



STATE
OF THE
SECTOR
2020

ECONOMIC
BENEFITS
FOR WALES

16 marine energy developers,
4 test sites, **2** new alliances

Driving international inward investment

Early mover advantage in a wave and tidal stream export market worth **£76 billion**

Boosting supply chain diversification opportunities

Early mover advantage in a floating offshore wind market that could create over **3000 jobs by 2030**

A new **Marine Energy Engineering Centre for Excellence**

Seabed agreements for **532MW**

Spurring low carbon economic growth in coastal regions

Providing high-skilled employment

£123.7 million invested in Wales

Part of a world leading innovative test centre network

World class research carried out by Welsh Universities

Developing future solutions to climate change

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INTRODUCTION AND KEY FINDINGS

Developing marine renewable energy offers Wales a realistic opportunity to deliver a low carbon economy and reduce carbon emissions in response to the Climate Emergency declaration by Welsh Government in 2019. However, the benefits for Wales go far beyond clean energy.

Wales is working hard to gain the early mover advantage and, with ongoing support, can continue to position itself as a global leader for the marine energy sector; an export market worth an estimated £76 billion by 2050.

We are already seeing the benefits that marine renewable energy can bring including highly-skilled employment in coastal regions, regeneration and growth of rural economies and ports, and export opportunities. An increase in work prospects could also attract more young people back to rural areas.

The marine energy sector also provides opportunity for existing local supply chain companies to diversify into a new industry, retaining jobs, upskilling staff and building resilience. By supporting local supply chain companies, value from investments can be kept locally in Wales.

In the last year a number of exciting developments have taken place in the sector, with projects progressing, new entrants emerging and ground-breaking research being concluded. This Marine Energy Wales: 2020 State of the Sector report details these positive changes in the industry and looks forward to what the next decade has to offer. This report summarises the findings of our industry survey and provides information on wave, tidal stream, tidal range, and floating offshore wind energy projects currently under development in Wales.

KEY FINDINGS

A total of **16 marine energy developers** are actively progressing projects in Wales with seabed agreements in place for over **532 MW of marine energy sites**. Further sites totalling almost **3.5 GW** have also been identified.

£123.7million has been spent to date in Wales on the development of the marine energy industry. The sector is driving **inward investment** with a number of international wave and tidal developers having relocated their headquarters to Wales.

With over **737 person years of employment to date**, the sector is providing **skilled employment** and spurring **low carbon economic growth in coastal regions across the country**.

Marine energy is offering real **diversification opportunities** for local **supply chain** companies. The Welsh **supply chain** has **capability, capacity and ambition to deliver** marine energy projects.

A number of **test and demonstration sites** are under development in Wales. These projects will provide test beds for innovative wave, tidal stream and floating wind technologies, enabling valuable learning across the sector and adding to the UK's **world-leading test centre network**.

A proposed **100MW floating offshore wind project** in the Celtic Sea will be, once developed, the largest floating wind project in the world.

Wales is home to **world class research facilities** offering a wide range of services to commercial businesses including a £17m SEACAMS2 research project.

Wales has the potential to establish an early mover advantage in an export market worth **an estimated £76 billion** by 2050, exporting marine energy technologies, skills, knowledge and intellectual property across the globe.

FOREWORD

In a UK political arena where net zero carbon emissions by 2050 is mandated in policy and 'levelling up' of economic performance across all regions is sought, the offshore renewable energy sector will be a major contributor. The UK currently has a global lead in developing offshore renewable energy technologies and for its part, Wales is playing a very active role. The Welsh Government continues to stimulate investment in the sector providing one of the most supportive and encouraging offshore and marine energy landscapes in the world, driving its own policies which include the Marine Plan, Natural Resources Policy and the Well-being of Future Generations Act.

Much practical work continues in tidal stream and wave energy development. Swedish developer Minesto has now successfully commissioned its first commercial scale low-flow tidal kite technology system off Anglesey in North Wales while Swansea based Marine Power Systems with new funding is pressing forward with a full scale WaveSub device after successfully testing a 1:4 scale prototype. In Pembrokeshire, Bombora are in the final stages of construction of their 1.5MW mWave™ commercial scale wave energy converter in readiness for deployment in 2021. Nova Innovation from Scotland are seeking consents to place an array of their new direct drive 100kW tidal turbines off the Llŷn Peninsula.

Tidal range too remains on the development agenda as business cases continue to be prepared for various schemes off both North and South Wales coasts.

Furthermore, there is quickly-growing interest in Wales in floating offshore wind energy, underpinned by participation in a newly-founded Celtic Sea Alliance which aims to promote utility-scale development in the ocean triangle bounded by the south and west coasts of Wales, the south west of England, and south east of Ireland. We welcome Total's arrival in the Celtic Sea with the announcement of the Erebus project forming part of their new joint venture with Simply Blue Energy.

And to help progress all these advances, Wales continues to strengthen its expanding network of test and demonstration facilities. The Morlais Tidal Demonstration Zone off Anglesey is seeking consent and planning approval for the onshore grid connection facilities. The Pembrokeshire Demonstration Zone (PDZ) initially planned to accommodate wave devices aims to be re-purposed to support floating wind too. Phase 1 of the Marine Energy Test Area (META) project in the Milford Haven Waterway, focussed on reduced-scale and component testing, is open for business. The Offshore Renewable Energy Catapult has opened its Marine Energy Engineering Centre of Excellence (MEECE) in Pembroke Dock. These projects, the PDZ, META and MEECE form part of the £60m Pembroke Dock Marine project, part of the Swansea Bay City Region Deal. These strategic developments, alongside enhancements to Pembroke Port infrastructure, will provide new and existing developers with a wide range of opportunities, placing Wales on the main stage for this emerging global market.

In Marine Energy Wales we are committed to the promotion of collaborative working, bringing together all stakeholders in our industry – government, regulators, project and technology developers, supply chain and academic research institutions. As you read this report I hope you will agree that great progress continues to be made by all and that we can be optimistic for a widely beneficial future.



**MARTIN
MURPHY**

A handwritten signature in black ink, appearing to read 'Martin Murphy'.

**CHAIR OF
MARINE ENERGY WALES**

INVESTMENT INTO WELSH MARINE ENERGY PROJECTS TO DATE

RESEARCH FINDINGS

Tidal stream energy: Tidal stream energy developers including Minesto and Nova Innovation along with the development of the Anglesey Tidal Demonstration Zone 'Morlais' have contributed a total of **£51.7 million** of direct investment to the Welsh economy to date. This represents an increase of £22.3 million since 2017, and an **increase of £5 million since 2019**.

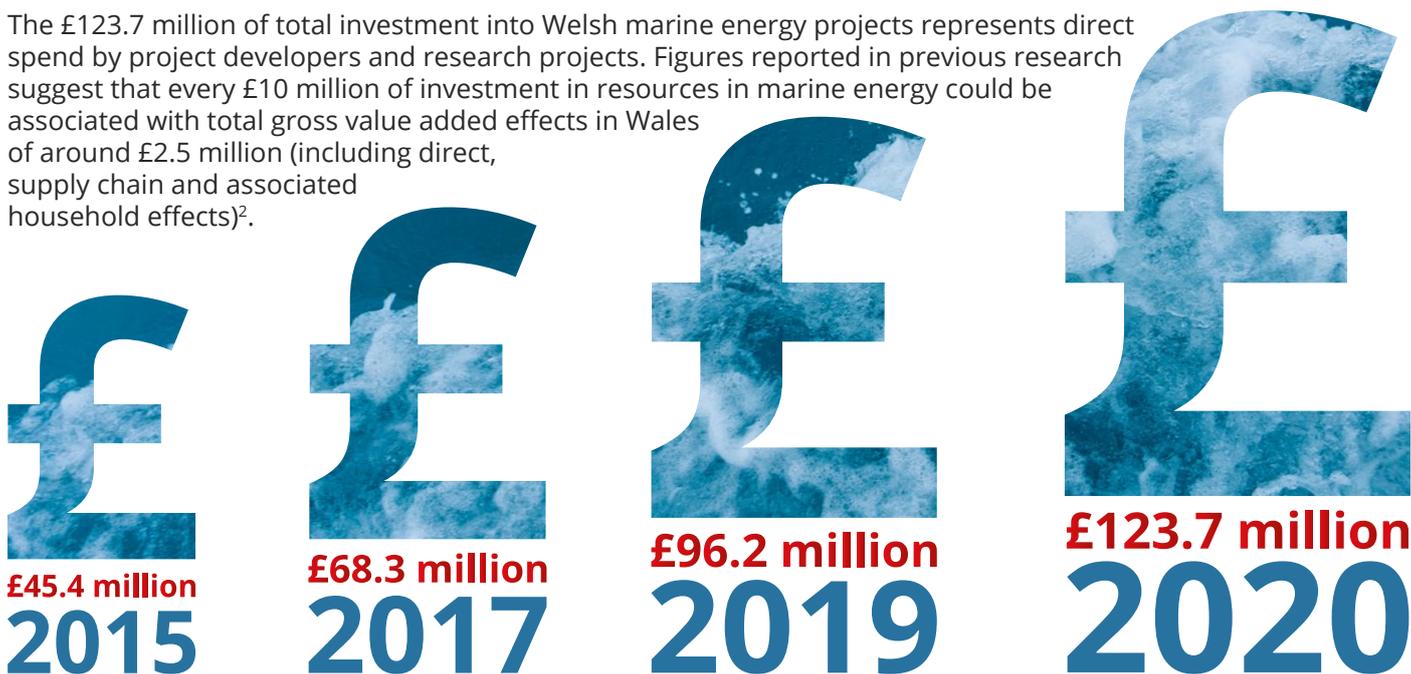
Wave energy: Wave energy developers, including Marine Power Systems, Bombora and the development of the Pembrokeshire Demonstration Zone have contributed **£29 million** direct investment to the Welsh economy to date. This represents an increase of £25.4 million over the past three years, and an **increase of £16.5 million** in the past year.

Tidal range energy: Tidal range energy development in Wales, including Swansea Bay Tidal Lagoon and the North Wales Tidal Energy and Coastal Protection project have contributed **£8.6 million** of direct investment to the Welsh economy to date.

Floating offshore wind energy: To date, the FLOW sector has contributed nearly £100,000 to the Welsh economy in recent years, and we expect to see significant growth in this sector over the next decade, as sites progress through consenting and the supply chain ramps up to deliver this burgeoning industry; culminating in a forecast **£682 million** in supply chain opportunities for Wales and Cornwall by 2030¹.

Total direct investment: Combining the investment into wave and tidal energy in Wales with publicly funded Welsh research projects brings the total investment to date in marine energy in Wales to **£123.7 million** – an increase of **£27.5 million** since 2019.

The £123.7 million of total investment into Welsh marine energy projects represents direct spend by project developers and research projects. Figures reported in previous research suggest that every £10 million of investment in resources in marine energy could be associated with total gross value added effects in Wales of around £2.5 million (including direct, supply chain and associated household effects)².



Tidal Stream Energy
£51.7 million



Wave Energy
£29 million



Tidal Range Energy
£8.6 million



Floating Offshore Wind
£100,000



Underpinning Research
£34.3 million

¹ ORE Catapult, (2020) Supply Chain Report: Benefits of floating offshore wind to Wales and the South West

² Fanning, T, Jones, C and Munday, M (2014) Regional Employment Returns from Wave and Tidal Energy: A Welsh Analysis. Regeneris Consulting and the Welsh Economy Research Unit.

SUPPORTING PERIPHERAL ECONOMIES AND COASTAL COMMUNITIES



Image credit: Bombora

Quickly growing since moving to Wales from 4 to 24, Bombora has brought together a team of experienced and ambitious professionals, with strong leadership from the Board. The team are based in Pembroke Dock.

The Welsh Government's economic action plan 'Prosperity for All' states that the Welsh Government wants 'all parts of Wales to benefit from economic growth and a fairer distribution of wealth and opportunity'. Of particular note the Institute for Welsh Affairs Plan for Wales' renewable future highlights that "Wales must capitalise on the future economic growth and jobs benefit of the (marine energy) sector by developing Welsh-focused supply chains that are competitive."

In line with the Welsh Government's ambition, it is clear that coastal and peripheral regions of Wales are experiencing the greatest benefits from this nascent industry. Of the £123.7 million investment in Wales to date, £52.3 million has been invested into North West Wales (£36 million on Anglesey and £16 million in Gwynedd) and £58 million has been invested into South West Wales (£35.4 million in Pembrokeshire and £22.6 million in Swansea). Developments in these areas have been relying on local skills, services and infrastructure providing additional indirect economic benefits.

In terms of employment, marine energy technology developers and associated Welsh project development have directly created 473 person years of employment to date. Alongside Welsh marine energy academic research, this figure rises to over 737 person years of employment. There has been continued growth in the overall number of FTE in the sector - with 176 people currently employed full time, an increase of 43 FTE from 2019.

Of the 176 FTE jobs created or retained, 64.4 FTE jobs are in North West Wales (39.4 FTE on Anglesey and 25 FTE in Gwynedd) with 100 FTE jobs in South West Wales (68 FTE in Pembrokeshire and 32 FTE in Swansea). Predictions for the UK as a whole see the wave and tidal stream sectors supporting a total of 22,600 jobs by 2040³. Crucially, 50-60% of the economic benefit of marine energy investment and jobs is expected to be generated in coastal areas in need of economic regeneration⁴.

