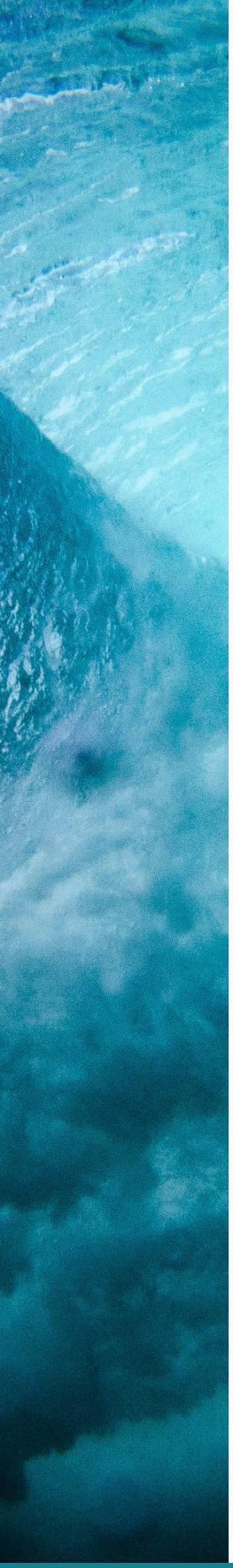
TIGER TIDAL STREAM INDUSTRY ENERGISER

EUROPEAN UNION
European Regional Development Fund

TIGER Case Studies

TIGER project driving growth of tidal energy in UK and France

Interreg France (Channel Manche) England
EUROPEAN UNION
European Regional Development Fund



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TIGER project overview

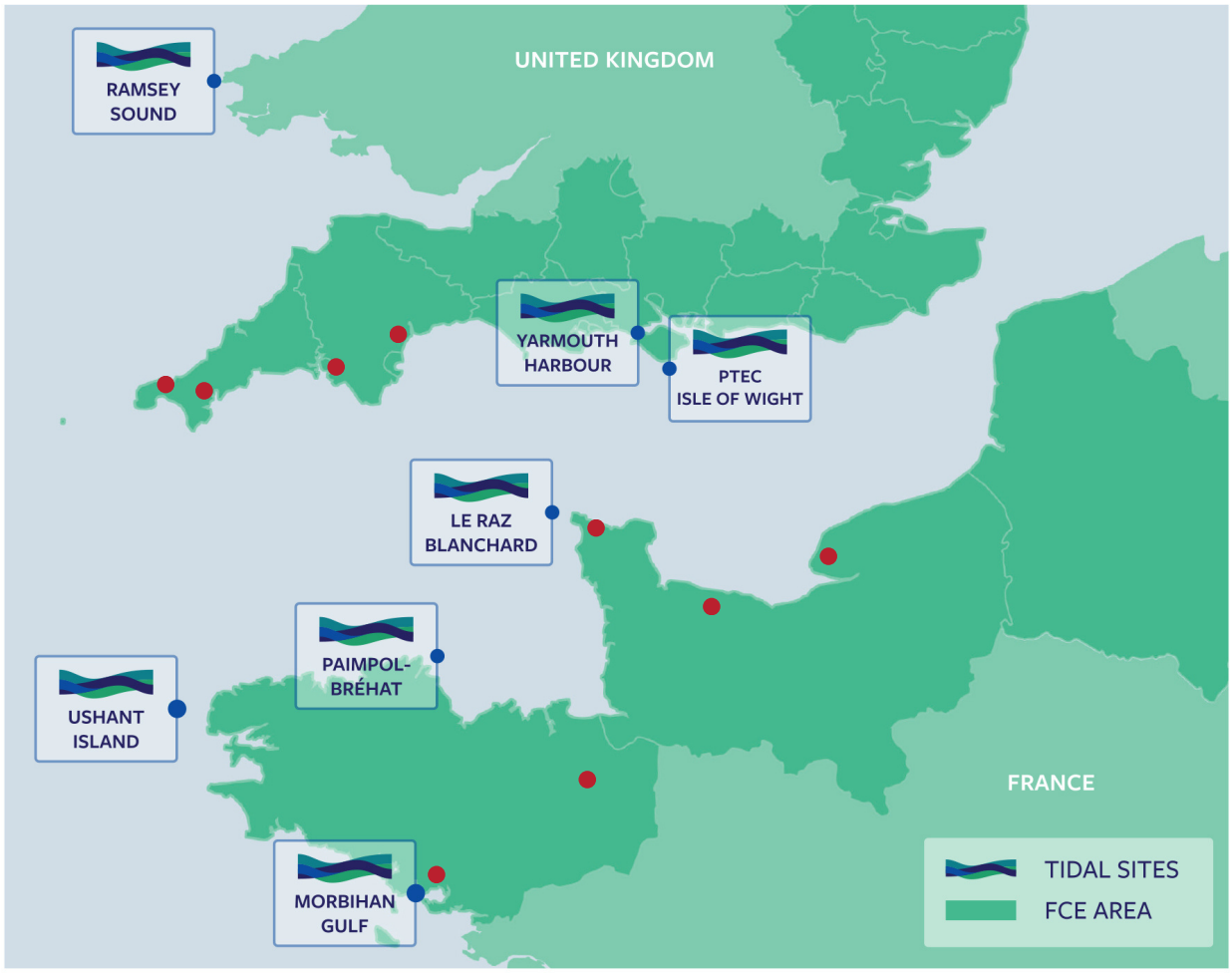
The Tidal Stream Industry Energiser (TIGER) project, which launched in 2019 to drive tidal energy growth in the UK and France, has successfully demonstrated the significant value tidal stream energy can bring to the future energy mix, economies and supply chains in both the UK and France.

TIGER is the largest project funded by the Interreg France (Channel) England Programme, with €48.4 million invested to drive collaboration and cost reduction through tidal turbine installations in the UK and France.

The project, led by the Offshore Renewable Energy (ORE) Catapult, has enabled installation of four new tidal stream energy devices at test sites in and around the Channel region, with a further 16 in development. This has created a total of 3.6MW new tidal capacity, with a further 57.4MW in the pipeline.

