 SMEs, in designing and developing novel concepts to resolve issues inherent with offshore renewables and improve performance.

With the largest concentration of open-access renewable energy testing facilities anywhere in the world, we have become the 'go to' organisation for testing and demonstration, a point highlighted by our work with Atlantis Resources Ltd to develop its next generation tidal turbine for deployment.

Importantly, having established six key 'Knowledge Areas' to focus our activity, we have helped the industry tackle key technology challenges and bring about the kind of rapid cost reduction that puts us on schedule to meet the UK Government's 2020 levelised cost of energy target.

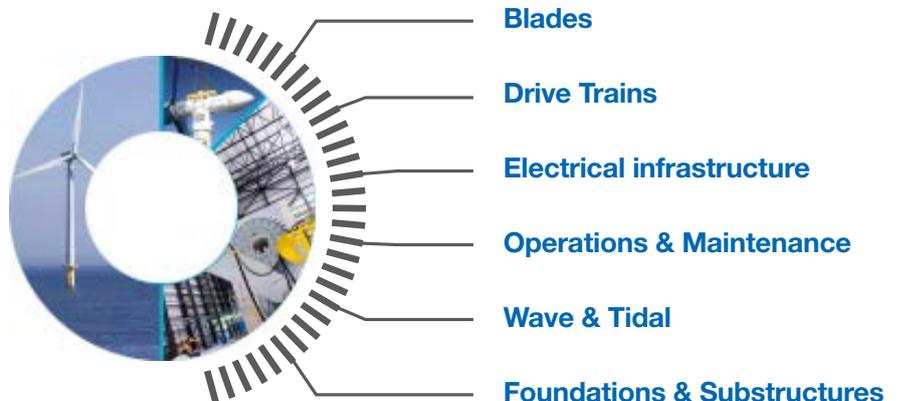
In the last year, we invested £5.7million on collaborative projects and programmes designed to accelerate the development of technology and solutions from concept to delivery. We spent almost double that again on improving our expertise and equipment to ensure we remain at the forefront of innovation, policy, design and testing.

In February, we acquired the 7MW Levenmouth Demonstration Turbine from Samsung Heavy Industries, in recognition of the unparalleled research and development opportunities it presents to industry and academia. This has already become a significant R&D asset, also giving us an opportunity to engage with the local community and inspire the engineers and policy makers of tomorrow.

Whether at national or international level, we will continue to focus on delivery, on people and, most importantly, innovation and we look forward to making an even greater impact in the years ahead.

“Whether at national or international level, we will continue to focus on delivery, on people and, most importantly, innovation.”

## Our Knowledge Areas



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The Offshore Renewable Energy Catapult is the UK's flagship technology innovation and research centre for offshore wind, wave and tidal energy.

We work closely with partners from across industry and academia, and use our world-leading test and demonstration facilities, to develop new ways of working and prove, de-risk and develop promising new technologies.

This helps to reduce the cost of offshore renewable energy, supporting business growth and delivering UK economic benefit.

To help position our testing capabilities, products, services, and supporting activities, we focus on six Knowledge Areas. These are areas on which we believe the industry must focus their technology innovation to drive down the cost of offshore renewable energy.

## Our People

We have continued to build world class teams of sector specialists, underpinning our deep technical expertise that enables us to tackle the most important challenges facing the offshore renewables sector.

We strengthened our Research team, headed by Ignacio Marti, with the arrival of a number of key recruits.

We have enhanced project delivery capability with the development of our Engineering and Programmes team, led by Chris Hill. With nine appointments over the year, the team includes an engineering function, headed by Peter MacDonald, and a projects function, headed by Andy Lewin. This team provides expertise across all major renewable engineering disciplines, combined with practical industrial experience across the offshore renewable energy sector.

Our Operations and Strategy teams, led by Tony Quinn and Stephen Wyatt, were also significantly enhanced with a number of key appointments, helping us remain on course to deliver on our ambitious targets.

## Collaboration

Our Industry Advisory Group is a valuable resource to help us identify critical areas where innovative approaches and technological development can accelerate industry to deliver at a lower risk and cost. It is made up of senior representation drawn from across the offshore renewables sector, including utilities, manufacturers, supply chain and marine organisations.

Similarly, our Research Advisory Group, made up of a range of UK Universities, acts as our primary vehicle to present industry's demands for innovation and provides a filter process to prioritise the best academic ideas for commercialisation.

## Health & Safety/ Standards

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We are delighted to have achieved internationally recognised standards in quality (ISO 9001:2008), environmental (ISO 14001:2004) and occupational health and safety management (OHSAS 18001).

These certifications of compliance recognise that the policies, practices, and procedures at ORE Catapult ensure best practice in the solutions and services it provides to all its stakeholders, both internally and externally.

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“Achieving all three certifications is testament to the hard work and dedication of our team. To be celebrating our accreditation within a year of our merger with NAREC shows the high level of commitment from all. Achieving these standards is very demanding, and attaining this certification speaks volumes of our commitment to continually improving our internal processes and procedures.”

**Chris Hill,**  
Innovation Engineering and Programmes Director

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# Highlights

## Acquisition of the 7MW Levenmouth Demonstration Turbine

Securing the world's most advanced, open access, offshore turbine and making it available for research was perhaps the most visible demonstration of our continued development, establishing us as the global leader in providing open-access physical assets for testing, validation and de-risking of technologies.

The turbine, developed by Samsung Heavy Industries, offers industry and academia an unrivalled opportunity to develop a deeper understanding of a wide range of technologies as well as the operations and maintenance aspects of offshore wind turbines, with the ultimate goal of reducing the cost of energy.

We are working closely with key academic and industry stakeholders to align the research programme of the Levenmouth Demonstration Turbine with industry priorities to drive cost reduction in offshore wind.

Already we are seeing the value as our technical experts familiarise themselves with the operational aspects of a state of the art multi-megawatt wind turbine, opening new channels for research and learning.

A significant benefit is our ability to replicate in-field conditions on the identical prototype nacelle in our large drive train test facility, thereby accelerating our understanding of potential failure modes.

In the short period we have owned the turbine it has stimulated significant interest from other research organisations and industry who are keen to collaborate on projects which involve access to the turbine. We have seen a step change in the level of engagement in areas such as turbine control, structural integrity, yield and wind resource.