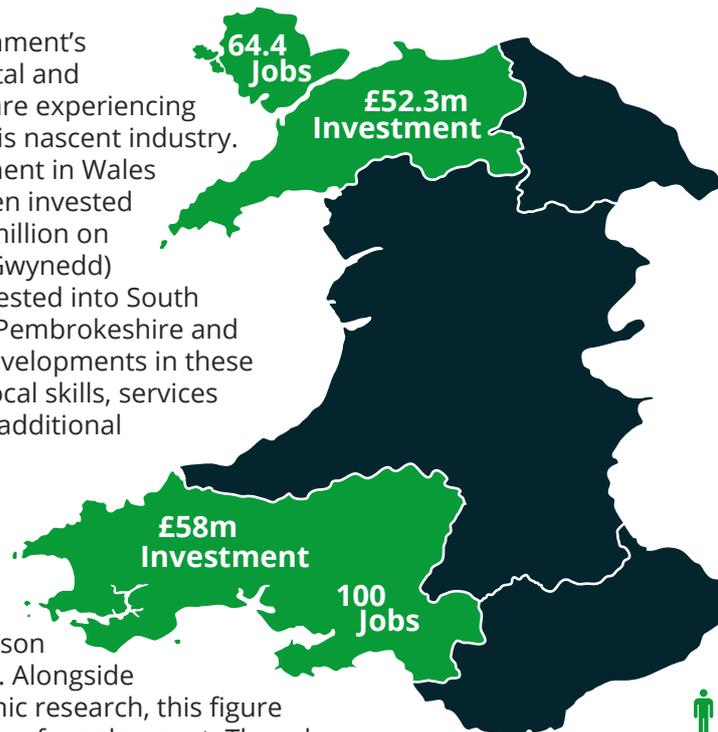


Image credit: Minesto

Swedish developer Minesto have recruited 23 FTE jobs in North Wales of which the majority are highly skilled jobs in electrical, mechanical and offshore engineering.



³ ORE Catapult (2018) Tidal Stream and Wave Energy Cost Reduction and Industrial Benefit Report.

⁴ Scottish Renewables, (2019) UK Marine Energy 2019 A New Industry

A CAPABLE AND AMBITIOUS SUPPLY CHAIN

MARINE
ENERGY WALES
WORKING GROUP
MEETINGS PROVIDE
OPPORTUNITIES FOR
SUPPLY CHAIN
COMPANIES TO
COLLABORATE.



Image credit: Marine Energy Wales

All wave and tidal energy companies featured in this report are actively engaged with local Welsh supply chain companies.

Of the companies who have built or are currently building devices in Wales, our research indicates that at least 50% of their supply chain has come from within Wales to date. Companies currently with projects under development have a similar aspirational Welsh supply chain content of at least 50%.

Supply chain companies across Wales are actively engaging in the sector and there are several clusters forming in Wales, primarily in regions close to project development.

The fact that much of the supply chain activity is focused in peripheral, coastal regions, many in need of economic regeneration, adds an extra layer of value to the investment and jobs supported by the sector. Further examples of supply chain companies involved in the Welsh marine energy sector can be found on page 11 and 13.

The newly published ORE Catapult floating wind supply chain report – ‘Benefits of Floating Offshore Wind to Wales and the South West, found that with considerable pre-existing marine expertise (e.g. fabrication, O&M, anchors etc.), high capacity electricity connection and embedded energy industry knowledge through oil and gas developments, Wales is well placed to capitalise on this expanding market (and the wider marine renewables sector)⁵.

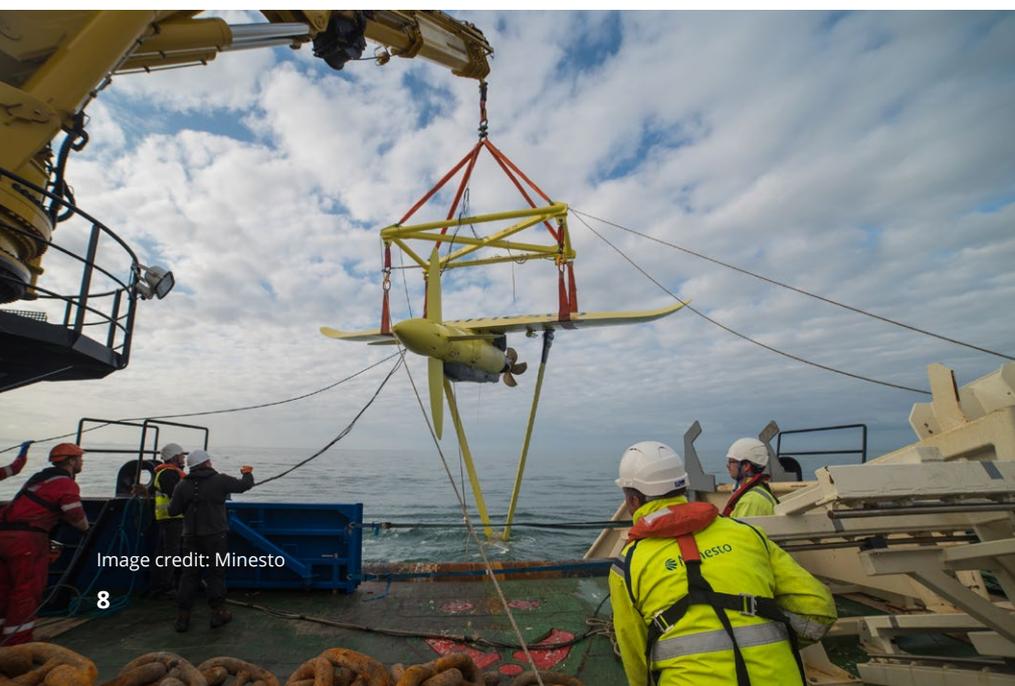


Image credit: Minesto

70% OF
MINESTO'S
SUPPLY CHAIN
IS DIRECTLY
RESOURCED
FROM
COMPANIES
IN WALES.

⁵ ORE Catapult, (2020) Benefits of Floating Offshore Wind to Wales and the South West

FUTURE DEVELOPMENT PLANS AND OPPORTUNITIES

GLOBAL OPPORTUNITIES

With opportunities developing in wave, tidal stream, range and floating wind, Wales has the potential to lead in exporting marine energy technologies, skills, knowledge and intellectual property across the globe.

Wales is collaborating on a number of projects with international nations and partners including Brittany, France on the TIGER project and Ireland on the SELKIE cross-border project. Wales is also part of the WaTERS global network of test centres.

MEW chairs the Celtic Sea Alliance which is a collaboration between Cornwall, Wales and Ireland to progress floating wind in the Celtic Sea.

MEW has established Memorandums of Understanding with Canada, Sweden, Ireland and Cornwall on marine energy and there is potential for future agreements with the United States of America and France.

The sector in Wales is driving inward investment with a number of international wave and tidal developers locating their headquarters in Wales. The recent announcement that Total, one of the world's largest energy companies, have established a partnership to develop floating wind projects in the Welsh waters of the Celtic Sea will see further low carbon inward investment reach our shores.

Companies involved in this report were asked to detail their future spending plans in Wales. Figures provided were very encouraging with a 10-year predicted spending total of almost £9.6 billion (including several large-scale tidal lagoon projects) if market and development incentives are in place.

With UK deployment of 100MW per year from 2021/22, and a realistic share of a growing global market, the tidal stream industry could generate a net cumulative benefit to the UK by 2030 of £1.4 billion. Assuming a 10-year lag behind tidal stream with a similar outlook for a global export market, wave energy will add a further net positive contribution to the UK economy by 2040 of £4 billion. *ORE Catapult (2018), Tidal Stream and Wave Energy Cost Reduction and Industrial Benefit.*

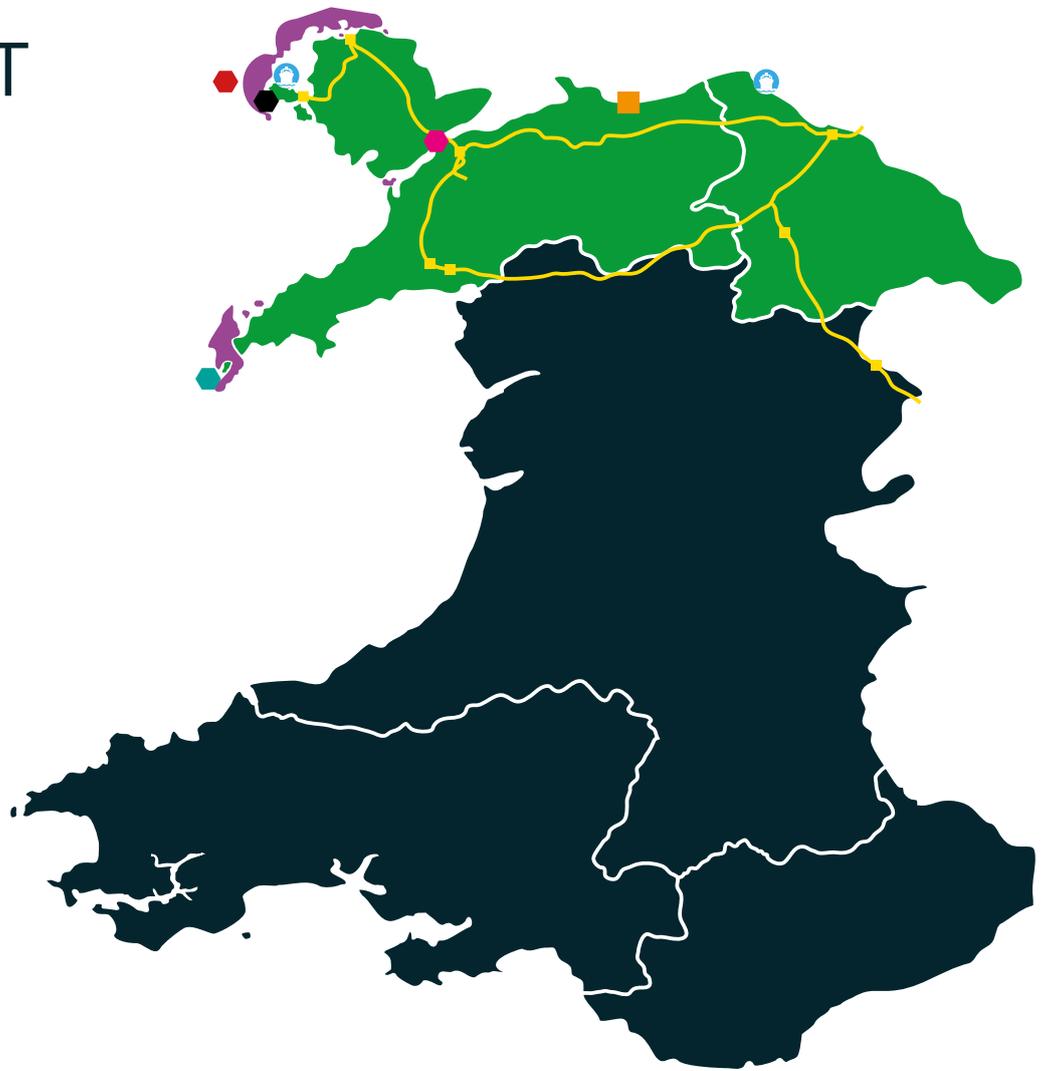
FORWARD THINKING

As world governments strive to meet their contributions under the Paris Climate Agreement and reach net-zero, the marine renewables sector continues to expand its horizons into new fields and opportunities. A number of respondents to our industry survey mentioned innovative new technologies and exciting potential uses for marine-generated power. This included hybrid power systems incorporating more than one marine energy technology (e.g. floating wind and wave power), as proposed by Bombora (page 14) and MPS (page 15). The possibility of using electricity generated from marine sources to produce hydrogen for heat and transport was mentioned alongside water desalination, on-shore energy storage, and coastal electric vehicle and vessel charging. These concepts illustrate the degree of innovation present in the sector.

"Decarbonisation of the global economy is placing demand upon us and we need to adapt. We want to position Wales to take advantage of rapidly growing, new and emerging markets." Welsh Government's Prosperity for All: economic action plan.

SPOTLIGHT ON NORTH WALES

- **Minesto**
0.5MW installed
+ 10MW Phase 2
(Page 16)
- **Morlais Tidal
Demonstration Zone**
Potential for 240MW
(Page 29)
- **Nova Innovation**
Up to 1MW project
(Page 17)
- **North Wales Tidal Energy
and Coastal Protection**
Potential for 2.5GW
(Page 24)
- **Marine Centre Wales
(MCW)**
(Page 11)
- **Tidal Stream Resource**
- **Grid 400kV**
- **Ports**



JOBS AND GROWTH: £53.6 MILLION HAS BEEN INVESTED INTO NORTH WALES. 65 FTE JOBS HAVE BEEN CREATED. THE MAJORITY OF THIS GROWTH AND INVESTMENT LIES IN NORTH WEST WALES WHICH INCLUDES AN INVESTMENT OF £36 MILLION AND 39.4 FTE ON ANGLESEY WITH AN INVESTMENT OF £16 MILLION AND 25 FTE IN GWYNEDD.

NORTH WALES RESOURCE: There are significant opportunities for both tidal stream and tidal range energy in North Wales. Anglesey in particular has huge potential for tidal stream energy with a peak spring velocity of over 3m/s. These tidal current speeds combined with water depth and seabed topography are among the best in Europe.

GRID: North Wales already has an established energy generating network with the Wylfa Nuclear Power Station operational from 1971 to 2015. North Wales is also home to several hydroelectric power stations and offshore wind farms including Gwynt y Môr – one of the largest operating offshore windfarms in the world. There is a 400kV double circuit overhead line which runs between Wylfa and Pentir which could be used by the marine energy sector.

