

IMPACT

Case Studies



MARINE RENEWABLE ENERGY



RENEWABLE ENERGY



MARINE RESEARCH

BLUE GROWTH • CLIMATE ACTION • ENERGY TRANSITION



RESEARCH EXCELLENCE



SOCIETAL IMPACT



SUPPORTING INDUSTRY

INTRODUCTION

MaREI is the marine and renewable energy research, development and innovation centre supported by Science Foundation Ireland. We combine the expertise of a wide range of research groups and industry partners, with the shared mission of solving the main scientific, technical and socio-economic challenges across the marine and renewable energy spaces.

In MaREI, a key aim is to ensure that scientific knowledge and breakthroughs are utilised by our diverse range of stakeholders. Accordingly, we believe that government, industry, local communities and ultimately society should benefit from our research. This short booklet is an overview of how just some of our research is being used to achieve this aim.

Any given project that we undertake normally has many different types of impact. This booklet uses a colour coding scheme to explain the multiplicity of impacts that projects have. The different types of impacts are set out alongside here.

This booklet provides insight into the type of work we do and the impact of our activities.



MaREI Facts and Figures

6	Academic Partners
200	Researchers
90	Academic Collaborations
46	Industry Partners
20	Collaborating Countries
€5	Million Industry Funding
€11	Million EU Funding

58

PUBLICATIONS WITH AT
LEAST ONE CO-AUTHOR
FROM INDUSTRY

20

PUBLICATIONS COMING
FROM COLLABORATION
ACROSS RESEARCH
DIVISIONS HAVE BEEN
PRODUCED FROM 2016
TO DATE

48

INDUSTRY PARTNERS
(33% MNC/67% SME)
CONTRIBUTING €3.5M
CASH

20

PUBLICATIONS WITH CO-
AUTHORS FROM MORE
THAN ONE INSTITUTION
WITHIN MAREI

16

ENTERPRISE IRELAND
COMMERCIALISATION
AWARDS (INNOVATION
VOUCHERS AND
AWARDS)

40%

OF TRAINEES MOVED TO
INDUSTRY AS A FIRST
DESTINATION

266

JOURNAL PUBLICATIONS
AND 255 CONFERENCE
PUBLICATIONS ACROSS
THE CENTRE

59

PEER-REVIEWED
JOURNAL PAPERS IN
HIGH-IMPACT
PUBLICATIONS



SUPPORTING AN ENVIRONMENTALLY COMPLIANT MARINE INDUSTRY

The Marine Ecology Group in MaREI has a long record of working with industry to secure compliance in the offshore industry.

For example, MaREI has had a long-term relationship with RSK that commenced when they won the contract to monitor the Broadhaven Bay site during Shell's development of the Corrib gas field. Both Shell and RSK recognised the Centre's expertise in the monitoring of marine mammals and based on its reputation contacted it to explore ways to work together. This project focused on visual and acoustic monitoring of marine mammals in a coastal environment, building on existing time-series of data obtained at Broadhaven Bay, Co. Mayo, in order to determine and understand the impact of anthropogenic activity on sensitive marine species. The project dealt with the identification of construction/post-construction impacts, and potential recovery of the system, including Passive Acoustic Monitoring and visual observations.

The project had significant commercial implications. In order to achieve sustainable exploitation of

natural resources, any project that has the potential to affect marine mammals in EU waters is required to evaluate this impact. Should negative impacts be detected, the industry is required to halt, modify or moderate their activities. The magnitude of the effect noted in this case was, however, quite small, enabling the construction work to continue. This project has had an environmental impact through the provision of baseline data for future studies. It successfully delivered a sizeable dataset that, for the first time in Irish waters, provided a long-term view of the presence/absence patterns of marine mammals. Data provide an important framework for future projects and provide a valuable baseline against which other impacts can be monitored.

In terms of social impact, positive engagement with the community has ensured a wider understanding of the need for monitoring. There has also been a human capacity impact with the training elements having ensured that the next generation of researchers have exposure to best practice in environmental monitoring that they will take with them in their future careers both nationally and internationally.