### Skills development and having a local impact

Whilst our focus is on delivering maximum impact in the development of economic and environmental benefits from offshore renewables, ORE Catapult is also playing an active role both in the development of vital skills for the industry and in our local communities.

We have worked with schools, higher and further education institutions and Professional associations, encouraging students to pursue Science, Technology, Engineering and Mathematics (STEM) related careers and promoting the massive opportunity presented by offshore renewables.

The Levenmouth Development Turbine is giving us the opportunity to play a significant role in developing skills and education programmes. Working with the Energy Skills Partnership, we are directly influencing and contributing to the energy curriculum across Scotland's college network to ensure that it meets the demands of tomorrow's offshore renewables industries.

Using generation revenues from the turbine, we are sponsoring a STEM engagement officer at Levenmouth Academy to work with pupils to help them achieve their full potential in further and higher education and ultimate employment in STEM related areas.

### Other community engagement work

Our technical specialists worked with pupils from Northumberland Church of England Academy (NCEA) on a STEM school project called 'Catching the breeze', with the aim of selecting components for a wind turbine, based on site information, material data and costs. This promoted the application of relevant maths topics such as trigonometry, Pythagoras' theorem and quadratic equations, and encouraged pupils to consider analytical techniques and cost implications. In Fife, two of our engineers have mentored Benarty Primary School P7 pupils as they designed and built prototype wave energy capture devices as part of the Junior Saltire Prize.





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“The Levenmouth turbine is a real game changer for the UK academic community. Access to the Levenmouth Demonstration Turbine will make it possible to position the UK academic research community right at the heart of wind research, funding opportunities and technology development.”

**Professor William Leithead,**  
Chair of the EPSRC Supergen Wind Hub, and  
Director of the EPSRC Doctoral Training Centre for  
Wind and Marine Energy Systems

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# Highlights

## Testing & Validation



**Tony Quinn**  
Operations Director

ORE Catapult plays a key role in proving and de-risking innovative new technologies, to lower the cost of energy from offshore sources. Our multi-disciplinary team of experts and engineers use our unique portfolio of assets to conduct tests that reflect real life conditions.

We have the largest concentration of offshore renewable energy test facilities anywhere in the world and we continuously seek ways to upgrade our facilities and expand our portfolio. In 2015, several additions enhanced our asset base significantly, adding to our testing highlights throughout the year.

### Improved bearing life from greater reliability

During 2016 we successfully adapted our small Drive Train test facility to assess a large diameter, main shaft bearing for an offshore wind turbine. The challenging load cases required high frequency response from our test rig and made full use of the operating envelope of the machine.

We made a considerable investment in test set up, which allowed us to replicate in-situ conditions and observe damage in the test piece within weeks, rather than the years it might have taken to materialise in the field. Being able to apply load regimes, as seen in field conditions, allows OEMs, operators and investors confidence in the lifespan of the turbines and thus their return on investment through the project.

Our client was delighted with the results and the service we were able to provide.



### Atlantis AR1500

Atlantis Resources Limited first came to ORE Catapult's National Renewable Energy Centre in Blyth in 2012 to test its AR1000 1MW tidal current power device. The Catapult's 3MW drive train test facility provided a dry and controlled environment in which they were able to prove their innovative technology, reduce risk associated with the installation process and provide vital investor confidence.

Following the success of that initial test, ORE Catapult worked with Atlantis to secure €1.3million Eurostars funding to support the development and testing of the 1.5MW AR1500 turbine, due to be installed at MeyGen, the world's flagship tidal stream power project in the Pentland Firth off the Scottish coast, in late 2016.

The Catapult worked closely with Atlantis to design the rig required for the new device and to develop and deliver a six week test programme in summer 2016 that has significantly derisked the AR1500's deployment by proving its reliability and validating the performance of its power train system.

This pre-installation testing program is an important stage in the turbine quality assurance and acceptance procedures conducted by the project prior to deployment and electricity generation.

“We are delighted to be working with ORE Catapult again. The ability to check the performance characteristics of the turbine, validate the control system, and prove the AR1500's reliability prior to deployment is a critical element in the technology's development lifecycle and will provide the market and investors with value-added confidence.”

**Luke Murray,**  
Design Director at Atlantis Resources Ltd

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## Faster, more accurate tests with our ground-mounted actuation system for fatigue testing of long blades

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Continuing our proud record of in-house design and build of new test equipment, we successfully commissioned our ground-mounted actuation system for fatigue testing of long blades. The system was commissioned in October 2015 and UKAS accreditation is now underway.

This system is able to impart greater energy into the blade and hence reduce test durations. Our ability to develop and implement our own new test methodologies is a great advantage and brings significant added value to our clients.

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## Upgrading the power rating of the HV reactor within our electrical laboratory

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This upgrade allows us to carry out automated breakdown testing of 66kV cable systems, and paves the way for an industry shift from 33kV to 66kV for offshore inter-array electrical systems. Moving to 66kV will deliver a material improvement in lifecycle costs and therefore supports our strategic objective to reduce costs.

Exemplifying our commitment to develop compressed lifetime test methodologies, this upgrade exerts up to twenty times the operating stresses on the cable and means our electrical laboratory is now capable of performing Highly Accelerated Lifetime Testing (HALT).