BUSINESS SUPPORT: Anglesey Enterprise Zone and the existing Energy Island Programme have been set up to bring high skilled jobs to the area through major energy investments. They will help to establish the island as a world renowned centre of excellence in low carbon energy generation.

NORTH WALES HAS AN ESTABLISHED ENERGY SECTOR SUPPLY CHAIN AND A WORKFORCE WITH TRANSFERABLE SKILL OPPORTUNITIES

Black and Veatch (with offices in Swansea) has been awarded the Design Services Contract for the Morlais Demonstration Zone. This includes designing the surface infrastructure connecting power generated by tidal arrays to the National Grid; as well as other support to bring the project to the construction tender phase.

Orbital Marine Power Ltd (Orbital), has been working with **Faun Trackway** who will deliver the contract to manufacture the four steel anchor structures and bespoke mooring connectors for the first O2 machine from their facilities in Llangefni, Anglesey. Orbital has signed an agreement to deploy an array of its technology at the Morlais Demonstration Zone.

Minesto has engaged significantly with small and medium sized enterprises (SMEs) across Anglesey and North Wales (such as **Anglesey Mechanical Solutions**, **Holyhead Boatyard**, **Jones Brothers**, **Anglesey Mechanical Services** and **Mona Lifting**) to support engineering aspects of their project on Anglesey; helping these companies to expand their service offer to the market. Minesto has also worked with Orkney based marine contractor **Leask Marine** (with offices in South Wales) who have assisted with the installation of aspects on Minesto's Technology system.

Aquatera (specialising in environmental and operational support for marine, coastal and land based activities) now has an established Welsh team based in North Wales, with an office at M-SPARC, Anglesey; and in South Wales with a base in Pembroke Dock. Aquatera continues to support companies with Welsh interests in site assessment, consenting and socio-economic areas of their project development as well as supporting the sector to develop globally.



RESEARCH:

SEACAMS2 is a five year £17 million project led by **Bangor University** in association with **Swansea University** seeking to deliver assistance to companies wanting to create a sustainable marine energy industry in Wales. Areas of expertise include marine ecosystems, design engineering, coastal zone management and hydrodynamics.

MARINE CENTRE WALES is a new centre for innovation in applied marine science that has been developed during the SEACAMS project. The Centre has been designed to facilitate interactions between researchers, businesses and policy makers.

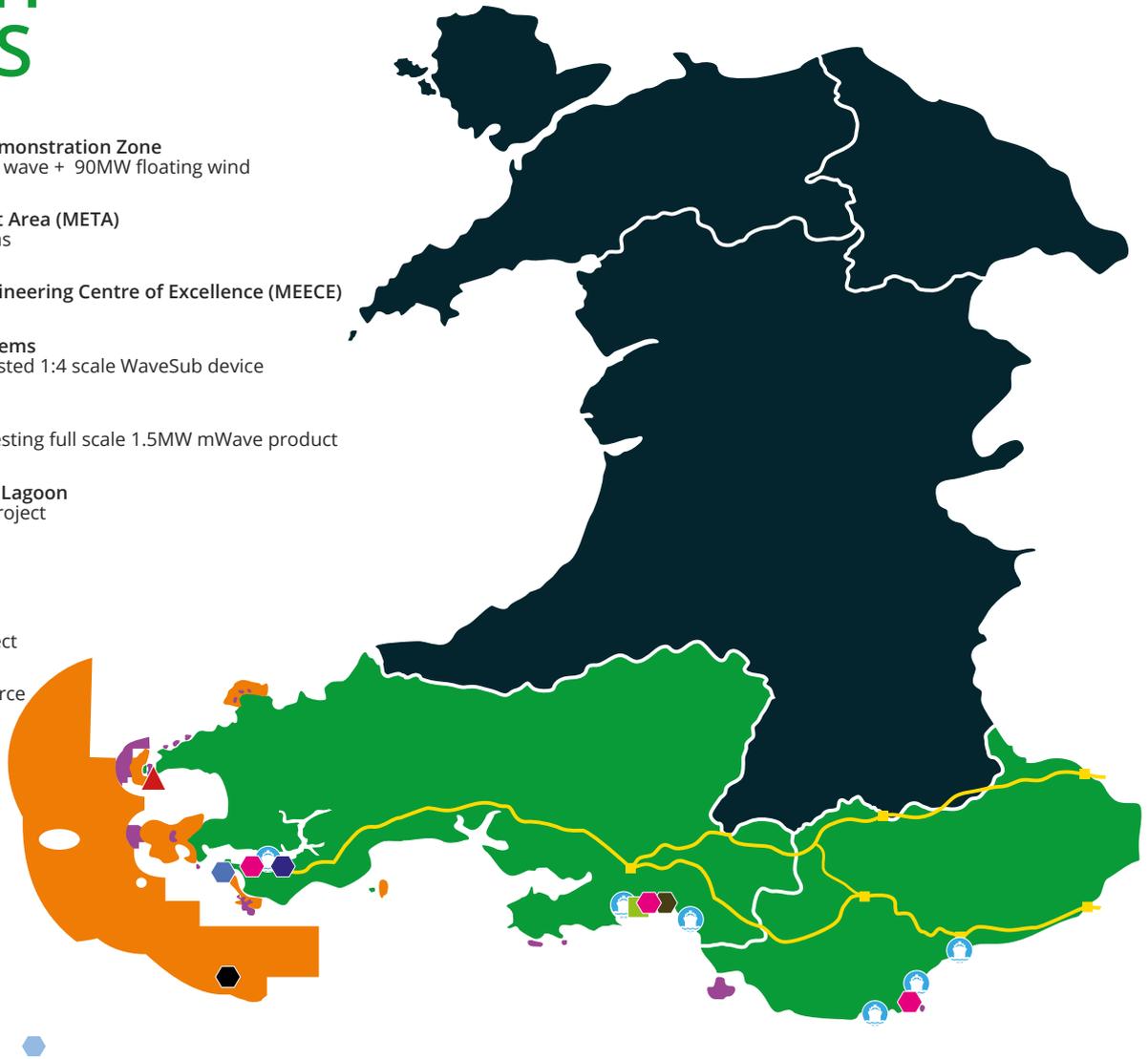
PORTS:

The Port of Holyhead is located on the Isle of Anglesey, North Wales. Holyhead is a 24 hr, deep water, lock-free port, centrally located on the Irish Sea Coast within easy reach of several major conurbations both in the UK and Ireland.

The Port of Mostyn is a privately owned and operated port. Over recent years, Mostyn has become one of the main centres in Europe for the assembly and installation of wind turbines; a large portion of its business is now dedicated to the offshore renewable energy sector.

SPOTLIGHT ON SOUTH WALES

- Pembrokeshire Demonstration Zone
potential for 90MW wave + 90MW floating wind
(Page 30)
- Marine Energy Test Area (META)
Series of 8 test areas
(Page 28)
- Marine Energy Engineering Centre of Excellence (MEECE)
(Page 31)
- Marine Power Systems
Constructed and tested 1:4 scale WaveSub device
(Page 15)
- Bombora
Constructing and testing full scale 1.5MW mWave product
(Page 14)
- Swansea Bay Tidal Lagoon
Potential 320MW project
(Page 25)
- ▲ TIGER Project
(Page 30)
- Blue Gem Wind
Erebus 96MW project
(Page 27)
- Tidal Stream Resource
- Wave Resource
- Grid 400kV
- Ports



JOBS AND GROWTH: £70.8 MILLION HAS BEEN INVESTED INTO SOUTH WALES AND 110 FTE JOBS HAVE BEEN CREATED. THE MAJORITY OF THIS GROWTH AND INVESTMENT LIES IN SOUTH WEST WALES INCLUDING AN INVESTMENT OF £35.4 MILLION AND 68 FTE IN PEMBROKESHIRE AND AN INVESTMENT OF £22.6 MILLION AND 32 FTE IN SWANSEA

SOUTH WALES RESOURCE: South Wales has a significant wave, tidal stream and tidal range climate. Pembrokeshire has the highest concentration of wave resource in Wales equating to an indicative capacity of up to 5.6 GW.

GRID: Existing land based grid connections are excellent in Pembrokeshire with a 400kV National Grid connection being available at the Pembroke Power Station site.

BUSINESS SUPPORT: The Haven Waterway Enterprise Zone offers renewable and traditional energy companies an experienced industry base and supply chain with a skilled workforce, an established distribution infrastructure, a variety of sites to suit a range of needs and a network of universities with expertise in a range of energy related fields.

SUPPLY CHAIN: Pembrokeshire is home to an energy sector supply chain and workforce which supplies 25% of the UK's petrochemicals, 30% of the UK's gas requirements and includes steel fabricators, marine and other engineering specialisms, boat builders and ship repairers. These skills are transferable and are of tangible benefit to the renewables industry.

PEMBROKE DOCK MARINE: Pembroke Port has plans to reshape the physical infrastructure of Pembroke Port, Gate 4, to ensure maximum operational efficiency as part of the Pembroke Dock Marine project, which also includes META, PDZ and MEECE. See page 31.

Three marine energy devices have been fabricated in Pembroke Dock and deployed from Pembroke Port. A fourth device – Bombora's mWave is currently under construction.

Mainstay Marine Solutions has benefited greatly from the growth in the marine renewable energy sector having completed the build and fabrication of a number of innovative prototyping projects to date. The first project Mainstay became involved with was the build of the 400kW, 200t tidal energy device for Tidal Energy Ltd. Following on from this, the company was commissioned to convert a WW2 water carrier into a wave energy converting device on behalf of the developer 'Wavetricity'. The third and fourth projects were both of Australian origin in the form of a 48te pendulum wave energy converter for AMOG Consulting and currently in build and due for delivery imminently; the 75m long, 1.5MW device for Bombora. As the leading marine energy fabricator in Wales, Mainstay has substantial technical understanding of fabricating and assembling prototype devices.

Altrad Services, a key Pembrokeshire fabricator, won the contract to build the cell modules for Bombora's mWave project. The steel in each cell module will weigh over 30 tonnes. The scale of Bombora's mWave wave energy converter demonstration project has also involved locally based **Kingswood Engineering**, **Bartlett Engineering** and **3K's Engineering** in steel fabrication work.

Marine Power Systems worked extensively with **Ledwood Mechanical Engineering** based in Pembroke Dock to deliver their complex engineering and fabrication requirements, with additional components supplied by **Camplas Technology** of Bridgend and **3K's Engineering** of Llanelli. They also used Mainstay Marine.

Orkney based marine contractor **Leask Marine**, with offices in Pembroke Dock, provided marine operation services for Marine Power Systems WaveSub towage activities within the Milford Haven Waterway and deployment activities for testing in Cornwall.

Leask Marine has now established additional offices in Pembroke Dock and is also advising other developers on their designs. Leask's extensive sector experience enables them to reduce project costs and risk, with ease of installation, operations and maintenance at the forefront. Leask Marine will manage the deployment phase of Bombora's 1.5MW mWave wave energy converter project.

Transition Bro Gwaun (TBG) plan to install a community owned and led tidal flow project in Wales. TBG has drawn together a strong team of volunteers who lead the project and have worked with local supply chain company **MarineSpace**. **MarineSpace** have also been appointed as lead offshore EIA and consenting consultants for Blue Gem Wind's 96MW Erebus Project which is a partnership between Total and Simply Blue Energy.

RESEARCH: Swansea University (Engineering) Energy and Environment Research group covers both fundamental and applied research into ocean energy, coastal processes, flooding and climate change impacts using computational modelling, experimental investigations and field measurements.

The Hydro Environmental Research Centre, Cardiff University provides computational modelling predicting flow, water quality, sediment and contaminant transport processes. Cardiff Marine Energy Research Group undertake engineering modelling and experiments on tidal stream turbines.

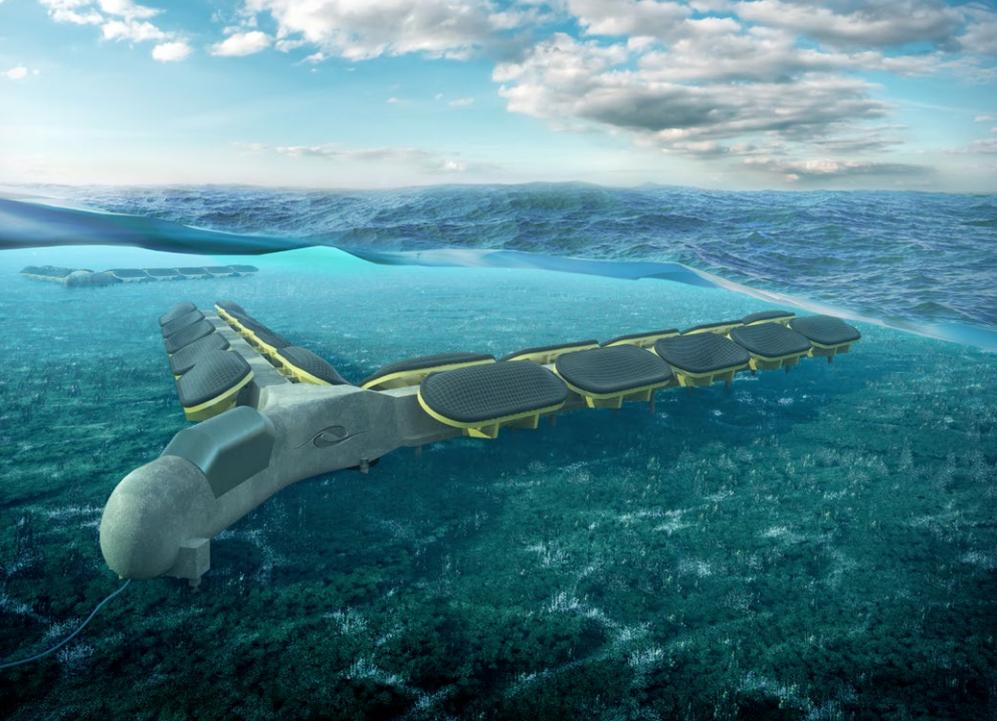


Image credit: Bombora

WAVE ENERGY DEVELOPERS IN WALES



PROJECT UPDATE

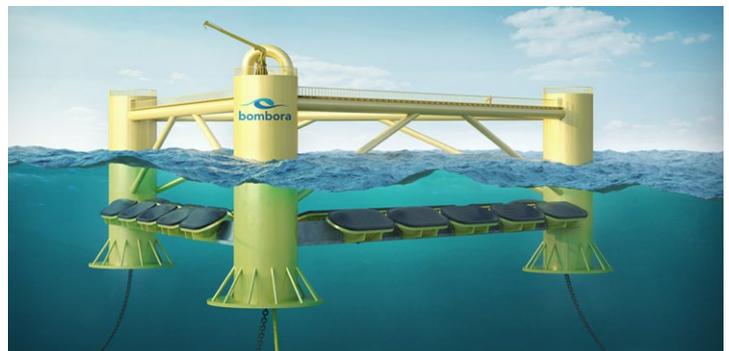
Bombora's mWave™ wave energy converter (WEC) delivers low cost, low impact renewable electricity for use in national and island electricity grids.

