Irish Research Activity in Floating Offshore Wind

Dr Jimmy Murphy - UCC Senior Lecturer, Lead of UCC ORE Research Group and of the Lir National Ocean Test Facility

12th March 2021

MaREI, the SFI Research Centre for Energy, Climate and Marine

Environmental Research Institute, UCC

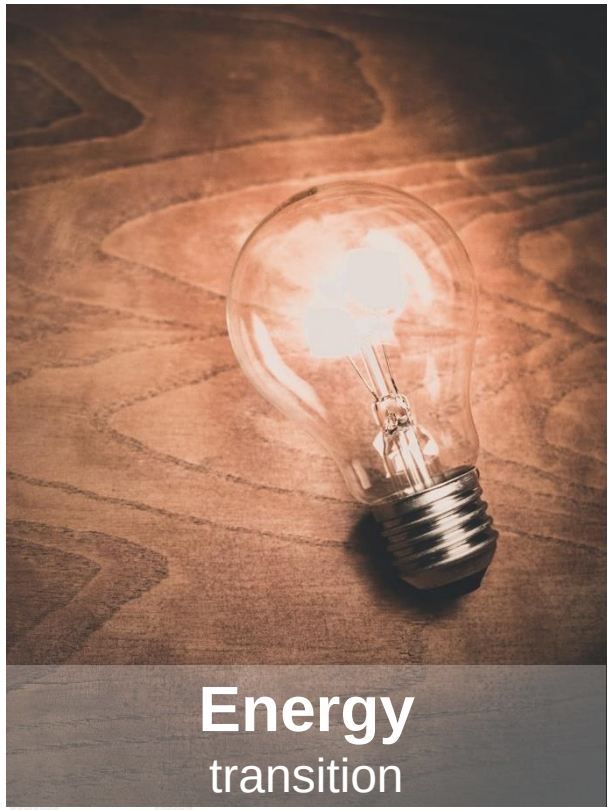
OUR VISION

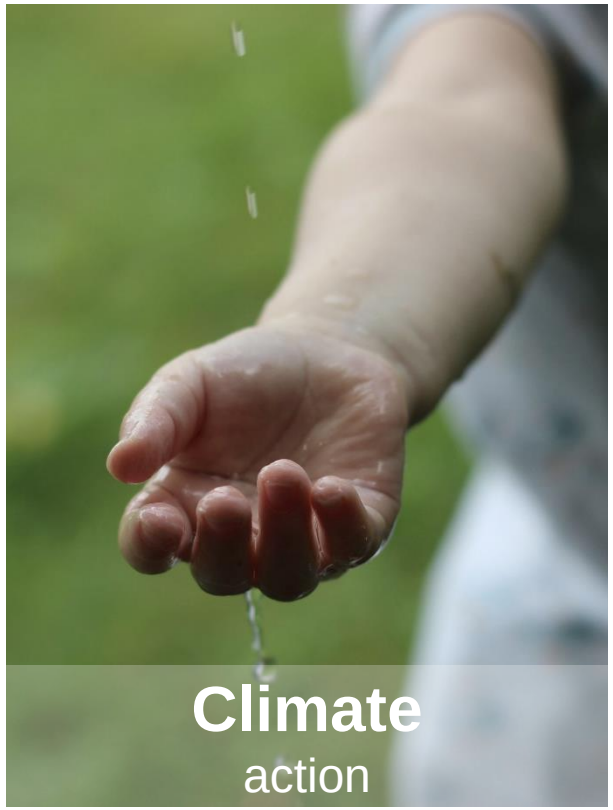
"To make Ireland a global leader in energy and marine research and innovation"

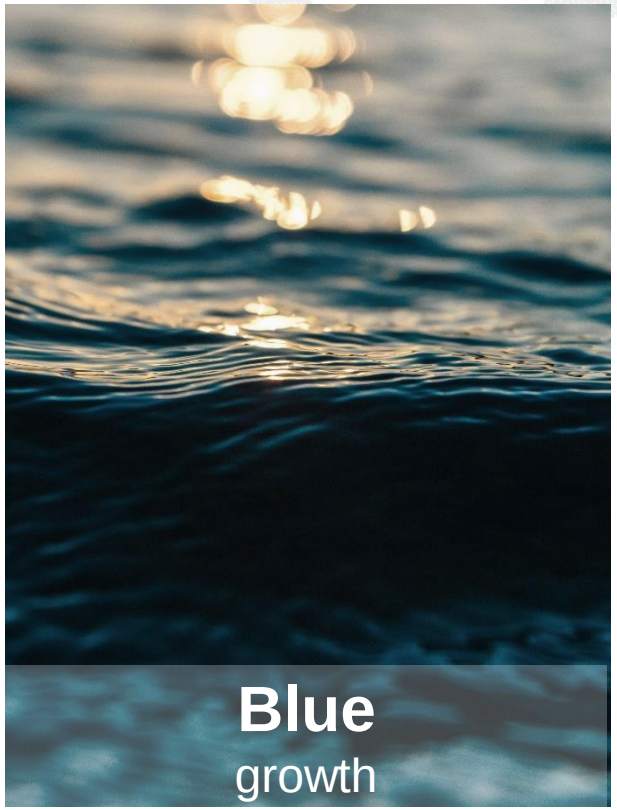
OUR MISSION

"To advance energy and marine research, innovation, and commercialisation to facilitate Ireland's leadership in confronting urgent global challenges, specifically the **energy transition**, **climate action**, and **blue growth**; and to provide the underlying capacity, policy context, industry collaborations, and societal engagement to enable this"