TEACHING EXCELLENCE

MaREI Researchers contribute to several Masters Degree programmes. Our researchers bring their expertise to subjects on Marine Spatial Planning, Remote Sensing and Earth Observation as well as the latest trends in offshore wind, wave and tidal energy. The Masters Programme in Marine Renewable Energy was launched in 2014, involving shared input from four MaREI partner institutions, including UCC (coordinator), UL, NUIM and UCD. This course covers a range of engineering and non-engineering topics relevant to the MRE industry, with a strong emphasis on the industry placement, and directly supports research topics central to the MaREI Research Programme.

The Applied Coastal and Marine Management Masters is a cross-disciplinary masters coordinated by the Geography Department in UCC with input from Civil Engineering and Biological, Earth and Environmental Sciences. It innovatively incorporates guest lecturers from both local planning authorities, government agencies and departments and from key maritime industries including MRE, Shipping, Oil and Gas, Coastal Protection, Tourism, Aquaculture, and Fisheries. The LL.M in Marine and Maritime Law is a new cutting-edge Masters Programme in UCC School of Law in the areas of marine law, maritime law, maritime security and port law.

Approximately half of these graduates have joined industry directly and fulfil the Centre's objective to transfer knowledge, and know-how to MNCs and SMEs based in Ireland with the other half continuing to engage industry through employment in MaREI. This is critical in creating the workforce required to deliver on Ireland's Marine and Energy policies.



ECONOMIC

HUMAN CAPACITY

PROFESSIONAL SERVICES



Researcher in Focus

Dr Anne Marie O'Hagan

Dr. Anne Marie O'Hagan is a Senior Research Fellow in Marine and Coastal Governance at the MaREI Centre, ERI, UCC and has over 15 years of experience in applied marine and coastal research. Her background is in environmental science and law. Anne Marie has worked extensively on integrated coastal management, the UN Law of the Sea and more recently the legal aspects of ocean energy development. The latter focused on the environmental effects of devices, how their development is considered in planning and management systems and new approaches to management such as adaptive and risk-based management. She is involved in a number of multi-disciplinary projects focused on aquaculture, maritime spatial planning, environmental assessment, and risk-based consenting. Anne Marie represents