Bombora transferred its operations from Australia to Wales at the end of 2017, soon after launching a 2½ year, £17 million project to construct and test a 1.5MW mWave.

Bombora's full scale mWave is due to be installed just off the coast of south west Wales in 2021, having received marine licence consent. As well as testing the product in a nearshore environment, Bombora is using mWave's modular and scalable technology to develop offshore and co-located floating wave and wind energy solutions.

Bombora's Pembrokeshire Project is funded by a £10.3 million grant from the European Regional Development Fund through the Welsh Government and match funding provided by shareholders including Enzen, a rapidly growing global energy consultancy.

mWave is located on the ocean floor where it remains invisible while extracting maximum energy in an environmentally sensitive way. mWave is non-disruptive to ocean users and robust enough to survive storm conditions. Its flexible rubber membranes pump air through a turbine to generate electricity as waves cause changes in the water pressure above.



BENEFITS TO WALES

Quickly growing since moving to Wales from 4 staff to 24, Bombora has brought together a team of experienced and ambitious professionals, and attracted significant inward investment to the Pembrokeshire coastal region, resulting in a boost to the economy and development of the skilled local workforce.

Bombora is currently progressing a pipeline of global commercial opportunities. Consenting for the first grid connected project, a 3.0MW Lanzarote Wave Park Project, is underway.

With plans to export mWave technical know-how and expertise, Wales is well positioned to be a major beneficiary of this global opportunity.



MARINE POWER SYSTEMS



Image credit: Marine Power Systems

PROJECT UPDATE

Marine Power Systems' flexible ocean energy technology can be configured to deliver wave power (WaveSub), floating wind power (WindSub) or a combination of both (DualSub). WaveSub, WindSub and DualSub can be deployed individually or together in the optimum configuration to best exploit each location's ocean energy resource. MPS' vision is to see affordable, reliable and scalable offshore energy farms built to supply the clean power demand. MPS' WaveSub wave energy converter is an important step in the journey towards commercialisation. A 1:4 scale prototype was manufactured in Wales and tests at sea have demonstrated the unique selling points of the technology.

MPS are now in the process of designing, manufacturing, and testing a full scale WaveSub, with £12.8m of support from the Welsh European Funding Office. MPS were awarded a further European Regional Development Fund grant of £4.3m in 2019 from the Cornwall and Isles of Scilly Local Enterprise Partnership to accelerate combined wind and wave power technology.

BENEFITS TO WALES

MPS is a Wales based company that is supporting the creation of a Welsh supply chain and benefiting the local economy by using a range of Wales based suppliers in Wales. The flexible technology can be towed considerable distances; MPS therefore see a significant opportunity for the manufacture and commercialisation of devices from Wales. This will create a substantial export opportunity, with MPS planning to establish itself as a long-term sustainable business creating varied and highly skilled jobs.

MPS' ambition is to contribute to the full decarbonisation of Wales' electricity system, contributing to the 2035 target for 100% renewable electricity set out in 'A Plan for Wales' produced by the Institute of Welsh Affairs.



Image credit:
Marine Power Systems



Image credit: Minesto

PROJECT UPDATE

Minesto has had a physical presence in Holyhead (headquarters of Minesto UK Ltd) since 2015. After securing an 10MW agreement for lease at Holyhead Deep off Anglesey in June 2014, Minesto has focused its Welsh activities on demonstrating the functionality and power production of their Deep Green Technology at full scale.

Following the successful commissioning of the first 0.5MW Deep Green system in the Summer and Autumn of 2018 and 2019, Minesto is continuing to develop its site and operations at Holyhead Deep with the aims of developing a commercial demonstration array of up to 10MW and a future 80MW commercial array. Minesto has also completed the first significant step in establishing its assembly and manufacturing capability in North Wales.

BENEFITS FOR WALES

To date, Minesto has invested around £32 million of private equity funding and European Regional Development Fund grants in its project and operations in Wales. 23 FTE jobs – of which the majority are highly skilled jobs in electrical, mechanical and offshore engineering – have been recruited within the Minesto organisation in the UK, with around 70% of Minesto's supply chain (c.40 companies) directly procured from companies based in Wales.

The long-term ambition of a phased expansion of the Holyhead Deep project towards an 80MW commercial tidal energy array would see further substantial inbound investment, job creation and supply chain opportunities created in North Wales – in addition to supplying the equivalent of some 60,000 Welsh homes (5%) with affordable, reliable and predictable clean electricity.

"It is too difficult to build a new industry on your own. Developers, suppliers and public actors in marine energy have to work closely together to secure the path towards commercial breakthrough. Marine Energy Wales is the driver and enabler of such collaboration and thus plays a vital role for Minesto to succeed in our number one market, Wales"
Dr Martin Edlund, CEO, Minesto



NOVA INNOVATION



Image credit:
Nova Innovation

PROJECT UPDATE

Nova Innovation deployed the world's first offshore array of tidal turbines in Bluemull Sound, Shetland in 2016. Nova has chosen Wales as the location to drive down the cost of tidal energy production. Drawing on lessons from the wind industry, Nova believe the way to do this is to demonstrate commercial devices at a small scale, before scaling up as the technology matures.

Nova's 0.5 MW Ynys Enlli Tidal Energy project will involve placing five 100 kW turbines under the water in Swnt Enlli (Bardsey Sound) between Ynys Enlli (Bardsey Island) and the Llŷn Peninsula mainland in north Wales. Nova will build on their experience and expertise from Shetland (including installing Tesla battery storage to deliver baseload tidal power to grid) to deliver the project and work towards a future Nova Tidal Array at the Morlais site.

BENEFITS FOR WALES

Nova's ambition for their Ynys Enlli tidal project is to deliver locally generated renewable electricity that will create significant benefits for local people and communities. Nova's tidal turbines are fully-submerged on the seafloor and have no visual impact – meaning the turbines can deliver clean, predictable energy without affecting the spectacular natural scenery. To date 25% of project spend for their Bluemull Sound project has been in Shetland and 80% in Scotland. Nova hopes to achieve similar levels of local content for their Welsh projects, delivering significant supply chain and employment benefits. Nova is working with local community groups to fully explore the possible local benefits of the Enlli tidal project.



Image credit:
Nova Innovation

ORBITAL

MARINE POWER

TIDAL STREAM ENERGY DEVELOPERS IN WALES

PROJECT UPDATE

Orbital Marine Power's floating tidal energy system technology has been under continuous development, including rigorous testing of scaled systems in both tank conditions and open ocean environments, since the company was founded in Orkney in 2002. In 2016, the company launched the SR2000, a 2MW turbine which produced over 3,000 MWh of electricity at the European Marine Energy Centre in Orkney.

In 2020, Orbital will launch an optimised turbine model, the O2 2MW. The O2, as with the SR2000, is designed for low cost access to all systems and components to minimise the costs of onsite maintenance. The machine will also feature new 'gull wing' style retractable legs that raise all components to the water surface for easy access without the need for any specialist vessels.

The steel structure of the turbine has been simplified to reduce fabrication costs and futureproof the product for volume manufacturing at existing offshore fabrication and shipbuilding facilities. The new configuration also reduces the draught of the unit to less than 3m to ensure the machine can be towed, installed and serviced with locally based small workboats.

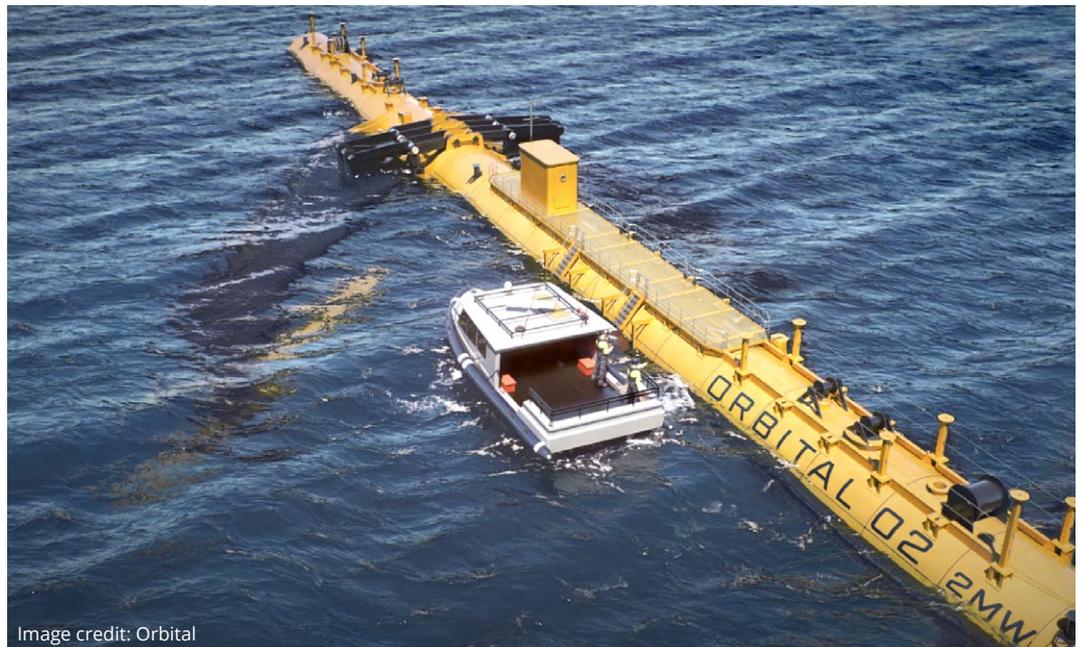


Image credit: Orbital

BENEFITS FOR WALES

Orbital Marine Power has also signed an agreement to deploy a commercial array of its technology at the Morlais Tidal Energy Project.

Orbital has already ramped up engagement with the Welsh supply chain to deliver its technology. Faun Trackway will deliver the contract to manufacture the four steel anchor structures and bespoke mooring connectors for Orbital's first O2 machine from their facilities in Llangefni, Anglesey. This first O2 machine will be deployed in Orkney, where Orbital have an existing berth and grid connection at the European Marine Energy Centre (EMEC).

PROJECT UPDATE

Verdant Power, Inc., established in 2000, has formed a joint-venture with Duggan Brothers Ltd. (Verdant Isles, Ltd.) to develop tidal energy projects in Ireland and the UK. Verdant Power's Free Flow System (FFS) has been under development in New York City's East River since 2002. The fourth generation FFS launched in 2006 was the world's first grid-connected tidal device array, logging more than 9,000 operational hours.

Verdant Power's FFS or kinetic hydropower system (KHPS) turbines can be readily scaled to multiple sizes and are arranged to optimise energy generation at particular sites. Verdant Power has advanced the KHPS to the 5th Generation (Gen5). The Gen5 is designed for high reliability, longevity, and environmental compatibility and will be demonstrated as half-scale in 2020 at the New York City East River test site.



Image credit:
Verdant Power



Image credit: Verdant Power

PLANS FOR WALES

Verdant Power is following the development of the Morlais Development Zone off the west coast of Anglesey closely, and is working towards launching its full-scale project and developing a presence in Wales during 2022-23 if, as expected, the resource assessment is successful. The Company plans to hire full-time staff and establish relationships with the Welsh supply chain, not only for its projects at Morlais and in other locations in the UK and Ireland, but also for global projects requiring exportation of componentry and services from Wales. The company plans to expand its Morlais project to a least a 30MW project by 2025-26.



TIDAL STREAM ENERGY DEVELOPERS IN WALES

PROJECT UPDATE

BigMoon Power Kinetic Keel technology was successfully tested in the world's strongest tides in the Minas Passage, Nova Scotia in 2017. The Kinetic Keel performed well, with further tests completed in 2018/19. The technology focuses on BigMoon's core principles of value for money, simplicity of design and benefit to the environment.

