MARINE ENERGY WALES

YNNI MOROL CYMRU

STATE OF THE SECTOR 2021

ECONOMIC BENEFITS FOR WALES

www.marineenergywales.co.uk

With each new edition of this annual report, we look to build upon and improve the quality of the information we present. Collaboration and knowledge sharing on methodologies and best practices is therefore an important part of this process of improvement.

In order to add a greater level of rigour to the facts and figures presented in this year's report we reached out to the Offshore Renewable Energy Catapult during the study's initial design phase. Staff from the Catapult reviewed and interrogated our methodology, providing feedback to help improve our data collection and to ensure that the overall results were produced by reliable means.

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INTRODUCTION

In response to the Climate Emergency declaration by Welsh Government in 2019, developing marine renewable energy offers Wales a realistic opportunity to deliver a low carbon economy and reduce carbon emissions. 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. This is through tapping into an export market worth an estimated £76 billion by 2050 and by making Wales one of the most attractive locations for offshore renewable energy. 2020 saw the first export of a Welsh manufactured marine renewable energy device, with many other developers now also pursuing opportunities to sell their technology internationally. Additionally, international companies have their sights set on Wales thanks to the development of world leading plug-and-play test and demonstration zones for marine energy.

We are already seeing the benefits created by a growing marine renewable energy industry, including highly-skilled employment in coastal regions, and regeneration and growth of rural economies and port infrastructure. A further increase in work prospects is also expected to retain and attract more young people to rural areas. For existing local supply chain companies, the marine energy sector provides opportunity to diversify into a new industry; anchoring jobs, upskilling staff and building overall resilience. By supporting local supply chain companies, value from investments can be kept locally in Welsh communities.

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: 2021 State of the Sector report details these positive developments in the industry, and looks forward to what the future has to offer. The findings of our industry survey will also be revealed, along with information on wave, tidal stream, tidal range, and floating offshore wind energy projects currently under development in Wales.

KEY FINDINGS

20 emerging marine renewable energy developers are actively progressing projects in Wales.

465 MW of marine energy sites have been leased in Welsh waters, with developments underway to begin generating power.

3.4 GW of additional sites have been identified for future development.

£152.4 million has been spent to date in Wales on the development of the marine energy industry. This includes wave, tidal stream, tidal range and floating offshore wind technologies as well as the supply chain and academic research.

£29.1 million has been invested over the last year, showing that the sector continues to grow in spite of the economic uncertainty brought on by the Covid-19 pandemic.

1,210 person years of employment have been generated within the industry in Wales to date, creating economic opportunity while working towards net zero, the sector is providing skilled employment and spurring low carbon economic growth in coastal regions across the country.

4 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.

1.5 GW of floating offshore wind projects have now been proposed in the Celtic Sea, as the region looks set to take centre stage in the deployment of floating wind turbines over the coming decades.

1.5 MW Bombora mWave will be deployed into Welsh waters later this year, making it the world's most powerful wave energy device built and deployed to date.

Minesto's DG100 tidal kite became the first Welsh manufactured marine energy device to be installed internationally.

Anglesey and Pembrokeshire ports have secured a significant amount of investment to increase their capacity in line with growth of marine renewable energy.

World class research facilities continue to expand across Wales, offering a wide range of services to commercial businesses.

The Selkie Project has ramped up activity: channelling lessons learned from industry and academia into useful tools and outputs; helping to bring down costs in industry; and offering business support to new companies breaking into the sector.

FOREWORD

As I write this foreword for the 2021 State of the Sector Report the First Minister has just published his Welsh Government's Programme for the 6th Senedd. Amongst much salient policy related to the extreme circumstances through which we have been living for nearly 18 months now, the First Minister in his foreword for the Programme writes that his Government "will act decisively to tackle the climate and nature emergency so that people can go on treasuring Wales' rich natural resources for generations to come". And "At this extraordinary time [the Programme] will move us forward towards the greener, ever more successful Wales that we all want for ourselves and for each other".

Can there be a better remit for our work in MEW and in our industry, as is so amply demonstrated in this report?

MEW's roots are deep in the coastline of Pembrokeshire where it was recognised that the region's natural wave and tidal resources presented a great opportunity to explore the prospect of marine renewable energy sources but recognising too the conservation sensitivities in the rich and diverse environment. Marine Energy Pembrokeshire became Marine Energy Wales in 2015 to reflect the simple fact that those natural resources are apparent around all the coastline of Wales and Anglesey in particular has become a hive of activity; our work is to promote the development of our industry on a Welsh national scale. Happily, I am sure that as you digest the content in the following pages highlighting the progress not only this year but in past years too, you will see that the extent of projects is a true pan-Wales success story.

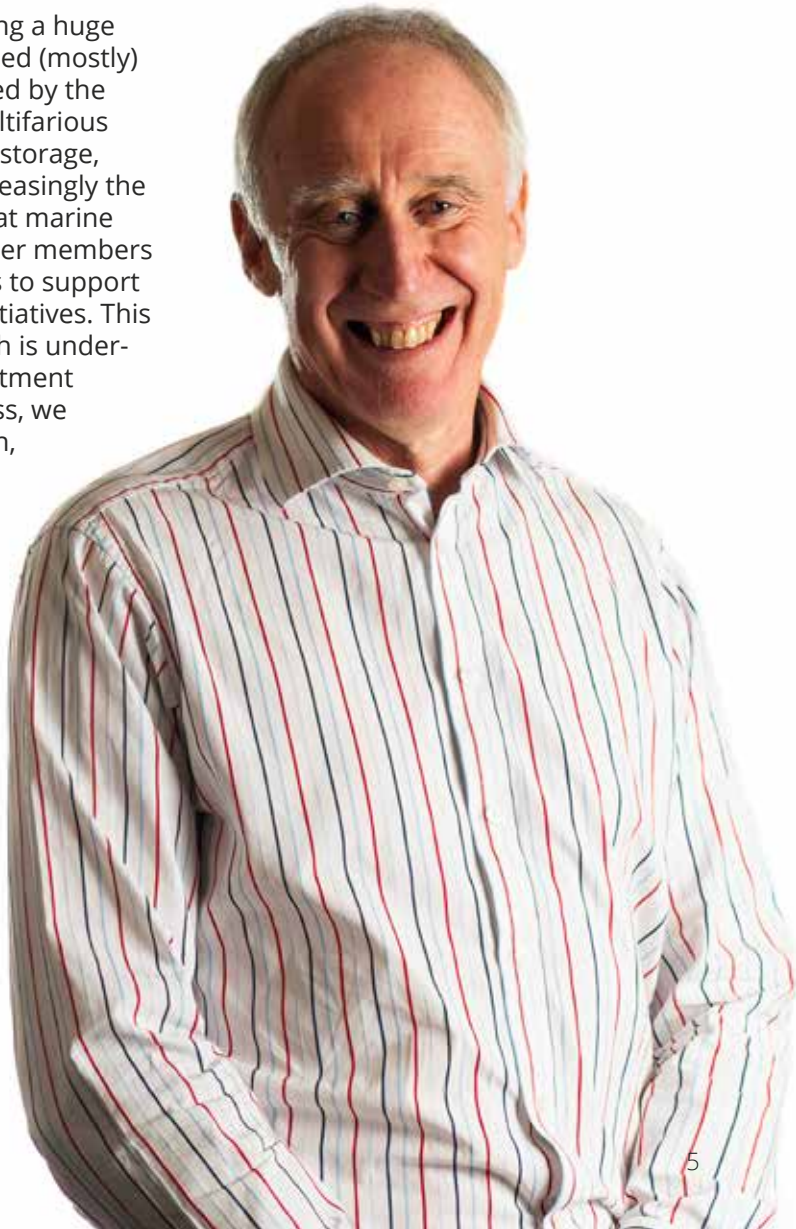
But there is much to do and to play for. We are witnessing a huge transformation in our energy systems from the centralised (mostly) fossil-fuel based electricity generating network stimulated by the Industrial Revolution, to a significantly decentralised multifarious system to include renewable energy generation, energy storage, nuclear power and hydrogen. System integration is increasingly the watchword, and in that context we remain convinced that marine energy will have its part to play. Our technology developer members are repeatedly reporting success in fundraising activities to support their work, notably in over-subscribed crowd funding initiatives. This demonstrates clear public support for what we do, which is under-pinned by the quite excellent endorsements and commitment from the First Minister and his Government. Nevertheless, we should be fleet of foot, as necessary adjust our approach, and re-position as required to reflect transition to wider integration in the energy system.

And so, to all who may read these pages, I commend the work of our developers who continue to show their commitment to wave energy systems, to tidal stream and tidal range. We are increasingly alert to the coming of Floating Offshore Wind Energy which has so much synergistic benefit with what we are already doing, and to the developments in hydrogen championed for example in the South Wales Industry Cluster and the Holyhead H2 Hub.

In MEW we remain committed to the promotion of collaborative working, bringing together all stakeholders in our industry – government, regulators, project and technology developers, supply chain and academic institutions. I hope you can agree that this report demonstrates how we collectively are accepting the First Minister's challenge.

MARTIN MURPHY

CHAIR OF MARINE ENERGY WALES



MARINE ENERGY'S UNIQUE BENEFITS TO WALES

Marine renewables offer an untapped solution to climate change. They offer the possibility of harnessing an abundance of predictable clean energy from Welsh waters, which can contribute to Wales' net zero targets and fulfil our international agreements on carbon emissions reductions, whilst also decarbonising our energy supplies.

Marine renewables contribute to a diverse and resilient energy mix. The wind is not always blowing and the sun is not always shining. Marine renewables can address fluctuations in these energy sources to ensure that the lights stay on. They also enable energy independence by reducing our reliance on fuels imported from abroad. Generating power from multiple diverse sources is key to delivering a continuous uninterrupted supply of renewable energy to our homes.

Marine renewables provide jobs and opportunities in coastal communities. A homegrown industry creating high-quality skilled jobs can help bring about regeneration to level up coastal regions. By creating more opportunities across a range of careers for meaningful employment around our coast and so helps retain talent and nurture skills in Wales.

Marine renewables can play a key role in a green recovery. The industry has already shown continued growth in the face of the covid-19 pandemic. Targeted support can stimulate further growth as part of a sustainable economic recovery, creating and maintaining jobs in a resilient industry with long-term prospects.

Marine renewables can become a national export, bringing prosperity to Wales. Through supporting innovation to develop world class marine renewable technologies and their specialist supply chains, Wales can become a global leader in this industry. Aligning our rich maritime and industrial heritage with 21st Century needs could enable Wales to become a major exporter of marine renewable technologies and the associated knowledge, know-how and expertise; tapping into an ocean of wealth and opportunity.

Marine renewables can position Wales as the leading offshore renewable energy power station in the UK. Wales's unique geography has blessed the country's waters with abundant tidal stream, tidal range and wave resource, as well as significant deep-water areas suitable for floating offshore wind. In Wales, we have the ability to host technologies that draw on all of the above resources, providing clean, green energy through harnessing the power of our oceans and accelerating Wales' commitment to decarbonisation. With the right level of support and investment to enable continued innovation, Wales could become one of the best and easiest places to produce offshore renewable energy.

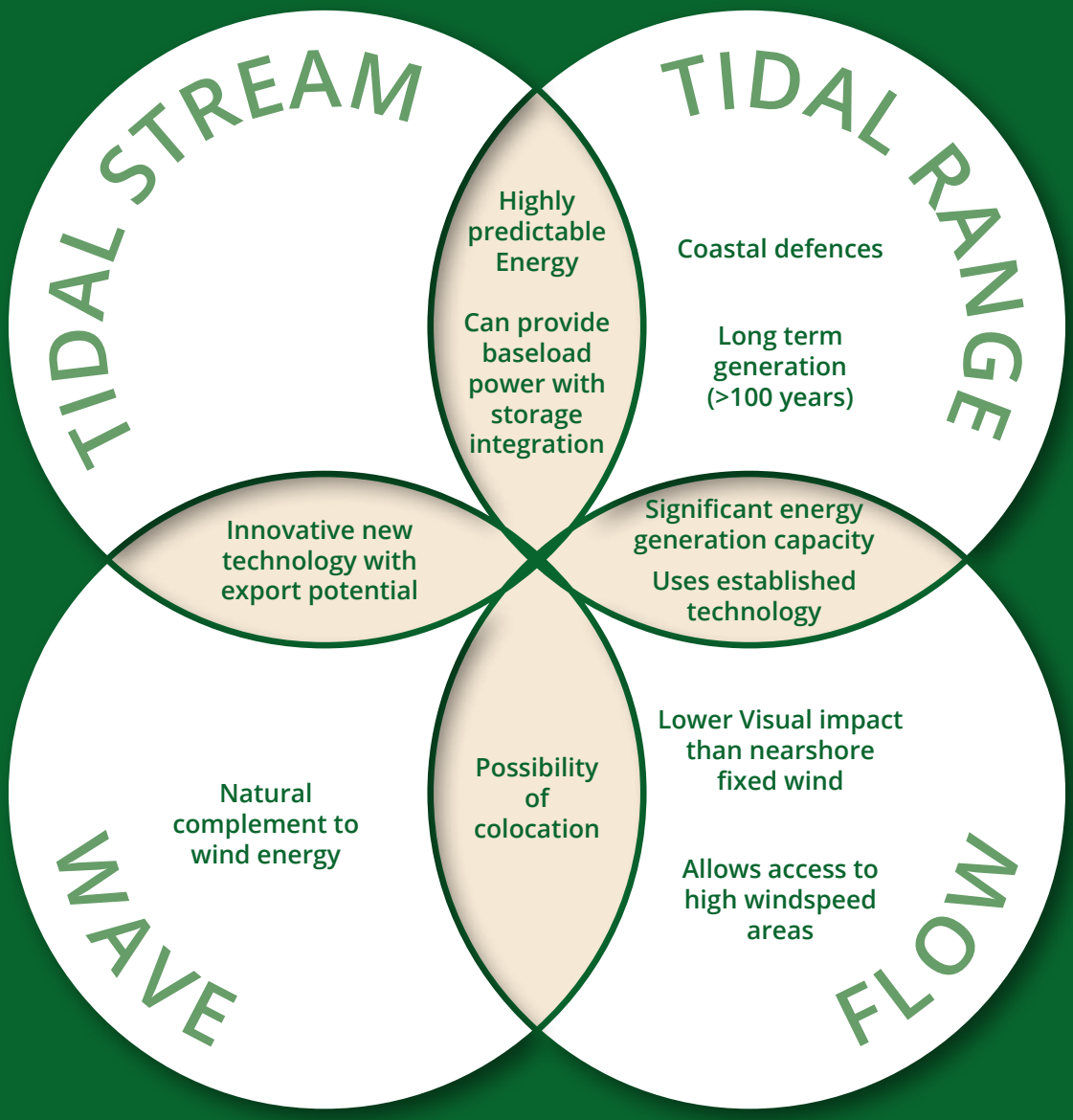
TYPES OF MARINE ENERGY AND THEIR UNIQUE BENEFITS

TIDAL STREAM

Tapping into the powerful tidal currents that flow around our shores offers renewable energy that can be planned for and predicted, using tried and tested turbine technology in the marine environment. The technology is now well established and costs continue to fall with every new project installed.

TIDAL RANGE

The construction of large-scale lagoons or barrages that retain and then release the incoming tide also offers renewable energy that can be planned for and predicted. Tidal range projects can generate electricity on a substantial scale and are able to power homes for generations to come, with many also providing a coastal defence against flooding.



WAVE

Driven to our shores by distant winds over the ocean, waves are a forecastable form of renewable energy representing an opportunity of unrivalled scale. Innovative new technology continues to be developed, tested and demonstrated to expand the possibilities of harnessing clean power from the sea.