TIGER comprises 18 partners from across the UK and France spanning turbine developers, ocean energy demonstration sites, research organisations, as well local and regional authorities.

Map of France Channel England (FCE) area (dark green), partners within FCE area (red) and TIGER tidal sites:



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Case Study

Influencing Economic Policy

TIGER TIDAL STREAM INDUSTRY ENERGISER

Interreg France (Channel Manche) England

TIGER Partner: *ORE Catapult*

Summary

The key objective of the TIGER project was to convince UK and French Governments to take a fresh look at tidal stream energy.

The weight of evidence from the TIGER project, particularly 'Cost Reduction and Energy System' reports, provided a compelling argument of cost reduction certainty. This is however subject to continued Government subsidy support and potential savings offsetting energy storage costs for less predictable renewables.

Engagement with Governments was through country trade bodies using TIGER data and insights and in the UK, ORE Catapult also had regular dialogue with Energy department officials.

ACHIEVEMENTS

- Evidence base: TIGER Cost Reduction Report and Energy Systems Report. University of Plymouth led Tidal Stream Resource paper.
- Evidence presented to Marine Energy Council, Ocean Energy Europe, Department for Energy Security and Net Zero, The Crown Estate and Crown Estate Scotland.
- In the UK, tidal stream was awarded a £20m ring fenced fund in Contracts for Difference (CfD) Allocation Round (AR) 4 and £10m in AR5.
- In France the Government is in discussion with French developers for awarding feed in tariff mechanism.
- The size and scale of the TIGER project provided reassurance that cost reduction data was based on a wide and variable range of tidal devices and sites.
- HM Treasury is now asking for a tidal stream strategy. The success experienced by the tidal stream sector has promoted interest from other Marine Energy sectors, wave and tidal range to look at a similar modelling exercise.

CHALLENGES

- Sceptics in UK Government and HM Treasury.

TIGER PROJECT SUPPORT

- OREC led the data collection through 1-2-1 interviews with TIGER project partner sites and technology developers.
- Project partners provided cost data and cost reduction forecasts and identified areas for cost reduction.

IMPACT

TIGER has supported a clear route to commercialisation for those tidal developers receiving CfD and a huge boost of confidence to the tidal sector itself and optimism for other Marine Renewable sectors.

Policy

Funding support

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Case Study
Finance and Insurance

TIGER Partner: *ORE Catapult*

Summary

Through the TIGER project, ORE Catapult worked to understand the finance market for tidal stream energy and considered the necessary actions to improve developers' access to investment. In particular, looking at ways to provide cost-effective products for the sector.

The resulting report envisages the formation of a protected cell company (PCC) captive insurer as a structure to overcome the lack of robust insurance products to enable new ocean energy projects to be demonstrated and commercially deployed.

The document is aimed at project developers, policymakers, the insurance market, project financiers, and opinion formers for prospective public sector guarantors.

ACHIEVEMENTS

Drawing on the financial expertise available in the London financial sector, specifically the insurance market, ORE Catapult, has engaged experts to define an innovative **'Protected Cell Captive'** (PCC) insurance mechanism. The PCC mechanism draws on established insurance methods to cover extreme events and proposes **the application of such insurance techniques to support the development of the tidal stream energy sector.**

The insurance mechanisms defined in the report will also likely define an innovative insurance product that would be of interest to other early stages offshore marine renewable developers operating in sectors such as floating offshore wind, marine, solar and wave energy.

Insurance mechnism

CHALLENGES

The challenges included:

- Accessing public sector finance to support the deployment of the PCC mechanism proposed. Discussions with the Department for Business, Energy & Industrial Strategy (BEIS) officials is ongoing in an attempt to 'unlock' the required public funding support.

- Identifying suitable qualifying projects: This was overcome by consultation with industry colleagues and Ocean Energy Europe to identify marine renewable energy projects at a suitable stage in development.

- Identifying a suitable 'Fronting Insurer': This was overcome by leveraging the knowledge of the London insurance market and approaching appropriate parties for their participation in the project.

- Selecting the risk panel membership: This was overcome again by leveraging knowledge of London insurance market and approaching appropriate parties for their participation in the project.

TIGER PROJECT SUPPORT

ORE Catapult led the procurement, management and consultation with Offshore Marine Renewable insurance experts. The work involved building on the recommendations of the Ocean Energy Europe report and defining an innovative 'Protected Cell Company' insurance product, that could be developed to support the tidal stream energy sector and mitigate exposure to financial risk. ORE Catapult also provided technical advice and industry insight to support the identification of suitable projects and risk panel membership.

TIGER report: The Ocean Energy Accelerator.

IMPACT

The legacy will be the development of the 'Protected Cell Company' insurance mechanism to enable tidal developers to mitigate high-risk activities to enable access to project funding at a reduced cost of capital.

Therefore the next steps are two-fold:

- To share the proposed 'Protected Cell Company' insurance mechanism structure with interested parties in France.

- To identify the public sector guarantors. This includes continued discussions with the UK Government/ BEIS officials to identify a potential route to public sector funding support to enable the 'Protected Cell Company' insurance mechanism to be trialled with interested tidal stream energy partners.
- Planning a pilot project to validate OEA methodology and PCC principles.

"As the first tidal stream developers in the UK secure access to UK Government Contracts for Difference scheme, it's critical that project developers have access to the right insurance and warranty products that enable them to raise project finance and build out to scale."

Simon Cheeseman, ORE Catapult, Lead TIGER Partner

Case Study

Optimal wave and current modelling for the Channel region

TIGER TIDAL STREAM INDUSTRY ENERGISER
Interreg France (Channel Manche) England

TIGER Partners: *University of Exeter*

Summary

A hydrodynamic model was created to assess the combined current and wave climate at tidal energy sites in the English Channel region. The model captures the complex interactions between currents and waves over a 31 year period. New statistical methods were developed to assess joint extremes of waves and currents. This combination of the long wave-current dataset, with the new statistical methodology, allows designers to choose more accurate combinations of wave and current conditions to assess the energy yield and structural responses, giving greater confidence in the resilience of tidal turbines.

ACHIEVEMENTS

The scope of the modelling work was to understand the interactions between waves and currents at tidal energy sites, and derive descriptions of the climatic conditions, suitable for use in the design of tidal turbines and assessment of their performance.