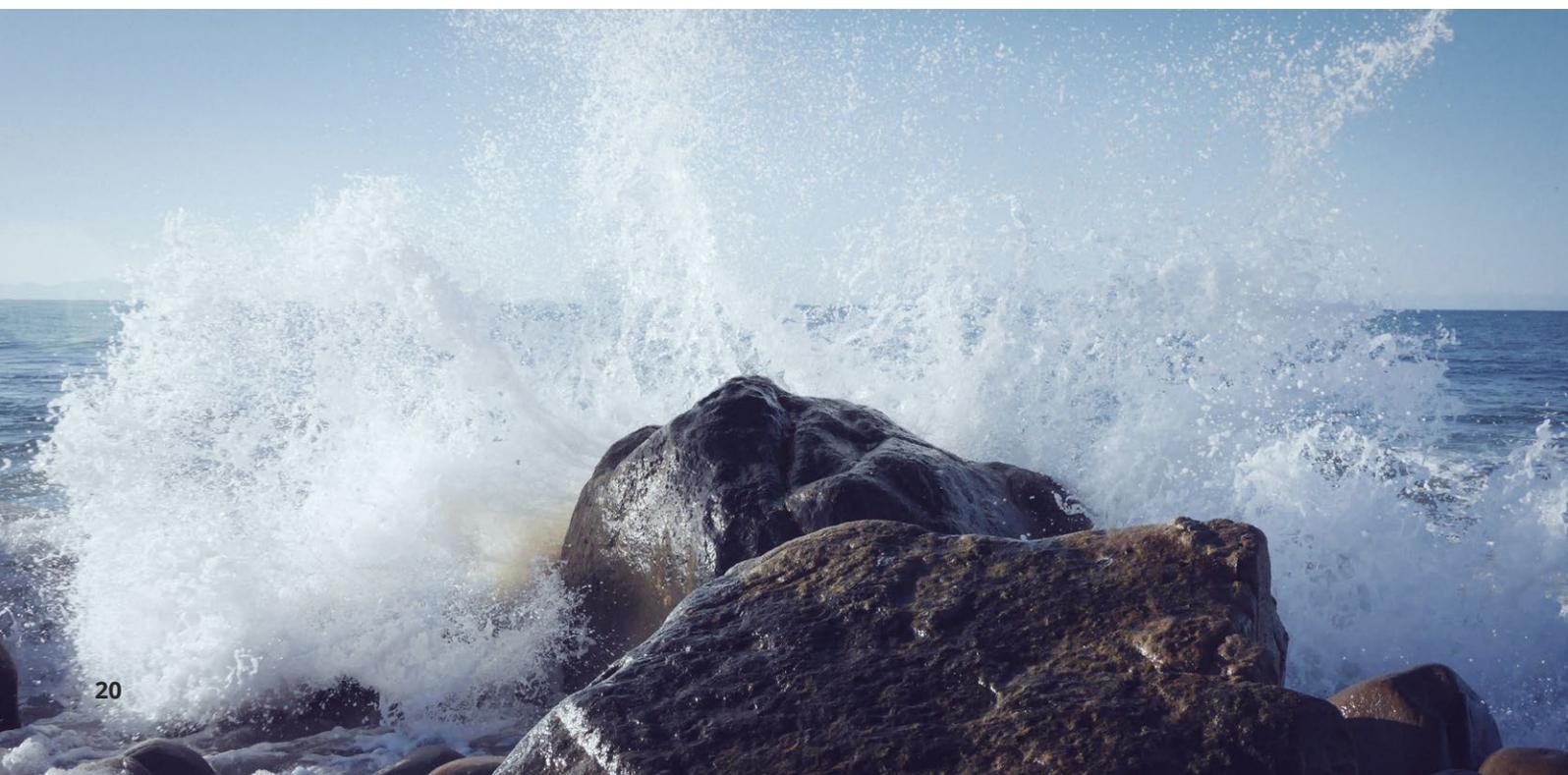
BigMoon will now deploy its first grid connected, commercial unit in Nova Scotia in summer 2020, with a permit from, and 15 year Power Purchase Agreement (worth CAD \$350/MWh) with the Government of Nova Scotia under their Marine Renewable Energy Act.

BigMoon also plans to demonstrate the Kinetic Keel's ability to generate significant volumes of energy without the need for fast moving water. This will be done by working closely with the Government of New Brunswick to deploy Kinetic Keels on the other side of the Bay of Fundy, where the water is significantly slower.

PLANS FOR WALES

BigMoon is looking forward to the full development of the Morlais Project in North Wales. BigMoon is one of the earliest developers to be part of the project, joining the tremendous team assembled at Morlais.

BigMoon believes natural resources belong to the people who live, work, and play in a region. BigMoon's technology is designed to be easily fabricated and maintained meaning local expertise can be used to construct the device, and a local workforce which does not require 'specialised' training can provide ongoing maintenance over the project lifetime. BigMoon are continuously focused on what can be done to lower the cost and increase the value of their product to customers.



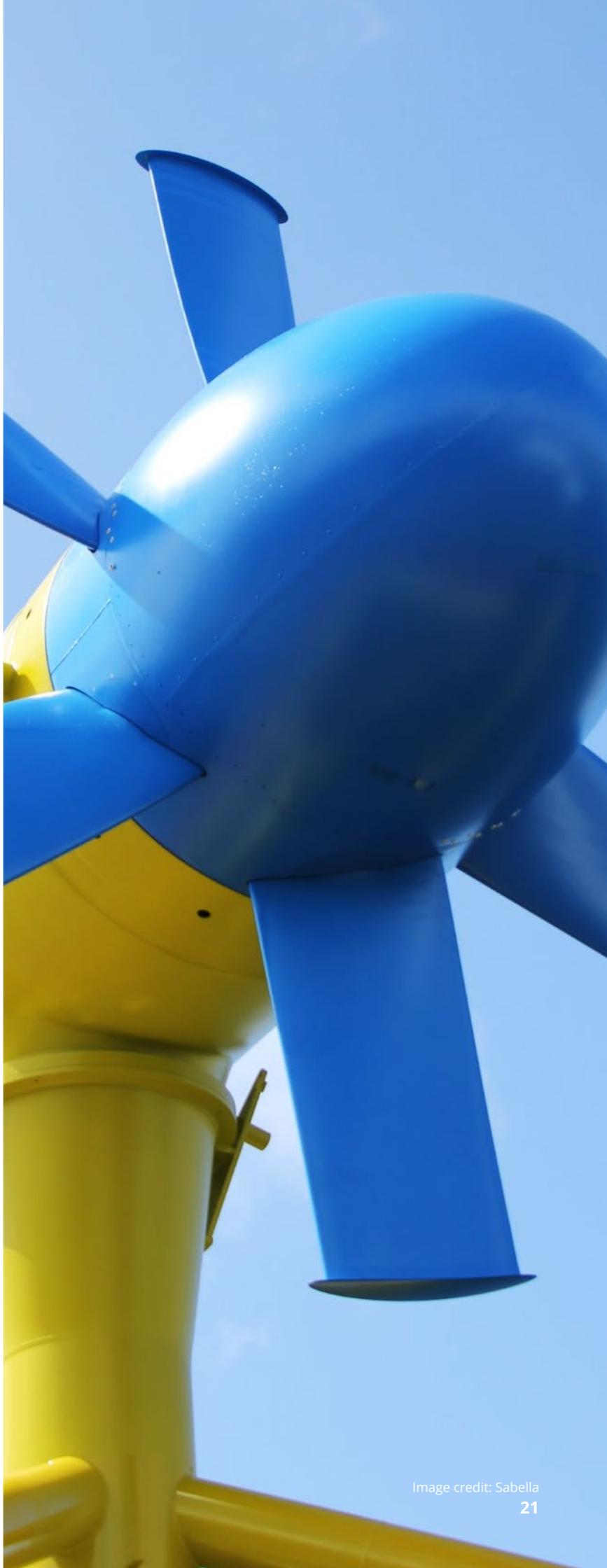


PROJECT UPDATE

SABELLA is a French SME with 25 employees that is developing tidal and ocean stream energy technologies. SABELLA has successfully demonstrated its grid connected D10-1000 1MW 10m diameter tidal turbine at Ushant Island off the north-west of France, a small island with 800 inhabitants. With the island's electricity network usually powered by polluting and costly diesel generators, the D10-1000 tidal turbine was deployed for the first time in 2015 for one year, and again in 2018 and 2019, following maintenance and optimisation works. In 2022, SABELLA will deploy one tidal pilot array of two devices at Ushant Island, as part of the Akuo Energy led PHARES project, which will also install one wind turbine, solar panels and an energy storage system to decarbonise the island.

PLANS FOR WALES

SABELLA is aiming to deploy their horizontal-axis technology which has already been tried-and-tested in France in the Morlais Demonstration Zone. SABELLA is looking forward to the Morlais Demonstration Zone going live and believes Wales' waters have an excellent potential to build a tidal industry with major local economic benefits.



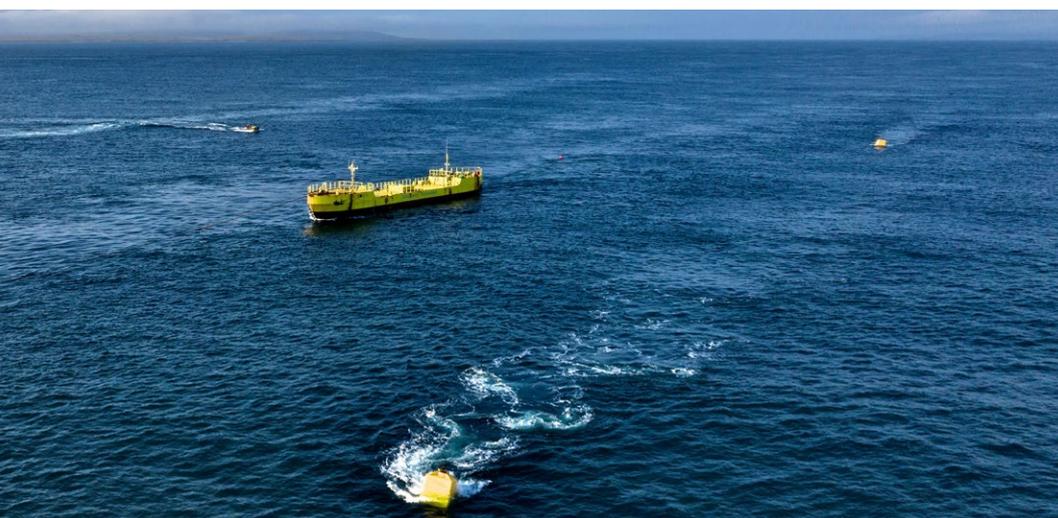
PROJECT UPDATE

Magallanes Renovables was conceived in 2009 with the objective of developing a technology capable of harnessing the energy from the tidal currents that could generate a high output at low cost. Following their research and development, in 2014 Magallanes built and tested a 1:10 scale model, successfully completing official testing at the European Marine Energy Centre (EMEC) in the Orkney Islands (Scotland). In March 2019, a second generation full scale 45 meters, 1,5MW platform (the ATIR) was successfully deployed, with first power exported to the national grid at EMEC shortly after.

The Key advantages of Magallanes Technology are:

- High output 1,5MW single device
- Low CAPEX with naval and windmill components
- Low OPEX with easy on board maintenance
- Floating device with full and easy access to all machinery
- Efficient generation with variable pitch
- Double counterrotating rotos give great stability

The ATIR continues to harvest energy from Scotland's tidal currents. The structured programme of testing at EMEC continues after which Magallanes has set its sights on a multi-platform deployment at the West Anglesey Tidal Demonstration Zone; Morlais.



PLANS FOR WALES

After many years of research and successful testing in Scotland, Magallanes are now looking forward to being part of this exciting project in Wales which has the potential to become one of the largest tidal energy arrays in the world. Local skills, resources and supply chain are key for developers like Magallanes who rely on them for every step of the value chain. The Morlais project is not only being developed in one of the best geographical sites for tidal energy, but also in a country with the skills and expertise needed to move the industry forward.

The Tidal Range Alliance (TRA) is a formal working group of the British Hydro Association that promotes the multi-disciplinary and multi-generational features and benefits of tidal range projects to key stakeholders across Government, industry and the media.

The Alliance highlights that the scale, capacity, reliability and energy security/stability offered by tidal lagoons and barrages will help to meet future electricity demand in a way that is compatible with climate change commitments.

THE OBJECTIVES OF THE TRA ARE TO:

- Help to instigate development of the UK's tidal range industry
- Raise awareness of the range and scale of tidal range projects across the UK
- Communicate the key features and benefits of tidal range projects
- Create and respond to media opportunities for tidal range projects
- Grow and sustain interest in tidal range
- Support tidal range developers and suppliers

Membership is open to developers, civil engineering contractors and consultancies, turbine manufacturers, academic and research organisations and supply chain businesses.