FLOATING OFFSHORE WIND

Bringing together proven wind turbines and innovations in floating structures opens up new opportunities in offshore wind. Deeper waters and windier areas, further out to sea, are now accessible. The new frontier of the Celtic Sea offers up a wealth of opportunity to the Welsh supply chain.

INVESTMENT INTO MARINE ENERGY PROJECTS TO DATE

TIDAL STREAM ENERGY:

Tidal stream energy developers including Minesto and Nova Innovation, along with the development of the Morlais demonstration zone, have contributed a total of £66.8 million of direct investment to the Welsh economy to date. This represents an increase of £48.4 million since 2015, and an increase of £16.9 million since 2020.

WAVE ENERGY:

Wave energy developers, including Marine Power Systems and Bombora, and the development of the Pembrokeshire Demonstration Zone have contributed £31.1 million direct investment to the Welsh economy to date. This represents an increase of £30.2 million over the past six years, and an increase of £4 million in the past year.

TIDAL RANGE ENERGY:

Tidal range energy developments in Wales, including Swansea Bay Tidal Lagoon and North Wales Tidal Energy have contributed £6.3 million of direct investment to the Welsh economy to date.

FLOATING OFFSHORE WIND ENERGY

The FLOW sector has contributed nearly £2.2 million 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[1] in supply chain opportunities for Wales and Cornwall by 2030.

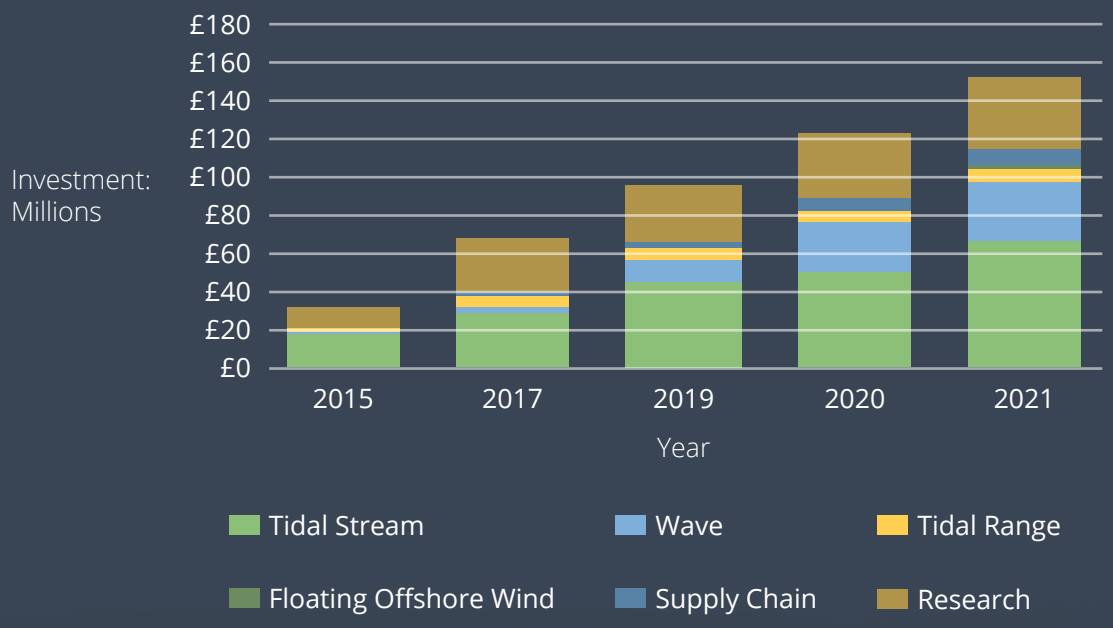
TOTAL DIRECT INVESTMENT:

When combined with supply chain investment and publicly funded Welsh research projects, the total investment in all marine renewable energy in Wales to date comes to £152.4 million – an increase of £29.1 million since 2020.

The continued growth of the sector over the last year in the face of global economic uncertainty brought on by the pandemic underscores the strength and resilience of the marine renewables industry as a whole. With further investment and support, marine renewables could play a major role in a green economic recovery.

Total	Tidal Stream	Wave	Tidal Range	Floating Offshore Wind	Supply Chain	Underpinning Research
£152.4 million	£66.8 million	£31.1 million	£6.3 million	£2.2 million	£8.4 million	£37.6 million

[1] ORE Catapult (2020), Benefit of Floating Offshore Wind to Wales and the South West: Supply Chain Report



	2015	2016	2019	2020	2021
Tidal Stream	£18,356,685	£29,081,000	£45,552,614	£49,862,509	£66,775,000
Wave	£885,795	£3,300,500	£11,316,000	£27,116,000	£31,116,000
Tidal Range	£1,500,000	£5,948,000	£6,198,000	£6,298,000	£6,298,000
Floating Offshore Wind	£0	£0	£0	£84,000	£2,200,000
Supply Chain	£250,000	£1,086,947	£2,469,000	£5,712,500	£8,445,000
Research	£10,900,000	£28,900,000	£30,686,815	£34,268,815	£37,624,818

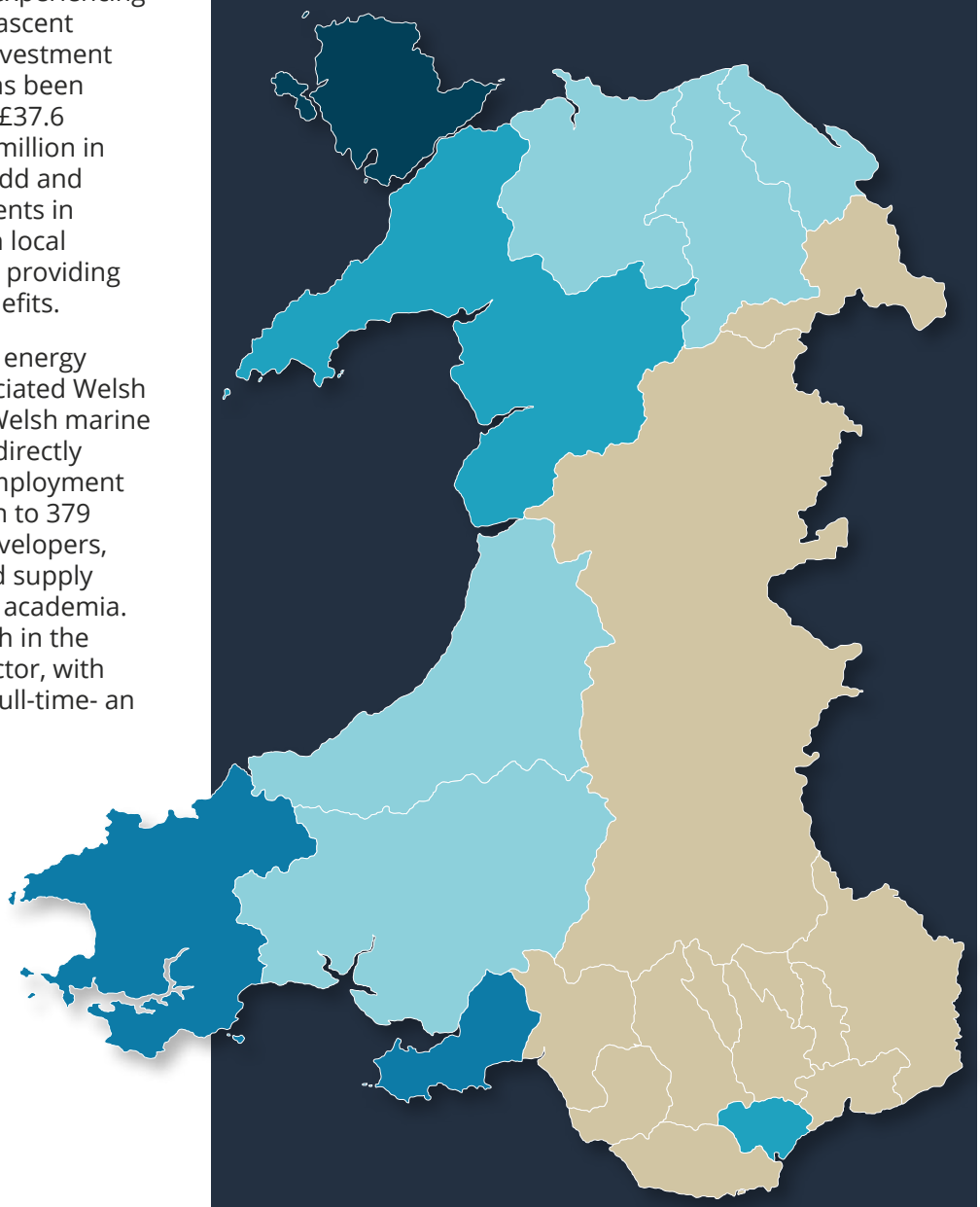
SUPPORTING PERIPHERAL ECONOMIES AND COASTAL COMMUNITIES

The Welsh Government's economic action plan 'Prosperity for All' demands that 'all parts of Wales benefit from economic growth and a fairer distribution of wealth and opportunity'. Of particular note is the Institute of Welsh Affairs' Plan for Wales' renewable energy future, which 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 £152.4 million investment in Wales to date, £55.5 million has been invested on the Isle of Anglesey, £37.6 million in Pembrokeshire, £26.6 million in Swansea, £16.9 million in Gwynedd and £12 million in Cardiff. 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 alongside Welsh marine energy academic research have directly created 1,210 person years of employment to date. This can be broken down to 379 person years with technology developers, 567 person years with associated supply chain and 264 person years with academia. There has been continued growth in the overall number of FTEs in the sector, with 234 people currently employed full-time- an increase of 58 FTE from 2020.

Anglesey	£55,477,000
Pembrokeshire	£37,602,000
Swansea	£26,649,000
Gwynedd	£16,990,000
Cardiff	£12,047,000
Ceredigion	£932,000
Flintshire	£400,000
Carmarthenshire	£300,000
Dengbigshire	£100,000
Conwy	£100,000



A CAPABLE AND AMBITIOUS SUPPLY CHAIN

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 around these developing clusters in peripheral, coastal regions - many in need of economic regeneration - provides further value to the investment and jobs supported by the sector.

The South Wales Industrial Cluster (SWIC) has also formed, encapsulating a diverse mix of critical industry that have come together to collaboratively achieve common objectives for decarbonisation and clean growth-delivering job security.

MAINSTAY MARINE SOLUTIONS

As one of Wales' leading marine energy fabricators, Mainstay 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 initial project Mainstay became involved with was the build of the 400kW, tidal energy device for Tidal Energy Ltd. Following on from this, the company was commissioned to convert a vessel 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 48 tonnes pendulum wave energy converter for AMOG Consulting and due for deployment from Mainstay's slipway imminently; the 75m long, 850 tonnes mWave device for Bombora. Mainstay has also recently secured its fifth marine energy project with QED Naval for fabrication and refits works to its Subhub device.

FAUN TRACKWAY

FAUN Trackway Limited have successfully worked with a number of Marine Energy Developers such as Orbital Marine Power Limited and Minesto, on a variety of projects. One of the key projects to date was for the manufacture of four deep sea anchor baskets for the new O2 tidal turbine. We support the project at all stages of the process, including using our experience to offer manufacturing design reviews and providing full certification to DNV standards to ensure that everything would withstand the time test. This project suited our core capabilities in welding, fabrication and specialist coating, and showcased our bespoke manufacturing services.

FAUN Trackway see that the growth in marine energy sector in Wales will help to further drive the demand for specialist manufacturing. Bringing more manufacturing and skills into the area will create more growth for supply chains such as ourselves who are able to work on these marine energy projects to make Wales more sustainable and environmentally friendly. FAUN Trackway hope to support this demand, and in turn provide job opportunities for both higher skilled workers and the younger generation in the local area.

FUTURE DEVELOPMENT PLANS: **THE PATHWAY TO COMMERCIALISATION**

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

Ports in Anglesey and Pembrokeshire are now seeing the early stages of redevelopment initiatives aimed at expanding capacities in line with growing marine renewable activity. Leading wave and tidal energy developers like Bombora and Minesto have established assembly and export centres in Pembroke Dock and Holyhead, in close proximity to deployment opportunities associated with large scale first-of-their-kind test and demonstration zones under development, such as Pembrokeshire and Morlais Array Demonstration Zones; promising to attract more marine renewable technology developers to the Welsh coast.

As more devices are deployed to these demonstration zones it's expected that the levelised cost of energy (LCOE) will steadily decrease as designs are optimised, operations improved, access to finance increased, and economies of scale tapped into. High-deployment scenarios estimate LCOE falling to £80/MWh for tidal stream and £95/MWh for wave by the end of the current decade[2], at which point these technologies will be capable of competing with fossil fuels and nuclear on cost.

Despite this initial promise, more needs to be done to fully maximise this future opportunity. Our port and grid infrastructure vitally need to be further expanded and developed in order to facilitate marine renewable energy generation at scale. This will allow them to continue to address climate change, contribute to a stable renewable energy mix complementing wind and solar, bring economic opportunity to Welsh coastal regions, and support a green recovery from the impacts of covid-19.

Over the last year Total, RWE and Shell, some of the world's largest energy companies, have turned their attention to the commercial opportunities presented by the deeper waters of the Celtic Sea between Wales, Ireland and Cornwall. Floating offshore wind, much like fixed-bottom offshore wind, could provide large amounts of clean energy to the UK grid, and large amounts of investment from these global companies is likely to help make this happen. However, the scale of these structures poses its own set of challenges. Again, ports need to be further developed to ensure that we have the capacity to produce these devices at scale or else they are likely to be produced elsewhere.

[2] Ocean Energy Europe (2020), 2030 Ocean Energy Vision

The Crown Estate are now designing a new leasing process to enable pre-commercial floating offshore wind projects of up to 300 MW in the Celtic Sea. With the development of this new leasing process, it can be expected that the Celtic Sea region will see a significant portion of the UK Government's target of 1GW of installed floating offshore wind by 2030.

Hydrogen projects will also play a significant role in enabling marine energy technologies. The ports of Holyhead and Milford Haven are already home to pilot projects, which will see the zero-carbon fuel created from renewable energy sources and used to replace carbon-heavy fuels or to store energy from peak production periods, ready for periods of energy demand. The co-development of hydrogen in coastal marine energy hubs and clusters will provide a vector to plug any gaps in marine energy power generation, allowing for a smooth and continuous supply to the grid.

Marine Energy Wales works tirelessly to assist developers on their pathway to commercialisation within Wales and to ensure that broad benefits are felt throughout the Welsh supply chain. We campaign at a UK and Welsh government level for revenue support on behalf of our members, to assist projects and companies transition from innovative ideas to commercial deployment. We work with the regulator Natural Resources Wales as part of the Consenting Strategic Advisory Group (CSAG) and the Science & Evidence Advisory Group (SEAGp) to ensure that evidence-based decision-making supports developers getting their devices in the water. We collaborate on international projects such as Selkie and TIGER to help bring down costs and facilitate knowledge transfer throughout the industry. We also chair the Celtic Sea Alliance between Cornwall, Wales and Ireland to maximise regional benefits from the floating offshore wind industry.

POLICY SUPPORT

Marine Energy Wales works to create a supportive policy environment for marine energy to ensure that Wales remains one of the best places globally for emerging offshore renewables. To date, MEW has been increasing support for the sector by engaging with politicians and decision-makers to outline the industry's key asks and to influence change.

WELSH GOVERNMENT LEVEL

At a Welsh Government level, emerging offshore renewables are recognised as a key part of the green recovery and decarbonisation agenda, the foundation of this being the Wellbeing of Future Generations Act. To ensure these commitments are transferred into actions, we continue to support the work of the Marine Energy Programme and promote the sector's unique offering; in building economic opportunity and contributing to a diverse energy mix while driving towards net zero. In addition, we work to ensure the industry remains a component of several other policy areas, including international strategy, infrastructure development and investment, the future of manufacturing, and developing the green hydrogen sector. We also continue vital conversations around post-EU funding for the industry in Wales.