A series of models were developed and run to assess the impact of various modelling techniques. These included two-way coupled and one-way coupled models using the Delft D-flow 2D model coupled with a SWAN spectral wave model. The two-way coupled models included both the effect of the currents on the waves, and also the effect of the waves on the currents.

In the one-way coupled model, only the influence of the currents on the waves is considered.

The models showed that, at the sites considered, the net difference in the energy resource was less than 2.5%. Although the net impact on the flow power was found to be small for the present sites, the effect is site specific and may be significant at sites with large wave exposure or strong asymmetry in the flow conditions and should thus be considered for detailed resource and engineering assessments.

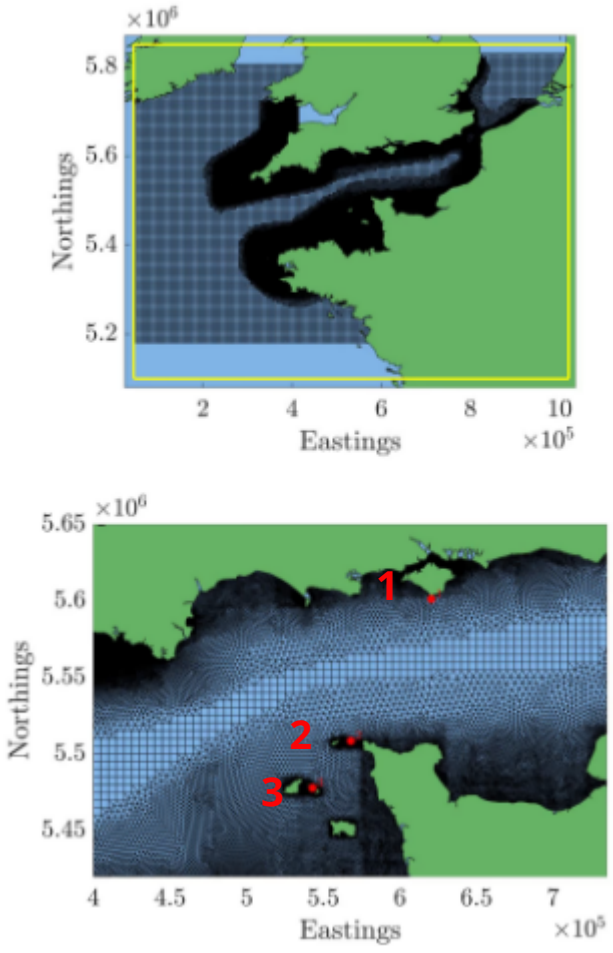

Figure 1. The D-Flow FM computational mesh: (top) the entire grid; and (bottom) a subsection of the domain showing the location of the three points of interest: 1, :PTEC; 2, Alderney Race; 3, Guernsey. The extent of the SWAN model domain is shown as the yellow box.

The one-way coupled model was used to create a 31-year hindcast of current and wave conditions in the English Channel. This data was used to examine the joint distribution of wave and current conditions for tidal energy sites near the Isle of Wight (UK) and in the Alderney Race (Normandy).

A new statistical methodology was developed to construct 3D environmental contours of current speed, significant wave height and relative direction between the waves and currents. It was shown that the largest waves occur when waves and currents are in opposing directions. Understanding the directional misalignment between waves and currents is important as it has a strong influence on structural loading.

The new methodology allows designers to select combinations of waves and currents at given misalignment directions, with a specified return period. This ensures that designs are assessed for resilience in conditions that have the correct level of conservatism, reducing uncertainties.

Building models

Developing statistical methodology

TIGER PROJECT SUPPORT

The TIGER project provided the funding for this research as well as opportunities for collaborations with commercial partners. Orbital Marine Power, in particular, provided the motivation for developing new statistical methods for quantifying joint extremes of waves and currents. Understanding how wave-current misalignment direction influences loads on the O2 device, was of key importance and helped focus the research to provide solutions relevant to the industry.

IMPACT

The improved detail and high accuracy provided by the models and analysis techniques have supported detailed design of tidal turbines for installation at the PTEC test site. The work provides consistent, high-quality data across the region. The methods developed provide an improvement on methods proposed in current design standards, reducing the uncertainty in the survivability of structures and improving resilience. This is applicable to tidal energy zones globally and it is expected that this work will be used by other developers for designing tidal turbines.

"Utilising this dataset, Orbital was able to quantify the resulting effect on Levelised Cost of Energy between different potential turbine and array locations, thereby helping Orbital to shortlist some locations over others."

Callum Miller, Orbital Marine Power

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Case Study

Tidal Stream Site Selection

TIGER TIDAL STREAM INDUSTRY ENERGISER

Interreg France (Channel Manche) England

TIGER Partners: *University of Plymouth, University of Manchester, University of Exeter*

Summary

Research was carried out to establish the UK's practical tidal stream energy potential. This considered both the tidal stream energy resource and practical considerations such as economics, environmental impacts and grid connections. The research contributed to calls for evidence issued by UK Government in 2020/21 to improve understanding of the role(s) tidal stream energy can contribute in the future, and the support needed to grow the sector. Since this time, UK Government announced £20 million per year ring-fenced subsidy in the Contracts for Difference (CfD) Allocation Round 4, which was won by four tidal stream projects with a combined install capacity of 40MW.

ACHIEVEMENTS

The research was conducted to reduce uncertainty in the UK's tidal stream energy potential. To gain support for developing a tidal stream power sector, it must be demonstratable that the resource can contribute significantly to net-zero carbon emissions aspirations. The research builds a case that tidal stream energy can provide 11% of the UK's current electricity demand.

The research contributed significantly to a pool of evidence used in successful lobbying of the UK Government to provide subsidy support for tidal stream energy projects. This included responses to calls for evidence, via the Marine Energy Council and through the publication of the research paper 'A review of the UK and British Channel Islands practical tidal stream energy resource', in the 'Proceedings of the Royal Society A.' As a result of this successful lobbying, four tidal stream energy projects have won subsidy support in CfD Allocation Round 4.