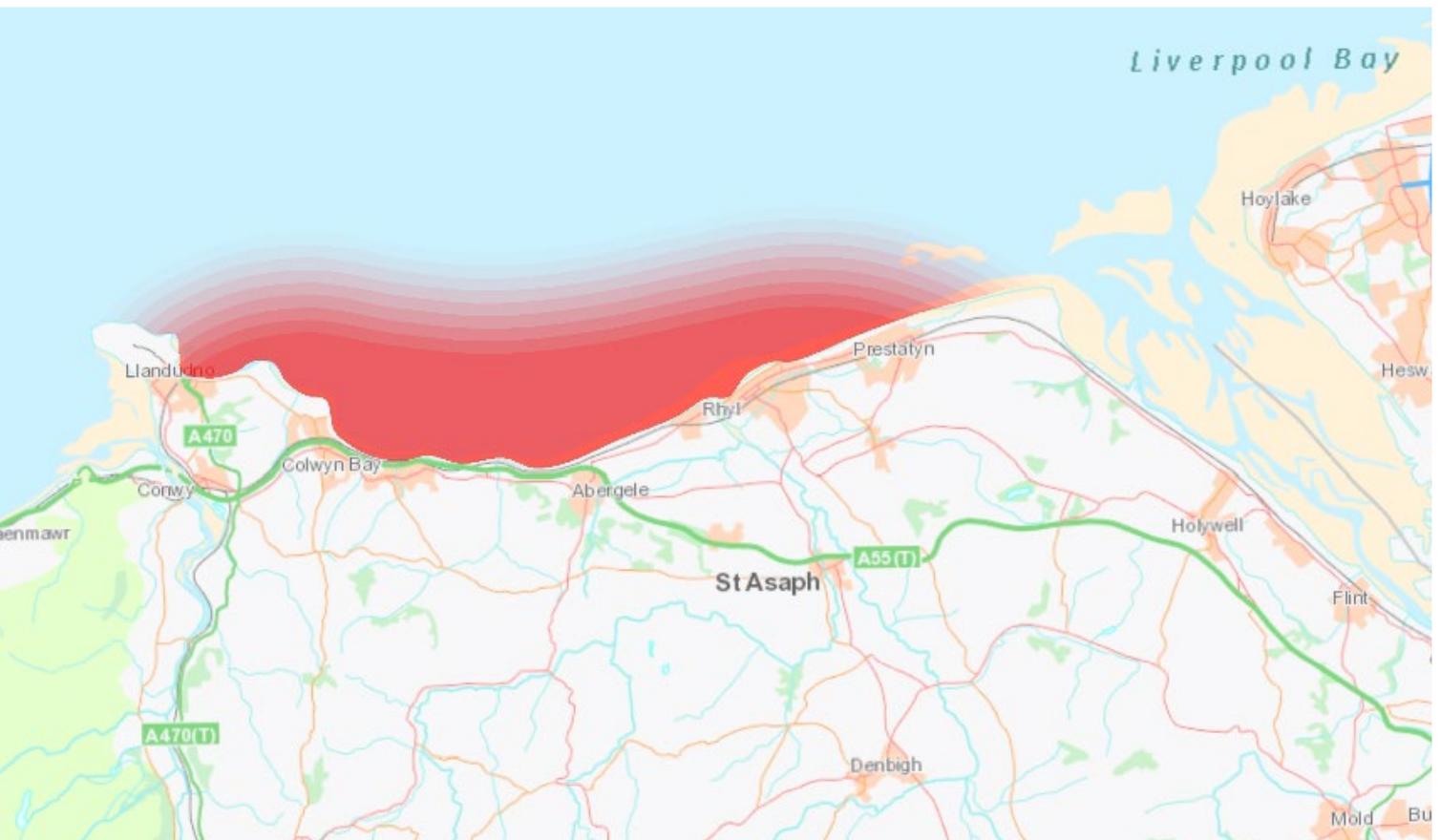




North Wales Tidal Energy Ynni Llanw Gogledd Cymru

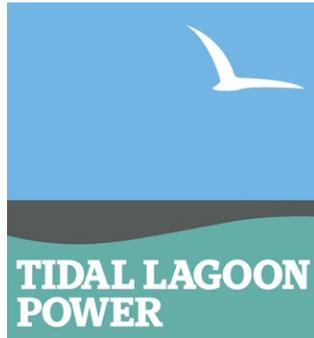
PROJECT UPDATE

North Wales Tidal Energy is driving the development of the North Wales Tidal Lagoon, with a sea wall potentially stretching over 30 km from Llandudno to Prestatyn and covering an area of 157 km². With an installed capacity of 2.5GW, generating over 4.5TWh per annum, the North Wales Tidal Lagoon could deliver entirely predictable blue power to over 1 million homes (nearly 90% of the homes in Wales) and create over 20,000 job opportunities across Wales and the UK. The project's wide-ranging benefits have gained increasing attention as providing a powerful alternative to the employment and energy gap caused by the suspension of the Wylfa Newydd nuclear power plant.



BENEFITS TO WALES

The North Wales Tidal Lagoon has a number of potential benefits including coastal protection and freeing up coastal change land for consideration for development, marine and bird life habitat creation, and providing reliable and predictable electricity for the National Grid with significantly reduced greenhouse gas emissions (2 million tonne reduction per year). Once the capital cost has been paid off, the lagoon could deliver ultra-low-cost energy for a further 70+ years with no waste and no decommissioning needed.



PROJECT UPDATE

The Swansea Bay Tidal Lagoon is designed as the pathfinder for a potential fleet of tidal lagoons capable of satisfying more than 10% of the UK's electricity demand for the next five generations.

Work is currently underway to discharge planning conditions with the aim that Swansea Bay Tidal Lagoon will be a vital component of a Welsh green recovery from the impacts of Covid-19. The developers have completed a statutory 30-day public consultation on the decommissioning plan required by the Department of Business, Energy and Industrial Strategy (BEIS). They have also been working iteratively to sign off the Adaptive Environmental Monitoring Programme (AEMP) for the project with Swansea Council and their consultee, Natural Resources Wales. The purpose of the AEMP is to guide the monitoring, mitigation and management of the environmental effects of the project throughout its lifetime.



BENEFITS TO WALES

The Swansea Bay Tidal Lagoon will create thousands of jobs and launch a new British manufacturing industry. It will pioneer UK built modular construction methodologies, result in the building of a new UK hydro-turbine manufacturing plant and establish Wales as the world leader in tidal power. The project would operate 14 hours a day to generate electricity for 175,000 homes for the next 120 years – working in harmony with nature while regenerating deprived coastal communities and bolstering nationwide industrial employment.

FLOATING OFFSHORE WIND IN WALES

Floating offshore wind (FLOW) projects involve turbines mounted on floating structures tethered to the sea bed, meaning electricity can be generated in water depths where fixed-foundation turbines are not feasible but wind speed is typically higher and more sustained.

In a recent report, the Offshore Renewable Energy Catapult has advised that there could be as much as 50GW of electricity capacity available in the Celtic Sea in Irish and UK waters. It is estimated by the Catapult that the first GW in the Celtic Sea could potentially deliver over 3,000 jobs and £682m in supply chain opportunities for Wales and Cornwall by 2030. Opportunities for floating wind are currently progressing in Wales with the 96MW Erebus project led by Total and Simply Blue Energy announced in 2020 and plans for the Pembrokeshire Demonstration Zone to co-locate floating wind and wave technology.

“The Erebus project represents not only a huge step towards our ambitious climate goals here in Wales, as we look to tackle the impact of climate change, but will also represent a huge low-carbon inward investment into Wales, as we move towards a stronger green economy and provide new supply chain opportunities to businesses within the region. Projects such as these will form the backbone of a prosperous low carbon economy, and will be powered by Welsh ingenuity and innovation.”
Welsh Minister for Environment, Energy and Rural Affairs, Lesley Griffiths.

Image credit: Principle Power

The Celtic Sea Alliance is a collaboration between Wales, Ireland and Cornwall to progress floating wind projects in the Celtic Sea region.

The Alliance includes Cornwall and the Isles of Scilly LEP, Marine Energy Wales and the Marine Renewables Industry Association of Ireland. It actively works with national, devolved and local governments on the best approach to delivering floating wind. Next steps for the Alliance include the formation of a Celtic Sea Offshore Wind Industrial Cluster and continued policy engagement to secure a pipeline of at least 1GW of floating wind turbines in the Celtic Sea before 2030, in turn attracting over £2bn worth of regional investment.

CELTIC SEA ALLIANCE

CELTIC SEA PARTNERS
WITH WELSH MINISTER FOR
ENVIRONMENT, ENERGY
AND RURAL AFFAIRS LESLEY
GRIFFITHS (CENTRE) IN
DUBLIN



Image credit: Roger Kenny Photography



Simply Blue Energy



Blue Gem Wind

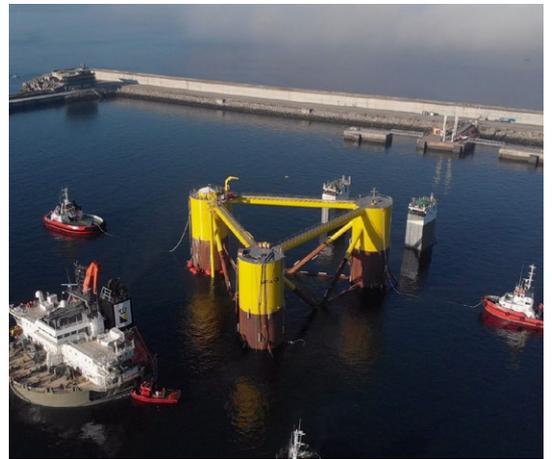
PROJECT UPDATE

Simply Blue Energy, a pioneering Celtic Sea energy developer, and Total, one of the world's largest energy companies, have established a partnership, Blue Gem Wind, to develop floating wind projects in the Welsh waters of the Celtic Sea. The first development will be Erebus, a 96MW demonstration project at water depths of 70m, for which an application has already been submitted to the Crown Estate. The intention is that the project will be developed to use Principle Power's Windfloat® technology, one of the most advanced floating technologies worldwide.

BENEFITS TO WALES

This new partnership between Total and Simply Blue Energy opens a new chapter in the development of renewable energy in the UK. Developing the potential of the Celtic Sea will make a positive contribution to the UK's target of reaching Net-Zero by 2050, whilst offering exciting new opportunities for industry in areas such as Wales and Cornwall. Simply Blue Energy has established an office in Pembrokeshire to work with the local supply chain on the opportunities created by this project.

Simply Blue Energy was founded in 2011. The company develops energy and aquaculture projects around the coasts of the UK and Ireland. This is through capturing energy from floating wind or wave energy projects, or by developing sustainable salmon farms. It secures the best project opportunities in the UK and Irish waters and then brings together the right partners to make it happen. Simply Blue Energy employs 12 people and has offices in Cornwall, Pembroke Dock, Edinburgh and County Cork.



WALES' TEST CENTRE NETWORK – A STEPPING STONE APPROACH

Wales is currently developing a wide range of marine energy test and demonstration facilities. These facilities will provide wave, tidal stream and floating offshore wind developers with a full range of testing stepping stones from component, to scale and full scale sites, through to grid-connected multi array testing, including development and fabrication opportunities. Combined, they will enable valuable learning across the sector allowing developers to reduce the time, risk and cost of developing new technologies. These facilities add value and fit into the existing network of UK test centres and directly support Welsh projects and wider UK deployments, placing Wales on the main stage for this emerging global market.

WALES; A WORLD CLASS CENTRE FOR MARINE ENERGY



SWANSEA UNIVERSITY TEST TANK

The Coastal Engineering laboratory, located in Swansea University Bay Campus houses a 30m wave flume which provides facilities for testing wave forces on coastal structures, nearshore hydrodynamics, wave runup and overtopping, nearshore sediment transport and marine renewable energy devices.

This wave flume, and other laboratory facilities in Welsh Universities allow renewable energy developers to test models and scaled versions of devices in a controlled environment to prove technology concepts, explore simulated forces and engineering challenges and work with the university to find innovation solutions. This test tank can help developers ascend the TRL (Technology Readiness Level) ladder from level 1 to 4.

- Swansea University
- META
- Pembrokeshire Demonstration Zone
- Morlais



META is a £1.9 million project managed by Marine Energy Wales and is developing a series of eight test areas in the Milford Haven Waterway and surrounding areas; providing the opportunity to test devices, sub-assemblies and components. The project's mission is to reduce the time, cost and risks faced by marine energy developers in order to accelerate growth in the sector, while enabling collaborative research and innovation.

Phase 1 of the project is officially open for business allowing short term component and subassembly testing, and consents are currently being sought for phase 2 (expected in 2020) for operational testing of devices. META is easily accessible and therefore ideal for early stage developers, and is also a perfect base for research and innovation. Targeting Technology Readiness Level 4-6, the sites range from sheltered port-based to energetic open sea, yet accessible, locations. META is part funded by the European Regional Development Fund (through the Welsh Government), and the Coastal Communities Fund, and contributes towards Wales' plans to play a key role in a growing global market.

WELSH DEMONSTRATION ZONES

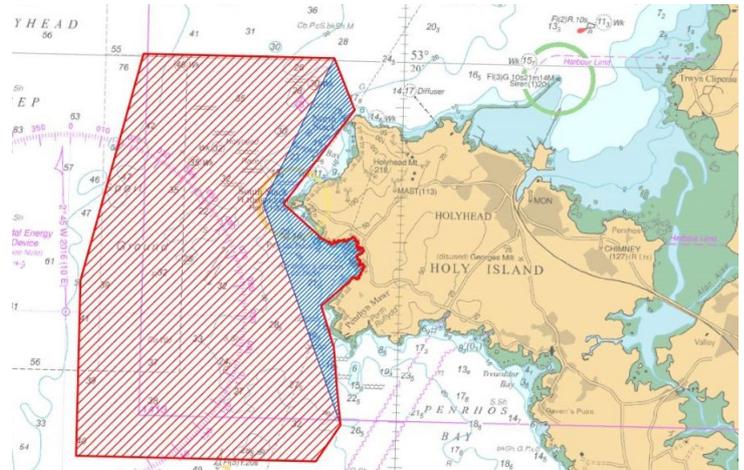
The West Anglesey Tidal Demonstration Zone and Pembrokeshire Demonstration Zone are two of several zones around the United Kingdom which have been leased by The Crown Estate in a bid to encourage and accelerate marine energy technology development. These zones are array scale demonstration zones aimed at testing multiple devices. They were identified because they offer appropriate wave and tidal energy potential and access to necessary infrastructure, including ports and electricity grid.

