

THIS IS ENERGY & ENVIRONMENT

Renewable Energy



RENEWABLE



Cymru
Wales



T H I S I S R E N E W A B L E E N E R G Y

We have a clear ambition in Wales, to create a sustainable, low carbon future.

Wales is situated on the western edge of the United Kingdom, and has a population of 3 million with direct access to over 60 million people within the rest of the UK. Crucially, we have access to a supportive devolved government, which has the ability to make things happen quickly.

Wales is committed on achieving a transition to a low carbon economy that allows us to live sustainably and focus on delivering results both economically and socially. This has driven our focus to embed a wide range of technologies into the mainstream including on and

off-shore wind, small and large scale hydro projects plus explore the opportunities available from our marine resource.

Access to our major renewable energy locations is swift which enables hassle free travel by our project partners to do business with our supply chain and academics. This also means that anyone connecting to the grid has easy access to consumers on their doorstep.

Therefore, for local businesses and inward investors, this drive towards a cleaner environment and sustainable economy creates significant economic opportunities. Wales is a place to develop commercially viable solutions and present them to a global audience.

M A R I N E E N E R G Y

Wales has the potential to generate around 10 GW from marine energy when the Severn Estuary resource is included.

Rapid innovation is taking place in areas of marine energy initiatives and low-carbon projects with a growing number of projects underway in Wales. Take a look at some of the work that's happening here...

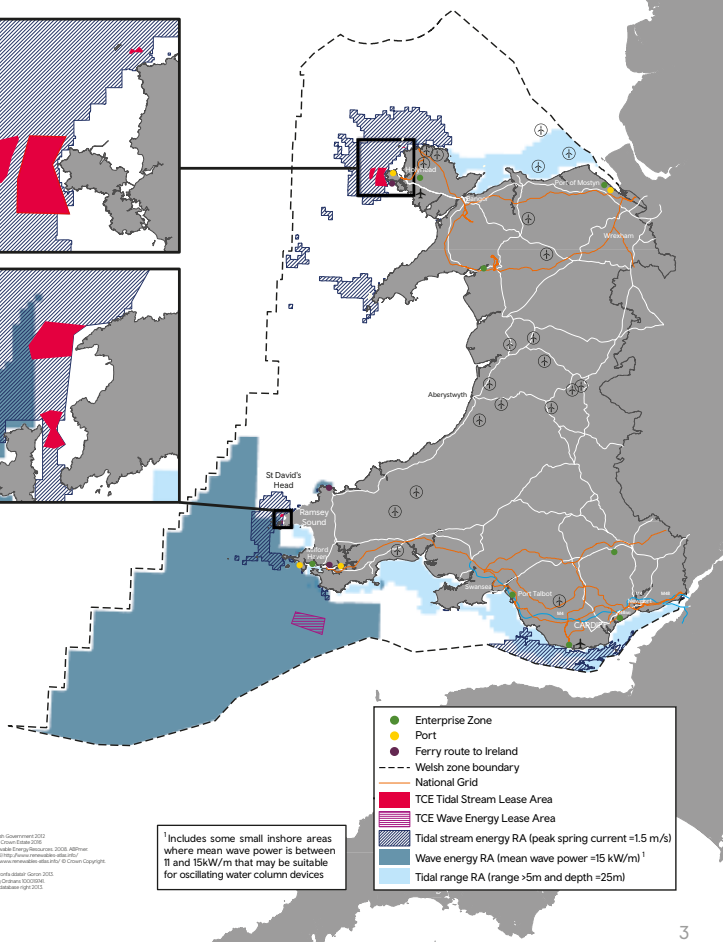
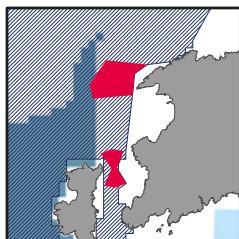
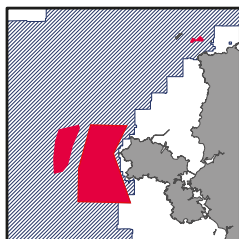
Concept to Deployment

Wales is working in tandem with our developers to assist them from initial device concept to deployment. The ability to directly assist through the development stages to physical deployment has benefitted companies such as Marine Power Systems (a wave device developer) who are receiving continuing support through the project lifecycle.