MEW provides sector input to a number of policy groups to maintain engagement, collaboration and open dialogue with Welsh Government including those focused on Marine Planning and Marine Action. We're the secretariat of the Consenting Strategic Advisory Group, which aims to streamline the consenting and decision-making process for marine renewable deployments. Last year, this led to the formation of an additional Science and Evidence Advisory Group, to address strategic evidence gaps and data sharing needs.

The Senedd election was a key part of our political engagement activities in 2020. We developed a manifesto briefing to engage with political parties and Senedd candidates and met with key Members of Senedd to highlight the need for action on the sector's asks. We also organised a political showcase and an 'Ask the Candidates' hustings event to enable direct discussion between our members and potential decision-makers in Wales. We look forward to working collaboratively with the Welsh Government and cross-party during the next Senedd term to further progress the emerging offshore renewable energy sector in Wales.

UK GOVERNMENT LEVEL

We represent Welsh sector interests at UK Government level and work to build government and cross-party support and recognition of the emerging offshore renewables opportunity to further enable progress. Over the past year, MEW has actively engaged in a number of consultations on behalf of our members, which have highlighted growing interest in the sector, including: Amendments to the Contracts for Difference (CfD) scheme, Call for Marine Energy evidence, the Environmental Audit Committee's Tidal Power Inquiry, and Welsh Affairs Committee's Inquiry in to Renewable Energy in Wales. To best support the industry, our core asks of the UK Government focus on post-EU grant funding availability and the implementation of appropriate revenue support mechanisms to provide a route to market for marine renewable energy developers. Through a reformed CfD and an Innovative Power Purchase Agreement for pre-commercial developments, the industry would be able to further refine the technology and bring costs down; therefore, reducing risks across the sector and enabling developers to transition from testing to commercialisation. We work collaboratively with the Marine Energy Council, RenewableUK and Scottish Renewables to engage with the UK Government and we play an active role in the All-Party Parliamentary Groups for Marine Energy and the Celtic Sea.

With Wales already having partnered with Cornwall to form the Celtic Sea Cluster - established to prepare industry for the growing pipeline of projects - our work on floating offshore wind in the Celtic Sea brings us further into valuable cross-border cooperative work between Wales, Cornwall and Ireland. We chair the Celtic Sea Alliance between the three regions to promote engagement and knowledge sharing for the sector as well as work collaboratively through the Ireland-Wales statement to progress clean energy deployment across the Irish and Celtic Sea regions. Sector engagement with The Crown Estate has also seen the development of a new leasing process for larger floating offshore wind sites which will enable a significant growth of projects in Welsh waters. Working cross-border with neighboring nations provides an opportunity to share lessons on marine energy deployment, such as those of consenting, port collaboration, funding and investment opportunities.

EUROPEAN & INTERNATIONAL LEVEL

On a European level, we continue to represent our industry's interests post-Brexit through being active members of Ocean Energy Europe. Internationally, our sights are fixed on COP26, the international climate summit held in Glasgow later this year where we expect to see a ramping up of UK and Welsh climate commitments and ambition. This is a significant opportunity for Wales to demonstrate its capability and delivery of emerging offshore renewable energy on the world's stage, and we look forward to collaborating with our members to make the most of it.

WELSH GOVERNMENT TIDAL LAGOON CHALLENGE

The Welsh Government is currently investigating the feasibility of undertaking a competition to support the delivery of a Tidal Lagoon in Welsh waters.

The Welsh Government is engaging with the market to understand how delivery barriers may be addressed, including considering the engineering, environmental, heritage and financial factors. The Welsh Government is keen to understand the potential role Tidal Range could play in enabling delivery.

The Welsh Government's vision for the potential competition is to:

- Enable the delivery of a tidal lagoon facility in Wales and the production of low-carbon energy at scale.
- Catalyse research and data to enable future tidal lagoon projects to be delivered more easily than at present.
- Have direct benefits to Welsh supply chain organisations and new high-quality jobs.
- Support industrial activity in Wales related to the ongoing delivery of tidal lagoon projects in the future.
- Navigate complex marine planning and environmental regulations, fostering a 'best practice' approach, paving the way for potential future tidal energy projects in Wales.
- Promote an approach to the marine licencing process that seeks to safeguard and protect species and habitats, while encouraging net-gain outcomes, where opportunities exist.
- Consider heritage impacts and to safeguard heritage on the Welsh coast and in Welsh waters.
- Unlock opportunities for development, economic, amenity and social benefits where possible.
- Embody the Welsh Government's Wellbeing of Wales goals and ways of working, to support resilience and growth.
- Consider future energy demands, operation, resilience against climate change and potential adaption options in the future.

Further to engaging with the market, the Welsh Government will consider how best its objectives can be met and will develop options for the competition and support package. It is anticipated that the Welsh Government will have determined the best approach to any competition by late 2021 or early 2022.

Throughout the process the Welsh Government is keen to hear from interested organisations, and stakeholders about the views and perspectives on Tidal Lagoons.

Contact the MEW team for introductions to the Tidal Lagoon Challenge representatives.

SPOTLIGHT ON NORTH WALES

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:

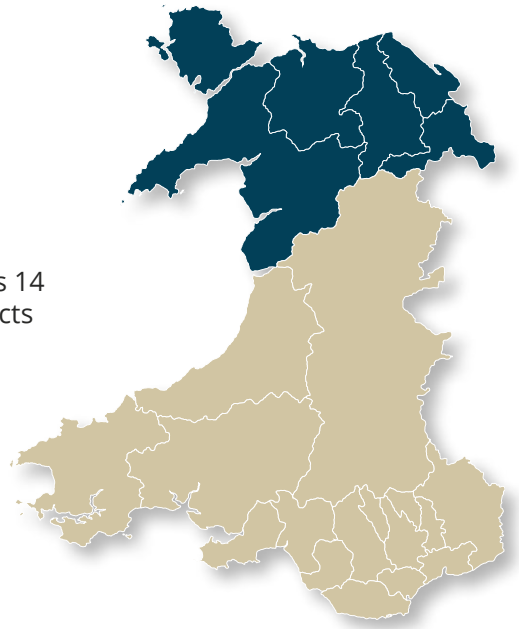
North Wales already has an established energy generating network with the Wylfa Nuclear Power Station operational from 1971 to 2015. North Wales is also home to several hydroelectric power stations and offshore wind farms including Gwynt y Môr – one of the largest operating offshore windfarms in the 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 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. Anglesey based social enterprise Menter Môn offer business support to those looking to join the marine renewable energy sector as part of the Selkie Project.

JOBS AND GROWTH:

Over £73 million has been invested into North Wales with 88 FTE jobs created in the region. The majority of this growth and activity has taken place on Anglesey (almost £55.5 million), fuelled by the activity of tidal kite developers Minesto and the development of the Morlais tidal demonstration zone. Gwynedd has also seen significant investment (almost £17 million) with this being driven by research at Bangor University and Nova Innovation's tidal project under development on the Llyn peninsula.



NORTH WALES GROWTH DEAL

The North Wales Growth Deal comprises 14 transformational projects aimed at boosting the local economy and better preparing the region for many of the challenges of the future. This has been kickstarted with a combined initial investment of £240 million from the Welsh and UK governments. The West Anglesey tidal demonstration zone known as Morlais is working to become one of these projects and the Port of Holyhead could also be redeveloped with proposals to add deep water loading capacity and the creation of the UK's first hydrogen hub.

NORTH WALES SUPPLY CHAIN

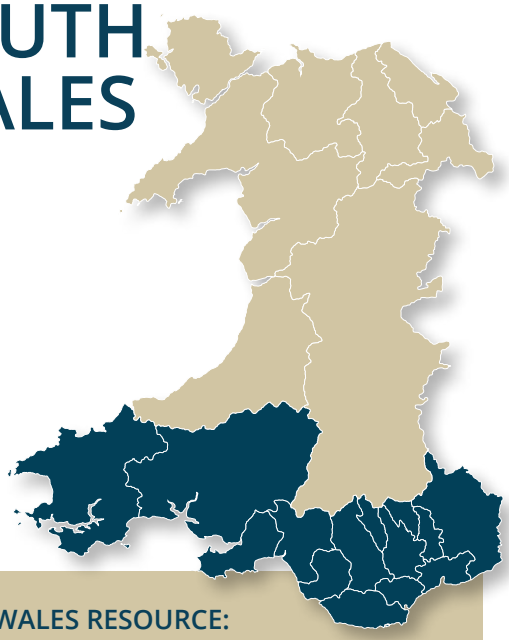
North Wales hosts an established and fully capable supply chain that has been feeding into the marine renewables sector for many years. Additionally, many transferable skills have been built up in organisations servicing the local nuclear sector and offshore wind farms in the Irish Sea. The presence of Morlais and Minesto on Anglesey has tapped into a strong base of manufacturing and fabrication expertise on the island, with one such manufacturer FAUN Trackway Ltd even designing and building mooring solutions for Orbital Marine's O2 tidal turbine in Scotland.

PORTS

The Port of Holyhead is a deep water port located on the western side of the Isle of Anglesey, owned and operated by Stena Line. As well as servicing a large number of ferries the port sees some of the highest Heavy Goods Vehicle traffic of any port in the UK, making it an ideal location for the country's first hydrogen production and refueler hub which was confirmed in the last year. Holyhead is the closest port to the Morlais demonstration zone and also home to Minesto's assembly hall.

The Port of Mostyn is a major hub in the assembly and installation of fixed bottom offshore wind turbines in the Irish Sea. Most recently a large portion of RWE's Gwynt-y-Mor wind farm was fabricated and assembled at the port with RWE's operations and maintenance base for the Irish Sea also being established here. The Port of Mostyn is also home to a proposed tidal lagoon project which would further boost the port's clean power credentials.

SPOTLIGHT ON SOUTH WALES



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. The tidal range resource increases steadily as one moves east along the south coast, towards the Severn estuary.

GRID:

Pembrokeshire has an established 400kV National Grid connection available at the Pembroke Power Station site thanks in part to Milford Haven's long history as one of the UK's leading energy ports.

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 research and education facilities with expertise in a range of energy related fields.

JOBS AND GROWTH:

Over £70 million has been invested into South Wales with 168.3 FTE jobs created in the region. The majority of this growth has taken place in Pembrokeshire (£34.6 million) and Swansea (£26.6 million). This has been driven by the likes of Bombora Wave Power and Marine Power Systems as well as research at Swansea University. Historic developments from the likes of Tidal Lagoon Power and Tidal Energy Limited have also brought in significant investment and increasing investment is now being seen from floating offshore wind developers.

SWANSEA BAY CITY DEAL

The Swansea Bay City Deal is a portfolio of 9 major projects in the South West Wales region with the aim of driving economic growth while focusing on sustainable industry, digitisation and wellbeing. Over a 15-year period, investment of up to £1.3 billion is expected across the projects. Pembroke Dock Marine is one of the major projects receiving funding through the Swansea Bay City Deal. This is a collaboration between the Port of Milford Haven, Marine Energy Wales, Offshore Renewable Energy Catapult, and Wave Hub Development Services Limited; with the aim of delivering the facilities, services and spaces needed to establish a world-class centre for marine engineering in South West Wales.

SOUTH WALES INDUSTRIAL CLUSTER

The South Wales Industrial Cluster is regional project that seeks to decarbonise much of the industry situated along the M4 corridor in South Wales. Through collaboration the project aims to develop mechanisms and skills to achieve net zero ambition. This includes circular economy innovations, energy efficiency, the hydrogen economy, carbon capture utilisation and storage, and low carbon power generation.

SOUTH WALES SUPPLY CHAIN

South Wales has a long history of manufacturing and heavy industry, therefore providing a wealth of fabricating and engineering expertise across the region. Additionally, South Wales is home to a growing and internationally recognised digital technology cluster. Much of the marine energy activity in South Wales is centred in Pembrokeshire, which has historically been home to a large number of full-scale test projects for both wave and tidal energy. The area features a number of manufacturers and fabricators with oil and gas or boat building expertise, most notably Mainstay Marine who have become one of Wales's leading marine renewable device fabricators.

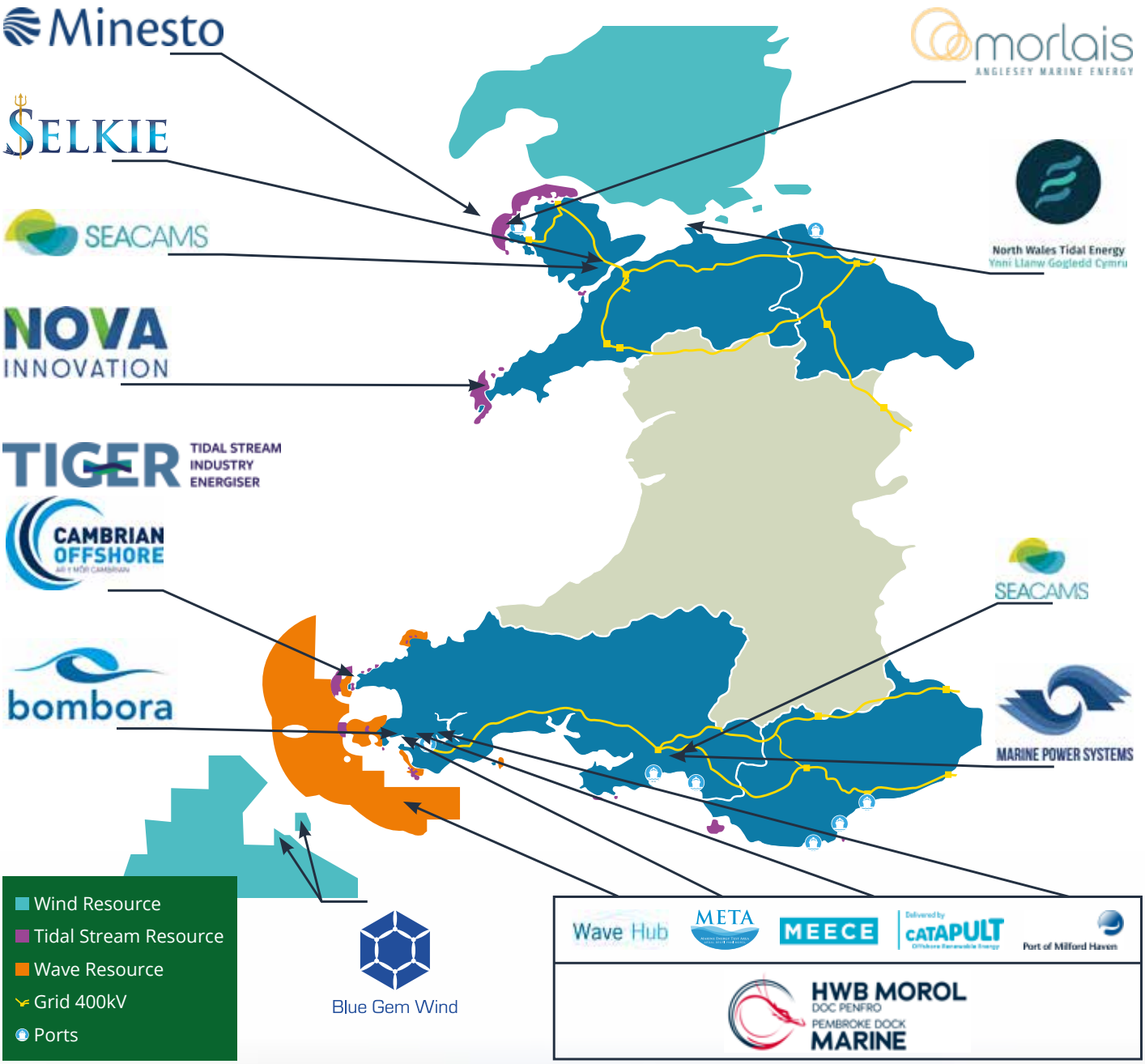
PORTS

The Port of Milford Haven is situated in a sheltered estuary in Pembrokeshire, known to be one of the deepest natural harbours in the world. It is an important energy port as large volumes of oil and natural gas are imported to the refinery and power station. The port is also the site of the Pembroke Dock Marine project, redeveloping and expanding areas of the port ready for future growth in the marine renewables sector and is well positioned relative to future Celtic Sea opportunities in floating wind. The port is currently home to Bombora Wave Power, the Marine Energy Test Area, the Marine Energy Engineering Centre of Excellence and Blue Gem Wind.