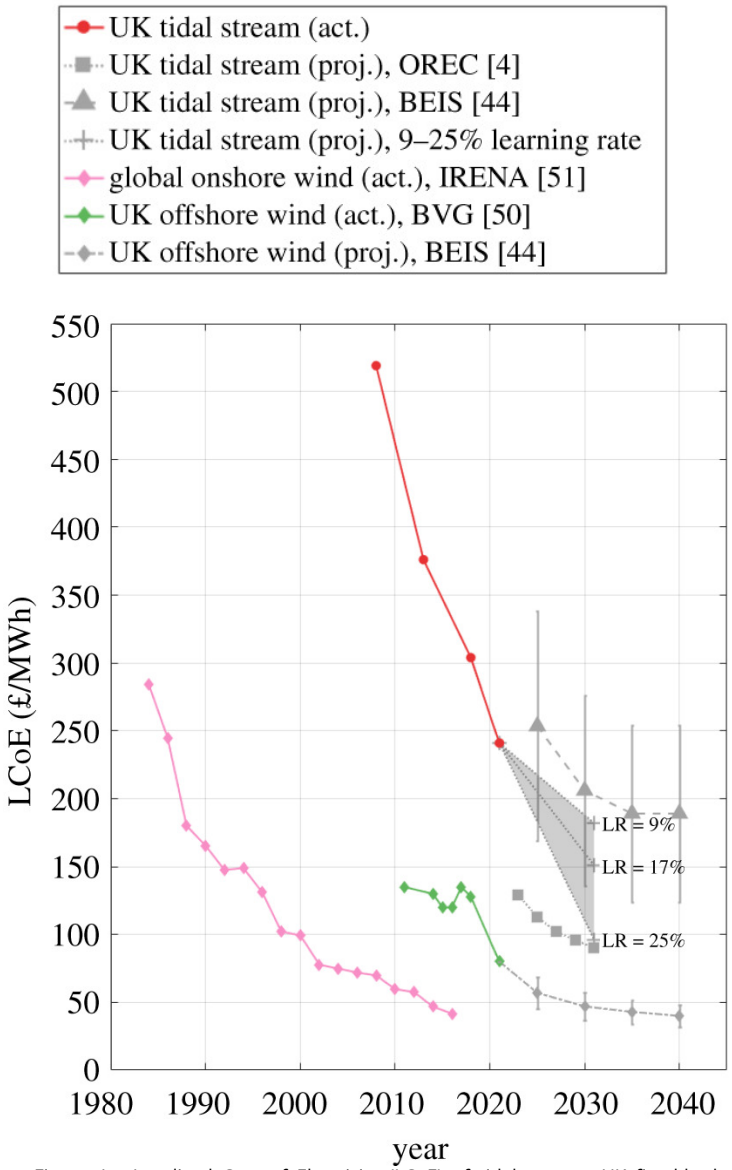

Figure 1 - Levelized Cost of Electricity (LCoE) of tidal stream, UK fixed-bed offshore wind and global onshore wind, based on actual data from operational projects and projections.

Tidal research

Government funding

TIGER PROJECT SUPPORT

The research carried out was made possible with funding provided by the TIGER project. The University of Plymouth led the research and collaborated with partners from the Universities of Manchester and Exeter. Partners assisted in data and information collection and drafting of the manuscript. This allowed for the publication of the research paper 'A review of the UK and British Channel Islands practical tidal stream energy resource'.

"This study provides an in depth, multi-faceted review of the tidal stream energy sector, and its potential to contribute to the net-zero transition in the UK. It identifies the significant opportunities and challenges the sector is facing, which can help to guide future policy decisions."

Dr. Danny Coles, Research Fellow at the University of Plymouth

IMPACT

When CfDs are delivered in 2026/27, the four projects will have a combined installed capacity of 40MW. This will increase the cumulative installed capacity achieved to date by 200%.

It is estimated that through this subsidy support and the resulting expansion in installed capacity, **the levelised cost of tidal stream energy will reduce by approximately 30%.**

From a research perspective, it was considered worthwhile disseminating research through different channels to increase readership and impact.

The research was disseminated through the following channels:

- The journal article, downloaded over 12,500 times, was been picked up by 23 news outlets and cited 21 times in academic journals.
- To provide three responses to calls for evidence from (i) UK Government Department for Business, Energy and Industrial Strategy, (ii) UK Parliament Committees, and (iii) National Grid ESO (Future Energy Scenarios).
- An article in The Conversation reached over 110,000 readers globally to date.
- The publication was cited in a recent UK Government House of Commons debate (Tidal Energy Generation: Ringfenced Funding).

The next step is to repeat lobbying efforts to highlight the need for additional subsidy support in the future (e.g. CfD Allocation Round 5, 6, etc). This will be achieved by tracking and communicating on sector progress.

"If we build up targeted support for the tidal industry, it will drive down the Levelised Cost of Energy to below £150 per megawatt-hour. This would make tidal stream cost-competitive with other technologies such as combined cycle gas turbines, biomass and anaerobic digestion."

Ian Blackford, Member of Parliment UK

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Case Study

Planning Consent & Grid Connection

TIGER Partner: *EMEC in association with PTEC*

Summary

The Perpetuus Tidal Energy Centre (PTEC) is a pre-commercial demonstration site for tidal energy. The site is capable of hosting up to 30MW of tidal energy device capacity, with 300MW of potential tidal resource.

Privately funded, the additional collaboration opportunities with the European Marine Energy Centre (EMEC), facilitated by the TIGER project, enabled the tidal site to reinstate full consent. It was also instrumental in obtaining a Scottish and Southern Electricity Network (SSEN) grid offer of 20MW.

This progress will have a significant impact on the tidal sector and PTEC will join a handful of fully consented UK tidal sites. These sites are seeking large scale tidal investment opportunities with expanding capacities, that are able to submit a bid into Contracts for Difference (CfD) rounds.

ACHIEVEMENTS

The aim of the project was to **demonstrate the full commercial capability of tidal stream energy**. TIGER funding supported the PTEC and EMEC teams to research and deliver the most cost effective grid connection and reconsent package.