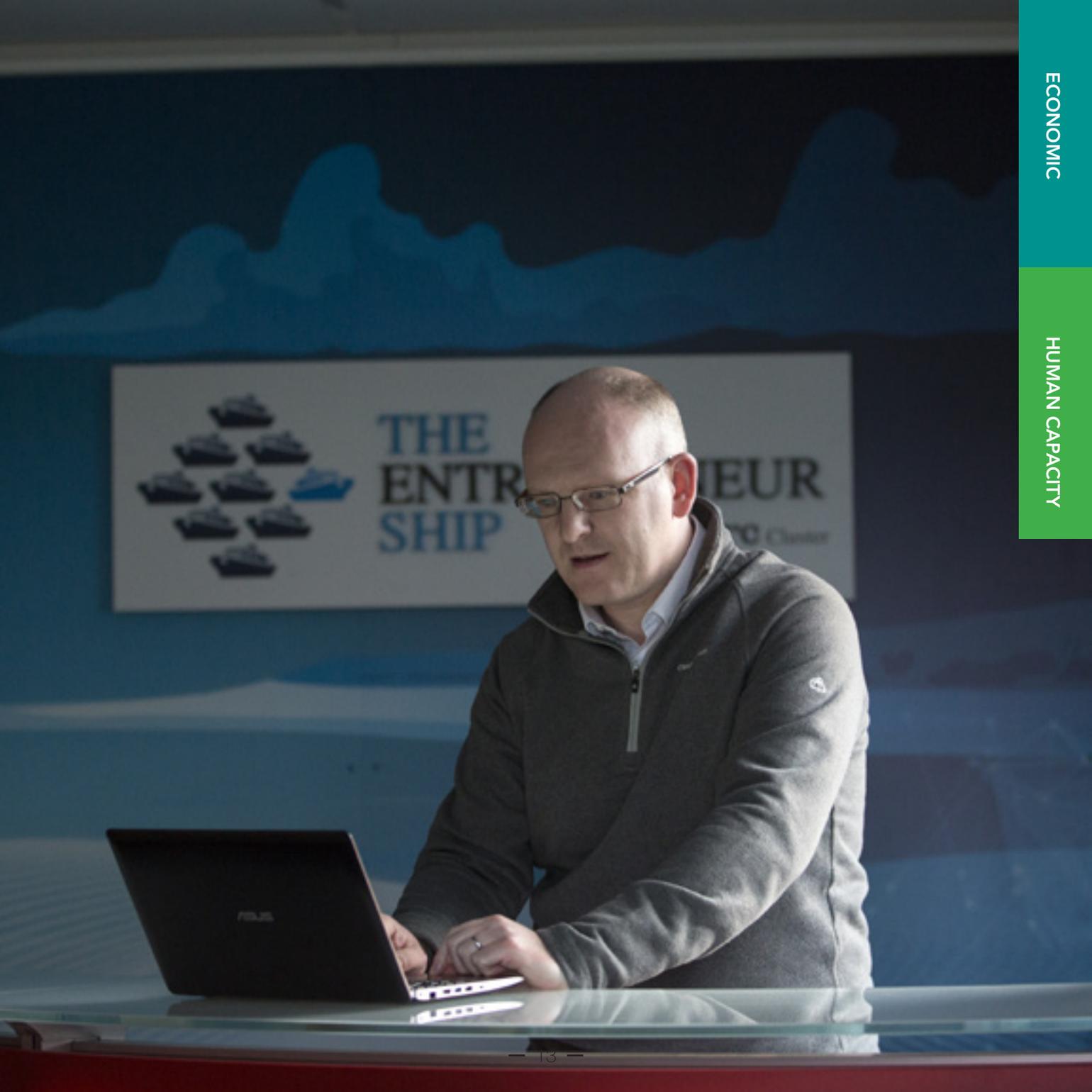
MaREI on a number of working groups including the International Energy Agency's Ocean Energy Systems Agreement (IEA-OES) Annex IV on environmental effects of wave and tidal energy, the EC's Ocean Energy Forum Environment and Consenting Steering Committee, ICES Working Group on Marine Renewable Energy and the all-Ireland Marine Renewables Industry Association (MRIA). Anne Marie has participated in many national and international conferences (e.g. Harnessing Our Ocean Wealth) and publishes in relevant journals and books. She maintains a keen interest in the management of Ireland's marine and coastal resources and follows policy developments in this regard. She also teaches on the LLM in Maritime/Marine Law (Law School, UCC) and the MSc in Applied Coastal and Marine Management (Department of Geography, UCC).

EXCEEDENCE MARINE RENEWABLE ENERGY SPINOUT

Exceedence Ltd. was set up in late 2014 and officially spun-out of UCC in mid-2015. Exceedence incubated in The Entrepreneur Ship, now part of MaREI and in 2017, moved its base of activities to the ERI building. The Company sells B2B techno-financial software that empowers all Renewable Energy stakeholders and provides Scalable Standardised Renewables Decision Assessment Tools for Development and Investment. The disruptive innovation couples technical databases and a financial calculation tool that allows users to quickly produce and compare financial KPIs to assess their profitability. Initially developed for the marine renewable energy sector, demand from other sectors in the renewable energy sector has been a motivator to add features to the software to make it usable by all the supply chain. The software was developed by a team of software engineers, finan-

cial analysts, renewable specialists and researchers in University College Cork. It started life in Excel format in 2011 as a prototype and was continually developed and improved before being fully ported to a professional piece of software over a 3-year project.

The development of this venture was possible through Enterprise Ireland Commercialisation funds. Exceedence became UCC's first spin-out in the marine renewable energy sector and was been awarded "Spin Out establishment of the year" at UCC's Innovation Awards 2016. The IP of interest to Exceedence was funded through three Enterprise Ireland Commercialisation awards projects that ran from 2010 to 2014. In combination, these projects have 18 person years of effort and represent an investment by Enterprise Ireland of almost €1m.