The Deep Green project off the coast of Anglesey is a revolutionary underwater power plant being developed by Swedish company Minesto. The company has received planning permission and a licence from the Crown Estate and is working to deploy an initial 1.5 MW Deep Green Array in 2017, which they aim to increase to 100 MW over time.

"We are reaching some exciting milestones in the development of our technology, specifically the deployment of a quarter-scale prototype WaveSub in 2016. We are thrilled to be liaising with Astute 2020 for advanced computational modelling of the float."

*Gareth Stockman,
Managing Director,
Marine Power Systems*



Source: BSI
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 Atlas of UK Marine Renewable Energy Resources, 2008, ABPmer
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¹Includes some small inshore areas where mean wave power is between 11 and 15kW/m that may be suitable for oscillating water column devices

- Enterprise Zone
- Port
- Ferry route to Ireland
- Welsh zone boundary
- National Grid
- TCE Tidal Stream Lease Area
- TCE Wave Energy Lease Area
- Tidal stream energy RA (peak spring current =1.5 m/s)
- Wave energy RA (mean wave power =15 kW/m)¹
- Tidal range RA (range >5m and depth =25m)

T I D A L

Tidal range could provide significant generation opportunities along the Welsh coastline.

Tidal Lagoon Power has received planning permission for its proposed £1.3 billion Swansea Bay development; and, if fully developed will have a capacity of 320 MW which could generate over 530 GWh of marine energy. They have also submitted planning applications for an additional two projects in south Wales, at Newport and Cardiff.

Demonstration Zones

Wales has two marine areas known as demonstration zones which have been awarded by the Crown Estate to facilitate the growth of the sector.

Morlais Energy is managing the development of the west Anglesey tidal stream zone and is working towards providing a fully resourced tidal demonstration zone.

Morlais Energy has completed a selection process and has made offers to several technology developers which are progressing through the legal process.

The south Pembrokeshire wave demonstration zone is 13 km off the coast and managed by Wave Hub. The area of seabed covers 90 km² and has a 19 kW/h resource. Project partners include Marine Energy Pembrokeshire who is the local delivery arm of Marine Energy Wales plus Pembroke Port and MarineSpace Ltd.

“The work on consent has started and the aim is to seek approval on the deployment on a wide range of technologies. Negotiations are underway and several options are being explored in order to export up to 150 MW from the tidal demonstration zone.”

*Geraltt Llewellyn,
Managing Director, Morlais Energy*



S O L A R

We have a mature solar energy sector here, with expertise in solar photovoltaic (PV) energy.

Dulas design, manufacture and install a range of solar PV systems including solar medical refrigeration. The pioneering business has played a key role in preventing illness and enhancing lives in the remotest parts of the world, including Africa, through its solar powered fridges, which allow vital vaccines to be preserved in areas beyond the reach of national grids. The World Health Organisation and UN are among the high-profile organisations working alongside the team from Mid Wales, who are setting new standards in one of the world's fastest growing sectors.

BIPVco based in north Wales, designs and manufactures solar integrated roofs using super thin photovoltaic sheets integrated directly onto

pre-coated metal and membrane components to create a combined PV roof system that can be installed in the same way as a conventional roofing system.

Sure Chill.

A business idea combining global ambition and revolutionary innovation is going to raise eyebrows. Add to that the potential for providing life-saving refrigeration in remote parts of the world without electricity and it's easy to understand the appeal of Sure Chill.

Ian Tansley was a product designer with great experience in emerging technologies and sustainable development. His Eureka moment came in 2008, while out walking in the Snowdonia National Park. He passed a frozen lake and reflected on the physics that allowed fish to continue swimming happily beneath the surface.



'We're changing the way the world keep things cool'. If the catchline is intriguing, the technology and ambition of the Cardiff-based company illustrates the fresh thinking needed to provide sustainable solutions for the future.