The PTEC site required a grid connection with a capacity at, or close to, 30MW at a reasonable cost. The TIGER project enabled EMEC to review cable and grid options and negotiate with SSEN, the distribution network operator (DNO).

Three separate grid applications were submitted in parallel, with support from EMEC, as the fastest way to explore options within the project timescale.

As a result of the process, **the 20MW offer was selected as the preferred grid connection option**, with the need for some additional network reinforcement.

Alongside this, EMEC led the reconsenting works at the site including an updated Section 36, full planning application and Environmental Impact Assessment, drawing on expertise within their environmental and consents team.

The **TIGER project brought the site to full consent with a combination of onshore and offshore consents,** as well as commercial support.

Grid connection offer

Consents gained

Ventnor, Isle of Wight (Credit PTEC)

TIGER PROJECT SUPPORT

TIGER funding was used to accelerate the development of the PTEC tidal site at Ventnor, Isle of Wight providing a path to market for TIGER partners and a vital energiser for the tidal stream industry.

The support and collaboration provided by EMEC, through TIGER, was vital to the process of gaining consents, the grid connection offer and enabling PTEC to bid in CfD allocation rounds.

"At a time when the world's reliance on fossil fuels is causing significant challenges, gaining permission for the onshore elements of the PTEC project is of national importance. The government's commitment comes at the perfect time, enabling the UK to take advantage of this source of carbon neutral energy generation.

Rob Stevens, Chairman of PTEC

Orbital O2, Orkney arrival (Credit: Orbital Marine Power)

IMPACT

As a result of the process, PTEC has already secured an option with technology developer Orbital Marine Power to install 20MW of capacity at PTEC.

This work is therefore already having a significant impact on the sector as a whole, with the project enabling PTEC to join only a handful of fully consented UK tidal sites able to submit a bid into CfD rounds. The development of sites like PTEC shows growth and development of the sector and provides confidence to investors, ultimately increasing revenue to the sector.

Wider industry research has shown the waters around the PTEC site have the potential to offer greater capacity of up to 300MW than that sought by PTEC to date. This was also validated through a PTEC commissioned feasibility study, carried out by EMEC, for the south of England. Encouragingly, significantly more tidal stream energy could be generated in and around the Isle of Wight and throughout the English Channel.

"The PTEC site is crucial as it provides a clear consented pathway for the commercialisation of tidal stream power in England and is fully compliant for applications under the government's Contracts for Difference scheme. A zero carbon energy mix is vital for the country to meet and hopefully exceed its climate goals."

Heather Turnbull, Project Manager, EMEC

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Case Study
Design Development

TIGER Partners: *Minesto AB*

Summary

The primary target of Minesto's participation in the TIGER project was to reduce the cost of energy for Minesto's kite technology, as well as for tidal energy in general.

The TIGER project provided an opportunity to take a significant step in the development of the Dragon 4 technology in terms of cost, performance and operation. The new D4 was installed and tested at the Minesto test site in Vestmannasund, Faroe Islands.

The lessons learnt testing the new design have been incorporated into a range of Dragon products scaled from the D4, which are ready for rolling out in commercial arrays.

Minesto Dragon Class tidal kite (Credit: Minesto).

ACHIEVEMENTS

The primary target was to **reduce the cost of energy for tidal energy** in general and for Minesto's Deep Green technology, this has been achieved.

Compared with previous versions the Dragon 4 has **improved reliability, maintainability, and launch & recovery processes**. For example, the launch and recovery procedure has been greatly improved by removing the struts and moving the rotor to the rear of the nacelle, as this reduced the draft requirements and enabled a much more robust tow to site.
Moving the turbine to the rear also facilitated the adoption of an integrated nacelle wing design, rather than separate wing and nacelle components. This single piece composite wing construction provided the following advantages:

- Reduced manufacturing costs
- Facilitated easier assembly and maintenance
- Increasing the kite wing hydrodynamic properties
- Reduced kite drag
- Improved the performance of the kite

Turbine design

Demonstrate technology

In addition, a significant amount of work has been undertaken in the **development of the kite control system to improve reliability and performance,** all without modifications to the kite hardware.

These design and manufacturing improvements resulted in a reduction in both CAPEX and the OPEX of the D4 kite system which have significantly contributed to a reduction in LCOE.

Through the TIGER project, Minesto has not only successfully redesigned the D4 kite but as the technology is scalable, it has been possible to introduce the same lessons learnt into the range of the "Dragon Class" products. This has created a significant step towards producing commercial tidal power which is ready, either to support small micro grids or be set to work in large array to generate utility scale power.

CHALLENGES & LESSONS LEARNT

There are always difficulties in managing the supply chain for one off prototype components, these difficulties were exacerbated during and following the restrictions in place to control the spread of the COVID virus. Restriction in visiting manufacturers for inspection and testing compounded with delays in material deliveries and resource limitations increased costs and created schedule delays that were not in the control of Minesto. New work and procurement methods had to be quickly introduced to try and maintain the development schedule.

- Minesto originally planned to deploy, and grid connect the D4 kite via the existing Paimpol-Bréhat cable infrastructure, this cable had some pre-existing faults and some specialist components were required to make the connection, which unfortunately were subject to severe supply chain delays.
- Therefore, a new plan was developed by Minesto to test the kite, connected to a Micro-Grid system (MGS) onboard a DP vessel permanently on station. Unfortunately, the wet mate components, required for this plan, were also affected by COVID related delays. The procurements delays would have resulted in a shift of the testing period from the summer to the winter. Minesto felt this was unacceptable from both a technology performance and cost overrun perspective, i.e. risking very short testing periods using expensive vessels in winter did not provide value for money.
- A third plan was developed to achieve the same key outputs, in a cost-effective manner. Minesto agreed with the key project partners a proposal to move the D4 testing activities to an established grid connected and proven location in the Faroe Islands. It was proposed that all activities, data sharing and TIGER partner interactions would remain the same, only the location of the deployment and testing would change. Unfortunately, even though the move to the Faroe Islands was agreed and undertaken, the TIGER funding for the performance testing was withheld and the TIGER has not benefitted from the sharing of the D4 testing results.