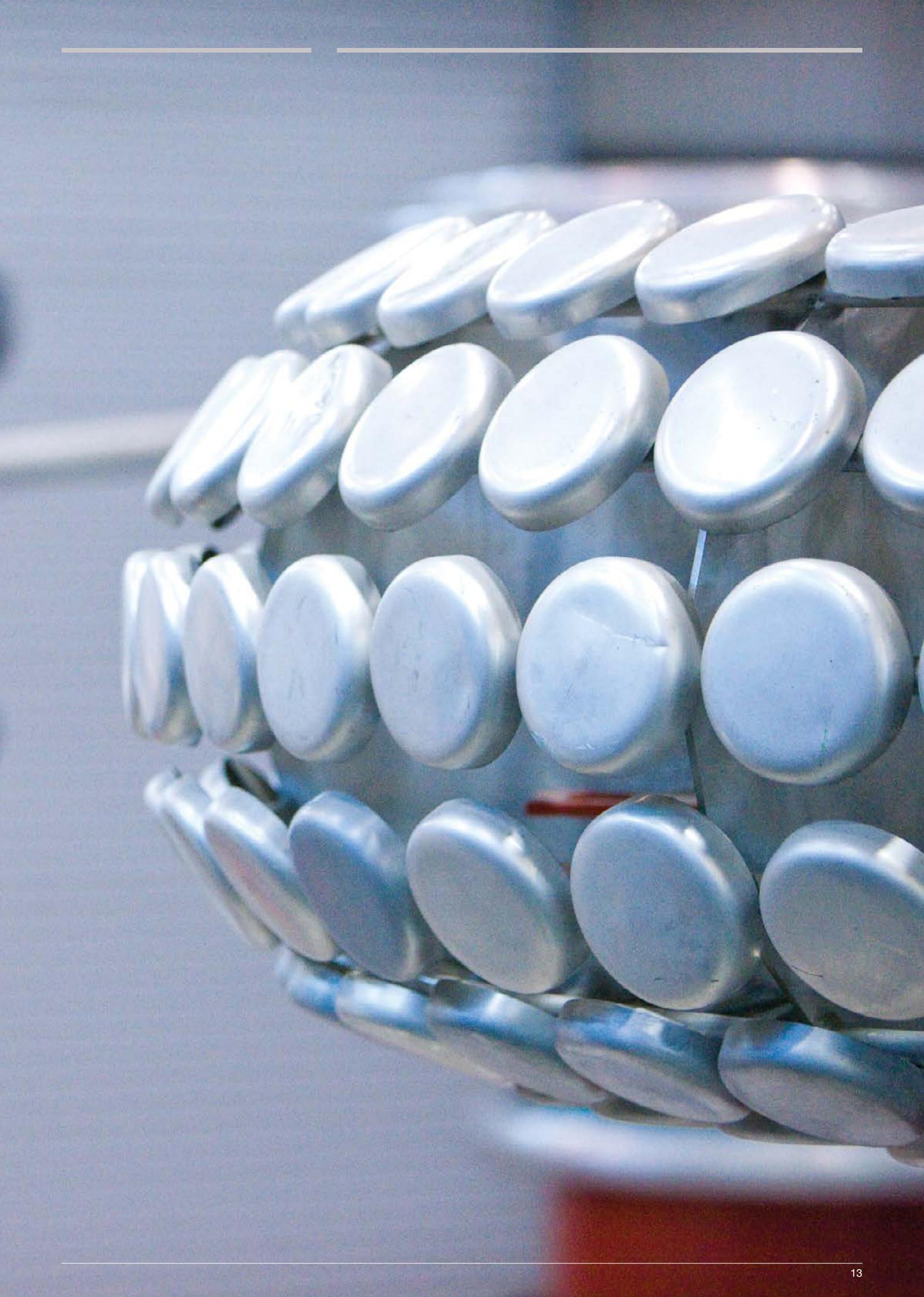
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“ORE Catapult has a strong track record in delivering key industry programmes focused on cost reduction and I look forward to continuing that work with them to ensure the successful deployment of offshore renewable energy.”

**Jonathan Cole,**  
Co-Chair of the Offshore Wind Programme Board

“ORE Catapult’s Academic Engagement Strategy ensures that its own research activities are directly linked to the UK’s leading university programmes, creating a unique framework for industry-driven research that leverages the Catapult’s assets and capabilities with outstanding academic research.”

**Professor Robin Wallace,**  
Head of Institute for Energy Systems, University of Edinburgh



# Highlights Research

ORE Catapult has regularly participated in large-scale collaborative R&D and innovative commercial and publicly funded projects, amassing vast technical knowledge; our laboratory and testing facilities have also been invaluable to their success.

Our multi-disciplined team of highly qualified engineers and technical specialists have in-depth experience of renewable energy technologies.

## Blade Innovation

Our innovative dual axis blade test methodology, in partnership with LM Wind, is nearing completion. Funding from the Demowind programme has augmented our own investments and we are generating significant industry interest in adopting our novel testing methods.



## IEA Wind Activity

The International Energy Agency (IEA) Wind is a global network of researchers and policy experts which plays an integral role in advancing wind energy development within its 24 member countries and organisations. R&D collaboration among IEA Wind member countries has played a major role in addressing the most difficult to solve wind technology challenges; and collaboration will continue to be important as future challenges are identified and addressed.

ORE Catapult has been involved in a significant volume of activity carried out within IEA Wind including contribution to five IEA Wind Research Tasks in key areas including reliability, LIDAR technologies, cost of energy calculation, innovative testing methodologies and wind energy systems engineering. Together with research organisations from 24 countries, ORE Catapult is developing best practice guides and developing new knowledge in key areas that contribute to the deployment of wind energy worldwide.

## IEA Appointment

Ignacio Marti Perez, Innovation & Research Director at ORE Catapult, was elected Chairman of the International Energy Agency's Technology Collaboration Programme.



“This is a critical time for the development of the global wind industry and I am determined that IEA Wind will continue to have a hugely significant role in driving forward its further development. Major international collaborative research and development programmes and activities are more essential than ever to advance wind energy’s vital contribution to global energy security.”

**Ignacio Marti,**  
Innovation & Research Director

## Dual Axis blade test service

Wind turbine blades need to be tested statically for extreme loads, and fatigue tested to prove that they will survive for the designed lifetime. Longer blades require tests that can last for many months, significantly increasing costs and time to market.

Dual Axis began as a co-funded PhD with Durham University, continued as a KTP project and then as core ORE Catapult research utilising its blade test facilities. Our research has developed software and a test methodology that enables blades to undergo flapwise and edgewise fatigue testing simultaneously, more realistically creating real-world operating conditions and significantly reducing the time and cost of such tests. This breakthrough could help to reduce overall blade test times by up to 25%.

The fatigue analysis software has received independent accredited certification.

The project has attracted considerable industry interest, including a major collaboration with leading international blade manufacturer LM Wind Power and its customer, wind turbine manufacturer Adwen. LM Wind Power has provided extensive data and a 40.3m blade for initial testing prior to an 88.4m blade for on-going development as part of a €13.2m European project.

The research is now being used in teaching and to develop further academic papers by Durham University, as well as providing a case study for how academic research leads to real industry impact.