Port Talbot is situated on the Eastern side of Swansea Bay in close proximity to Wales's largest steel works and therefore an important hub for the majority of Wales's industrial activity. The port boasts large amounts of laydown space adjacent to one of the UK's deepest harbours. These factors make Port Talbot well suited to servicing the large-scale commercial assembly and installation of floating offshore wind and other marine energy destined for the Celtic Sea.

The Port of Swansea is another key piece of South Wales's industrial activity, handling large amounts of imports and exports, with rail links and large storage facilities. The port is already an operations and maintenance base and therefore well positioned to service future Celtic Sea developments.

WELSH ACTIVITY MAP



North Wales Tidal Energy | Ynni Llanw Gogledd Cymru

Climate Change is gathering pace, as is recognition that society and Government need to act now to mitigate its impact on future generations.

The North Wales Tidal Lagoon will not only supply a totally reliable source of sustainable low-carbon energy, reducing carbon emissions by millions of tonnes per year, but also provide the communities and businesses of North Wales with economic and environmental protection.

Generation and distribution of renewable energy is critical to achieving the UK and Wales' Net Zero goals. However, wind and solar farms cannot do the job on their own. The sun only shines during the day and the wind doesn't always blow – leaving the national grid vulnerable to demand and supply surges. The predictability, reliability and flexibility of energy generated by tidal lagoons will bring significant benefits to energy security and stability.

There are a number of choices for the final design and landing points of the North Wales Tidal Lagoon, but the favoured option is likely to stretch from Llandudno to Prestatyn:

- Over 100,000 people will gain protection against rising sea levels and storm surges and over 500 Ha of land will become available for development.
- A 31km sea wall with an installed capacity of 2.5GW will deliver in excess of 4.5 TWh pa – enough electricity for virtually every home in Wales.
- Linked energy storage (pumped hydro or hydrogen electrolysis) or operation in conjunction with other tidal lagoons will deliver much needed baseload to the Grid.
- Research, design, construction, operation and economic stimulation will create over 22,000 jobs.
- An operating life in excess of 120 years means that the North Wales Tidal Lagoon will continue to benefit North Wales long after wind and solar farms (30 years), and nuclear plants (50 years) have been decommissioned and replaced.

The North Wales Tidal Lagoon is a massive infrastructure development that will be transformational for the region.

Closely mirroring the scope and ambitions of the Welsh Government's "Wellbeing of Future Generations (Wales) Act", this is a project that will benefit, and be appreciated by our children and grandchildren.

www.northwalestidalenergy.com

Minesto

PROJECT UPDATE

Minesto has had a physical presence in Wales (in the form of its UK Headquarters in Holyhead) since 2015. Upon securing an 10MW agreement for lease at Holyhead Deep off Anglesey in June 2014, Minesto has continued to focus its Welsh activities on demonstrating the functionality and power production of their Deep Green kite Technology at utilities scale. Following the successful commissioning of the first 0.5MW Deep Green system in the Summer and Autumn of 2018 and 2019, Minesto is preparing to develop the Holyhead Deep site and associated operations with the aim of demonstrating the latest iteration of its tidal kite at the Holyhead Deep Site. This next generation device will act as a pre-cursor to the development of a commercial demonstration array of up to 10MW and a future 80MW commercial array.

STRENGTHENING WELSH ASSET BASE

During 2020 Minesto has demonstrated considerable progress in establishing its assembly and manufacturing capability in Anglesey alongside expanding the expertise of its highly skilled Operations Staff to effectively deliver world class services across Minesto sites.

Minesto's Assembly Hall located in Holyhead, Wales is now fully operational, the construction of which was managed by Stena Line with Minesto taking possession in the spring of 2020 and undertaking all the internal fitout work. Located with the port of Holyhead, the building is specifically designed for Minesto and contains a capable overhead gantry crane required for the complete assembly, testing and maintenance of Deep Green kite system components.

The Assembly Hall acts as Minesto's centre of engineering activities relating to Holyhead Deep site including testing subsea infrastructure, the maintenance work on kite systems and components, active support to Minesto's other projects, including the Faroe Islands and is the development hub for Minesto's Operational activities.

Expanding the Welsh asset base has allowed Minesto to invest considerable resources in additional onshore and offshore operational staff, which in turn has enabled the company to bring all operations and maintenance activities 'in-house', securing its ability to deliver multiple projects effectively and efficiently.

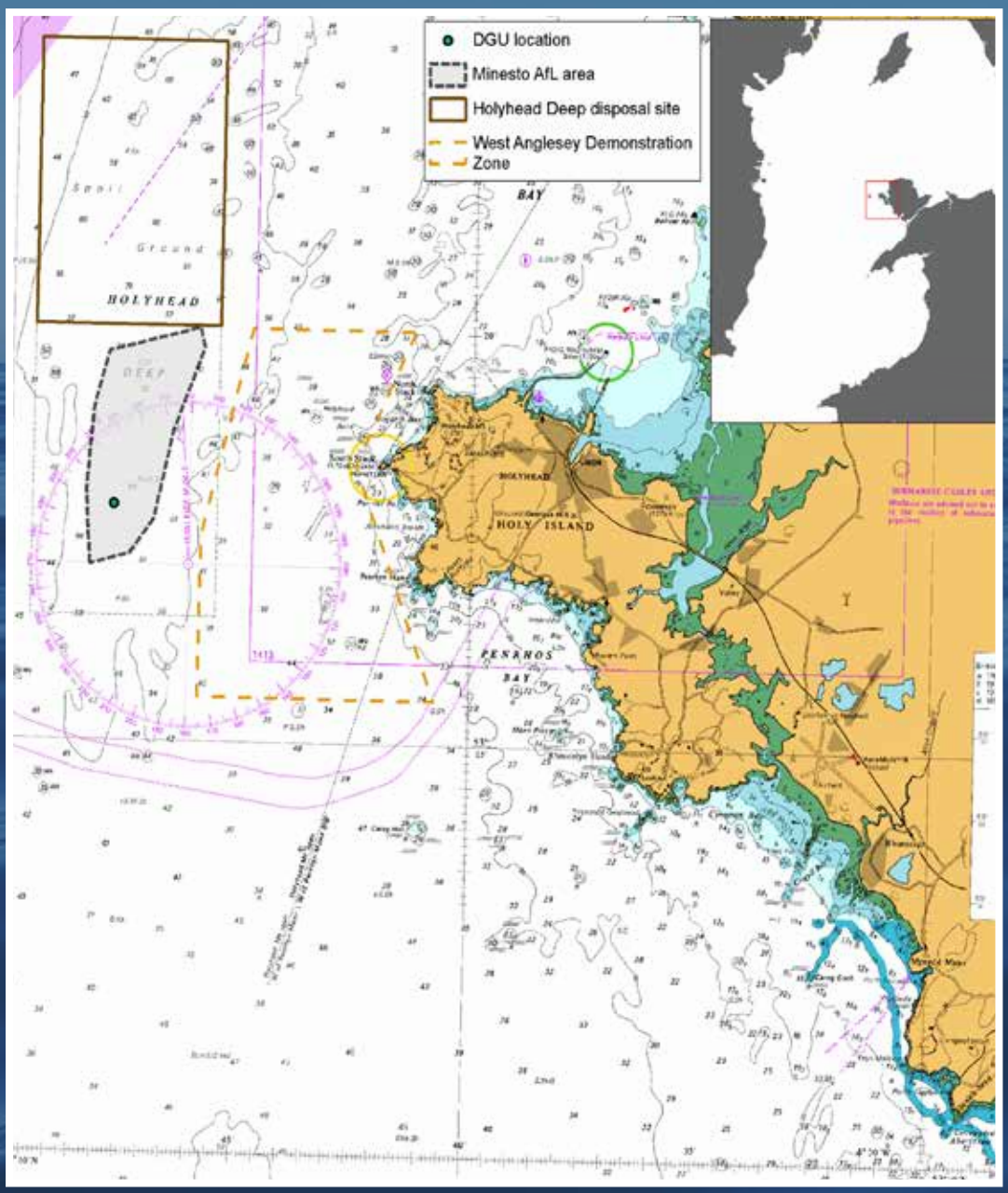
Minesto continued focus on developing the Deep Green technology and operational capability in Wales through the expansion of Minesto's Holyhead Deep site, can establish Anglesey as a hub for developing the tidal energy industry in the UK; contributing to the future energy mix of the UK and globally - thereby helping to attract inbound investments, support jobs and growth locally in the area.

"As an organisation, Minesto has seen considerable success across the organisation over the last twelve months. The expansion and strengthening of our Welsh operations has been a key component in enabling the optimisation of operational procedures as well as acting as an invaluable asset for component testing and verification. Minesto's operations in Wales will be increased further with the future expansion of the Holyhead Deep site towards its full capacity," said Dr Martin Edlund, CEO of Minesto.

INVESTMENTS TO DATE

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 over 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.

www.minesto.com



NOVA INNOVATION

TIDAL POWER

Nova Innovation's Enlli tidal energy project in north Wales, has forged the opportunity to generate electricity from the natural ebb and flow of the tide.

The 'Island in the Currents' project between Ynys Enlli and the Llŷn Peninsula could create the world's first blue energy island, contributing to the island's year-round energy needs from the power of the tides. Nova plans to install five 100kW turbines on the seabed, with the potential for more in the future. Nova's gravity-based turbines do not require seabed drilling, and environmental monitoring of Nova's operational Shetland Tidal Array has detected no negative impacts on marine wildlife.
In November 2020, Nova announced that the project had secured £1.2m investment from the Welsh Government through the European Regional Development Fund (ERDF).

PEOPLE POWER

Nova's ambition is to deliver locally generated renewable electricity that will create tangible benefits for the local community. Nova includes a highly skilled team of mechanical, electrical and offshore engineers, and environmental specialists which it will now build on in Wales. Nova is working with key stakeholders including regional renewable energy organisation YnNi Llŷn and the Bardsey Island Trust to explore the potential local benefits of the project.

BASELOAD POWER

Tidal is a unique form of renewable energy as it is predictable months and years ahead. In 2018, Nova worked with electric vehicle experts Tesla to add energy storage to its tidal technology, creating the world's first baseload tidal power plant. This means Nova can supply baseload tidal power, potentially replacing traditional sources such as coal and nuclear, and the system can respond to client demand.

COMMERCIAL POWER

The tidal turbines in the Enlli project will be similar to those operating in the Shetland Tidal Array. Nova's continuous technological development means that the turbine design has recently been upgraded to remove the gearbox, making these new direct drive turbines more efficient.

The unique Enlli tidal project provides the opportunity for local communities to power their homes, businesses and vehicles using the power of the tides and help drive forward the blue economy in North Wales.

www.novainnovation.com

ORBITAL
MARINE POWER

Orbital Marine Power, Ltd. (Orbital), Scottish-based developers of a world-leading floating tidal turbine technology, launched the world's most powerful tidal turbine, the Orbital O2 2MW in April, 2021.

The O2, a commercial demonstrator, will be grid connected in the waters off the Orkney Islands, Scotland in the summer of 2021 at the European Marine Energy Centre (EMEC). The O2 comprises a unique and futuristic design of grand proportions, with a 72m long floating superstructure, 600 sq metre rotors (the largest ever on a tidal generator) and award winning 'gull wing' style retractable legs to facilitate access to the machines underwater systems. It has the capacity to generate electricity for 2,000 homes, offset approximately 2,200 tonnes of CO2 production per year, and is the most powerful renewable generating unit of any kind being fabricated in the UK this year. The O2 is the first tidal energy project in the world to be financed with construction debt finance, that has been raised through the Abundance platform.

Under Orbital's participation in the Interreg Channel Region TiGER Project, Orbital continues to carry out thorough identification and commercial evaluations of innovations to their pioneering O2 floating tidal technology whilst considering technical feasibility. This work covers a wide variety of enhancements to reduce costs and increase yield by looking at ideas such as larger swept areas, pitch control strategies as well as structural and manufacturing efficiencies – concepts that have already proven successful in sectors such as wind energy.

FAUN Trackway®, based in Llangefni, North Wales, manufactured the O2's four steel anchor structures, along with bespoke mooring connectors.

Orbital is a berth holder at the Morlais project and has continued to progress both site investigation and array design works.

www.orbitalmarine.com

QEDNAVAL

With the UK's dependency on a green recovery, and net zero target of 2050, we are very dependent on renewables. Unfortunately, we are well behind in all areas and very dependent of fossil fuels, having invested so heavily on wind and solar as, when there is no sun or wind, we see great gaps in our grid, and are paying heavily in balancing, with costs of up to £400/MWh. We urgently need a predictable energy mix and storage solutions.

Our seas and rivers can make a difference. As a maritime nation the UK, with 50% of Europe's tidal energy, is well placed to benefit from this 100% predictable, abundant resource which can deliver 11% of our electricity and a GVA of £1.4 billion by 2030.

Technology developers. Like QED Naval, have however to compete with the likes of wind who have benefitted from Government assistance up to now. This is changing as the UK, devolved Welsh Government and Marine Energy Wales, now look to help bring on the next generation of energy with AR4, grants and CfD initiatives.

The tide is turning for companies like QED. With their innovative self-deploying foundation system and recently acquired Dutch turbine operation, Tocardo (partnering with Hydrowing) they have had years of product testing and development in the water, and are ready to deploy. On receiving Interreg EU funding for its TIGER, QED is now showcasing its community scale Subhub platform and Tocardo tidal turbines, and is building its next generation1MW industrial scale platform.

Wales has benefitted from this already with QED establishing itself here and from recent orders and, as QED sets about acquiring site options for the future, it could benefit more ie from its MORLAIS tidal site.

2021 has already seen QED acquire, through their JV, Holland's iconic infrastructure Oosterschelde Dam Project. QED is aligning itself to a $76Bn global market and sees supply chain partnerships as key. With every 300MW, QED has some £600m of supply chain opportunity and GDV. It sees the UK, and Wales in particular, as well positioned to lead this sector and benefit, especially with global focus and COP26 coming to Glasgow.

www.qednaval.co.uk

VERDANT POWER

Verdant Power's contribution to marine renewable energy (MRE) is in its vision for New York City's Roosevelt Island Tidal Energy (RITE) Project that is focused on advancing the broader MRE industry by delivering value in the following three areas:

- Cost-efficient installation and O&M – Cost-efficient approaches to operations and maintenance of the Company's fifth-generation (Gen5) tidal power system has been analyzed through the RITE Project, in partnership with leaders from the marine engineering and oil and gas industries. Achieving efficient, low-cost installation and O&M procedures remains the key challenge to making MRE cost-competitive with other resources.

- Technology performance, longevity, and reliability – Resource and hydrodynamic analysis of MRE systems has occurred at the RITE Project through a focus on maximizing the efficient operation of multiple Gen5 turbine systems in array and the advancement of its technology to commercial readiness.

- Environmental compatibility – Working with state and federal natural resource agencies, Verdant Power will continue to advance the science of environmental monitoring to better understand the interactions of its Gen5 system with the local environment, especially as projects grow to include larger arrays of turbines. This is another key cornerstone of the MRE industry roadmap – the development and application of environmental monitoring tools and analysis of operating MRE technologies.