Sure Chill's Chief Technical Officer went on to conceive a breakthrough refrigeration system that can operate without power for weeks. In 2014, the company received a \$1.5 million award from the Bill & Melinda Gates Foundation to support the development of a passive vaccine cooler that works in some of the remotest places on the planet.

Sure Chill technology is now used in over 35 countries. As well as providing an environmentally-friendly solution in hostile environments, the

company's innovation also provides solutions in sustainable energy storage, breaking cold-chain barriers in food distribution and providing new opportunities for global drinks brands.

The company has developed a close working relationship with the Welsh Government, which has made a number of funds available to Sure Chill, ranging from Technical Commercial Feasibility funding to staff training in Customer Relationship Management (CRM) and systems for sales and marketing.

The background of the entire page is a photograph of a row of wind turbines on a rolling hill. The sky is a warm, orange-hued sunset or sunrise, and the turbines are silhouetted against it. The word "WIND" is centered in the upper half of the image.

W I N D

Our 86 operational wind farms, including RWE Innogy's three offshore wind farms, are feeding the National Grid, as well as serving large industrial users and smaller community projects, farm projects, and small industry.*

At one end of the scale, microsites are powering small farm operations – while at the other end, major development projects are operated by the likes of Vattenfall, Statkraft and Falck Renewables.

These sites, positioned all over Wales, have a capacity of over 1,320 MW of energy, while we have sixteen new windfarms currently under construction, with 58 more consented.

Wales has a developed O&M supply chain including companies such as Vestas, Siemens and Safety Technology Ltd providing support.

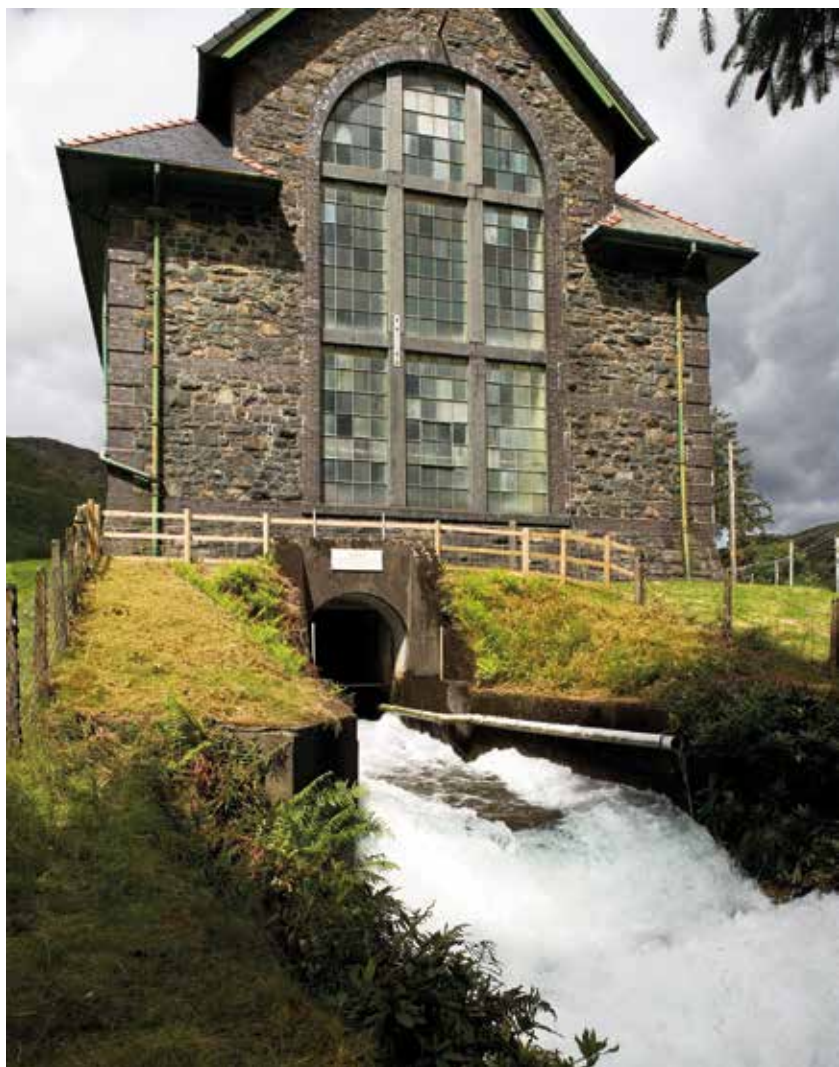
*Source: RenewableUK Wind Energy Statistics, November 2016