## EERA JP Wind

ORE Catapult has supported the Joint Programme on Wind Energy of the European Energy Research Alliance (EERA JP Wind) by working together with the University of Strathclyde on UK research priorities in the European research agenda that the European Commission is using as a reference to allocate the funding related to Horizon 2020 activities.

## OPTIMUS

ORE Catapult has a strong track record of working with industry and academia on a variety of projects including Optimus. This EU-funded, collaborative FP7 project has 12 partners from six European countries, developing novel strategies to help monitor and predict the remaining operational life of key wind turbine components. We intend to build on this work and to increase our focus on the development of products and services that have a longer-term economic benefit.

## EDF

Our R&D partnership with EDF progressed significantly in 2015, with FS Found - a successful consultancy project on drive train testing protocols, and a Demowind project – the Offshore Wind European Research Area Network (ERA-NET), on gravity base foundations.

## LIFES50+

We are a key partner in the LIFES50+ programme, the leading EU research project on floating wind technology, involving proving cost effective technology for floating substructures for 10MW wind turbines at water depths greater than 50m.

Ultimately, the project will facilitate innovation and competition in the industry, reduce risks, and therefore contribute to a lower levelised cost of energy.

## TIDAL EC

We are the project coordinator of a €1.3million EU FP7 funded project involving seven consortium partners.

It aims to determine the optimum design of a tidal energy converter power take-off system and permanent magnet generator, developing an optimised system that will improve reliability, increase power conversion efficiency and facilitate reduction in the cost of tidal power.



# Highlights Programmes



**Chris Hill**  
Innovation Engineering &  
Programmes Director

“Understanding and quantifying the impact of leading edge erosion on turbine performance is essential in order to manage the operating business, planning and forecasting and managing the OEM to help them to plan blade inspection and repair activities. ORE Catapult has brought operators together to participate in the BLEEP JIP, enabling the sector to share knowledge and reduce costs. It is often difficult for operators to share knowledge and data but ORE Catapult’s independence has enabled it to facilitate this and win the trust of the participants.”

**Bailey Bradley,**  
Commercial Manager: Wind, Centrica

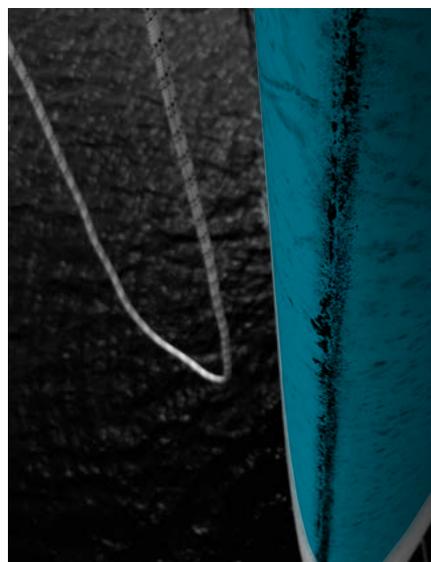
**ORE Catapult plays a key role in pulling together multiple players across industry, academia, the supply chain and other Catapults to participate in major Joint Industry Programmes (JIPs).**

These are initiatives that may leverage public and private sector funds for large-scale demonstrations, or wrap together a set of related projects into an attractive and highly fundable package that draws on the strengths of a diverse group of stakeholders.

## Blade Leading Edge Erosion Programme (BLEEP)

Blade leading edge erosion has been identified as a high priority concern by offshore wind operators and the supply chain, and industry-led research is required to develop solutions that reduce its impact on cost of energy. ORE Catapult, in collaboration with Centrica, successfully delivered the first in-field measurement campaign to quantify wind turbine performance loss due to erosion, and concluded that an uplift in annual energy production (AEP) of between 1.5 to 2% is possible following the repair of moderate blade erosion. This equates to millions of pounds of lost revenue.

The measurement campaign used LIDAR technology to accurately measure the power performance impact of blade leading edge erosion by assessing performance before and after blade repairs were carried out.



The results will allow owner/operators to optimise their repair and maintenance strategies, balancing cost versus benefit in order to minimise levelised cost of energy impact and maximise revenue.

The resultant method will now be used to carry out a further two measurement campaigns as part of the wider collaborative industry programme of works, to validate the results and the methodology used.

In response to a strong steer from our Industry Advisory Group (IAG), we launched the BLEEP Joint Industry Project (BLEEP JIP) to accelerate the development of solutions for this problem.

This was well received by a group of major Operators, OEMs and potential solution providers in the supply chain. The BLEEP project continues to evolve and is one of the key projects at the Catapult.

## Driving best practice in O&M

Operations and Maintenance (O&M) costs can account for up to 25% of the overall Levelised Cost of Energy (LCoE) for offshore wind farms. Reducing those costs is a huge driver for today’s Owner/Operators and so ORE Catapult is delivering a programme of offshore wind farm O&M case studies to share best practice, knowledge and experience of O&M topics.

The project, sponsored by the Offshore Wind Programme Board and The Crown Estate, provides a platform for operations and maintenance experts from across the UK offshore wind sector to share their knowledge on specific technical, commercial and operations challenges.

Eleven case studies have been documented in partnership with Owner/Operators and an experienced O&M professional consultant and all of the resulting case study reports are available on our website.

# Cost Reduction Monitoring Framework (CRMF)

“CRMF published in February 2015 provided evidence that LCOE for UK offshore wind had reduced by 11% from £136/MWh for projects reaching works completion in 2010 – 2011 to £121/MWh for projects taking FID in 2012 – 2014”

In 2015, the total installed capacity of offshore wind generation exceeded 5GW and the sector is now established as an important part of the UK's low carbon energy mix. The UK Government has stated that there will be funding available for a further three Contracts for Difference (CfD) auctions in the current parliament, provided that the sector continues to reduce costs. Tracking cost reduction and taking action to safeguard the pathway to the current target of £100/MWh has never been more important.

ORE Catapult, on behalf of the Offshore Wind Programme Board, delivers the annual Cost Reduction Monitoring Framework (CRMF) report. It provides the most substantive and comprehensive analysis of offshore wind cost reduction through a systematic method to assess progress against key milestones, and has become the widely accepted benchmark.

Now in its second year, it enables year-on-year comparisons across the sector and provides a firm basis for guiding more in depth analysis of innovation needs.