TIGER PROJECT SUPPORT

The TIGER project enabled Minesto to achieve the key objectives set out at the beginning of the project. The objective was to develop a new kite design (Dragon Class) which, in comparison to the previous iteration, would be higher performing; more reliable; and easier and cheaper to build, install, and recover.

The funding from the TIGER project enabled Minesto to test this design in real sea environment, which resulted in a reduction of Levelised Cost of Electricity (LCoE). This supported the commissioning of a more attractive system to project developers in the channel region and the UK, and eventually around the world.

Minesto, together with the partners involved in the TIGER project, facilitated the cost reduction trajectory (LCoE) of the tidal energy sector as a whole.

IMPACT

In addition to added knowledge and added capacity, the TIGER project (in combination with other partners) supported step changes and improvements in tidal technology, which ultimately will make tidal energy more attractive to developers and investors.

Minesto Dragon Class tidal kite (Credit: Minesto).

"Thanks to the TIGER project and the associated funding we have been able to make a step change to the design, construction, reliability and operability of the Dragon 4 Kite System and hence significantly improve its overall LOCE. Due to its inherent scalability, these improvements have now been shared with the complete product range accelerating the transition of the Dragon Kite System to full commercial status."

David Collier, Cheif, Operating Officer - Minesto

Case Study
Testing & Validation

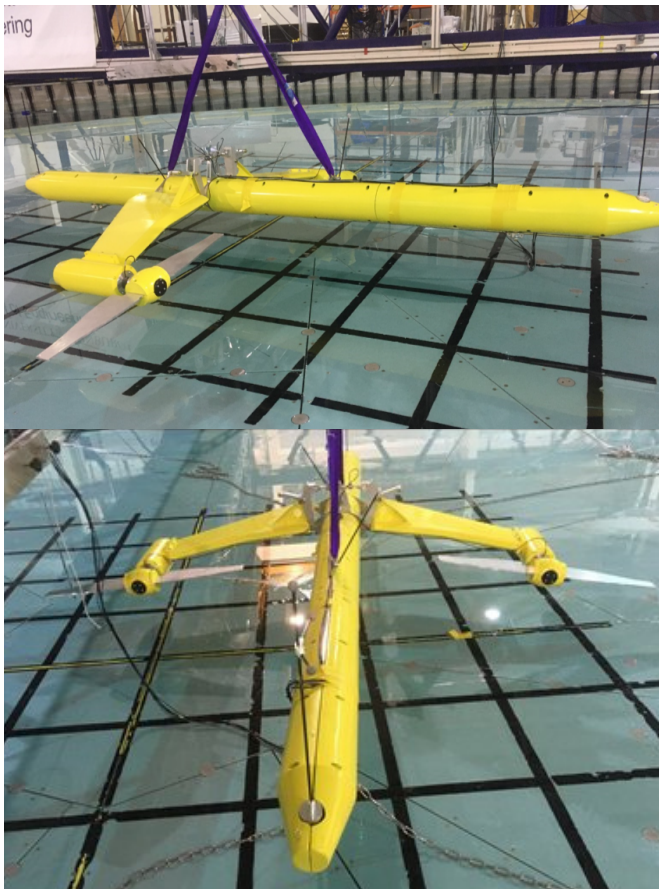
TIGER TIDAL STREAM INDUSTRY ENERGISER

Interreg France (Channel Manche) England

TIGER Partner: *Orbital Marine Power*

Summary

Orbital Marine Power (Orbital) tested a scale model of the O2-2000 floating structure at Edinburgh's Flowave tank testing facility. The tests allowed the hydrodynamic models used in the turbine design to be validated, thereby de-risking the design, and in turn reducing the Levelised Cost of Energy. One of the key test results was the validation of the leg loads during towing, which de-risks the transportation of the turbine. This increases the flexibility of the operation, which is particularly important as Orbital ramps up to launching multiple turbines per year.



Images of the 20th scale floating Orbital Turbine testing at the University of Edinburgh's Flowave facility

ACHIEVEMENTS

Orbital carried out a two-week tank testing campaign at the University of Edinburgh Flowave facility in January 2021.

A 20th-scale floating turbine platform and its moorings were tested in a variety of inflow and wave conditions. This would aid to further de-risk the turbine design by reducing uncertainty in incident load predictions.

The first of the two most important outcomes of the tank tests related to towing simulations. When towing, the legs of the turbine are horizontal. Due to the associated surface piercing, wave slamming and surface interaction of the blades, towing loads are particularly challenging to model. **Thanks to the tank tests, the design leg loads were validated and the safe wave limit for towing was confirmed**. This de-risked the operation and helped enable third-party verification by a Marine Warranty Surveyor of the towing loads.

The second important outcome of the tank tests regarded the **validation of device performance in beam-on waves**, i.e. waves incident on the turbine side-on. Modelling beam-on waves using numerical models is challenging due to conflicting assumptions of the typically used hydrodynamic equations. Scale model testing is also challenging as there are few facilities in the world that can create the desired conditions.

Flowave is the only testing facility worldwide that allows the simulation of waves at a 90-degree angle to the current.

Significant calibration and baselining was necessary prior to these tests, by the Flowave operators, to safeguard that the required conditions could be suitably reproduced. This ensured a successful test programme.

Overall, the test campaign allowed Orbital to validate the predictions of turbine behaviour in large (6m Hs) beam-on waves, and increased confidence in predicted peak loads.

Further outcomes of the tank tests included validation of the device stability, mooring design and hydrostatics such as the free-floating draft, all of which further validated Orbital's predicted loads and significantly de-risked the turbine's design.

TIGER PROJECT SUPPORT

The TIGER project was instrumental in enabling these tank tests as the project provided funds for facility hire and model fabrication. In addition project management support was provided by Black & Veatch, who managed the procurement and fabrication of the scaled device.

"Black & Veatch provided an effective mix of engineering and project management support to the test campaign. The team integrated very efficiently into the Orbital team to allow Orbital to increase their engineering resources to deliver the test campaign successfully."

Calum Miller, Principal Engineer & Hydrodynamics Manager, Orbital Marine Power

IMPACT

The successful tank tests contributed to significantly de-risking the most advanced floating tidal turbine in existence, particularly with regards to towing loads. This increases flexibility in design and during operations, and reduces costs during the load out and transportation phase of the project. This is particularly important as Orbital ramp up to launching multiple turbines per year.