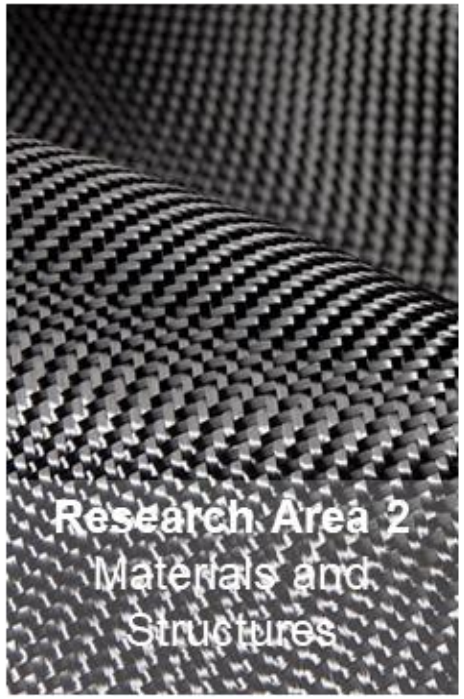
OUR MOTIVATIONS



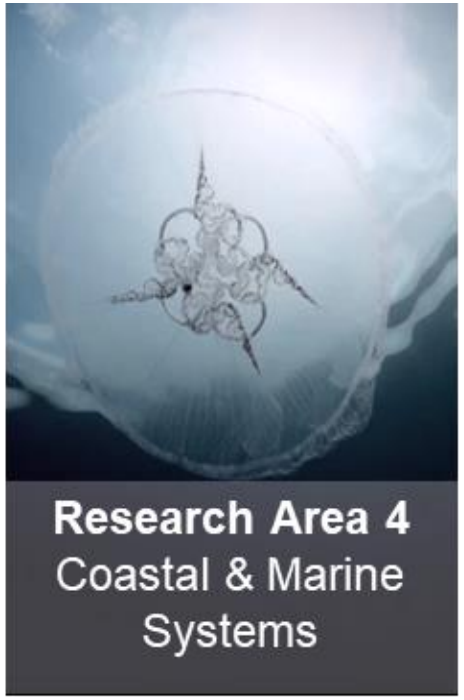





Research Area 1
Marine Renewable Energy


Research Area 2
Materials and Structures


Research Area 3
Observations & Operations


Research Area 4
Coastal & Marine Systems


Research Area 5
Bioenergy

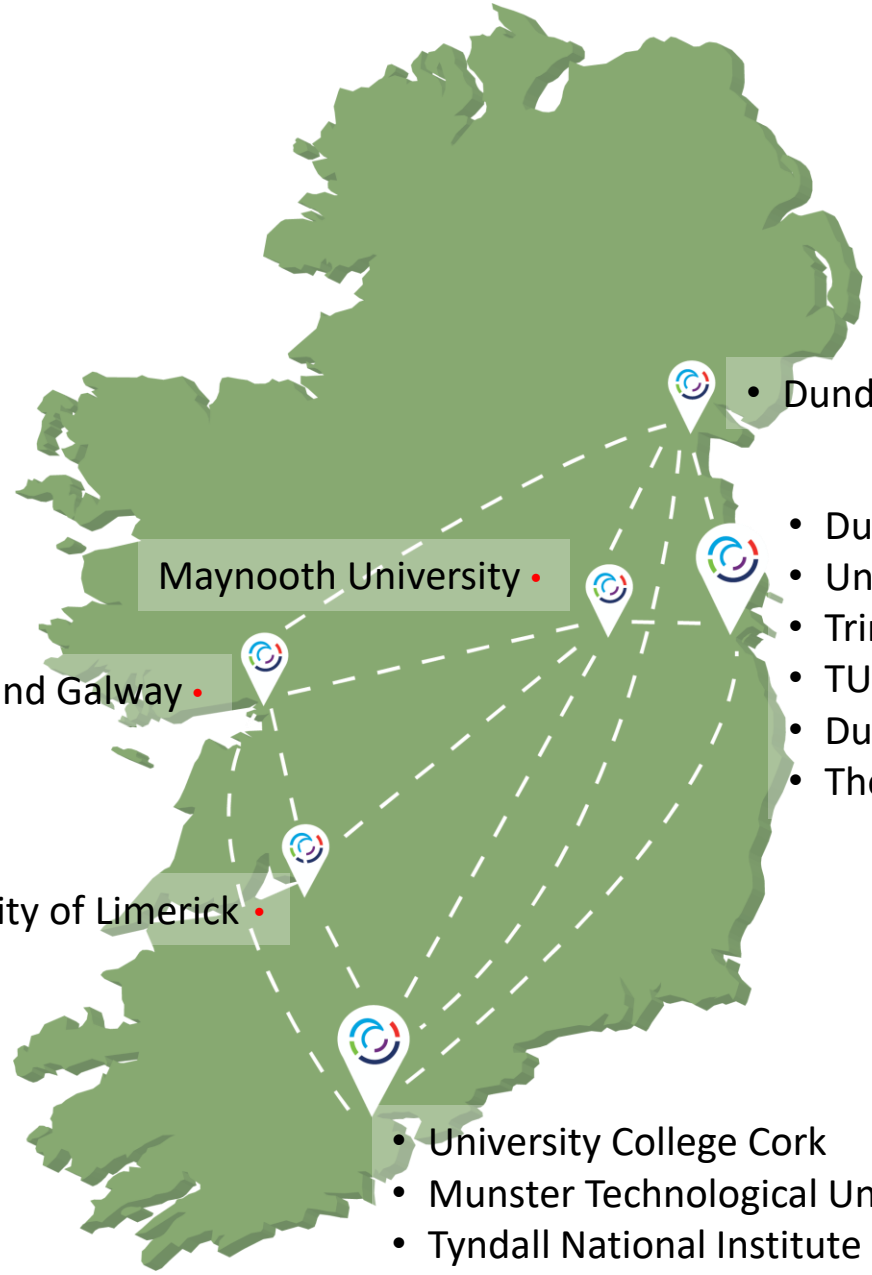

Research Area 6
Energy Policy & Modelling


Research Area 7
Energy Management

MaREI Phase 2: 2019- 2025

MaREI
Energy · Climate · Marine

WORKING ACROSS
13 INSTITUTIONS



- Dundalk Institute of Technology

- Dublin Institute for Advanced Studies
- University College Dublin
- Trinity College Dublin
- TU Dublin
- Dublin Institute of Technology
- The Economic and Social Research Institute

Maynooth University

National University of Ireland Galway

University of Limerick

- University College Cork
- Munster Technological University
- Tyndall National Institute

200+
multi-disciplinary researchers across our institutional partners

13
institutional partners combining Ireland's best talent in energy, climate and marine

40%
of departees moving to industry as a first destination

75
industry partners including start-ups, SMEs and large enterprises

36
collaborating countries across industry, academia and government

€55m
funding secured from industry, exchequer and non-exchequer sources


OUR
PEOPLE
Mathematicians
Environmental Scientists
Civil Engineers
Material Scientists
Mechanical Engineers
Marine Biologists
Electrical Engineers
Chemists
Microbiologists
Climatologists