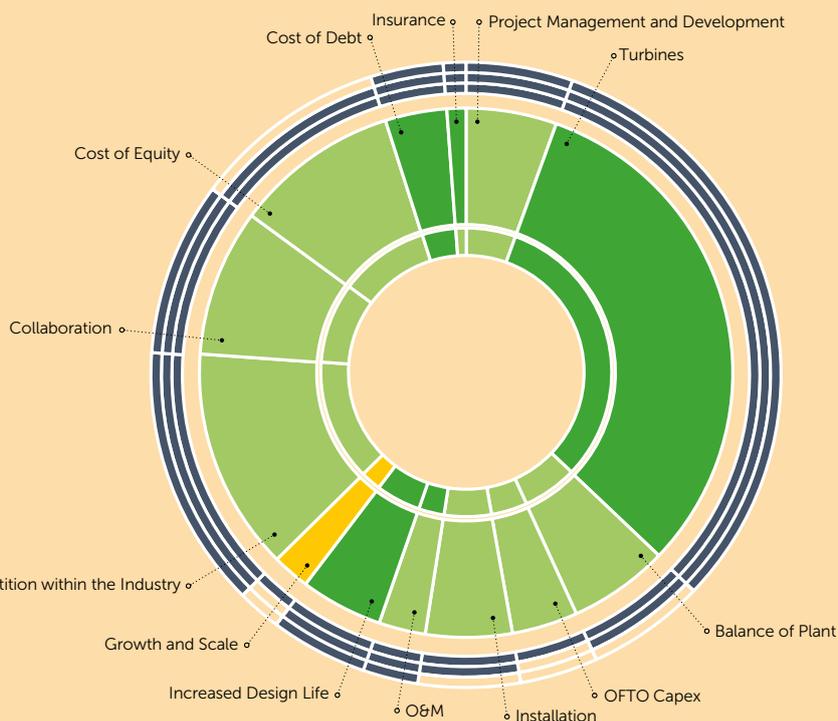
The second CRMF report shows that investment in turbine technology has delivered significant benefits, driving continued reduction in offshore wind costs in the UK. In fact, the industry is ahead of schedule in its efforts to hit the joint industry-government target of £100/MWh by 2020. However, ORE Catapult analysis shows that further reduction will need to come from innovations in ‘balance of plant’, such as foundations, cables and substations.

The report sets out a clear pathway to further cost reduction through technology innovation and collaboration to ensure that the UK continues to reap both economic and environmental benefits.

“We have continued to see excellent progress in reducing the cost of clean energy from offshore wind. The industry is fast-tracking adoption of new innovation in turbine design and in project operations, putting us ahead of the curve in efforts to bring down the cost of offshore wind. We are very confident that we can not only reach our £100/MWh milestone, but go beyond this to become fully cost competitive with other generation technologies.”

**Benj Sykes,**  
Industry co-Chair of the Offshore Wind Industry Council

The graph illustrates the high degree of confidence that cost reduction targets will be met with just one of 13 metrics behind schedule.



**Inner ring:** 2014 score  
**Main ring:** 2015 score  
**Outer ring:** Outlook 2020

**Inner and main ring**  
■ Ahead of target  
■ On target  
■ Behind target  
■ Missed target

**Outer ring**  
■ High confidence  
■ Medium confidence  
■ Low confidence

# Highlights

## Commercialising Technology

The rapid commercialisation of new technology solutions will keep the UK at the forefront of this ever more global sector.

ORE Catapult is working with highly innovative companies rising to the cost reduction opportunities our industry presents, helping them to shape, test and demonstrate their ideas and turn them into high impact, market-ready solutions.

ORE Catapult has developed a unique service offering that supports each critical stage of the technology commercialisation journey:



### ACT Blade Ltd



Transferring technology from one sector to another is one of the most effective forms of innovation. Challenging established ways of working can be difficult, but ideas from other sectors can bring about step changes in efficiency. Catapults can play a key role in this process – understanding the challenges and having inside knowledge of how the sector works.

We were quick to see the potential when an SME from the sail design industry – SMAR-Azure – responded to one of our Innovation Challenges.

Their advanced modelling techniques relating to active aerodynamic control, and the use of textiles to significantly reduce blade weight, are both exciting areas of potential cross-over.

ORE Catapult guided SMAR-Azure through a successful application process for Energy Catalyst funding. From there, we delivered a feasibility study which provided strong evidence to recommend the launch of ACT Blade Ltd, to further pursue opportunities in this sector.

### JDR Cables



Hartlepool-based JDR Cables is a global pioneer in the development of inter-array cabling for the offshore energy industry with a solid track record for delivering high quality and reliable cable systems.

With the capacity of wind farms growing as developments move further offshore, the reliability of cabling systems is becoming a more critical factor as the industry strives to de-risk and reduce capital investment, operating and maintenance costs.

JDR was seeking a long-term partner to not only formulate and deliver testing programmes to develop and certify new cabling systems but also understand opportunities for design improvements. The services provided through ORE Catapult's UKAS-accredited laboratories and specialist expertise are supporting JDR through its product development.

For more than four years, the JDR/ORE Catapult partnership has resulted in testing programmes that have supported product development and ultimately increased customers' confidence in the reliability and quality of cabling systems deployed, and led to JDR co-investing to upgrade ORE Catapult's facilities to meet evolving requirements.

The partnership has contributed to an increase in the shared insight and expertise that both parties have developed during this time, accelerating product development and overcoming design challenges.

## Innovation Challenges

One proven route to engage SMEs, and academics, is through Innovation Challenges.

Our Innovation Challenges aim to accelerate the path to commercialisation of well-focussed technology innovations and are structured to encourage the transfer of solutions from other sectors, in combination with experience and data from within the sector.

Our Innovation Challenges are hosted on our website, which is regularly updated with clear descriptions of the context and detail surrounding key issues, in sufficient detail to enable solutions to be developed, but without being prescriptive as to the form of any solution. As SMEs or academics respond, we then provide further advice, access to test assets and engineering skills, and options for further development.

### Wideblue Ltd

As longer blades are developed and deployed offshore, there is an increasing need to remotely monitor the structural response in all operating conditions. ORE Catapult is working with Wideblue Ltd (formerly Polaroid's European Design Centre), a Glasgow based optical product design SME, to help diversify their imaging technology into the offshore wind sector. Following a successful application to the Innovate UK Energy Catalyst public funding competition, ORE Catapult is providing engineering skills and access to both Blyth blade test facilities and its 7MW R&D turbine at Levenmouth to develop an innovative solution for measuring blade deflection during operation. Cameras and reflective targets placed inside the wind turbine blades measure changes to their shape in real time in normal and extreme operating conditions. The project will develop the camera system, the exposure method, the environmental protection of the equipment and analysis of the data, and will be completed in 12 months, enabling a very rapid product development cycle.