Verdant Power's achievements at the RITE Project have been ground-breaking with turbines demonstrating 100 percent availability and receiving an internationally recognized accredited test report providing third-party verification of operational results. Through continuing efforts under a federal government license, Verdant Power looks to the RITE Project not only to develop its own technology and deliver clean energy to Welsh residents, but also to anchor the development of a vital MRE industry in Wales.

Verdant Power, working as Verdant Isles with Menter Môn, plans launch its full-scale project in Wales during 2024. 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, 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.

www.verdantpower.com

bombora

WELSH WAVES PAVE A WAY TO 100% RELIABLE RENEWABLES

After a virtual tour of Bombora's Assembly Centre in March 2021 Welsh First Minister, Mark Drakeford commented:

"The Welsh Government is committed to the marine energy sector and supporting companies like Bombora. Wales can make a significant contribution to delivering renewable energy and there's a huge potential to build a thriving industry and create jobs in regions where skilled employment has been in short supply."

Commercial Fixed-Bottom mWave wave energy farm

DEMONSTRATING THE MOST POWERFUL WAVE ENERGY DEVICE IN WALES

At the end of 2017 Bombora relocated from Australia to Pembroke Dock in Wales, which lies at the heart of a thriving marine energy sector, to progress mWave product development.

Having received full test site consents in the autumn of 2019, Bombora is currently at the final assembly phase of the full scale 1.5MW mWave Pembrokeshire Demonstration Project.

90% of contracts have been awarded to date and the project has more than 80% supply chain resourced from UK companies. Over 50% of this is Welsh content, with 33% of the largest contracts awarded to Pembrokeshire based companies Mainstay Marine and Altrad Services.

Two of the four 15 meter long cell modules that will be covered in a flexible rubber membrane and fixed to the 75 meter long demonstrator device

mWave cable delivered to the dockside at Pembroke Dock Port

Bombora's mWave project is part funded with £13.4 million from the European Regional Development Fund through the Welsh Government and has bought an inward investment of £20 million to the Pembrokeshire coastal region.

Bombora engineers assembling mWave electrical components

As well as supply chain development the project has created skilled, well paid jobs. Bombora's team has grown rapidly since arriving in Wales, from 4 to 29 staff. An additional 45 jobs have been sustained through supply chain contracts in West Wales.

Conduit installation at East Pickard Bay where mWave demonstrator cable lands ashore

The full-scale 1.5MW mWave demonstration is scheduled for deployment off the coast of Pembrokeshire later in 2021 with an initial planned testing period of 6 months.

MWAVE POWERING A BRIGHTER SUSTAINABLE FUTURE FOR PEMBROKE DOCK

Looking beyond the test and validation of mWave in 2021, Bombora is forging ahead with technological and commercial advancements.

Bombora's mWave technology has the potential to deliver gigawatts of additional install capacity to floating wind projects, assist the electrification challenge for offshore operations and support the decarbonisation journey of Island nations.

In 2020 Bombora collaborated with the ORE Catapult, utilising the full techno-commercial capabilities of the Marine Energy Centre of Excellence based in Pembroke Dock to optimise the performance and cost of mWave technology in an offshore environment. Experts in the field of offshore engineering, Apollo, were also appointed to support the development of a Floating mWave in deeper waters. Both research studies were fundamental milestones in progressing Bombora's Integrated Floating mWave platform.

InSPIRE 18MW Integrated mWave and Wind project platform

InSPIRE, Bombora's partnership project with global EPC contractor, TechnipFMC, to integrate mWave and wind generation on one floating offshore platform commenced in 2020. The demonstration of a 6MW Integrated mWave and wind floating platform will precede a Series 1 - 12MW platform project, leading on to a Series 2 - 18MW platform project. Significant gains are made from integrating mWave and wind onto a single platform:

- 50% more power from seabed lease areas
- 50% more consistent power than just offshore wind alone
- 20% lower cost of energy than floating offshore wind alone

Further afield Bombora have formed a partnership with Mitsui O.S.K. Lines, Ltd. (MOL) the global marine transport group that operates one of the world's largest merchant fleets. The collaboration is working to identify potential sites for both mWave energy projects and combined wind and mWave projects in Japan and the neighbouring regions.

A phased expansion of the Assembly and Export Centre in Pembroke Dock is planned to service Bombora's growing project pipeline. Wales is well positioned to be a major beneficiary of Bombora's global export growth plans.

www.bomborawave.com
www.inspireoffshoreneergy.com

MARINE POWER SYSTEMS

PROJECT UPDATE

Marine Power Systems (MPS) is revolutionising the way we harvest energy from the world's oceans. The company is on track to be a world leader in the supply of floating wind and wave energy extraction hardware by having the highest performance and most cost-effective technology available in the market. Following successful medium scale testing of their fully patent protected marine energy generation technology MPS are now working at megawatt scale to prove their grid connected technology ahead of commercialisation.

MPS have made significant progress towards achieving their goals and are in the process of completing the build and test of their commercial megawatt scale wind and wave device. They have reserved a grid connected test site at the Biscay Marine Energy Platform (BiMEP) site in the Basque Country, Spain and will shortly be embarking on a detailed geotechnical survey of that site. In addition, two pre-commercial projects at grid connected revenue generating sites will further support research and development around manufacturing and deployment at commercial scale. Two 3MW wave energy generation devices will be deployed at EMEC, Orkney and three floating wind energy generation devices will be deployed in a European site, each supporting turbines of up to 10MW. In parallel with their ongoing testing, MPS have developed a highly sophisticated computational simulation capability which has enabled them to further optimise the performance capabilities of their unique technology; the only modular wave, floating wind and combined solution that can be used in deep water.

The first commercially available wave only devices will have a rated power of 4.5MW, increasing to 10MW of wave power as the technology is developed. The wind and combined wind and wave devices will support the largest and most powerful wind turbines available today and in the future. Starting at 10MW but increasing to over 15MW.

Marine Power Systems have developed a revolutionary and flexible technology solution that can be configured to harness wind power, wave power or combined wind and wave power at grid scale. Between WaveSub, WindSub and DualSub Marine Power Systems support optimised energy capture for any particular site through the combination of wave and wind energy generation technology. All the devices can be assembled and towed from port and they retain common deployment, anchoring and operation & maintenance solutions. This reduces the costs of ownership and maximises the energy generation cost effectiveness. A designed-in survivability strategy combined with a proven mooring system that provides excellent stability in adverse weather conditions.

BENEFITS TO WALES

Marine Power Systems' head office is in Swansea and they have built an incredibly talented team of 25 staff that are not only experienced in the design, manufacture and build of their hardware but also the deployment and maintenance of the technology at sea as well as the regulatory and consenting requirements associated with delivering real world projects. The most recent appointment, Martin Carruth as Commercial Director, will take responsibility for revenue generation, progressing the sales pipeline and translating everything the business has achieved so far into the first orders. This will create a substantial export opportunity, with MPS continuing to establish itself as a long-term sustainable business creating varied and highly skilled jobs here in Wales. The team also includes some of the best suppliers, sub-contractors and independent experts in the business. That includes the manufacturing expertise to be found in West Wales and research partners in Welsh academia and industrial research organisations.

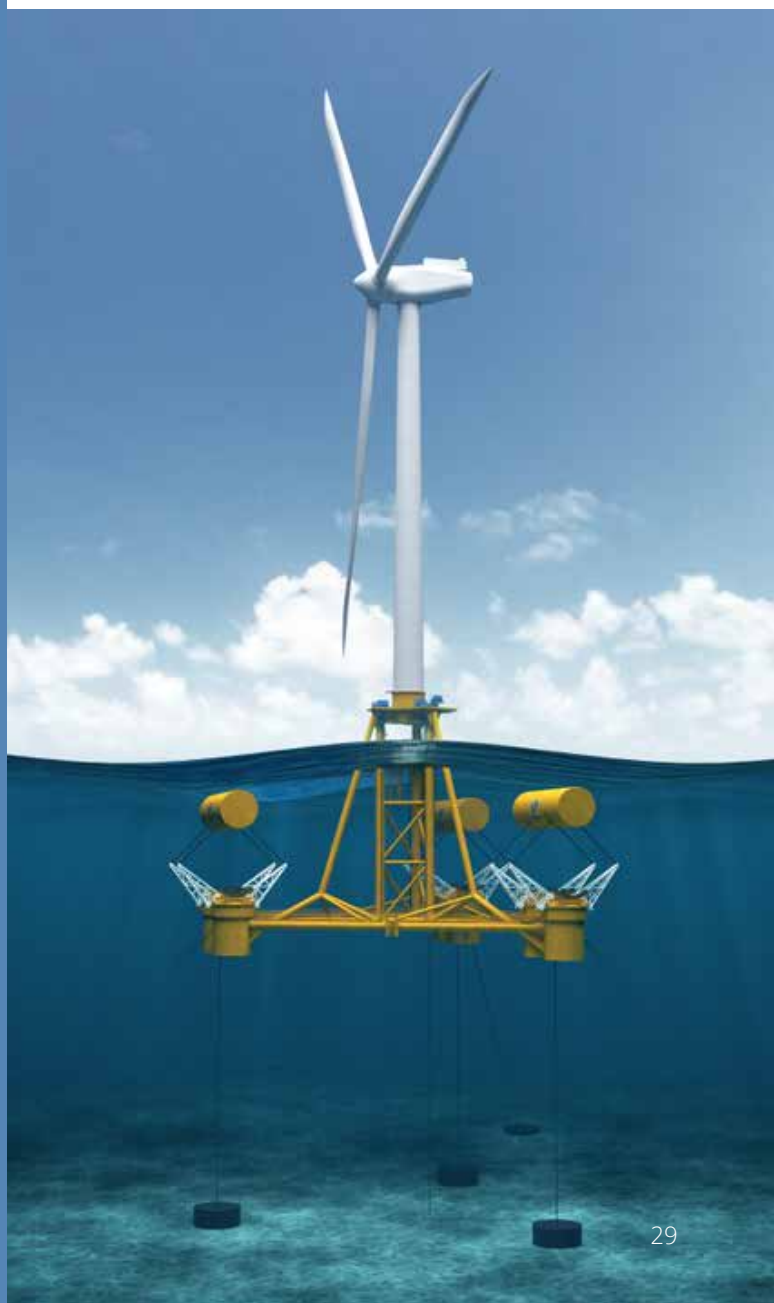
Marine Power Systems is making a significant contribution to achieving Wales' commitment to decarbonisation and achieving net zero. One where business and technology supports both economic and environmental sustainability.

Following the award of £12.8m of support from the European Regional Development Fund through the Welsh Government MPS completed a successful round of crowdfunding and private investment in the summer of 2020. The business has just raised a further £1.7 million, including £250,000 of match funding from the Development Bank of Wales' Wales Angel Co-investment Fund, and they are running a crowdfunding campaign with equity investment experts Crowdcube during June and July this year.

Their investment success is based on significant third-party due diligence and is testament to the belief that Marine Power Systems' technology will be a market leader in the manufacturing and supply of marine energy extraction hardware.

The scheme has been part-funded by the European Regional Development Fund through the Welsh Government

www.marinepowersystems.co.uk



Blue Gem Wind

THE CELTIC SEA – A NEW CHAPTER IN DELIVERING NET ZERO

March 2020 may just become a date that changed the way we think about the Celtic Sea. This was the month when Simply Blue Energy, a pioneering Celtic Sea energy developer, and Total, one of the world's largest energy companies established a partnership to develop floating wind projects in waters off the Welsh coast. The joint venture company, Blue Gem Wind, opened a new chapter in the development of offshore energy in the South West, using a technology that will play a critical role in delivering the UK's Net Zero target.

Today's offshore wind turbines, fixed to the seabed by monopile or jacket foundations, are restricted to waters up to 60 metres deep. However, further offshore is where floating wind has enormous potential to be a core technology in the fight against climate change. 80% of the world's wind resource can be found in water deeper than 60 metres. Being further offshore, in deeper waters, can also mean less visual impact, reduced conflicts with other marine users and it is where windspeeds are faster and more consistent meaning higher capacity factors.

With between 150 – 250 GW of wind resource off the coast of Southern Ireland, Wales and the South West of England you could say the Celtic Sea was made for floating wind. Independent reports suggest that between 15-50 GW of the wind resource could be captured providing the region with a nationally important low carbon opportunity. Studies also suggest that the Celtic Sea has different weather patterns to the North Sea, potentially providing system benefits to the UK grid.

Blue Gem Wind's vision is to create the first stepping stones to a new low carbon offshore energy sector in the Celtic Sea, one that contributes to climate change targets, provides high skilled jobs, supply chain diversification and energy security.

STEPPING STONES TO ASSIST LOCAL SUPPLY CHAIN

We believe that a stepping stone approach to the development of floating wind in the Celtic Sea brings a number of benefits. Starting with smaller demonstration and early-commercial projects, increasing in size, will help to capture the highest local supply chain content. It will also maximise knowledge transfer and facilitate a sustainable transfer to a low carbon economy.

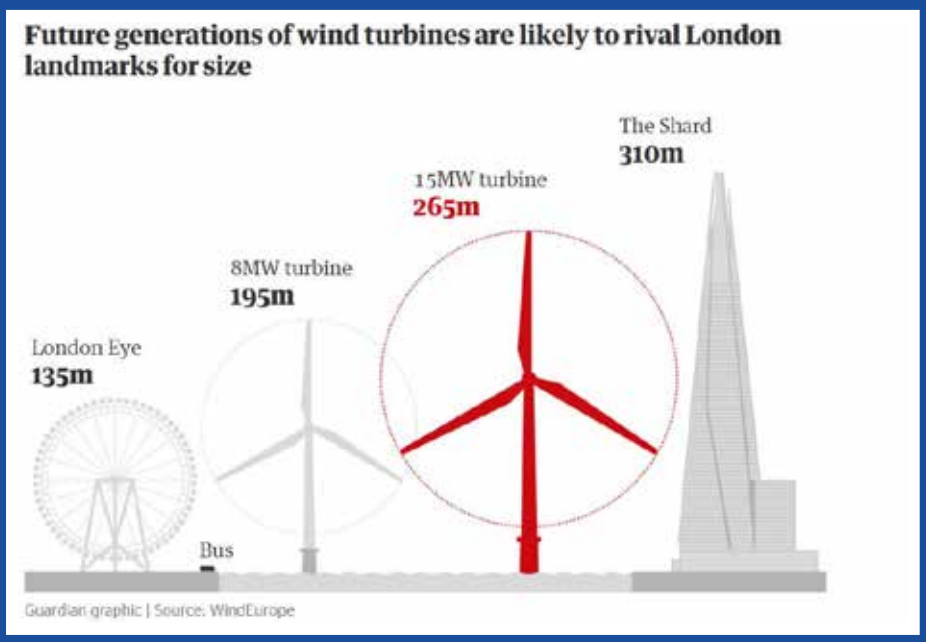
Because of this focus on stepping stone projects we have proposed Erebus, a 100MW test and demonstration project followed by Valorous, a 300MW early-commercial project.

Erebus, named after the famous ship built in Pembroke Dock in 1826 once constructed in 2026, will become one of the largest floating offshore wind projects in Europe and provide enough power for approx 90,000 homes. The site is approximately 45 kms South West of Pembrokeshire, with a seabed lease covering 32 km2 or 0.02% of the Celtic Sea.

A plan-led approach was taken for site selection with the process driven by technical, commercial and environmental considerations, with the overarching objective of identifying a viable site, whilst minimising impacts on the environment and stakeholders.

A wide range of factors were considered during the process including: bathymetry, water depth, wind resource, proximity to nature conservation designations, seabirds and marine mammals, fisheries, shipping, proximity to ports and visual impact.