"Flowave understands the value of de-risking technology development, and the role testing can play in this. Flowave put real effort into making sure the tests delivered the information that we needed and this effort paid off during the test program."

Calum Miller, Principal Engineer & Hydrodynamics Manager, Orbital Marine Power

Tank testing

Validation of predictions

Orbital O2 operating at EMEC test site in Orkney (Credit: Orbital Marine Power).

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Case Study

Component Manufacture & Turbine Assembly

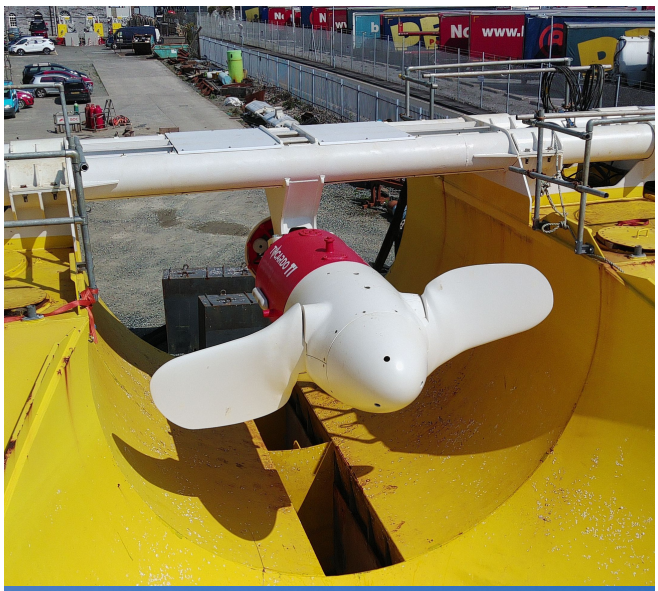
TIGER TIDAL STREAM INDUSTRY ENERGISER

Interreg France (Channel Manche) England

TIGER Partner: *QED Naval*

Summary

Through the TIGER project QED Naval showcased the Subhub Community Demonstrator, their self deploying tidal turbine platform, with the Tocardo turbines. Along with developing a test barge, this proved the Subhub's capabilities in reducing deployment costs, improving yields and in generating power, leaving a TIGER legacy and test site in the South Coast at Yarmouth Harbour.



Torcado turbine blades attached to Subhub-CD platform (Credit: QED Naval)

ACHIEVEMENTS

The Subhub turbine platform was successfully decommissioned and re-deployed over 200 nautical miles away, along with its older Schottel turbines. Subhub was then refitted with three new Torcado turbines, fully tested and commissioned, which included onshore full system simulations. The Subhub platform has since been de-mobilised and re-launched. The technology will then be towed to the south coast of the UK, Yarmouth, ready to further demonstrate its capabilities.

The main project achievement was the **proof of ease of deployment, and cost savings in use**. Completion of commissioning and testing of all equipment onshore, provided the necessary confidence in the technology. In addition, QED Naval developed a new generator specification, which significantly upgrades the power performance, required to simulate grid and loadings.

Remote control aspects and operations of the platform have also been significantly enhanced with the new platform, turbine, and environmental resource and monitoring systems.

Subhub's numerous launches, have provided significant operational data, learning and confidence in the systems performance which can be shared with the sector.

Successful deployments

Improved operations

TIGER PROJECT SUPPORT

Funding provided by the TIGER project was important for allowing these operations to be carried out.

In addition, ORE Catapult assisted with reviews and advice on technology development, operational requirements and procurement procedures.

The QED Naval team also collaborated effectively with Tocardo Turbine's main contractors, the local shipyard and supply chain. Set up was completed by QED and supported by Mainstay Marine Solutions. All three turbines were commissioned efficiently due to the the teams experience and practised systems, as well as the effective processes in place through Tocardo. This provided essential training, establishment, and testing of key processes for QED in the operation of the turbines.

Retreival of Subhub-CD turbine platform from Yarmouth harbour (Credit: QED Naval)

IMPACT

QED's plan to deploy its Subhub platform and turbines in one of the UK's busiest water channels, will demonstrate its ease of deployment and yield, improving characteristics with further testing and monitoring. Through Subhub, QED has demonstrated to the sector a cost saving, yield improving tidal turbine platform, which others can take learnings from. With third party consents, QED also aims to leave a TIGER legacy and test site in the Solent at Yarmouth Harbour.

Subhub-CD turbine platform (Credit: QED Naval)

"We were delighted with how the commissioning and testing of the Subhub-CD tidal platform and Tocardo tidal turbines has gone. This now gives QED and its stakeholders ultimate confidence in deploying such systems offshore.

Jeremy Smith, QED CEO

"It's been a pleasure working with QED developing low cost, reliable tidal solutions with our turbine technology - with much learning for the sector and future"

Andries van Unen, Tocardo CEO

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Case Study

Turbine Deployment & Entry Into Service

TIGER Partners: *Morbihan Hydro Energies and Université Bretagne Sud*

Summary

The TIGER project involved the consent, design, engineering studies and the beginning of the construction of two 250kW pilot turbines. The turbines were intended for a near-shore, fast-flowing, shallow water site at the heart of a protected marine ecosystem in the Golfe de Morbihan. The project has assisted the developer to secure permits which will enable the project to look at the environmental and technological impacts of two innovative pilot turbines over a three year period. The turbines included a series of different innovations to reduce maintenance interventions and lower the cost of energy thanks to easier deployment and retrieval.

Morbihan Hydro Energies ADCP being prepared for deployment in the Golfe de Morbihan

ACHIEVEMENTS

The first main outcomes achieved were the **detailed designs for two 250kW turbines** each with different innovative aspects. The design of the turbines benefitted from the detailed site-specific information on flow rates and environmental constraints.

The project will allow the developer to complete rigorous testing of turbine components on a dedicated test bench in the Port of Brest before they are shipped to the site following the completion of the TIGER project.

Alongside the turbine development, detailed environmental impact studies were carried out for the proposed site as part of the consenting process with the French authorities.