## Regional Engagement

We made good progress with our regional engagement strategy, working in collaboration with regional organisations involved in innovation and economic development in offshore renewable energy. We want to establish new strategic partnerships, investing resources to build project relationships with key OEMs, develop local supply chains and support SME-led innovation and to drive regional delivery.

We have Regional Coordinators based in the South West and Wales – (two strategically important areas), who are engaging with regional clusters and SMEs to accelerate the identification, development and commercialisation of innovative technology in offshore renewable energy.

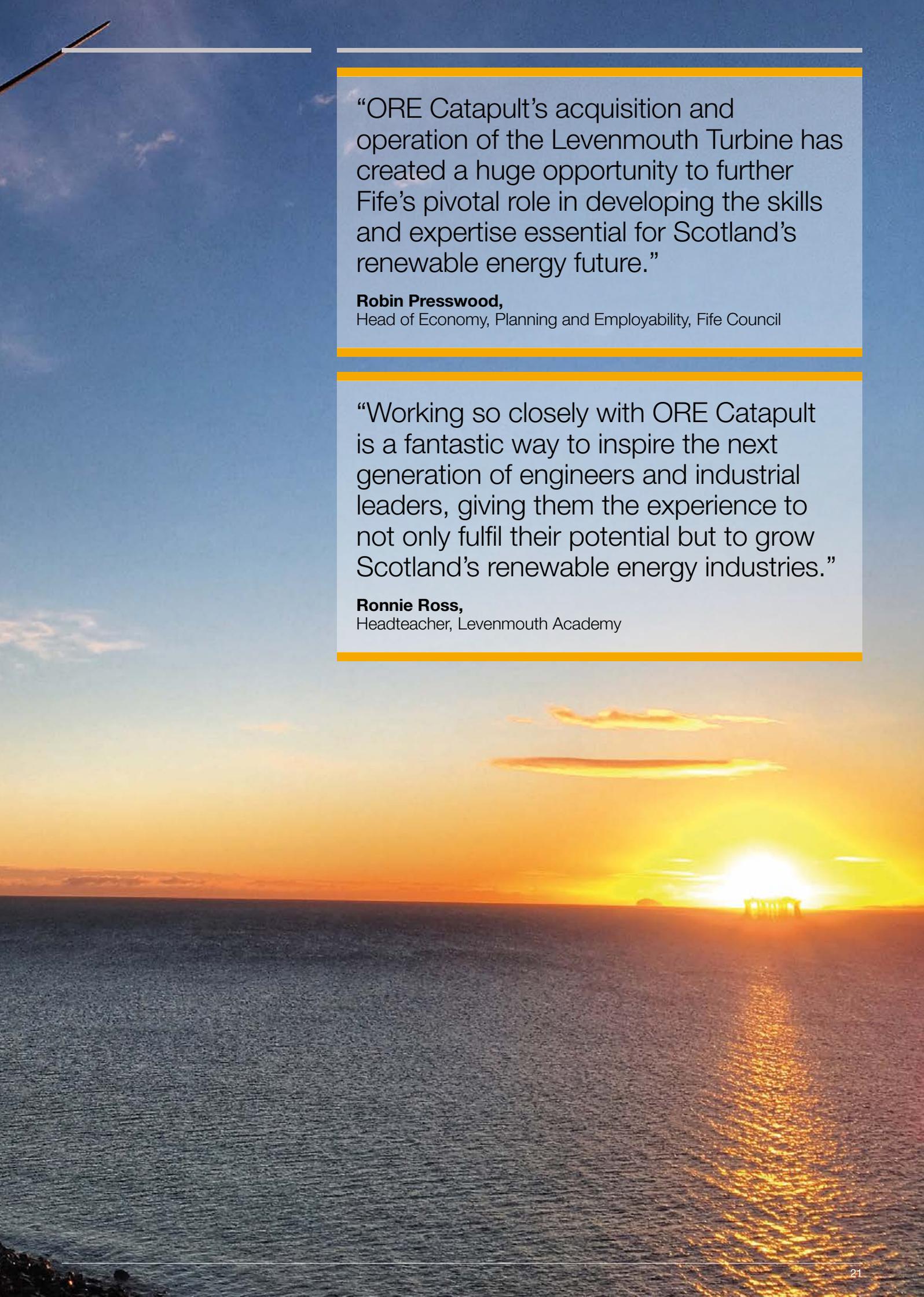
This regional engagement strategy builds on direct discussions with Local Enterprise Partnerships, Economic Development bodies and Devolved Administrations across the UK over a number of months, and has been designed based on input from the regions. The objective is to help build national capability by focusing ORE Catapult advice and guidance on developing local marine renewables based strategies to establish, integrate and grow local capabilities.



**Dr Stephen Wyatt**  
Strategy & Commercialisation Director







“ORE Catapult’s acquisition and operation of the Levenmouth Turbine has created a huge opportunity to further Fife’s pivotal role in developing the skills and expertise essential for Scotland’s renewable energy future.”

**Robin Presswood,**

Head of Economy, Planning and Employability, Fife Council

“Working so closely with ORE Catapult is a fantastic way to inspire the next generation of engineers and industrial leaders, giving them the experience to not only fulfil their potential but to grow Scotland’s renewable energy industries.”

**Ronnie Ross,**

Headteacher, Levenmouth Academy

## Advisory Services

The need for market visibility beyond 2020 and the requirement for actions to ensure collaboration in the more competitive market created by Contracts for Difference (CfD) are vital. CRMF identified balance of plant (electrical infrastructure and substructures) as an area that should be the focus of further innovation programmes.

Throughout 2015 we continued to run industry forums on such key challenges as O&M, turbine reliability, electrical systems and drive train innovation.

## Technology Assessment Process

Our Wave & Tidal team launched its Technology Assessment Process (TAP) for new and developing wave and tidal energy technologies that allows developers to benchmark their technologies and map out and follow a more structured technology development journey. This will result in a less expensive, faster and more certain development pathway.