Erebus will comprise of between 6 to 10 turbines which will depend on the turbine rating up to a maximum of 16MW in size. These turbines could be up to 265 metres from sea surface to blade tip and will sit on Principle Power's Windfloat platform technology. Just one rotation provides enough energy to power an entire household for over 24 hrs.



The policy landscape for floating wind looks positive with the Committee on Climate Change stating that offshore wind will become the backbone of the UK's energy system with over 100GW needed by 2050. In October 2020, the UK Government set a 2030 floating wind target of 1GW, a target which Blue Gem Wind can deliver 40%. In 2019, the Welsh Government commissioned ORE Catapult report stated the first GW of floating wind in the Celtic Sea could produce 3,000 jobs for Wales and Cornwall, demonstrating the socio-economic benefits and COVID Green Recovery potential of floating wind in the Celtic Sea.

www.bluegemwind.com

Photos courtesy of Principle Power. Artist: DOCK90

RWE

RWE Renewables is one of the world's leading renewable energy companies. With around 2,600 employees in the UK, the company's wider portfolio encompasses onshore and offshore wind projects, photovoltaic plants and battery storage facilities with a combined capacity of approximately 9GW. RWE Renewables is driving the expansion of renewable energy in more than 15 countries on four continents.

RWE has a special relationship with Wales. We are Wales' largest power generator and its largest renewable power generator, as well as one of the biggest private sector energy investors into Wales. Over the last decade, together with project partners, we have invested over £3 billion to deliver ground-breaking energy projects in Wales. Our renewables projects include four onshore wind farms, five hydro power stations and three offshore wind farms, including as operator of North Hoyle, the UK's first large-scale offshore wind farm. Over the years, projects operated by RWE have contributed £8.6m to neighbouring communities from the funds associated with our renewable energy sites in Wales. The annual community funding in Wales alone amounts to over £2.4 million, with local people deciding how to use funds to improve their communities. Furthermore, our Gwynt y Môr offshore wind project in North Wales makes an estimated annual economic contribution of £8 million to the local economy.

With a likely capital budget of c.£1.5-2 billion, if consented, Awel y Môr Offshore Wind Farm in North Wales (the extension to the Gwynt y Môr project) is a once in a decade opportunity for Wales. Awel y Môr is Wales' only commercial-scale offshore wind project that will be delivered in the 2020s and with it we, along with our partners, are determined to ensure that Wales has a stake in the next phase of the UK offshore wind growth story. This project is scheduled to be the largest single renewable energy investment in Wales in the next decade and is critical to Wales achieving its renewable energy and decarboninsation targets.

We are also developing an Innovation and Demonstration Floating Offshore Wind Project – Draig y Môr - off the West coast of Anglesey. Floating Offshore Wind offers a significnat opportunity for Wales if adequate seabed leases are made available by The Crown Estate in Welsh waters at an appropriate scale to deploy innovative projects. Securing a pipeline of such leases with increasing capacity alongside a long-term two-sided CfD and grid infrastructure commitments will give Wales the best chance to secure investment in research and development as well as developing manufacturing scale and expertise to lead a growing global market in floating wind.

Looking beyond Draig y Môr, the Celtic Sea has significant potential for the deployment of future floating offshore wind. The UK Government, working alongside the Welsh (and Irish) Governments, could consider developing an overarching economic strategy for the Celtic Sea, taking a strategic view of the potential for offshore renewable developments in the area. This could for example include the prospect of a cross-border enterprise zone to facilitate trade and investment in and around the Celtic Sea. Whilst development of renewables at scale in the Celtic Sea is not likely for another 10 years, such an approach should be accelerated immediately to include developments in complementary sectors such as oil and gas, hydrogen, CCUS, interconnectors and ports.

RWE is strategically well placed to support those developments. In addition to our renewables portfolio in Wales, RWE owns and operates the 2.2GW Pembroke Power Station. Built in 2012, Pembroke is a highly efficient, state-of-art gas-fired power station, providing firm, flexible capacity and contributing an estimated £20m per annum to the local economy. We want Pembroke to be part of Wales' net zero journey. As part of the South Wales Industrial Cluster, we are exploring the feasibility of blending and burning low-carbon hydrogen as a substitute for natural gas – early indications show 20% by volume could be achievable. Furthermore, access to floating offshore wind makes Pembroke a prime location to produce green hydrogen. We have identified potential options for electrolysis; partnering via Cluster partners to find an off-taker for the hydrogen produced.

The transition to net zero offers significant opportunities for Wales, both developing the marine environment with offshore wind and investing in coastal communities along the north Wales Coast and Pembroke. Working with Marine Energy Wales and all stakeholders, RWE will continue to build on its special relationship with Wales to make sure that together we can make the most of that opportunity.

For more information, please see our RWE in Wales webpage:

https://uk-ireland.rwe.com/rwe-in-wales

Grafmarine is an innovative technology company developing innovative renewable energy products into the marine and other associated markets through our Energy Nano Deck System®. After winning Innovate UK competition funding, we have been working with a number of leading commercial and academic partners to develop a new, and market leading range of products that will help the maritime industry to meet worldwide legislation on Zero carbon emissions by 2040.

Under simulation we have demonstrated a 10% marine fuel saving on an oil tanker, which is around 10-15 tonnes of heavy marine fuel a day. We have now successfully gained our second patent and, have additional IP under development for novel composite designs and further enhanced design for the management and distribution of energy. We now have a prototype under testing and later this year we will be working with the ORE for offshore testing and have a pilot testing phase with a UK port for off-grid power.

We are based at OpTIC UK Technology & Photonics centre in St. Asaph, as well as in Altrincham, Cheshire. We have now successfully worked with 6 UK catapult centres for different development phases to get towards commercialisation. We have also engaged with Graphene Manchester in the design of novel electrical storage for propulsion energy. We are now actively engaging with the maritime industry in customer discovery to finalise our MVP to with Brooks Bell, including early talks with a Global oil company.

We plan to continue in development of new materials to improve our technology until it can provide full propulsion power for the marine sector. We also have an interest in the wind farm sector as well as other transport or structural opportunities, such as tidal energy, offshore oil and gas.

www.grafmarine.com

STRATEGIC PROJECT DEVELOPMENT IN WALES

Recognising the requirements of the sector as it grows and evolves, investment into key strategic projects that include and go beyond the test centre network has been pushed up the agenda in Wales. Leading to energy projects attracting support and investment from the City & Growth Deals.

SWANSEA BAY CITY DEAL

The Swansea Bay City Deal is a £1.3 billion investment that will transform the economic landscape of the area, boosting the local economy by £1.8 billion, and generating almost 10,000 new jobs over the next 15 years

Pembroke Dock Marine will deliver the facilities, services and spaces needed to establish a world-class centre for marine engineering. It will have cross-industry application, but its immediate focus is on the low carbon energy sector. It is a £60m Swansea Bay City Deal project comprising of 4 key elements.

1. Pembroke Port Infrastructure Upgrades, delivered by Port of Milford Haven (page 40)
2. Marine Energy Engineering Centre of Excellence, delivered by ORE Catapult (page 43)
3. Marine Energy Test Area, delivered by Marine Energy Wales (page 42)
4. Pembrokeshire Demonstration Zone, delivered by Wave Hub Development Services (page 38)

NORTH WALES GROWTH DEAL

The North Wales Growth Deal is an agreement between the UK Government, Welsh Government and the North Wales Economic Ambition Board to deliver £1.1billion investment in the north Wales economy. The aim of the Growth Deal is to build a more vibrant, sustainable and resilient economy in north Wales, building on strengths to boost productivity whilst tackling long-term challenges and economic barriers to delivering inclusive growth.

Of the Growth Deal's transformational projects, several could be of particular significance to the marine energy sector, including:

1. The Morlais West Anglesey demonstration zone, delivered by Menter Môn.
2. The Transport Decarbonisation Project, which supports delivery of a demonstrator involving the production of green hydrogen from low carbon energy for use within regional transport networks.
3. Holyhead Gateway, which will aim to future proof Holyhead Port through redevelopment and improvement projects.
4. The Smart Local Energy Project, which aims to create prosperity in North Wales by supporting and enabling clean energy and decarbonisation solutions.

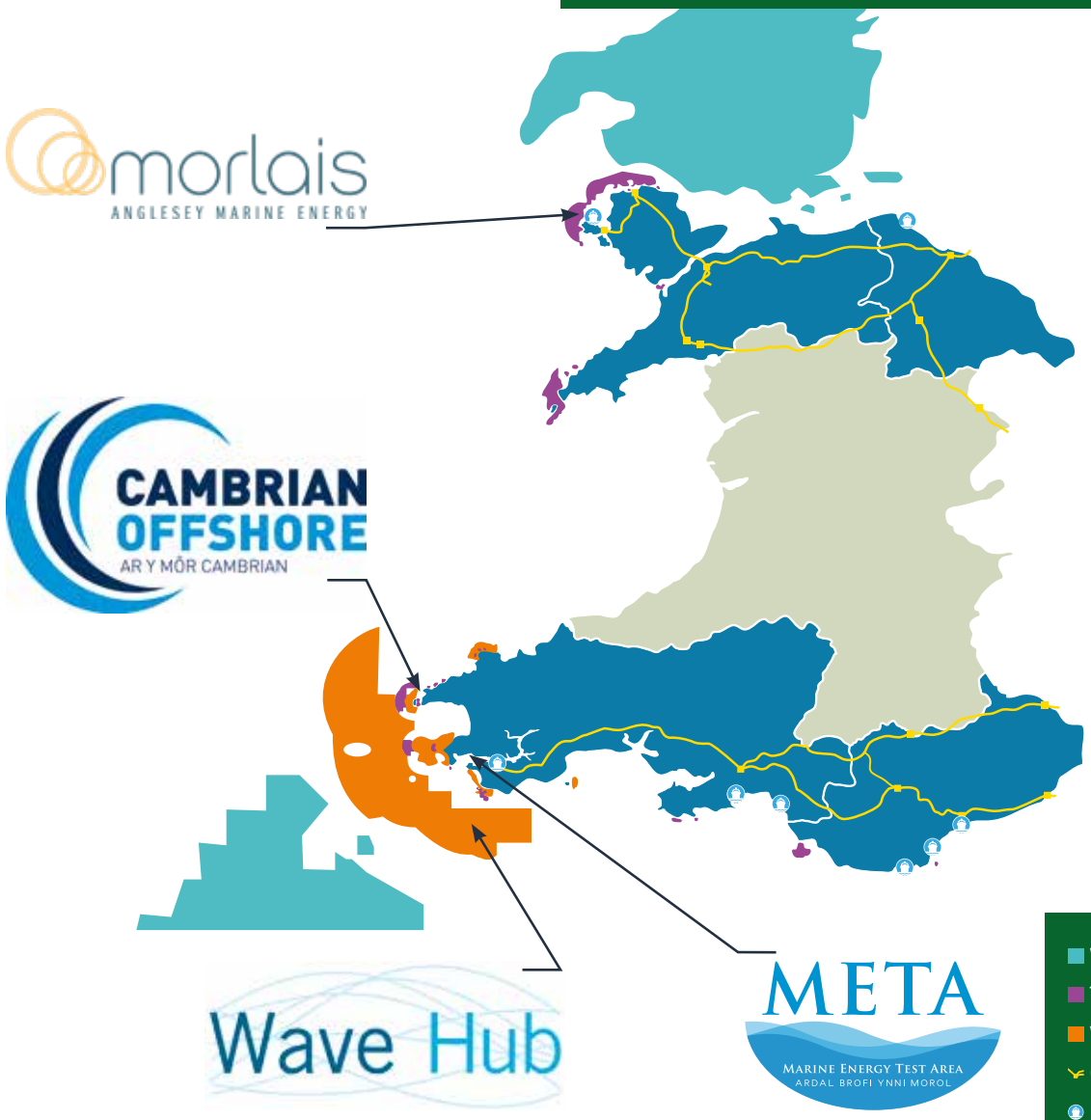
north wales economic ambition board
bwrdd uchelgais economaidd gogledd cymru

TEST SITES

Wales is uniquely blessed with abundant and diverse resources suitable for generating electricity from wind, waves and tides. This, alongside a supportive policy environment, experienced supply chains and a history of investment, make Wales the perfect location for the testing and demonstration of the technologies that can be used to harness the power of the ocean.

£8.5 million has been invested into the strategic development of Wales' test centre network to date. Because of this, there are testing opportunities across a wide range of scales, from controlled tank testing for scaled prototypes; to sheltered quayside zones for components, instruments and smaller devices; open water sites for individual full-scale prototypes; and high energy areas for array-scale demonstration of multiple devices. The Welsh test centre network includes:

- Welsh Universities, both Cardiff and Swansea universities own and operate test tanks for testing in a controlled environment. Collaborative research between Swansea and Bangor universities under the banner of the SEACAMS project also explores ways in which academia can support sector innovation, P44 - P45 for a synopsis of university research projects underway in Wales in support of the sector).
- The Marine Energy Test Area (META) where academia, supply chain and technology developers alike can test equipment and designs in conditions increasing in intensity from quayside to open water, suitable for all marine energy technology types.
- The TIGER tidal test site at Ramsey Sound
- Morlais, West Anglesey's tidal demonstration zone for array scale testing of multiple devices.
- The Pembrokeshire Demonstration Zone, adapted to enable the demonstration of floating offshore wind technologies alongside wave energy converters.



- Wind Resource
- Tidal Stream Resource
- Wave Resource
- Grid 400kV
- Ports

morlais
ANGLESEY MARINE ENERGY

PROJECT UPDATE

Morlais is the tidal stream energy project located in the West Anglesey Demonstration Zone, off the north west coast of Holy Island. The project is run by social enterprise, Menter Môn, which secured the 45-year Crown Estate lease for the zone in 2014.

Since then, the project team has been working towards securing consent. An application under the Transport and Works Act was submitted to Welsh Government in the summer of 2019, along with the marine license application to Natural Resources Wales. A public inquiry held on-line as part of the planning process ended mid-March, with a decision expected by Welsh Ministers later this year.

The project is phased and will gradually scale up over time to a generating capacity of 240MW – monitoring and mitigating any potential effects as it is developed. It has featured in the North Wales Growth Deal and subject to a business case, Morlais could receive £9m which will be a match to unlock a further £26m from the Wales European Funding Office (WEFO).

WHAT'S SO SPECIAL ABOUT MORLAIS?

But why is this project on Anglesey different to other tidal schemes?

Ask the team and anyone who is familiar with the project and they will tell you there are many things that make this project stand out from the crowd.

Most significantly perhaps, is that fact that Morlais is home grown. It is owned and run locally by Anglesey-based Menter Môn. It is the only project on this scale to be run by a third sector organisation.

Menter Môn has been running green projects on the island since 1996. So, there's history here. And Menter Môn is driven today, as it was 25 years ago, by its vision to create opportunities for local communities by making the most of resources available on its door step.

This is exactly what Morlais is – borne from the vision of one of its directors in 2014 to see renewable electricity generated off the coast of Anglesey.

Local ownership for Morlais means it's part of the community in every sense – and its very existence is to ensure benefits and any profit from the scheme come right back into that community. The driver for Morlais has always been to make sure the huge potential of the marine energy sector in terms of jobs, skills, investment and the supply chain are realised locally.

And as 'a local', Morlais is in it for the long haul. It will be many years until the scheme will reach the 240 MW capacity in its consenting application due to its adaptive management model. This means its potential to deliver local jobs and investment will continue to grow as the scheme grows.

Along with Morlais, other Menter Môn projects, including its plans for a Hydrogen Hub at Holyhead, create a solid platform for Ynys Môn and wider region to be at the forefront of the renewables sector.