H Y D R O

Wales is home to a wide mix of hydro-related companies, ranging from utility water providers such as Dŵr Cymru Welsh Water to large hydro energy scheme operators including RWE Innogy and Statkraft Energy. And projects range from micro to large scale – including the largest pump storage project in the UK, operated by First Hydro Company.

In recent years, there's also been a surge of interest in small-scale hydro operations of 5 MW or less – especially in areas such as farmland and

community development. This expansion has been fuelled by a number of critical factors, including new equipment that makes full use of technological advances, allowing small-scale works to operate with a new level of efficiency in tandem with support via Feed in Tariffs. As a result, companies including Dulas, North Wales Hydro and TGV Hydro have been able to work with farmers, land owners and community leaders to establish small-scale developments at locations throughout Wales.



I N N O V A T I O N



The National Trust in Wales are working towards achieving 100% renewable energy generation.

This includes the development of a multi technology renewable energy farm on Snowdon which utilises a mixture of hydro, biomass, PV and heat pumps. They also operate the

UK's first open sea marine source heat pump at their Plas Newydd mansion on Anglesey which has received the Commercial Project of the Year in the Energy Efficiency and Renewables Awards at London's Kensington Roof Gardens for its novel integration of multiple technologies within the estate.

"The work across Wales is recognised by the UK renewables sector as outstanding and cutting edge (lots and lots of awards!) What I'm wanting to say is that this can only happen because we work in Wales. The skills, knowledge and experience across Wales has made this happen."

*Environment Advisor,
National Trust*



P O R T S & S U P P L Y C H A I N

Wales has strategically located ports which provide valuable supply chain and deployment support for offshore energy projects.

Ports here have reacted positively to maximise the market potential of renewable energy projects. A prime example would be the Port of Mostyn in north Wales who have made considerable capital investment to support the offshore wind energy sector which has enabled them to become RWE's preferred partner to service their three offshore wind farms in the area. The Port has also developed a comprehensive supply chain infrastructure to support the projects, which could provide significant input into the proposed marine energy development along the north Wales coast.

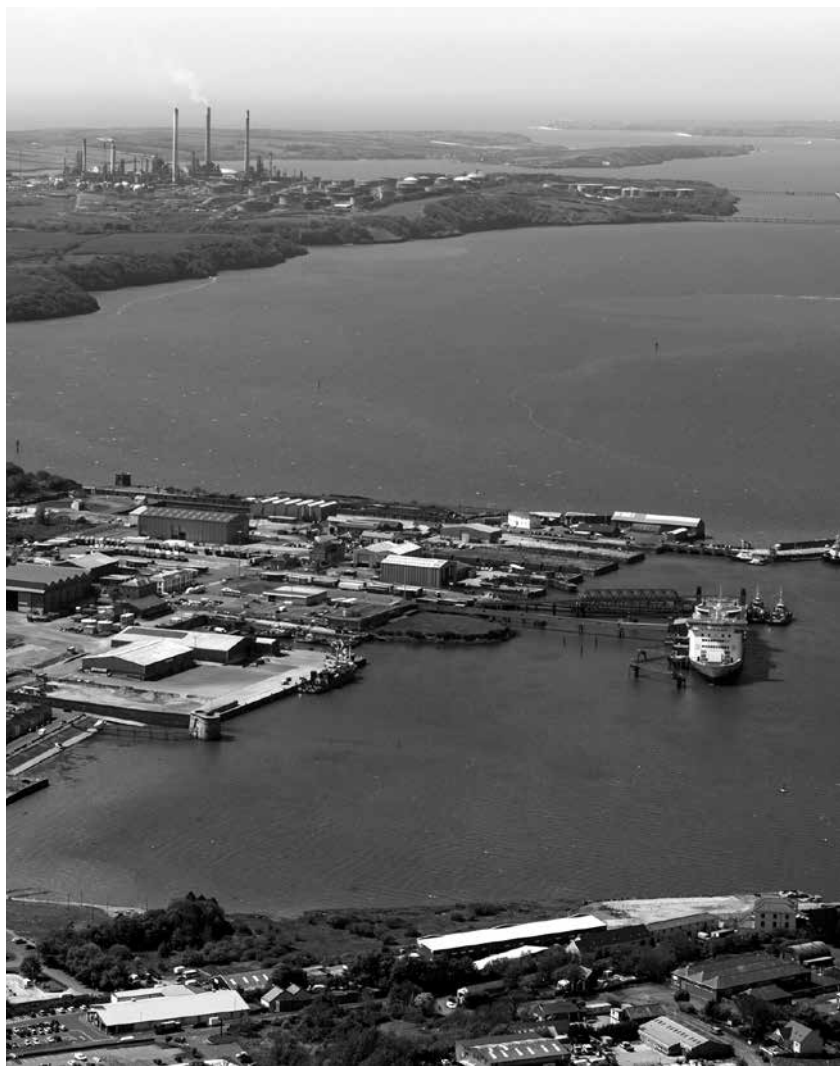
Holyhead Port is strategically located to support the west Anglesey marine energy demonstration zone and has actively worked alongside companies such as Minesto.