MARINE
INDUSTRY
AWARDS
2017

Excellence in
Marine Research Award

MaREI Centre for Marine
and Renewable Energy

Presented by

International
Maritime
Organization



SCIENTIFIC ACHIEVEMENT

MaREI Researchers Are Amongst The Most Cited In The World

MaREI director Professor Jerry Murphy and Funded Investigator Professor Henry Curran were ranked amongst the most cited researchers worldwide according to ShanghaiRanking's Global Ranking of Academic Subjects 2016 by Elsevier. Professor Murphy featured in the Civil Engineering category while MaREI researcher Prof Henry Curran at the Combustion Chemistry Centre in NUI Galway was amongst those most cited in both the Energy Science & Engineering and the Mechanical Engineering categories.

Professor Murphy is Director of the MaREI Centre and Professor of Bioenergy and Biofuels in the School of Engineering in UCC. He is the Leader of the International Energy Agency "Energy from Biogas" Task Force and he has served with IEA Bioenergy since 2007. Jerry's particular research focus is on second and third generation gaseous biofuels including for algae biofuels, power to gas concepts, and life cycle analyses of various biofuel systems.

Professor Curran is a Funded Investigator in MaREI and Director of the the Combustion Chemistry Centre at NUI Galway. His research interest lies in the study of the chemistry of how fuels burn in combustors in order to increase efficiency and reduce emissions for a cleaner world.

SUPPORTING IRISH SMES

“Our research activities within MaREI have provided us with access to world-class research capacity and testing infrastructure that have **enabled us to expand our knowledge on how our technology will perform** when subjected to extreme underwater conditions”

Declan Gavignon, R&D Manager OpenHydro

MaREI's work with OpenHydro focuses on acceleration lifetime testing of a tidal turbine cantilever rotor blade. This includes an analysis of the performance of the blades using numerical modelling, and the design of a test rig and preparation of algorithms for control of testing activities and acquisition of data during testing.

OpenHydro's collaboration with MaREI has delivered important learnings for turbine designs. Achieving cost targets through innovative material and design solutions are of critical importance to the commercial success of the technology. The assessment involved

physical testing of a half-scale sub-structure under fatigue loading (more than 800,000 cycles) in the Galway Large Structures Test Cell. MaREI developed the hardware-software systems for such testing, as well as expertise, over the last three years. The investment of over €1.5M in this facility in recent years makes it one of the few, if not only, test facilities in the world available for accelerated life testing study of full scale tidal turbines under fatigue loading. This type of facility is becoming essential to tidal turbine developers as the testing is an important step in the certification of tidal turbines for use in full-commercial projects.



OPENHYDRO TRISKELL
KIRKWALL

RESEARCH COLLABORATION WORTH OVER €3 MILLION TO IRISH SME ÉIRECOMPOSITES

ÉireComposites and MaREI researchers collaborate through SFI, ICOMP and the European Space Agency. MaREI enabled Eirecomposites to attain over €3m of revenue, which is significant for an indigenous Irish company who employ over 50 people and had a turnover of ca. €4.7M in the year to June 2016.

Without the support of MaREI, EireComposites believe that it would not have been part of the H2020 FloTEC consortium and would not be building tidal turbine blades for a 2MW device. Further, it is unlikely that EireComposites would have been successful

in its H2020 FTI PowderBlade funding application to develop components for 80m blades (roots and spar caps) in the absence of MaREI.

Over the course of the last 3 years a wind/tidal turbine rotor blade design software (BladeComp) has been developed in MaREI. An IDF has been filed for this invention. BladeComp, originally developed as a tool for tidal turbine blades, has also been shown to be effective for designing wind turbine blades and is expected to be taken from Technological Readiness Level (TRL) 6 to 8 in 2017 through a collaborative research project with Éirecomposites.

Models developed by MaREI of our blades provide additional assurance to our customers and allow ÉireComposites to access new markets.

- Tomás Flanagan, R&D Director ÉireComposites





THE ENTREPRENEUR SHIP SUPPORTING MARINE AND ENERGY STARTUPS

The Entrepreneur Ship, embedded in MaREI, is the world's first incubator dedicated to marine and energy startups. Supported by the Irish Naval Service and Cork Institute of Technology the companies in The Entrepreneur Ship are building cutting edge marine and energy products that will shape the future.