Morbihan Hydro Energies (MHE) and Université Bretagne Sud (UBS) worked closely together in the Golfe de Morbihan on impact studies relating to the turbines site, the export cable route and the foreshore landing area. **Consents were subsequently approved in January 2023.**

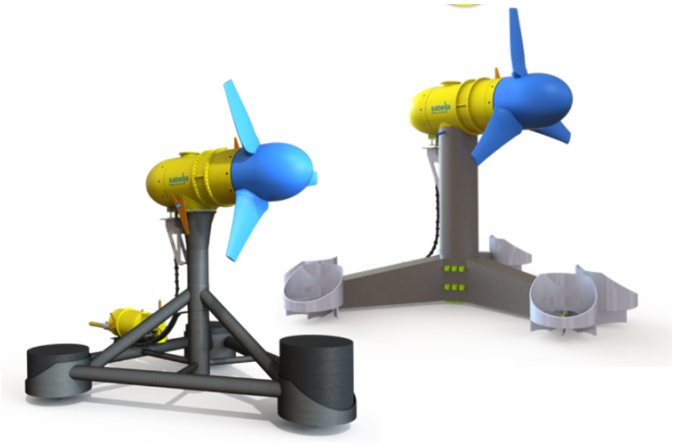
Turbine design

Contents gained

TIGER PROJECT SUPPORT

The TIGER project has played a vital role in creating the additional capacity for MHE to build upon the turbine experience to date. As a result, MHE was responsible for the successful design and procurement of the different components of the two turbines.

Alongside this, a collaborative partnership between MHE and UBS developed within the TIGER project. UBS has played a key role in helping MHE to better understand the state of the marine environment around the site, supporting MHE with data collection and analysis. Whilst MHE managed the preparation of the environmental impact studies, a key part is the consent procedure that responds to the expectations of the relevant national planning authorities.



Morbihan Hydro Energies 14 metre tall turbine designs

IMPACT

With the consents approved, MHE will deploy the two 250kW turbines at the site in December 2023.

To complement this, the Port of Brest now has a fully functional test bench as a result of the project.

With new turbine design innovations such as these, the progress from individual tidal pilots to the concept of fully functional arrays is increasingly becoming a reality. This is taking steps towards tidal energy contributing significantly to the future energy mix, reducing carbon emissions through a downscaling of more traditional energy generation used in peripheral, remote island and coastal areas.

Morbihan Hydro Energies ADCP deployment in the Golfe de Morbihan

"Thanks to TIGER and the work of partners we have been able to bring these pilots one step closer by preparing the way for us to test and monitor the impacts of the turbines in real world experimental pilot."

Christophe Laly, Director, Morbihan Hydro Énergies / SEM 56 Energies

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Case Study

Operate & Maintain, Recover & Decommission

TIGER Partners: *Hydroquest & EDF*

Summary

In 2021, French tidal developer, Hydroquest planned critical offshore works on Paimpol-Bréhat tidal test site aiming to recover its 1MW tidal prototype. This type of operation required specific vessels and skills, and only a handful of such vessels were available at the time.

As the operator of Paimpol-Bréhat tidal test site, EDF was fully involved in the operation, partners effectively collaborated to ensure operations ran smoothly and efficiently.

Hydroquest, as a tidal turbine manufacturer, and EDF, as the operator of Paimpol-Bréhat tidal test site, operated the 1MW Hydroquest tidal turbine from April 2019 to September 2021.

Hydroquest turbine being recovered at Paimpol-Bréhat tidal test site

ACHIEVEMENTS

One of the main goals of the TIGER project was to finalise this **turbine demonstration and decommission**. The most difficult task of the operation was to recover the turbine successfully while mastering the total budget. Indeed, this type of operation can easily fall behind schedule (due to delays from prior projects, bad weather conditions, contingencies during works, Covid-19 restrictions, etc.) and each additional day costs extra.

The organisation of the turbine recovery was even more complicated because the work had to be planned during neap tides, when tide currents are lighter. It was necessary for a dynamic positioning 2 vessel to be able to accurately maintain its position on the surface of the sea, while lifting up to 400 tons of steel.

The final objective was to deliver the turbine, its gravity-based foundation and the three cast-iron ballasts on the quayside, in Cherbourg harbour. In the end, Hydroquest successfully **completed its mission with the work delivered on schedule and within budget**. Activity reports have been written to consider this experience for future needs.

Demonstrate technology

Decommission turbine

TIGER PROJECT SUPPORT

The engineering work performed in the programme has been very useful to master the offshore work. Then, the exchanges with other turbine manufacturers in TIGER (Proteus and Sabella) allowed for efficient syenrgy in the search of a revevant shipowner, leading to the selection of a vessel at the best price. Beyond the sharing of market information, the partners even considered the opportunity to sign a collaborative contract in order to make their respective opportunities more attractive.

In addition, the **financial support from TIGER** definitely made the work possible in 2021 despite the difficult market conditions.

Finally, Hydroquest and EDF successfully recovered the device before mid-October 2021. Beyond this date, carrying out operations in the winter months, when weather conditions would have deteriorated, would have led to greater costs.

Turbine being transported to shore following recovery at Paimpol-Bréhat tidal test site

IMPACT

Operating costs will be a major factor of tidal energy Levelized Cost of Energy (LCOE). Therefore, the optimisation of offshore work is a crucial strategy to reduce it.

The lessons learnt in TIGER will enable Hydroquest to design the turbine in a way that will make offshore work faster and more efficient. By strengthening the relations within the supply chain, Hydroquest has been working closely with vessel owners with the aim to reduce uncertainties around the costs of similar operations.

"Thanks to the TIGER project and the efficient collaboration between partners, Hydroquest successfully reached the objectives to decommission its 1MW turbine prototype within time and budget. The lessons learnt will definitely help us to optimise costs of offshore works in the upcoming pilot farm project FloWatt".

Thomas Jaquier, CEO - Hydroquest

"EDF very willingly backed Hydroquest with their skills, expertise and infrastructures during this test programme in real-life conditions. The results are particularly encouraging."

Nicolas Gerard, Technologies Project Manager - EDF