Similarly, Pembroke Port in south Wales has an extensive oil and gas supply chain infrastructure, delivering products and services to both sectors. Recently, local companies have used their transferable skills and developed considerable expertise assisting marine energy device developers design, manufacture and deploy their devices off the Pembrokeshire coast.

Alongside our Ports, our manufacturing base is striving to meet the industry's need for world class products and services. Companies such as Ledwood Mechanical Engineering, MarineSpace Ltd and Mainstay Marine Solutions Ltd have all collaborated on marine energy projects.

Similarly, Vestas, Safety Technology Ltd and Llandrillo College have supported the wind sector in Wales.

We also have a thriving service sector ranging from Eversheds LLP and Hugh James solicitors, environmental consultancies such as RPS Energy, Xodus and APEM Ltd, to PR companies such as BurningRed and Crystal Fish.



A C A D E M I C E X P E R T I S E

Research and Development is supported through both industry and academia, with Wales-based researchers leading the way.

Wales has rich resources for academic collaboration. Many companies are already involved in research and technology transfer projects with academic institutions including major organisations such as Rolls Royce, Siemens, National Grid and Hitachi.

Local expertise covers the full spectrum of industry issues – including economics, technology, training, production and supply chain management.

SPECIFIC is a UK Innovation and Knowledge Centre based in Baglan, south Wales. Their new 5 year £26 million business plan is supported by the public sector, industry and academia. They are unique in their operation within the UK's Innovation Ecosystem, as they are the only UK centre that is developing building integrated solutions combining

solar thermal and heat storage in conjunction with PV and electrical storage. Industrial partners include NSG Pilkington Glass, Tata and BASF.

Going forward, the next 5 years sees SPECIFIC targeting a Building Demonstrator Programme aligned to its 'Buildings as Power Stations' vision. This translates as buildings being self-sufficient by generating, storing and releasing their own electrical energy.

Swansea University's Centre for Solar Energy Research are researching new PV materials for solar energy conversion, leading to a new generation of lowcost PV module products.

The Welsh European Funding Office has recently extended funding for several key research projects, including SEACAMS 2, a £17 million, three year project at Bangor and Swansea universities. Through SEACAMS, companies wanting to harness the sea's power and create

"SEACAMS 2 will continue and expand Swansea University's commitment to supporting the growth of marine and coastal businesses, especially in the marine renewable energy and affiliated sectors, in the convergence area via state-of-the-art collaborative R&D activities with the industry."

*Kam Tang,
Professor of Marine Biology*



a sustainable marine energy industry in Wales will be able to access vital research support they need if they are to be able to progress with their multi-million pound developments.

SEACAMS 2 is set to develop a network of coastal observatories to collect high-quality data and ensure its availability to potential developers.