Looking beyond the local, Morlais can also stand its ground on a global platform. Ten international turbine developers have already signed up to be part of project. Attracted by Morlais' unique 'plug and play' model which will provide them with the infrastructure and consent needed to develop their knowledge and understanding on a commercial scale. The Morlais pathway to commercialisation reduces the risk for developers, but promotes innovation in a sector which is yet to realise its full potential in terms of the energy mix.

And through all this of course Morlais as a player in the sector in Wales is poised to help governments in Cardiff and over the border in Westminster to reach their carbon reduction targets. The climate change narrative has been around for a while – but progress has been slow. Morlais along with its developers, similar projects across the UK and beyond, are well-placed to take action and make the real difference that's needed.

Green recovery is now the focus – with that there is more awareness and an urgency to act. Young people are vocal in their views on climate and inaction form governments. The sector can make a difference and has a responsibility to leave a greener and cleaner legacy for future generations.

www.morlaisenergy.com

Wave Hub

HWB MOROL
DOC PENFRO
PEMBROKE DOCK
MARINE

The Pembrokeshire Demonstration Zone (PDZ) is a 90Km^2 area of sea leased from the Crown Estate by Wave Hub Development Services Ltd, Cornwall Council's offshore renewables project development company. 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 the coast of wales; enable the deployment of current and future energy generating technologies, up to a capacity of 180MW within the zone, to generate green electricity from the sea; act as a location for Offshore Multi-Purpose Integration, to improve offshore renewables grid integration across a much wider sea area. 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 deep-water port facilities and support services. Detailed design and environmental surveys are planned to start in Spring 2021. Wave Hub Development Services Ltd has an office in the Marine Energy Hub in Pembroke Dock and plans to recruit two to three new members of staff in Spring/Summer 2021. Wave Hub Development Services 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 39) and deliver the project by mid-2023.

Cronfa Datblygu Rhanbarthol Ewrop
European Regional Development Fund

Bargen Ddinesig
BAE ABERTAWE
SWANSEA BAY
City Deal

CAMBRIAN OFFSHORE
SOUTH WEST LTD

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 €6.6 million 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.

Port of Milford Haven
delivering port infrastructure and services

HWB MOROL
DOC PENFRO
PEMBROKE DOCK
MARINE

An interesting story has been unfolding in Pembrokeshire. As a long-term home for the oil and gas industry, Pembrokeshire has key energy infrastructure and an exceptionally experienced engineering supply chain. In recent years we have seen the arrival of energy innovators looking to exploit the wave, tide, and, more recently, wind resources that are in abundance off our coastline. This is heralding in a new chapter in Pembrokeshire, a chapter that has local, national and global ramifications.

The readers of the State of the Sector report will be all too familiar with the national and global opportunities: A major growth in an advanced manufacturing industry and its resulting contribution to the Welsh and UK economies; the development of a new export commodity; becoming a market leader at the forefront of innovation; and, above all else, making a contribution to delivering clean green energy that will help address climate change and meet UK net zero targets. So, we will focus instead on the local aspect; what marine energy means at a local level.

Pembroke Dock Marine is very much a Pembrokeshire based development with exciting, far reaching implications for the local community and the wider south Wales region. As background, Pembroke Dock Marine is a £60m project funded by the Swansea Bay City Deal, European Regional Development Fund through the Welsh Government and with private, largely local, investment. It had been developed by ORE Catapult, Marine Energy Wales, Wave Hub Development Services Limited, and the Port of Milford Haven and it builds on the county's USP's: proximity to natural resource, experienced supply chain, and existing energy infrastructure. It also builds upon the experiences of the developers who are already based in Pembrokeshire. The principle behind the project is to support innovation and drive operational efficiencies to quickly reach commercialisation. By introducing enhanced port infrastructure, test areas and research and innovation facilities, Pembrokeshire is strengthening its offer recognising that fundamental changes are needed to ensure we keep meeting the needs of the industry and accumulating the benefits locally and regionally.

Pembrokeshire's economy is founded on the oil and gas industry, tourism and agriculture. For the latter two, productivity is hugely seasonal - which has a big impact. Alongside reduced annual productivity, it means that full-time rewarding careers can be hard to find. The county typically loses school leavers who pursue opportunities further afield. Pembroke Dock Marine provides a significant opportunity to change that. By supporting the long-term growth and future of the marine energy industry, school leavers alongside the current workforce, can enjoy rewarding, challenging careers on their doorstep – and be at the forefront of innovation and a drive towards decarbonisation. Skills development will become a key focus with support from local and regional training and education centres to ensure new and old learners make the most of the opportunities and to ensure Pembrokeshire's reputation for skilled engineering continues to grow.

The move to support marine energy also impacts our supply chains. The obvious beneficiary is the existing energy supply chain. With generations of experience, they are already delivering solutions for the industry – ensuring much needed resilience. But there are others too. The county has a long pedigree in the shipbuilding industry and that experience is being cross-transferred. They are bringing their knowledge of structures that need to survive in the challenging marine environment to astonishing effect. There is much to learn and much to share. The supply chain impact will continue to reach out beyond engineering firms to create year-round opportunities in the wider business community. Benefits will be felt across Wales.

We'll see more local companies winning contracts but we'd also expect to see new companies arriving – both supply chain and developers, just as we've seen the likes of Bombora and Wave Hub Development Services. This strengthens the business community even further creating new connections between old and new businesses. And while there are opportunities during the construction phase, the bigger opportunity will be once the project delivery is complete. This really is about bedding in a new industry to ensure long term goals and to move forward together.

The marine energy industry offers us all a more sustainable future. And for Pembrokeshire and the south Wales region in particular, it offers much needed prosperity.

www.mhpa.co.uk

META

MARINE ENERGY TEST AREA
ARDAL BROFI YNNI MOROL

HWB MOROL
DOC PENFRO
PEMBROKE DOCK
MARINE

META is the Marine Energy Test Area (META): Wales' national marine energy test facility, operated by Marine Energy Wales. Our goal is to create a haven for marine energy through providing a suite of fully licensed test sites in a unique, accessible location.

The META sites can facilitate testing programmes at various stages, from port side research and component or subsystem trials in less challenging conditions, to trials of scale and full-scale wave and tidal energy generators in real sea conditions.

Our pre-consented sites remove the considerable time, costs and risks associated with site identification, consenting and site characterisation, therefore simplifying access to sea-based testing for technology developers.

META is situated in the Milford Haven waterway, Pembrokeshire – an ideal location for a test centre. The project benefits from a variety of test areas which range in depth and resource exposure, as well as offering proximity to deep water port facilities and associated infrastructure, and an experienced local supply chain.

Providing an essential stepping stone facility to fill the gap between tank testing and full-scale demonstration, META is a key step of the developing Welsh test centre network facilitating a number of testing building blocks to enable developers to progress from concept & design through to commercialisation, and establishing Wales as a centre of excellence for marine energy development.

www.meta.wales

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European Regional Development Fund

Bargen Ddinesig
BAE ABERTAWE
SWANSEA BAY
City Deal

META acts as a key hub for research and innovation;

- Enabling academia to develop tools and reources to advance the sector.
- Supporting supply chain to bring innovative solutions to market.
- Allowing technology developers to deploy, re-risk and develop.

The META Phase 1 sites provide an unparalleled easy access and low risk area for testing marine energy equipment. This offers the ability to monitor and evaluate performance tests easily, as well as being able to adjust device parameters and retrieve equipment quickly. As a result, repeated deployment and retrieval can be achieved at low cost, enabling lessons to be learnt quickly to accelerate the pathway to commercialisation. META Phase 1 sites have the relevant licenses and consents in place and are now open for testing.

META Phase 2 offers moderate to high energy sites for operational testing: Warrior Way tidal site; Dale Roads wave test site; and East Pickard Bay wave and floating offshore wind component test site. These sites will be open for testing in summer 2021, and benefit from greater wave or tidal stream resource, depth and area whilst remaining close to port.

MEECE: DELIVERING CLEAN GROWTH FROM WELSH MARINE ENERGY RESOURCES

The Marine Energy Engineering Centre of Excellence (MEECE) is ORE Catapult's flagship hub for advancing the Welsh marine energy sector. It is a catalyst for research, technology innovation, testing and demonstration to accelerate the commercialisation of the offshore wind, wave and tidal sectors by reducing the cost of energy, improving efficiency and reliability, and supporting the growth of the Welsh supply chain.

A multi-million-pound collaboration between ORE Catapult, Swansea University, Cardiff University, Cardiff Metropolitan University and Bangor University, MEECE is based at Pembroke Dock and is part-funded by the European Regional Development Fund (ERDF) and Swansea Bay City Deal. It is part of the £60-million-pound Pembroke Dock Marine Project. Working alongside the Marine Energy Test Area (META), the Port of Milford Haven, Pembrokeshire Demonstration Zone and the local supply chain, MEECE offers unique facilities and capabilities to the Welsh marine energy sector.

MEECE can support innovative companies in Wales to develop new products, processes and services for the offshore renewable energy sector through:

- **Research, Development and Innovation**
- **Commercialisation Support**
- **Company Growth Support**

The Centre will also drive forward the development of offshore wind in Wales, with the upgrades to Pembroke Port's infrastructure enabling it to deploy large floating structures, such as floating wind foundations, much more effectively. MEECE can support offshore wind developers, and their supply chain, to develop new manufacturing processes, deployment techniques and operations and maintenance procedures.

Dr Stephen Wyatt, ORE Catapult Research & Innovation Director, said: "Wales has huge potential to develop clean energy from its abundant natural resources and already has a rich seam of ERDF-funded wave and tidal stream projects, worth over €100M. These projects will require ongoing innovation support to reduce costs and risks as they mature towards commercialisation, something which, drawing on the Catapult's existing expertise and those of our partners, MEECE is well-placed to provide."

www.meece.org.uk

BENEFITS TO WALES

MEECE aims to place Wales and Welsh companies at the heart of the UK's growing marine and offshore renewable energy sectors, ensuring they play a vital role in tackling global climate change and decarbonising our energy needs.

Cronfa Datblygu Rhanbarthol Ewrop
European Regional Development Fund

Bargen Ddinesig Bae Abertawe
Swansea Bay City Deal

UNIVERSITY RESEARCH

MARINE RENEWABLE ENERGY RESEARCH AT SWANSEA UNIVERSITY

The ocean is a very complex environment, and the goal of marine energy is to design the most cost effective energy capture device for this environment: one that requires minimal intervention maintenance to deliver good performance. No one organisation has all the answers to all of the questions that must be answered on the way to this goal, so therefore collaboration is essential to the continuing success of this industry. Swansea University Engineering has worked together with the marine energy industry for two decades, and we have found this collaborative approach works best for the questions that will need answers 2-3 years further down the development pathway. In the past year, our marine energy researchers have had several successes that could only have been achieved in collaboration with our industrial partners:

- Marine Power Systems: exploring the LCOE effects of changes in device layout of WaveSub
- Bombora: Building a thermo-visco-elastic continuum mechanics model of membrane materials.
- Magallanes and Sabella: Prediction of fatigue loading on rotors using experimental and numerical methods.
- Sustainable Marine Energy: reproduction of floating turbine movement path and station keeping from sensor measurements

Building on these recent research successes, we are working on several other projects that contribute to solving challenges for the wider marine energy industry, including our work on wave turbulence separation and wave resource classification. Aerial drone surveying has been applied to tidal range and tidal stream applications. Currently, we are developing new sensor deployment systems and new sensors, together with low-cost data logging. Although these projects are not specific collaborations like the ones identified above, we consistently engage with industrial partners to ensure that the projects keep a focus on the marine energy sector's needs.

Tidal turbine array modelling using CFD has been a long term project for the team at Swansea. The software is now stable and flexible, so we have taken the decision to freely share the code on our open source website https://www.swansim.org/. In the future the plan is to host more research outputs on this site and to build a community of users around these software systems.

MARINE RENEWABLE ENERGY RESEARCH AT BANGOR UNIVERSITY

The SEACAMS2 team at Bangor continues to undertake research supporting key MRE projects across Wales, including the Morlais and Minesto initiatives off Anglesey, the META project in Milford Haven and development of a North Wales tidal range scheme. Research on marine mammal collision risk, a priority for the sector, is the focus for work with Minesto on methods for tracking near-device cetacean movements and with Nova Innovation developing a new mobile application integrating marine mammal sightings data from both researchers and the general public. A number of cross-disciplinary projects are underway on interactions between artificial structures and physical and biological processes, that will support developers in optimising site selection and assist engineers in design and installation of marine renewable infrastructure to minimise environmental impacts, maximise the efficiency and ensure the long-term integrity of extremely costly installations. IMARDIS (Integrated Marine Data and Information System, portal.imardis.org) provides the MRE sector with a single point of access to the data acquired during SEACAMS2 and SEACAMS1 programmes, with ongoing development of new digital technology to create tailored and actionable information that is timely, accurate, credible and relevant to the MRE sector.

The Smart Efficient Energy Centre (SEEC) team have been developing projects on environmental interactions of marine renewable energy infrastructure. This has included cruises on the RV Prince Madog studying the interaction of subsea cables with sediments (ORE Supergen project) and of marine top predators with offshore wind turbines (INSITE). Staff have also investigated temporal and spatial variability of wave and tidal resources, and multiple resource interaction, through modelling and observational studies in the Irish Sea, including new collaboration with Marine Scotland and Deltares on standardizing tidal energy power curves, and upcoming procurement of an X-band radar system to be installed at various locations along the Welsh coastline. Further afield, SEEC staff have been developing models of the wave and tidal resource of the Philippines (with Nanyang Technological University in Singapore) and the tidal range resource of Australia (with CSIRO, Tasmania). Future directions include optimizing site selection for co-location of ocean energy and aquaculture, and characterizing the ocean energy resource through tracking surface features (VSCORES ORE Supergen project with UHI and Swansea University).

CARDIFF MARINE ENERGY RESEARCH GROUP (CMERG)

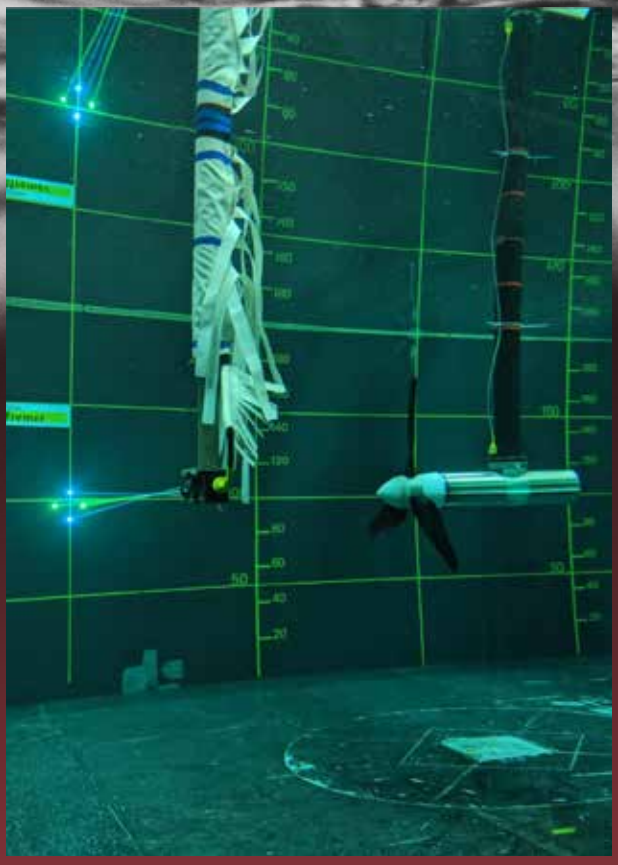
The Cardiff Marine Energy Research Group (CMERG http://cmerg.engineering.cf.ac.uk) is based in Cardiff University. Founded in 2001 its team includes academics from a range of Engineering disciplines in order to meet the demands and make a key contribution to the emerging UK tidal stream industry. The members include Profs Tim O'Doherty and Roger Grosvenor, Drs Allan Mason-Jones, Matthew Allmark and Carl Byrne and Mr Paul Prickett.