Working with delivery partner the European Marine Energy Centre (EMEC) in Orkney, ORE Catapult will guide technology developers through a more structured approach to developing their technologies, from concept development, through to laboratory and analytical testing, prototype proving at a nursery test site, single device deployment and preparations for first arrays.

TAP will allow developers to improve understanding and validate the competitive prospects for their innovations.

## Meygen

By the early 2020s MeyGen Limited intends to deploy up to 398MW of offshore tidal stream turbines to supply clean and renewable electricity to the UK National Grid. Phase 1 will consist of a maximum of 86 turbines (86MW). Phase 2, comprising the build out of the remainder of the project, will be subject to a separate consent application. Understanding that the project needs to prove concept, MeyGen will deploy a demonstration array of up to six turbines in the Inner Sound as a precursor to the subsequent development of the remaining lease area. ORE Catapult is supporting the first phase of this project through the provision of engineering staff into the Meygen project team to help develop and de-risk the technology and assist with interface management.



ORE Catapult has already established itself as a thought leader on a number of key issues. Cost reduction is the number one priority and industry, investors and government all require clarity around the potential for future cost reductions and the ultimate costs of electricity generated. Through our work with the Industry Programme Board, and the CRMF, we have brought qualitative analysis to this critical issue.

## Wave Energy Technology Landscaping

Wave Energy Scotland (WES), launched in March 2015, is a new research and development body funded by the Scottish Government. It launched with an international technology competition, focused on innovative power take-off (PTO) systems.

This is the first of five competitions to be run over the next year, with support from ORE Catapult, the Carbon Trust and the University of Edinburgh. The objective is to put wave energy technology developed in Scotland on the path towards a reliable, commercial product that generates electricity at no more than £150/MWh.

## Thought leadership

Over the last year, ORE Catapult has taken a lead in the emerging floating offshore wind sector. Realising the rate of acceleration in this potentially revolutionary technology, we have convened industry to inform government, delivered world-class research, and identified some of the priorities for cost reduction and accelerated deployment.

Our asset-based services are key enablers supporting manufacturers' large, in-house R&D and product development programmes. As such, they underpin major, additional innovation expenditures throughout the supply chain. Here is a snapshot of our activity in this area:

### Technology assessment and prioritisation

We commissioned a comprehensive study of the floating wind marketplace to understand the scale of the industry globally, the route to commercial adoption, and where innovation is required across the supply chain. More than 100 device types were identified, broadly encompassing the three variants of Tension Leg Platform (TLP), Semi-Submersible, and Spar Buoy.

### TLP Wind

This was a collaborative project between ORE Catapult, the University of Strathclyde and Iberdrola Engineering & Construction and it focused on developing 5MW TLPWIND® floating technology for offshore wind turbines tailored for UK waters.

TLPWIND® technology was successfully proven, able to adapt to variable site conditions and demonstrating exceptional dynamic behaviour with very low displacements and almost no rotations. Its lightweight and simple geometry lends itself to standardised manufacturing processes and extremely competitive LCoE levels.

### WIN WIN

We are participating in the DNV GL-led WIN WIN joint industry project that marries floating wind turbines with water injection technology for ageing offshore fields. Initial DNV GL studies showed that a standalone wind-powered water-injection system could become cost competitive for various types of applications, particularly for water injection far from the production platform, and when costly retrofitting is not an option.

### Technology strategies for offshore wind to 2025

In 2012 industry and government adopted a target to reduce the cost of electricity generated by offshore wind farms to £100/MWh, for projects making final investment decisions in 2020. This common goal unlocked government incentives and provided industry with the confidence to invest over £10 billion in the UK sector. ORE Catapult, in partnership with the Crown Estate, identified the need for a credible plan for the next decade, and undertook an analysis of the currently available evidence on the cost reduction pathway to 2025. Reporting via the leading industry body - the Offshore Wind Programme Board - ORE Catapult and the Crown Estate advised industry and government on the key areas where efforts will need to be concentrated if industry is to reach new cost goals set by the government. While the detailed results remain confidential, we have clearly laid out what needs to be done, and are preparing to examine how to achieve the goal for 2025. Through deeper engagement with industry, our follow-up work will examine the technical and economic potential for key areas of innovation to reduce costs further.

# Driving Collaboration

We have built strategic relationships with organisations such as EMEC in Orkney, Wave Hub in Cornwall, The Crown Estate and the Carbon Trust, working together to bring new offshore renewable energy technology to commercial reality.

Throughout the year, we continued to develop new strategic partnerships, including:

## Green Investment Bank

We signed a three year agreement with the UK's Green Investment Bank to work together to drive investment into offshore renewable energy through greater understanding and management of the associated risks, reducing the cost of energy from offshore renewables.

Each organisation will also benefit from direct access to the technical expertise of the other, avoiding the costs of developing non-core internal capability.

“This collaboration is a very positive step for our offshore wind industry – helping to increase business productivity, encourage green innovation and stimulate long-term growth.”

**Anna Soubry,**  
Business Minister

## Statoil MoU - Battery storage for offshore wind

We signed a Memorandum of Understanding (MoU) with Statoil, the Scottish Government and Scottish Enterprise in relation to Statoil's Batwind project - a new battery storage solution for offshore wind energy that will be piloted in the world's first floating wind farm, the Hywind pilot park off the coast of Peterhead in Aberdeenshire, Scotland.

A structured programme is being established under the MoU to support and fund innovation in the battery storage area between Statoil and Scottish industry and academia. This programme will be managed by ORE Catapult and Scottish Enterprise.

“This agreement represents a unique opportunity for government, researchers and industry to work together to develop new energy solutions for the global market.”

**Stephen Bull,**  
Senior Vice President for offshore wind, Statoil

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## EDF ER - Blyth Offshore Demonstrator site

ORE Catapult and EDF Energy Renewables signed a collaborative agreement, committing £200,000 to take forward research, development and demonstration projects at the Blyth Offshore Demonstrator site, following its acquisition of the site in 2014.