WEST ANGLESEY DEMONSTRATION ZONE



Menter Môn, a social enterprise, secured a 45-year lease from the Crown Estate for the “West Anglesey Demonstration Zone” in 2014. Morlais was set up by Menter Môn to manage this lease and to secure the maximum local benefit for Anglesey. The Anglesey Zone was selected for its strong tidal resource. Consent applications were submitted in September 2019 for both a Marine Licence and a Transport of Works Act Order. The proposal is to develop the necessary infrastructure to enable tidal stream technology to be deployed in the zone to generate electricity. It will provide a consented tidal technology demonstration zone specifically designed for the installation, testing and commercial demonstration of tidal energy devices as well as providing a route to the distribution network. Morlais has the potential to scale up over time to a generating capacity of 240MW of electricity.

Ten developers and manufacturers from around the world have signed agreements for berths in the zone. The companies who have secured berths include Aquantis, Instream Energy Systems, Nova Innovation, Sustainable Marine Energy, Verdant Isles, Orbital Marine Power, Hydroquest, BigMoon, Magallenes and Sabella. Morlais will develop a network and the necessary links between the local supply chain businesses and the Morlais’ developers.



PEMBROKESHIRE DEMONSTRATION ZONE

The Pembrokeshire Demonstration Zone (PDZ) is a 90km² area of sea leased from the Crown Estate by Wave Hub Ltd, the operating company of the Wave Hub site in Cornwall. The PDZ is located between 15 and 21 kilometres off the south Pembrokeshire coast with water depths of between 50-62 metres. It has the potential to; act as a catalyst in the establishment of a centre for low carbon, at sea, energy production in Wales; develop strategically enabling infrastructure to accelerate the development of offshore energy off of the coast of Wales; enable the deployment of current and future energy generating technologies, up to a capacity of 180MW, to generate green electricity from the sea. The site benefits from a 10 m/s wind resource and offers excellent grid connection possibilities, including a 132kV grid supply point located on the coast, along with world-class deepwater port facilities and support services. Detailed design and environmental surveys are planned to start later in 2020.

Wave Hub Ltd has an office in the Marine Energy Hub in Pembroke Dock and plans to recruit two new members of staff in 2020. Wave Hub Ltd is working in partnership with Milford Haven Port Authority, the Offshore Renewable Energy Catapult and Marine Energy Wales to secure funding for Pembroke Dock Marine (see page 31) and deliver the project over the next 5 years.

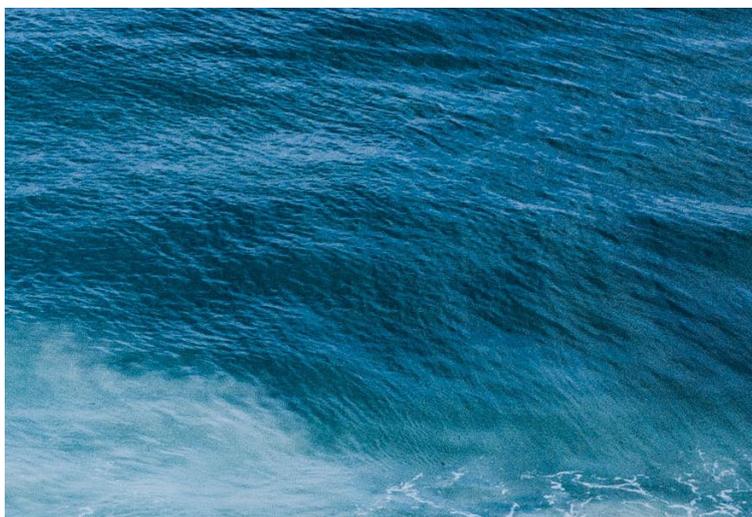
TIDAL STREAM INDUSTRY ENERGISER PROJECT

TIGER TIDAL STREAM
INDUSTRY
ENERGISER



PROJECT UPDATE

The Tidal Stream Industry Energiser Project (TIGER) is a €46 million pan-European project to accelerate the deployment of tidal stream technology and develop supply chain clusters. This work will be supported by a robust evidence base on technology readiness which will support policy. Cambrian Offshore has secured €6.6million of investment to regenerate the tidal energy site at Ramsey Sound. The project will see the site upgraded and a new turbine deployed, repowering the site.



BENEFITS FOR WALES

The Ramsey Sound Tidal Energy Regeneration Project being undertaken by Cambrian Offshore South West Ltd, will see redevelopment of the Ramsey Sound tidal test site. The site presents a considerable opportunity, having already secured over £10m of investment with a dedicated subsea cable, foundations and substation consented and installed. With a unique opportunity to acquire and disseminate learning from the previous deployment, Cambrian Offshore intends to build capacity at the site, redeploying an operational tidal turbine which will generate to the grid. This will aid the marine renewable sector and planned development in Wales by providing operational evidence, data and activity to support sector growth. The project will also provide an operational full scale tidal test facility for Wales and involve additional investment in Pembrokeshire.



MARINE ENERGY ENGINEERING CENTRE OF EXCELLENCE

MEECE, delivered by ORE Catapult, is moving forward as a Centre of Excellence for marine energy engineering based in Pembroke Dock, with a team of 9, and upcoming capability in Anglesey, Cardiff and Swansea. MEECE provides specialist knowledge, experience and capability for the benefit of the industry. MEECE provides a centre for collaboration through coordinated, joint industry approaches, whilst disseminating lessons learned for future projects and improving industry productivity and effectiveness. MEECE will bring the expertise and capabilities of Welsh universities and of the ORE Catapult into direct contact with technology developers and their supply chains, supporting more innovation, and capturing and embedding that innovation in Wales.

Currently housed in the Bridge Innovation Centre, the MEECE team will be looking at workshop delivery space and expanded premises, as the team and project pipeline continues to grow.



PEMBROKE DOCK MARINE



HWB MOROL DOC PENFRO PEMBROKE DOCK MARINE

Pembroke Dock Marine brings together the MEECE, META and PDZ projects alongside the Port of Milford Haven's Pembroke Dock Infrastructure development (PDI), under the £1.3 billion Swansea Bay City Deal. The bid is currently with UK and Welsh Government for final approval. PDI is focused on reshaping the physical infrastructure of Pembroke Port, Gate 4, to ensure maximum operational efficiency. This element of the project aims to create large open plan fabrication and laydown areas and create enhanced land to sea transition spaces including a supersize slipway and dedicated berthing for work boats to meet the needs of modern industry.

Representing a **£60 million project**, PDM is expected to bring over **1800 jobs** to the area and boost the Swansea Bay City Region economy by **£73.5 million a year**. Developing facilities and services that unlock growth, capacity and capability the focus is to drive marine energy innovation and maximise operational efficiencies through the development of a world-class centre for marine energy and engineering. Leveraging public and private investment of £32 million, PDM will support projects pan-Wales and enable the UK to retain its position in the world's top marine energy players, opening up a significant international export market. This will enable developers to design, test, build and deploy devices, while benefitting from Pembrokeshire's proximity to superb natural energy resources and an experienced, high-skill supply chain.

BY CREATING A UNIFIED, DEDICATED DEVELOPMENT AND DELIVERY SITE, PEMBROKE DOCK MARINE WILL:

- Support developers through the provision of infrastructure, facilities, knowledge and skills across the life-cycle of technical readiness levels as they move towards commercialisation.
- Help reduce the price of marine derived energy.
- Support regional economic growth.
- Minimise risk for investors and developers.



INVESTING IN SCIENCE, RESEARCH AND INNOVATION

WALES IS HOME TO TOP QUALITY RESEARCH
AND EDUCATION FACILITIES.
BELOW IS A SNAPSHOT OF CURRENT
RESEARCH PROJECTS WITHIN
WELSH UNIVERSITIES.

NEW PROJECTS

THE PAST YEAR HAS SEEN A NUMBER OF NEW AND NOVEL MARINE
ENERGY-CENTRED PROJECTS COMMENCE ACROSS WELSH INSTITUTIONS.



Developing a streamlined commercialisation pathway
for the marine renewable energy industry INTERREG,
2019-2021

Funded by the European Regional Development Fund, through the Ireland-Wales cooperation programme, SELKIE is a cross-border project which is bringing together leading researchers and businesses to improve the performance of marine energy devices and technologies. University College Cork are leading the project in partnership with Marine Energy Wales, Menter Môn, Swansea University, DP Energy Ireland and Gavin and Doherty Geosolutions. SELKIE aims to support the marine energy sector by developing tools and improving services that will assist developers and supply chain companies to progress towards commercialisation. These tools include techno-economic models, foundations and mooring designs, array models, and operations and maintenance logistics. As part of the project, the tools will be trialled on wave and tidal devices to test their reliability, survivability and commercial potential. Furthermore, over 150 Irish and Welsh businesses will benefit from the project over three years. Support for businesses looking to diversify in to the sector will be provided through events and consultations. The first event took place in North Wales in March with upcoming events planned for South Wales and Ireland. The project aims to strengthen collaboration between Wales and Ireland in the marine energy sector.

SMART EFFICIENT ENERGY CENTRE (SEEC), ERDF, 2019-2023

SEEC is a £7M research centre at Bangor University working across three low carbon energy sectors: ocean energy, nuclear energy, and energy efficient structures. The three themes are interconnected by a common cyberinfrastructure hub. SEEC has received £4.6M in funding support from the Welsh European Funding Office (WEFO).



Image credit: Pixabay

The overarching aim of the ocean renewable energy research in SEEC is cost reduction, through a combined modelling and observational approach. The specific objectives are:

- Improved resource characterization.
- Improved understanding of multiple resource interactions.
- Exploring future grid integration of marine renewable energy.
- Improved methods of quantifying environmental impacts.

ONGOING PROJECTS

2020 SEES THE CONTINUATION AND EXTENSION
OF A NUMBER OF BREAKTHROUGH PROJECTS.

SURFTEC, SURVIVABILITY AND RELIABILITY OF FLOATING TIDAL ENERGY CONVERTERS, EPSRC, 2016-2020

Computational modelling and real sea deployment measurements will provide a tool for floating tidal devices and arrays. Measurements have been taken from the deployment of Sustainable Marine Energy's PLAT-I device in Connel Sound, Scotland and Grand Passage, Canada. EMEC are providing input on extreme loadings (survivability) and working with Black and Veatch on guidelines.



Image credit: Jack Hughes, Swansea University

ECOSTRUCTURE, CLIMATE CHANGE ADAPTATION THROUGH ECOLOGICALLY SENSITIVE COASTAL INFRASTRUCTURE, IRELAND-WALES PROGRAMME, 2014-2020

Ecostructure is a collaboration between Aberystwyth University, Bangor University, Swansea University, University College Dublin and University College Cork. The project aims to promote the use of eco-engineering approaches to enhance biodiversity, ecosystem function and ecosystem services associated with artificial structures in the coastal and marine environments. Phase 1 of the project focussed on structures in the intertidal zone, associated with ports, marinas and sea defences. Phase 2 (beginning 2020) will extend this approach to offshore structures and investigate potential benefits for commercially important species.

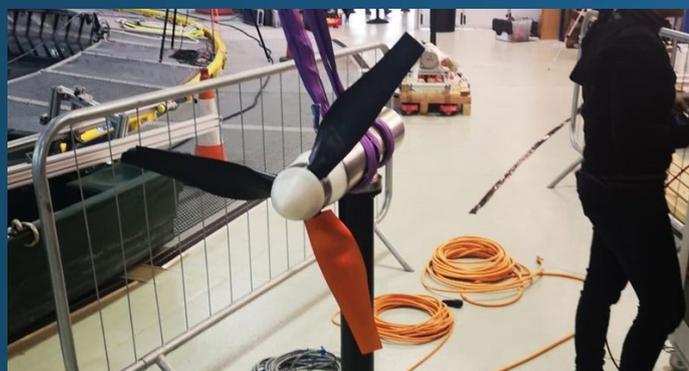


Image credit: DyLoTTA

DYNAMIC LOADINGS ON TURBINES IN A TIDAL ARRAY (DYLOTTA), EPSRC, 2016-2020

The Dylotta project research, led by Cardiff University, working with Strathclyde University investigated the nature of the loading patterns imparted onto tidal stream turbines when positioned and operated within an array and develop operational procedures to mitigate the impacts of these extreme loading patterns. Exposure to open sea wave climates with high wave-current interactions will influence the power generating, structural integrity, product durability and maintenance requirements of the technologies deployed. The research has undertaken both experimental and numerical analyses in a manner that will make the results and findings transferable to real-life implementations. This will inform developers of the peak and fluctuating loads that devices are exposed to in a commercial array environment and will also identify and test mitigating actions to be implemented in order to ensure the robustness and sustainability of the array. Partners include Nautricity and ANSYS.

METRIC, IMPROVING METHODS OF CHARACTERISING RESOURCE, INTERACTIONS AND CONDITIONS OF MARINE RENEWABLE ENERGY, EPSRC. 2018-2021.

The EPSRC Offshore Renewable Energy fellowship, METRIC, aims to support Blue Economy industries across the globe. In the marine energy sector METRIC aims to assist in the expansion from grid-connected low-MegaWatt developments to scalable and globally deployable devices. Working alongside global partners METRIC develops and applies numerical ocean modelling tools to map resource and ocean conditions. Recent publications in open access journals have shown: (1) tidal-stream electricity is of “high quality” and predictable to sub-second scales; (2) this work is already informing the design of optimal wave energy devices. Future research will consider bio-engineering of marine renewables and offshore aquaculture.