Since opening in 2015, companies in the incubator have created a combined 22 jobs in areas including wave energy devices, marinised communication devices, energy storage, offshore wind and drone technology. Companies benefit from a vibrant and collaborative environment with companies going through a similar startup process.

For MaREI, the opportunity in running an incubator like The Entrepreneur Ship is that it is a natural landing space for companies that spin out of the Centre. It also creates an entrepreneurial environment within the Centre, which is important in encouraging researchers to consider the commercial potential of the work that they are conducting .

MARINET2 AWARDS €1.3M TO DEVELOP NEXT GENERATION OF OFFSHORE RENEWABLES

“By helping **technology developers test** at facilities across the EU, and encouraging knowledge sharing and collaboration, MaRINET2 is strengthening Europe’s position as a **centre of excellence for offshore renewable energy research.**”

Dr Jimmy Murphy, MAREINET2 Coordinator

Coordinated by MaREI, MaRINET2 is a €10.5m project, funded by the European Commissions’ Horizon 2020 programme. The project provides support to technology developers of offshore wind, wave and tidal to test their devices in research facilities and in real sea conditions. It is a continuation of the highly successful MaRINET project which ran from 2011 - 2015.

The MaRINET2 project so far has awarded €1.3m to 34 technology development teams through a competitive call for proposals. This support will accelerate the

next generation of offshore renewable energy technologies towards the marketplace by providing technology testing at MaRINET2’s network of world-leading testing facilities.

The awards were made after the first in a series of competitive calls for proposals for fully funded access to the 57 test infrastructures in the MaRINET2 network. Through this first call the project will facilitate nearly 500 days of state-of-the-art testing at 20 facilities around Europe.



ECONOMIC

INTERNATIONAL ENGAGEMENT

The Ocean is the lifeblood
of our planet, yet we are
poisoning it with millions of
tonnes of plastic every year.

- Peter Thomson, President of the UN General Assembly

ENGAGING COMMUNITIES ON MARINE LITTER

Marine litter is a huge global issue impacting on all the world's oceans and causing environmental, health, economic and aesthetic problems. MaREI has been a key partner on European projects with the aim of addressing the issue.

MaREI was responsible for the development of the format, content and implementation guide for the National Fora on Marine Litter through the MARLISCO project which ran from 2012-2015. The fora were implemented in 12 European countries engaging over 1500 stakeholders across Europe from multiple sectors, from which suggestions, actions and ideas were put forward to be considered at EU level. As well as holding the first of the National Fora in Ireland, MaREI staff also ran a Marine Litter Exhibition at Cork's Lifetime Lab, Galway Atlantaquaria and Dingle Oceanworld, ensuring national exposure.

The expertise developed through MARLISCO led to involvement in a Microplastics project entitled EPHEMARE with JPI Oceans. It is a multidisciplinary consortium of 16 Partner Institutes running from 2016 to 2018. MaREI have established a stakeholder database, factsheets, newsletter and website. A photography competition is underway with an exhibition of the images planned. Based on expertise acquired, MaREI is now collaborating with the An Taisce Clean Coasts Programme, a state funded initiative to engage communities to protect Ireland's beaches, seas and marine life. MaREI is also a founding member of the newly established Irish Ocean Literacy Network which aims to coordinate the efforts of those who are working towards an ocean literate society.



‘FATHER OF OCEAN ENERGY’ PROFESSOR TONY LEWIS HONOURED WITH DISTINGUISHED AWARD

In recognition of his invaluable contribution to the offshore renewable energy sector across Europe, Jean-Pierre Thébault, Ambassador of France to Ireland presented MaREI Principal Investigator, Professor Tony Lewis with the Chevalier des Palmes Académiques in February 2017 at a ceremony in Dublin.

Originally a decoration founded by Emperor Napoléon to honour eminent members of the University of Paris the Chevalier des Palmes Académiques is a national order of France for distinguished academics and figures in the world of culture and education. Dubbed the ‘father of ocean energy’, Professor Lewis has dedicated his entire career to marine renewable energy and has been one of the most active members of the Ocean Energy community for the past four decades.