The site, the largest consented offshore wind testing facility in the UK, can accommodate up to 15 turbines and provides a testing area to install and trial new technology in realistic conditions before commercial operation. Our research and development activity is focusing on five key areas:

- Wind assessment
- Foundations
- Condition monitoring
- Deployment/installation/maintenance
- Innovative turbine control

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“Working together with EDF ER will enable us to focus on accelerating innovative technology and then demonstrating that technology in a practical, real-world environment. We can then share that knowledge, ultimately benefitting the whole offshore renewables industry and helping to drive down the cost of energy from offshore wind.”

**Ignacio Martí Pérez,**  
Innovation & Research Director

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## Tecnalia Collaboration

We have signed a collaboration agreement with Tecnalia, one of Europe's leading research centres, to work together to tackle some of the sector's key technology challenges. We will collaborate on EU frameworks and share testing and demonstration experience in offshore wind energy technologies, with a view to improving existing testing capabilities and facilitating access to each other's testing infrastructure.

Representatives from both organisations will sit on each other's respective advisory groups, helping to identify and prioritise critical areas where innovative approaches and technological development can accelerate cost reduction in the delivery of offshore renewable energy.

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“I was delighted to visit Tecnalia with ORE Catapult last year and I am even more delighted that this agreement has emerged from it. We are always pleased to support UK and Spain R&D collaborations, and we consider it one of our priorities in the Embassy. We hope this will be the first of a long list of successes between these two world leading technology centres.”

**Simon Manley,**  
United Kingdom ambassador in Spain

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## System Performance Availability and Reliability Trend Analysis (SPARTA)

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SPARTA is a collaborative UK offshore wind performance data platform, aimed at improving wind turbine operational performance by increasing reliability and availability. The project has delivered a database for sharing anonymised offshore wind performance and maintenance data, to provide Owner/Operator participants with robust and reliable benchmarked data.

SPARTA grew from strength to strength in 2015. One hundred percent of Owner/Operators with offshore wind farms in UK waters now provide data to the system, and the wind farm population already accounts for 63% of all installed capacity in territorial waters. All Owner/Operators are committed to providing data for their entire fleet and the focus is now on improving data quality, with priority on production based availability and reliability metrics.

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# Forward Look



## Testing

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Our testing activity is well established, and our task now is to improve how we marry research with commercial tests.

We made significant progress in commissioning our 15MW Drive Train test facility, which remains on target to be operational in late 2016. This is a vital project for us and marks a significant milestone in the development of the test facilities at Blyth. Once commissioned it will be one of the largest, if not the largest, of its type in the world, capable of performing independent performance, validation, functionality, endurance and accelerated lifetime testing of components, sub-assemblies, sub-systems and full systems.

Our testing facilities will continue to evolve with the following improvements in 2016:

- A system to provide accurate, three-dimensional measurement during static and dynamic testing of long blades. This will improve our blade test offering and provide enhanced data collection to support research into advanced fatigue testing techniques.
- An upgrade to the frequency response of the Non-Torque Load (NTL) machine within our 3MW Drive Train testing facility. This will allow us to conduct more onerous testing regimes. Its increased capacity will support a reduction in the overall duration of future test programmes and has the potential to make testing more economical.



## Research

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To maximise the impact of our research we will focus on three main topics: **Blades, Drive Trains and Electrical**, reflecting our expertise and main testing assets.

These areas have dedicated research leaders, and will form the basis for academic engagement through a small number of strategic partnerships with leading universities.

The backbone of our activities will be the development of products and services that solve industry needs. An Academic Engagement Plan supports our deep research capability and aims to leverage funding from academia and industry.

The acquisition of the Levenmouth 7MW turbine establishes us as the global leader in providing open-access physical assets for testing, validation and de-risking of technologies. It also places us in a unique position to understand turbine operation and develop research projects in a real, operational context.

The Innovation and Research team is also focused on deepening our partnerships with organisations such as Tecnalia and the wider ERA-NET network of European research institutions.



## Programmes

**With more than 5GW of installed capacity in UK waters today, and a further 5GW to be delivered for 2020, the UK's offshore wind asset management sector leads the world.**

There remain considerable challenges and opportunities if the UK is to maintain this leading position, in reducing costs and in increasing UK expertise.

Supporting initiatives to enhance benchmarking services, to investigate and provide solutions to asset integrity issues are all priorities for us.

Our work in industry-facing collaborative projects will continue to build around operational issues in areas such as O&M, electrical infrastructure and foundations. This allows us to gain immediate traction with our industry stakeholders.

We will continue to provide innovative monitoring and inspection solutions, working with SMEs, and promote knowledge transfer through our O&M Forum, and the Offshore Wind Programme Board's O&M Group.

We will also support the industry by continuing to improve on our strong health and safety performance by 2015/16.



## Working with SMEs

**Our SME and technology commercialisation activity continues to grow and have an impact with over 151 SMEs assisted in 2015/16.**

In the coming year we will build on the solid foundation we have created through working with the SMEs who respond to our Innovation Challenges, seeking help to secure investment or technical services. We will explore the potential to partner commercially with a small number of SMEs where it makes sense for both parties, perhaps opting to invest our own funding or time and resources in return for future commercial return.

We also plan to launch our research accelerator activity, which will see us engage proactively with leading universities who have the potential to develop products and services which we can jointly take to the offshore renewables market, often translating their existing IP into previously unknown applications.

Looking internally, we will continue to draw our research and commercial teams closer together resulting in more of our own research producing tangible commercial outputs and products and services for the market. Finally, we are looking forward to our new partnership with the ETP, who represent the leading universities in Scotland; leveraging their voucher scheme we can help see more emerging companies de-risk their technologies faster through access to the best possible expertise.



## Thought leadership

**Over the past year, the offshore wind industry has made significant progress on cost reduction.**

While the cost of energy continues to be the number one priority for our sector, in the coming year we will increasingly turn our attention to the opportunities which offshore wind in particular presents to drive economic growth.

In offshore wind, we are providing DECC and Innovate UK with a comprehensive view of the major innovation challenges in the next five years and expect to play a hands on coordination role across the innovation landscape to coordinate how these challenges are tackled. Through our growing presence across England, Scotland and Wales, we will link industry to regional and national government and coordinate the creation of a stable framework of support for supply chains and technology developers.

For wave and tidal energy, it is essential to develop and demonstrate technologies with strong prospects of being cost-competitive. While still early in the technology development journey, we see opportunities for cross sector learning and development which will allow technologies to progress in the most efficient way.

# CATAPULT

Offshore Renewable Energy

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