Cardiff University is leading a £24 million project aimed at developing more intelligent ways of managing future energy systems alongside Swansea University and the University of South Wales. FLEXIS aims to meet the diverse, complex and inter-dependent challenges that arise when new sources of energy are integrated into the grid by suppliers.

The challenges are varied and include: accommodating power supply from multiple, somewhat random places; storing energy when it is not needed; coping with extreme flows of energy into the system; accommodating an ailing infrastructure; and making sure all challenges are met in a socially acceptable, affordable way.

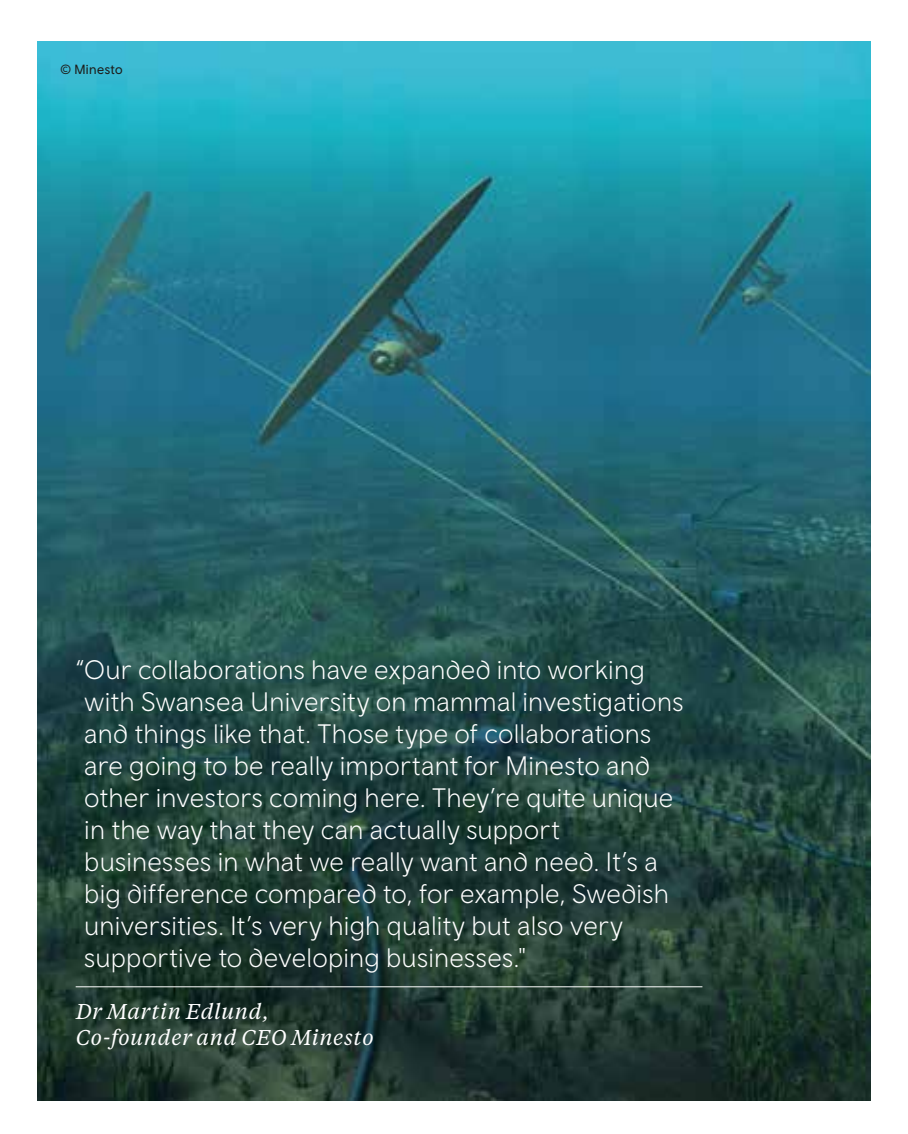
Cardiff University's Hydro-Environmental Research Centre is developing hydro-environmental

computational models to predict water quality, flow, sediment and contaminant transport processes in coastal waters, estuaries and river basins. The University has worked alongside companies such as ARUP, C2H2 and Scottish Water to deliver their project aspirations.