Speaking at the ceremony, Professor Lewis said; “I am hugely honoured to accept the award of Chevalier des Palmes Académiques from Mr. Jean-Pierre Thébault, the French Ambassador to Ireland. I have a longstanding positive relationship, with many French Universities through exchange of students as well as joint European funded research projects such as MaRINET2.”

Through his teaching, research, industrial and ambassadorial roles Professor Lewis has become a great influencer in the Marine Renewable Energy sector and led the first MaRINET programme which helps industry accelerate the development of offshore renewable energy technologies and infrastructure by opening access test facilities across European countries. Professor Lewis will continue to be a driving force in MaRINET2.



SUPPORTING A BETTER INFORMED AND ENGAGED PUBLIC

MaREI has an impressive record in bringing science to the public through its outreach activities. It is a founding member of Cork Science Festival and Cork Harbour Festival and has engaged thousands of others through initiatives such as SeaFest, Celebrate Science and STEAM Ed Engineering in a Box.

MaREI Researcher, Dr Donal Murray developed content and training material for the STEAM Ed 'Engineering in a Box' programme during 2015, which was subsequently piloted by MaREI researchers across three local primary schools before being rolled out to other schools. The programme content draws on hands-on activities that encourage creativity and innovation whilst embedding engineering principles at a young age.

PhD students have received training to deliver the programme in schools and MaREI students have specifically engaged with DEIS schools, girls schools, inner city and rural schools to ensure a broad reach. The programme is continuously being evaluated to ensure suitability and to demonstrate impact.



FUTURE EARTH COASTS

Future Earth Coasts is the coastal global research project of Future Earth - an international research programme providing the knowledge and support to accelerate transformations to a sustainable world. It is headquartered in MaREI and works within the framework of the Sustainable Development Goals. Future Earth Coasts provides a platform for networking and explores the drivers and social-environmental impacts of global environmental change in coastal zones.

Hosting the International Project Office (IPO) of Future Earth Coasts provides an opportunity to showcase the expertise and capacity within MaREI internationally through:

- promoting sustainable technologies in Ireland's marine area and providing a global example of best practice in integrated maritime development.
- positioning Ireland as the leader in transdisciplinary science and a networking hub for coastal sustainability science.
- building upon existing and establishing new working relationships with research centres and industry from other jurisdictions.

Having the IPO of Future Earth Coasts offers a doorway to the outside world as well as a window for the international community to see all that Ireland's scientific community has to offer.

- making available international expertise and best practice to the work of MaREI researchers.
- attracting and retaining leading international scientists to engage in policy and practice research for sustainability science.
- attracting and sustaining funding from international funding mechanisms to maintain capacity and supplement existing national and EU funding streams.

Future Earth Coasts creates the opportunity for young and mid-career scientists through the Erasmus Mundus programme to work with world class researchers globally in a cross and multi-transdisciplinary way.

Examples of projects include working with coastal communities in the Arctic through Future Earth Coast's Regional Engagement partner. This is an important element of co-design and co-production as the project focuses on an integrated approach to research whereby local communities are doing the research as well as using the data outputs for their livelihoods. This Smartice project which measures the thickness of ice in remote arctic communities has been recognised for its impact through its selection as a Lighthouse project under the United Nations Framework Convention on Climate Change Momentum for Change Awards.

Future Earth Coasts have been instrumental in setting up a pan-African network specifically convened to coordinate and promote ocean acidification (OA) awareness and research in Africa. Research activities on ocean acidification and related stressors on the African continent are developing rapidly in response to a clear need for action to minimize and address the impacts posed by changing climatic and system wide changes. This growing network is influencing local and national policy and is already instigating global activities for ocean health like at this year's World Ocean Day 2017 event where pH measurements were simultaneously conducted by scientists around the world. The data will be used to generate an international report which will be used to influence policy demonstrating how local and regional action can have a global impact.