**UK Research
and Innovation**



The SEACAMS2 project supports developing economic opportunities in Low Carbon, Energy and Environment through specialisation in commercial application of research and innovation in marine renewable energy, climate change resilience and resource efficiency in Wales. The £17m project, a partnership between Bangor University and Swansea University, is part-funded by the European Regional Development Fund and focuses on the convergence region of Wales. SEACAMS2 has made good progress in achieving its objectives and is producing results which support both individual companies and the sector as a whole. Examples of areas of SEACAMS2 Activity include:-



- Tide/wave modelling. Bangor University has developed current/wave interaction models to assess inner shelf environments on a range of scales (from local to regional) and predict energy resource, characterize specific sites and model environmental interactions. A North Wales sediment transport model has been developed to predict seabed stability and model effects of ORE installations. These models have been developed and applied in collaborations with a wide range of tidal stream, wave and tidal range developers. Swansea has developed tide and wave models covering the Welsh coast with Tidal Lagoon Power (TLP), which have been re-used in further projects with Wavehub (covering the Pembrokeshire Demonstration Zone), Bombora and Marine Energy Wales (MEW). More detailed monitoring and modelling of both wave and tides is being undertaken in the Milford Haven Marine Energy Test Area (META).
- Swansea University have also been undertaking some product development, including small scale flume tank initial testing of device configuration underpinning prototype, design, build and deployment (Wave-Tricity Ltd) and the development of a new Seabird survey tool (the 'Ornithodolite', with MEW) for MRE site characterisation and impact assessment. Ongoing development of the new iMarDIS data portal, which provides a platform for businesses in the ORE sector to access data, information, tools and products.
- The recent launch of the new iMarDIS data portal portal.imardis.org provides a platform for businesses in the ORE sector to access marine data, tools and products.
- Seabed characterization to map seabed morphology and sediments, assess seabed stability, risk mitigation (in both demonstration zones), and modelling of sediment transport and potential interactions with ORE development.
- Ecological interactions of ORE devices with seabirds, marine mammals, fish and benthic habitats and fish migration/populations studies, including projects with a range of developers and potential resource areas.
- Interaction of biota with engineering devices including biofouling and impact on construction materials.



MONITOR, MULTI-MODEL INVESTIGATION OF TIDAL TURBINE RELIABILITY, INTERREG ATLANTIC AREA, 2018-2021

If tidal energy converters (TECs) can contribute to decarbonisation of electricity generation, they must be able to compete with other renewable sources on price. The biggest technical obstacle to reducing the electricity price from early-stage tidal stream turbines is operations and maintenance, and improving turbine reliability is vital for reducing the amount of maintenance TECs require. MONITOR brings together an international network of universities and SMEs to use data from real early-stage commercial turbines, lab tests and numerical modelling to create a general reliability model of TECs based on real test cases, and to predict how much better reliability will improve the cost of tidal energy.

MARINE ENERGY WALES SUPPORTING EMERGING TECHNOLOGIES IN WALES

This report clearly demonstrates the positive impacts marine energy continues to have in Wales. Positive impacts on **peripheral economies**, where **well paid high skilled jobs** are being created in coastal communities. Positive impacts on the local supply chain where the sector has provided **diversification** opportunities and **resilience** as pre-existing engineering markets slow in Wales. Positive impacts on Welsh universities as **world-leading research** is carried out, creating synergies with other cutting-edge expertise and skills. Positive impacts on **inward international investment** as innovative global companies set up their British and global headquarters here in Wales.

Alongside this, **public support** for marine energy is at a record high with the UK currently holding onto a **global lead** in marine energy with concepts proven, devices breaking records and projects progressing towards commercialisation. With a history of developing energy projects with imported technology, wave and tidal may be the only low carbon technology that is **ours to own and export** into a growing market. The sector also offers potential to **'level-up' our coastal regions** and contribute to the overall health of the UK economy.

Whether the UK holds on to this lead and benefits fully from this new low carbon opportunity will ultimately **depend on UK Government policy providing a route to market and appropriate revenue mechanism for the industry**. The publication of the ORE Catapult report demonstrating that marine energy can **pass the 'Triple Test'** - achieving maximum carbon reduction; showing a clear cost reduction pathway, and demonstrating that the UK can be a world-leader in a global market, is extremely encouraging. As MEW, we will continue working with the Marine Energy Council and colleagues from across the UK to raise these points to UK Government.

Wales, along with other devolved nations and regions are supporting marine energy, both for the socio-economic reasons highlighted in this report and for the contribution marine energy can make to our **2050 net-zero targets**. With the recent IPCC report stating that urgent and unprecedented changes are needed to limit climate change catastrophe, I have no doubt energy from our oceans will need to play a future role in mitigating what is the most significant threat to the planet.



JESSICA
HOOPER

PROJECT LEAD
MARINE ENERGY WALES

MARINE ENERGY WALES OBJECTIVES



Marine Energy Wales brings together technology developers, the supply chain, academia and the public sector to establish Wales as a global leader in sustainable marine energy generation and to make a significant contribution to a low carbon economy. We collaborate with Celtic nation neighbours to promote and elevate the industry resulting in meaningful engagement and valuable development.

MEW has delivered multiple benefits to Welsh Government and industry, with Wales now recognised as one of the leading countries in the world for marine energy. Feedback received from MEW members has highlighted the top 5 industry priorities as:

- **Supporting marine energy policy development and leadership**
- **Promoting Welsh capability and attracting inward investment**
- Developing Welsh supply chain to promote jobs and growth
- **Collaboration, sector networking and sector representation**
- Education work with developers, teachers and schools to inspire future generations about marine energy
- **Facilitating the streamlining of consenting processes**
- Supporting the strategic alignment and integration of test sites and projects
- Operating a Marine Energy Testing Area in the Haven Waterway
- Facilitating research co-ordination in Wales
- Providing bespoke support, guidance and advice to developers and supply chain
- Facilitating knowledge transfer and collaboration
- Developing strategic international relationships
- **Ensure sector financing reflects industry needs**

"The formation of this pan-Wales body to drive forward the industry and encourage collaboration between all the interested parties is very timely and very welcome. The renewable marine energy sector has real potential for Wales which is a key location for the development and deployment of new innovative technologies. We need to ensure we are in pole position to maximise these opportunities, attract investment and create jobs and Marine Energy Wales has an important role to play in helping us achieve this."

*Cabinet Secretary For
Economy And Infrastructure,
Ken Skates*

"We are striving to make Wales a leading player in the marine energy field with energy generated from waves and the tide playing an important role in our ambitions for a low-carbon economy".

"Our aim is to generate 70% of our energy from renewable sources by 2030. The marine energy sector can play a significant role in helping Wales achieve this target and will be closely aligned with Wales' first National Marine Plan"

"All this underpins our ambition to build a thriving industry generating well-paid jobs and business opportunities in Wales. We want to continue to attract developers from around the world to our Welsh waters"

*First Minister
Mark Drakeford*

"We are determined the recovery from the Covid-19 pandemic will accelerate the transition to a low carbon economy and a healthier, more equal Wales. I consider marine and offshore renewable energy will play a fundamental part in building this future.

I have written urging the UK Government to work with the devolved nations to ensure their financial support mechanisms for energy deliver for the whole of the UK.

I am pleased the decision on our joint funding for the Swansea Bay City Deal will provide an additional boost for this industry in Wales. This is a demonstration of our commitment to the development of a Centre of Excellence for marine technology in Wales. The Welsh Government is committed to working with partners to deliver long term benefit from marine energy for Wales."

*Minister for Environment, Energy and Rural Affairs
Lesley Griffiths*

WHY WALES ?

Wales has a unique package to offer, including:

- **A Diverse Resource** Wales has significant wave, wind, tidal stream and tidal range resources.
- **People** Wales has an experienced and skilled supply chain with extensive industrial and energy sector experience, which has already seen diversification into construction and deployment of marine energy devices. The Welsh supply chain has the capability, capacity and ambition to deliver marine energy projects and the burgeoning industry offers real opportunities for local companies to diversify.
- **Developers** There are 16 marine energy developers actively progressing projects in Wales with seabed agreements in place for over 532MW of marine energy.
- **Test Centre Network and Demonstration Zones** A number of test and demonstration sites are under development in Wales including the Pembrokeshire and Anglesey array scale Demonstration Zones, Marine Energy Test Area and Ramsey Sound. These projects will provide test beds for innovative wave, tidal stream and floating wind technologies, enabling valuable learning across the sector and adding to the UK's world-leading test centre network.
- **Technology and Research** Expert academic and world-class marine energy research facilities at Swansea, Bangor and Cardiff universities.
- **Infrastructure** Wales has 8 strategically located ports and facilities sited along the North, West and South coast.
- **Grid Connection** Wales has accessible 400kv transmission lines adjacent to resource areas.
- **Celtic Sea Alliance** Wales is collaborating with Cornwall and Ireland to harness the huge opportunity for floating wind in the Celtic Sea.
- **Swansea Bay City Deal** The £60 million City Deal 'Pembroke Dock Marine' project includes a UK Catapult led Marine Energy Engineering Centre of Excellence based in Wales, Marine Energy Test Area, Pembrokeshire Demonstration Zone and port infrastructure upgrades to develop a hub for marine energy in Pembrokeshire.
- **Welsh Government support** Wales has a government that is championing marine energy through the Welsh National Marine Plan, Wellbeing of Future Generations Act, International Strategy and Natural Resources Policy. Policy is backed with significant funding which includes €100.4 million of EU structural funding specifically for wave and tidal stream and the £60 million Swansea Bay City Deal.

MARINE ENERGY WALES ANNUAL HIGHLIGHTS

CONSENTING STRATEGIC ADVISORY GROUP (CSAG)

In 2019 the First Minister and Minister for Environment, Energy and Rural Affairs met with representatives from Natural Resources Wales, Marine Energy Wales and Welsh Government to discuss the consenting process in Wales as it applies to marine renewables. CSAG was formed to collaborate on identifying and overcoming barriers to the efficient and timely licensing of marine renewables in Wales. The group includes MEW members, NGOs and NRW technical specialists and MEW acts as secretariat.

The CSAG meets bimonthly and aims to:

- Help to identify specific regulatory risks and issues
- Provide a forum for regulators, advisors, government and industry involved in marine energy projects to discuss and act to resolve the regulatory challenges associated with the deployment of marine energy projects.
- Identify appropriate routes by which regulatory and environmental issues and risks could be resolved
- Share good practice and encourage knowledge transfer

INTERNATIONAL STRATEGY

In 2019, the MEW team were delighted to host the Minister for International Relations at their offices in Pembrokeshire. Our engagement and demonstration of the Welsh capability represented in our membership no doubt aided in the inclusion of Marine Renewable Energy in Wales' International Strategy;

"It is our ambition for Wales to become established as a global centre of excellence for marine energy, including for its ongoing research and development. We will work with companies to create the conditions to test new technology and to grow the industry; to establish marine energy as a foundation of the Welsh economy and to export its potential beyond our shores.

Developers from around the world are keen to invest in Wales; to take forward projects in Welsh waters, as we have one of the best marine energy resources and support structures to be found anywhere in the world. We are taking a cross-government approach to encourage and support the development of the wave and tidal sector in Wales.

Today, the Welsh economy has been transformed and Wales is at the forefront of the green energy revolution - we have the winds, the waves and the water to power the energy needs of the next generations. We are poised to embrace and exploit the opportunities"

*Minister for International Relations & Welsh Language.
Eluned Morgan,*

In early 2020 MEW were thrilled when Natural Resources Wales launched an Offshore Renewable Energy Programme (OREP) to support the industry.

NATURAL RESOURCES WALES OFFSHORE RENEWABLE ENERGY PROGRAMME

Recruiting for thirteen positions within NRW to deliver a programme of work designed to support sustainable offshore renewable energy such as wind, wave and tidal power, it was recognised as further evidence of the commitment to marine energy in Wales.

Natural Resources Wales is critical to Wales' ambition to decarbonise our future and MEW will continue to work collaboratively with them so that marine energy can play a role in a low carbon Wales. OREP will undoubtedly support the recently adopted Welsh National Marine Plan which provides a framework for the sustainable management of Welsh seas where increasing marine energy is a priority.

MARINE ENERGY EDUCATION

MEW worked with ORE Catapult's MEECE Team and Mainstay Marine Ltd to develop a practical workshop to engage 16-18 year olds with some the challenges of developing a marine device. The resulting workshop saw the students designing a prototype, selecting materials and constructing to time and budget constraints. MEW were on hand to support ORE staff deliver the workshop receiving excellent feedback from participants."

MEW's Marine Energy education programme seeks to inspire future generations about marine energy. We work with schools, businesses and coastal stakeholders to provide learning opportunities that are engaging and authentic for learners at all levels.

- We work closely with teachers to create activities that meet the needs of the new curriculum and their learners.
- We work in partnership with marine energy experts from a range of organisations to give learners a genuine insight into the challenges and opportunities.
- We promote careers linked to the Marine Energy sector.

MARINE ENERGY VISITOR CENTRE

The mobile Marine Energy Visitor Centre is an interactive exhibition covering what marine energy is, and the opportunity it offers to provide clean energy and development of the economy for coastal Wales.

- It covers tidal range, tidal stream and wave technologies.
- Developed as part of Marine Energy Test Area, it showcases technology developed in Wales and the role that META will play in the development of the industry.
- The two robust interactive cabinets are designed to be loaned to public venues such as libraries, museums, and innovation centres. The display is also suitable for larger events.

Through 2019-2020 the visitor centre has been on tour, spending time in the Centre for Alternative Technology, in Anglesey and in various locations in Pembrokeshire.



YNNI MOROL CYMRU

Our Funders



Llywodraeth Cymru
Welsh Government



Our Members



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