CMERG has secured significant project funding from EPSRC (EP/J010200, EP/N0202782; EP/R000875), the British Council (with Mexico and the Philippines) and industry over the years and is part of the Centre for Research into Energy, Waste and the Environment (CREWE) which is based within the Cardiff School of Engineering and is part of Cardiff's Energy and Environment theme. The group conducts research in to renewable energy generation from tidal flows and has a variety of active research projects encompassing four main themes:

- Hydrodynamic modelling – single and array of devices; blade design, turbulence modelling, wake modelling, turbine design for low water velocities.
- Finite Element Analysis and Fluid Structural Interaction modelling – blade/stanchion interaction, Dynamic loading, and Fatigue.
- Condition monitoring – development of robust condition monitoring techniques
- Experimental testing – development, manufacture and testing of high specification instrumented laboratory scale turbines for individual and array testing, individual blade loading measurements, drive shaft torque, thrust measurements, generator V&I measurement, stanchion load measurements.

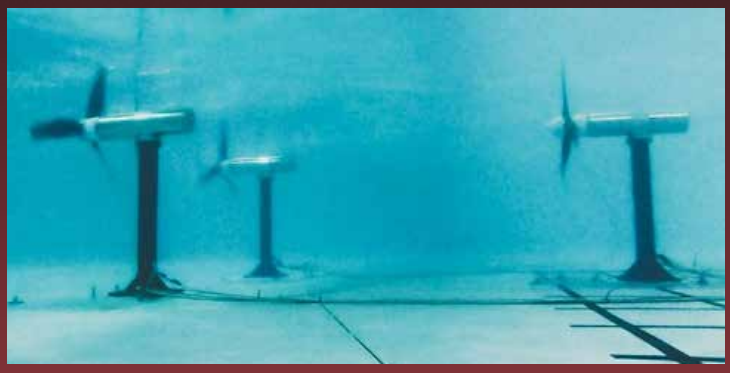
The group has strong links through collaboration and partnerships with Bangor Strathclyde and Swansea Universities particularly through the LCRI, NRN, Supergen Marine, British Council and UKRI projects with industrial partners such as Tidal Energy Ltd, ORE Catapult, Schottel Hydro, ANSYS, National Instruments, Bosch Rexroth, Intertek, Nautricity, and others.

The group is, and has, undertaken work in collaboration with a number of international partners including the National Renewable Energy Laboratory (NREL, USA), Mississippi State University (USA), Institut Francais de Recherche pour l'Exploitation de la MER (France), Universidad Nacional Autonoma de Mexico (Mexico), Inha University, Dalhousie University (Canada), University Philippines Diliman (The Philippines), Adelaide University (Australia).



Single CMERG turbine undergoing validation testing (funded by EPSRC DyLoTTA project with Strathclyde University)

Effects of Wake-current interaction on a downstream turbine. Testing using two CMERG turbines in IFREMER flume (funded by NRN Bangor led project, EPSRC DyLoTTA and EPSRC IAA)



Three CMERG turbines under test in Flowave (EPSRC DyLoTTA project with Strathclyde University)

SELKIE

Selkie is a cross-border project which aims to boost the marine energy industry in Wales and Ireland by bringing together leading researchers and businesses to improve the performance of marine renewable devices and technologies. University College Cork are leading the project in partnership with Swansea University, Marine Energy Wales, Menter Môn, DP Energy Ireland and Gavin & Doherty Geosolutions. The project is funded by the European Regional Development Fund through the Ireland Wales Cooperation programme.

The Selkie Project is developing multi-use tools models, test at pilot projects and develop a network of companies to reduce costs, increase collaboration and streamline the pathway towards commercialisation.

RESEARCH AND DEVELOPMENT

Tools and models
Tools are being developed to support suitable site selection, foundations and mooring systems, modelling interactions of arrays (farms), use of sensors and drones to make tidal measurements, tools to support logistics, operations, and maintenance of devices.

Two pilot projects (1 wave & 1 tidal) will:

- **Apply and demonstrate the value of the technology tools developed**
- **Assess reliability, survivability, operability, stability and commercial viability**

INDUSTRY ENGAGEMENT

Selkie aims to provide non-financial business support to 150 SMEs across Wales and Ireland through our business support network.

- **Full training for use of the Selkie tools**
- **Testing and developing new products**
- **Conducting data analysis and modelling**
- **Knowledge transfer from industry experts**
- **Business Support & Networking opportunities**

OUTPUTS AND ACHIEVEMENTS OVER THE PAST YEAR:

- Continued development of the suite of Selkie open-access tools with fieldwork and testing taking place over recent months. The Selkie sensor platform is being deployed at the Marine Energy Test Area in Spring 2021.
- Selkie pilot project tenders awarded to OceanEnergy Ltd. and Sabella to validate the Selkie tools. This collaboration between Selkie and developers will enable the theoretical basis of academic research to be interrogated on a real sea wave deployment, allowing robust ground truthing of the ideas and solutions generated cross borders between Welsh and Irish universities.
- Industry engagement through events, newsletters and surveys to gather input on tool development for operations and maintenance, GIS and foundations tools.
- The Selkie cross-border network continues to grow with over 65 members from across the marine renewable energy industry.
- Four online webinars covering supply chain diversification, operations & maintenance, foundations & mooring systems and skills for the marine energy sector engaged over 250 attendees and the recordings continue to engage with over 1000 views to date.
- Conference attendance, side events, poster presentations and exhibitions at Ocean Energy Europe, Marine Energy Wales, Supergen Annual Assembly and Marine Renewables Industry Association Ireland
- Three Selkie tool development workshops with industry and academia on the themes of Computational Fluid Dynamics, GIS Technoeconomic tool and Logistics modelling to gain early input to ensure the tools are fit for purpose.
- Selkie's 'Meet the Expert' event series providing business support to companies looking to diversify into the sector covering topics ranging from funding, insurance, legal services and testing.

www.selkie-project.eu

Llywodraeth Cymru
Welsh Government

"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

"The sector has continued to make great strides over the past 12 months in very challenging conditions, with over 460 MW of seabed leased projects around Wales representing all of the main marine energy technologies. I look forward to working with the sector over the coming years to deliver clean energy, strong Welsh supply chains and local jobs."

Minister for Climate Change
Julie James

POWERING A GREEN AND BLUE RECOVERY

As we look to promote a blue economy that can play a key role in our green recovery, it is important that we recognise the ocean of opportunity presented by marine renewables across Welsh society. From decarbonisation to sustainable economic growth and long term jobs in our coastal regions, through to adding diversity and resilience in our energy mix; there are many benefits to the continued growth of this Welsh industry.

We are seeing increased activity, interest and commitment and it is important to ensure that as we realise the true potential of harnessing the power of our oceans, that we are doing so in harmony with our marine environment. Our device developers and engineers recognise the challenges faced and actively seek resolutions, striving to strike a balance with the environment and sustainability.

There's no question that 2020-2021 was a busy, and in spite of a global pandemic, productive year for the emerging offshore renewables sector. The pandemic has forced a rethink to the status quo and demonstrated that different ways of doing things can be achieved and can be successful. With increasing attention on the ever more pressing need to address climate change, emerging offshore renewables offer a clean, green, sustainable opportunity for our energy needs. Wales has a unique strength from our geographical position, meaning we are able to host the full range of emerging marine technologies. This could position Wales as the leading offshore renewable energy generator in the UK, stimulating blue economic growth and crucially, a green recovery.

With a further £29.1 million invested this year alone, taking us to over £150 million of investment in the sector in Wales, the success in leveraging private investment and commitment is clear and underscores the strength and resilience of this home-grown sector. We are already capitalising on these investments with indigenous companies, projects and infrastructure alike, securing capacity and capability on our shores. With the right ongoing support, we are poised and strategically positioned to accelerate the sector's delivery, growth and success through;

- Our universities and collaborative research projects such as Selkie and Tiger,
- Our test centres and demonstration zones such as META, Morlais and Pembrokeshire Demonstration Zone,
- Our innovation network including the ORE Catapult's Marine Energy Engineering Centre of Excellence,
- Active policy support from the Marine Energy Programme and their Tidal Lagoon Challenge,
- Our increasingly experienced and resilient supply chain,
- Our technology developer successes, from Minesto's kite and Bombora's mWave to MPS's multi-platform solutions,
- Our site developer progress from the Floating Offshore Wind demonstrator Erebus and RWE's Net Zero Centre to Nova's Blue Energy Island,
- New and innovative solutions to the energy challenge including the South Wales Industrial Cluster and Anglesey's Hydrogen Hub,
- Two regional growth deals financing vital infrastructure redevelopments, and
- The innate marine resources of Wales.

However, the challenge of revenue support and a route to market lingers. Despite active engagement with multiple consultations about the Contracts for Difference scheme, we await commitment to the much-needed changes to Auction Round 4. Ringfencing 100MW for wave and tidal technologies will boost confidence, demonstrate commitment and drive further investment. Similarly, recognition that the 2020s needs to be about innovation, and not competition, is crucial. We need to facilitate supply chain development aligned to the sector's incremental buildout, rather than seeing our developers seek cheaper solutions from overseas, short-changing Welsh companies of the potential for sustainable economic growth.

As we look forward to a potential route to market that feels tantalisingly close, this year, the year of COP26, could be pivotal in anchoring an industry that is poised to bring sustainable prosperity to Wales and the UK through supply chain diversification, innovation and export opportunities. Currently at the forefront of the sector's development, Wales has the potential to strengthen our lead in offshore renewable power generation and create a marine energy technology export market, where not only the technology but also the skills, knowledge and intellectual property can be sold across the globe. We just need commitment to be converted to tangible delivery to maintain our position as global leaders.

JESSICA **HOOPER**

PROGRAMME LEAD
MARINE ENERGY WALES

MARINE ENERGY WALES OBJECTIVES

MARINE ENERGY WALES
YNNI MOROL CYMRU

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.

- **Provide support and guidance** for the sector by means of a single point of access, helping the sector to build knowledge and make sound business decisions and connecting businesses with key industry contacts.
- **Encourage learning and collaboration** through regular working group meetings which are viewed as unique on a UK level and highly valued by industry, allowing accelerated business-to-business relationships and knowledge sharing.
- **Raise awareness** of the country's key development undertakings, such as the €100.4 million of EU structural funding committed to marine energy projects in Wales and the £76 million Pembroke Dock Marine project, part of the Swansea Bay City Deal.
- **Engage with stakeholders** and allowing the unlocking of creativity and ideas for the development of the sector through public events, including an annual Conference that attracts delegates from across the world.
- **Provide a conduit for information** for industry and providing representation at relevant Governmental departmental and Ministerial level, maintaining the key profile of the marine energy opportunity and ensuring that it features strongly in energy policy.
- **Encourage wide participation** in the marine energy industry through widespread networking at local, national and global marine energy events.
- **Promote wider public understanding** of the benefits of marine energy, including the commitment to developing a low carbon economy which utilises our world leading position to create significant job and growth opportunities within the country.

Become a member at
www.marineenergywales.co.uk

MARINE ENERGY WALES' CURRENT WORK STREAMS

- **Supporting emerging marine energy policy development and leadership.** We continue to represent the industry on a range of policy groups from Marine Planning to Marine Advice. We work closely with the Marine Energy Council on UK political engagement; particularly on revenue support.

- **Promoting Welsh capability and attracting inward investment.** Our ongoing relationship with Welsh Government continues to facilitate growth and support for the sector and it's associated supply chain. Direct engagement with key Welsh ministers and assembly members has resulted in the inclusion of Marine Renewable Energy in key political papers.

- **Developing Welsh Supply Chain to promote jobs & growth.** Our ongoing efforts to promote local opportunity has helped Welsh companies to diversify into the sector and we are now carrying out our strategic plan to maximise Welsh economic benefit.

- **Facilitating and encouraging collaboration, sector networking & sector representation.** Our quarterly working group meetings and annual conference continue to provide key opportunities for the sector to come together and work towards common goals.

- **Education work with developers, teachers and schools to inspire future generations about marine energy.** We've developed curriculum-based resources on marine renewable energy to enable teachers to better engage their pupils with an array of renewable energy options. Our site visits provide young people in Wales opportunities to find out about the developing technology and learn what it is like to work in the sector. Facilitating the streamlining of consenting processes. Through engagement with the Welsh Regulatory body Natural Resource Wales we have been able to aid in the set-up of a dedicated department within NRW, the Offshore Renewable Energy Programme, tasked with processing offshore applications for consent.

- **Supporting the strategic alignment and integration of test sites and projects.** We engage in monthly calls with the Welsh test centre network and regularly liaise with EMEC for strategic support in the development of our own test site, META.

- **Operating a Marine Energy Testing Area in the Haven Waterway.** Through our WEFO funding, we have developed Wales' first National Marine Test Facility, META, complementing the existing UK test centre network and aiding in reducing time cost and risks faced by the industry.

- **Facilitating research co-ordination in Wales.** Our work as part of the Selkie Project has helped to bridge academic research with industry in a way that directly benefits the sector through lowering costs and streamlining pathways to commercialisation.

- **Providing bespoke support, guidance and advice to developers and supply chain.** Through our annual conference and regular working group meetings we disseminate industry information to key parties, ensuring that our members receive the relevant information they need.

- **Facilitating knowledge transfer and collaboration.** Our ongoing engagement through the Consenting Strategic Advisory Group allows bimonthly interaction between the key statutory stakeholders and project and technology developers in the region. As well as this we have formed a Scientific Evidence Advisory Group to work on strategic evidence gaps and data sharing.

- **Develop strategic international relationships.** We continue to nurture relationships already established with Canada, France, USA and Sweden and have extended our reach to Japan. We now provide secretariat services for the Celtic Sea Alliance, a triangular partnership of key stakeholders in Wales, Cornwall and Ireland.

MARINE ENERGY WALES

YNNI MOROL CYMRU

Premium Members

Blue Gem Wind
bombora
MARINE POWER SYSTEMS
GEOSCIENCE IRELAND
morlais
MENTER MÔN
Minesto
Port of Milford Haven
delivering port infrastructure and services
RWE
Llywodraeth Cymru
Welsh Government

Regular Members

ALUCOR
aquatera
BLACKFISH
BHA British Hydropower Association
Burges Salmon
CAMBRIAN OFFSHORE
Ynni Cymunedol Cymru Community Energy Wales
DP ENERGY
FAUN TRACKWAY
graf marine
GS Verde Group
FORMOSAN
HST
IM
intertek
LEASK MARINE
MAINSTAY MARINE SOLUTIONS
marine renewables canada
MarineSpace
MOREK
Cyfoeth Naturiol Cymru Natural Resources Wales
navmoor
NOVA INNOVATION
Ocean Resource
OGCS
ORBITAL MARINE POWER
CATAPULT Offshore Renewable Energy
Coleg Sir Benfro Pembrokeshire College
QEDNAVAL
Renewable Risk Advisers
renewableUK CYMRU
RHYAL ENGINEERING
Safinah Group
SEACAMS
Simply Blue Energy
Supergen Offshore Renewable Energy
THE CROWN ESTATE
TIDETEC Optimising two-way hydropower
TUGDOCK
wave energy SCOTLAND
Wave Hub
WAVE POWER ENGINEERING
WS

If you require this report in Welsh please contact: info@marineenergywales.co.uk

ANOTHER PCF PROJECT

Marine Energy Wales (MEW) and its associated projects including META are operated by Pembrokeshire Coastal Forum. Pembrokeshire Coastal Forum is a community interest company, registered in England and Wales with company number 08447094. Registered office : Pier House, Pier Road, Pembroke Dock, Pembrokeshire, SA72 6TR.

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