Through training workshops, we are working with the World Bank, the Inter-American Development Bank and the Organisation of Eastern Caribbean States to explore Blue Growth opportunities and climate change adaptation through Earth Observation to enhance maritime policies in the Caribbean.

13 CLIMATE ACTION



14 LIFE BELOW WATER



15 LIFE ON LAND



17 PARTNERSHIPS FOR THE GOALS



ENABLING SMALL AND MEDIUM ENTERPRISES ATTRACT EUROPEAN FUNDING

“GKinetic Energy has had a highly successful partnership with MaREI since the beginning of our project, **allowing us to develop our technology with access to top-class researchers.**”

Vincent McCormack, Founder, GKinetic

MaREI worked with GKinetic to optimise the design of its novel vertical axis tidal turbine through the use of computational fluid dynamic models. The results identified problems with the Power Take Off system. MaREI analyses made recommendations for redesign and material selection.

The analyses of scale-model test results have been critical to GKinetic Energy winning multiple awards of funding from the Sustainable Energy Authority of Ireland through the Prototype Development Fund.

Collaboration between MaREI and GKinetic Energy has grown over time, and the Centre has partnered in three SEAI Prototype Development Awards that have

been secured by the company to date. The Centre has provided technical assistance in this regard to the design of test set-ups, and has assisted in the development of test schedules and instrumentation of the scale models. The Centre is currently examining the potential for deployment of the second generation 1:10 scale model device in the River Corrib, adjacent to National University of Ireland, Galway, subsequent to the next round of testing.

Through MaREI, GKinetic has also worked closely with the University of Limerick. The picture opposite was taken in Limerick docks where GKinetic tow testing was completed with the support of the Shannon Foynes Port Company.



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EUROPEAN UNION
INTEGRITY AND INDEPENDENCE

MSE Gateway
OE Gateway

sfi

DesignPro

MaREI

A man with a beard, wearing a blue sweater over a checkered shirt, is looking upwards towards a tall, dark green pine tree. The background is a clear blue sky with some light clouds. The scene is outdoors, likely in a park or a wooded area. The man's expression is thoughtful and hopeful.

SUPPORTING STR

MaREI is supporting strong research led marine and energy policy through its work as demonstrated by MaREI research referenced in both the National Mitigation Plan and the National Adaptation Framework. Through its Energy Policy and Modelling Group led by Professor Brian Ó Gallachóir and its Climate Adaptation group led by Dr Barry O'Dwyer, MaREI is enabling evidence based policy supporting Climate Action. To achieve this, it collaborates with a variety of agencies. One example is through our work with the NTR Foundation.

In early 2015, the NTR Foundation approached a number of Irish universities seeking proposals to build research capacity that would contribute to identifying economic opportunities (particularly for SMEs) in a low-carbon economy in Ireland. NTR Foundation's mission is "to address the challenges of climate change and resource sustainability by providing targeted financial support to select projects, research and organisations" with a focus on "renewable energy and sustainability". After a competitive application process, the MaREI proposal was declared successful. The work focuses on the exploration of low-carbon energy futures for Ireland, and the associated technology opportunities arising from the various modelled scenarios over the next

ONG RESEARCH LED POLICY

35 years. It assesses the value chain for these technology opportunities, and development of an innovation system to enable delivery of these opportunities.

The project's impact is through informing policy makers. By enlarging the evidence base to show how the wider energy community can engage with the opportunities associated with both renewable energy and sustainability in a low-carbon economy, this project is helping to build a broad coalition of support for the low-carbon energy transition. So far this research has been successful in setting up communication channels with the Department of Jobs, Enterprise and Innovation (DJEI), a key government department when it comes to innovation policy. The project team have produced a number of policy briefs (3 to-date) which are summaries of some of the research topics and results will be delivered directly to key people within DJEI. These briefs will assist DJEI to integrate climate change and energy system challenges to their design of innovation policy that supports firms. Furthermore, through the presentation of research at a joint ESRI-UCC energy research seminar in June 2016, the project team made

initial positive engagement with the Chair of the Climate Change Advisory Council, which has a key role in implementing the Climate Action and Low-Carbon Development Act 2015. Further engagement with the Climate Change Advisory Council has been arranged.