Bangor University's Environment Research Centre is developing energy generation through waste, sewage and grown biomass, and the centre is also home to the Wales Centre of Excellence for Anaerobic Digestion. This is a technical support unit helping organisations to develop their own Anaerobic Digestion energy plants.

The entire renewable energy sector in Wales is underpinned by a pledge at government level to drive towards a Low Carbon Economy – a strategy developed to maximise energy investment and bring economic benefits to our businesses and communities.

So, every locally-based company has access to our full range of support and a chance to test and develop new technologies in our prime locations.

An underwater photograph showing three solar-powered drones (solar gliders) suspended in the water. Each drone has a large, dark, oval-shaped solar panel and a small, light-colored body with a camera. They are connected by thin, light-colored lines. The background is a deep blue-green water with a sandy and rocky seabed visible below. The lighting is soft and diffused, typical of an underwater environment.

"Our collaborations have expanded into working with Swansea University on mammal investigations and things like that. Those type of collaborations are going to be really important for Minesto and other investors coming here. They're quite unique in the way that they can actually support businesses in what we really want and need. It's a big difference compared to, for example, Swedish universities. It's very high quality but also very supportive to developing businesses."

*Dr Martin Edlund,
Co-founder and CEO Minesto*

S U P P O R T N E T W O R K

Join us in Wales and your business could work with a number of support bodies.

Marine Energy Wales (MEW) is one example. MEW is working alongside the public and private sectors to establish Wales as a centre of excellence in the field of sustainable marine energy.

Welsh Government is working alongside six partners including the Offshore Renewable Energy Catapult and RenewableUK to provide a comprehensive guide to the marine energy supply chain in the UK.

Registering with the Marine Energy Supply Chain Gateway is free of charge and offers a number of benefits:

- Access to a UK-wide supplier database.
- A customisable search function, allowing you to specify your requirements.

- The ability to create and save multiple search lists.
- The ability to view search results by location on an interactive map.

Interested? More details can be found here: www.mescg.co.uk

Natural Resources Wales is Wales' environmental regulator whose purpose is to ensure that the environment and natural resources of Wales are sustainably maintained, enhanced and used now, and in the future.

Their primary aim is for Wales to be a location of choice for renewable energy which is good for business, people and the environment.

Wales also works closely with the Crown Estate to deliver our offshore renewable energy aspirations.

WHAT NEXT?

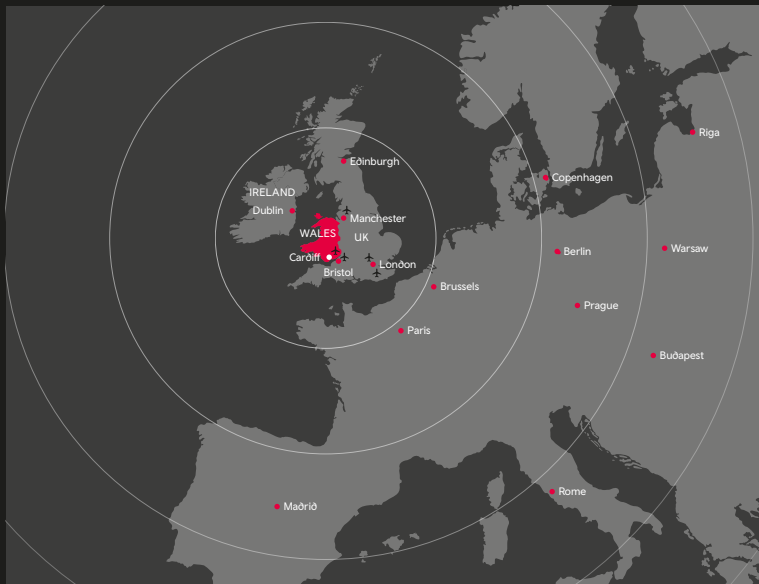
The opportunities for your company to engage with the sector are many and varied – so let's talk.

Find out what Wales can do for your business:

UK—

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