This project is contributing to broader societal objectives. For example, the government strategy document Innovation 2020 emphasized how research on the energy transition "can also help to create economic opportunities and to provide long-term societal and environmental benefits". This research is contributing to the evidence base that shows how economic opportunities and co-benefits can accrue from a low-carbon economy in Ireland. In terms of new project developments, through contacts made during the proposal presentation stage, a separate collaboration with a new climate change public visitor centre was initiated. The Cool Planet Experience, due to open in Powerscourt Estate in 2018, is expected to have a high profile nationally and to contribute significantly to mainstreaming awareness of climate change and related aspects.



Researcher in Focus

Prof Frédéric Dias

Over the last 20 years, MaREI Principal Investigator Professor Frédéric Dias (UCD School of Mathematical Sciences, UCD CASL and UCD Earth Institute) has been at the forefront of research on water waves.

Professor Dias is an applied mathematician with a PhD in Civil Engineering who has made numerous pioneering contributions that have significantly advanced the field of fluid dynamics. His research contributions have spanned the fields of mathematics, mechanics, physics and civil engineering, and he is widely recognised as an expert in nonlinear wave motion. A key element of his success is his ability to work at the interface of mathematics and engineering, a rare combination in this research field. As a result, he has been elected to the Royal Irish Academy.

Most recently Professor Dias was awarded a highly prestigious European Research Council (ERC) grant, for a project he is jointly leading with optics expert Professor John Dudley (Departments of Physics and Optics at the University of Franche-Comté and the CNRS in France). A selection of significant achievements include:

- development of a fast three-dimensional numerical wave tank, which efficiently mimics laboratory wave tanks;
- demonstration that the classical approach for tsunami generation, consisting of translating the frozen deformation of the sea bottom towards the free surface and letting it propagate, has some major drawbacks;
- derivation of a new system of equations for the study of water waves in the presence of viscous dissipation which is now used in industry;
- development of a highly novel approach for the study of wave stability using the Maslov index and application to reaction-diffusion systems;
- developments in the theory of wave turbulence and in particular in solitonic turbulence;
- derivation of pressure impact formulas which show the great importance of compressible effects and led to the new concept of complete Froude scaling, now used in industry for the design of new sloshing experiments.

PROVIDING NEXT GENERATION INDUSTRY LEADERS

MaREI's industry focus and the top class learning outcomes from the involvement of its researchers in delivering various courses at undergraduate and postgraduate level contributes to the centre providing the next generation in industry leaders.

Darren Hayes, a graduate of the Marine Renewable Energy Masters in University College Cork, is a prime example. Returning to study after several years working for industry, he had the idea to develop a portable wind turbine for use on commercial vessels. Developing the concept Darren started DARE Technology in 2015 with fellow Masters student Patrick Grehan. Darren has won Ireland's Best Young Entrepreneur as well as Enterprise Ireland Competitive Start and European Union Horizon 2020 funding to drive forward the business. Now two years old, the company has developed a prototype which it is scaling to meet industry needs.

Darren was working with MaREI industry partner OpenHydro when he developed the idea for a wind turbine, the Hi-Gen, that could be used to power small

vessels while at anchor or in port. "I experienced the problem we are trying to solve while working with OpenHydro, as I spent considerable time on vessels waiting for the right weather or tidal windows to materialise. I developed the solution during a year off to do a masters" Darren says. "After doing some research it became clear that small vessels worldwide could be spending a combined total of up to €300 million and using 374 million litres of fuel just to power themselves while not actually working. To me, this seemed like an area that was open to a better solution."

The Hi-Gen will be hoisted using the vessel's existing crane system and use the wind to power its processes. It has the potential to be used on any vessel which has an existing deck crane and the company estimates they could prevent over 1 million tonnes of carbon dioxide from being sent into the atmosphere every year.

The company remains close to MaREI with its headquarters in MaREI's incubator, The Entrepreneur Ship.



ECONOMIC

HUMAN CAPACITY

ENVIRONMENTAL

“Unlocking the **potential** of our **marine** and **renewable energy resources** through the **power of research** and **innovation**”



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