Environmental Engineers
Legal

INFRASTRUCTURE DEVELOPMENT HIGHLIGHTS

Supporting Device Development

Full scale

1/4

1/15
1/50
1/100

Floating Offshore Wind Research Overview

Most relevant MaREI Institutions

University College Cork (Jimmy Murphy and Gregorio Iglesias)

- Physical Model Testing & Numerical Modelling
- Techno-economic assessment

National University of Galway (Jamie Goggins, Sean Leen and Stephen Nash)

- Materials, Structural Testing & Numerical Modelling

University of Limerick (Dan Toal)

- Robotics and underwater inspection

University of Maynooth (John Ringwood)

- Numerical Modelling & Control Strategies

Dundalk Institute of Technology (Tom Dooley)

- WEC technology development

University College Dublin (Frederic Dias)

- Numerical Modelling

Most relevant MaREI Institutions

University College Cork (Jimmy Murphy and Gregorio Iglesias)

- Physical Model Testing & Numerical Modelling
- Techno-economic assessment

National University of Galway (Jamie Goggins, Sean Leen and Stephen Nash)

- Materials, Structural Testing & Numerical Modelling

University of Limerick (Dan Toal)

- Robotics and underwater inspection

University of Maynooth (John Ringwood)

- Numerical Modelling & Control Strategies

Dundalk Institute of Technology (Tom Dooley)

- WEC technology development

University College Dublin (Frederic Dias)

- Numerical Modelling

Floating Platform Development -Physical Model Testing

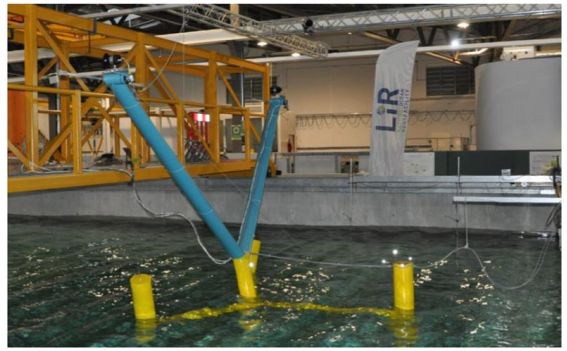
Tested first floating wind platform in 2004 – TLP design (Irish led)

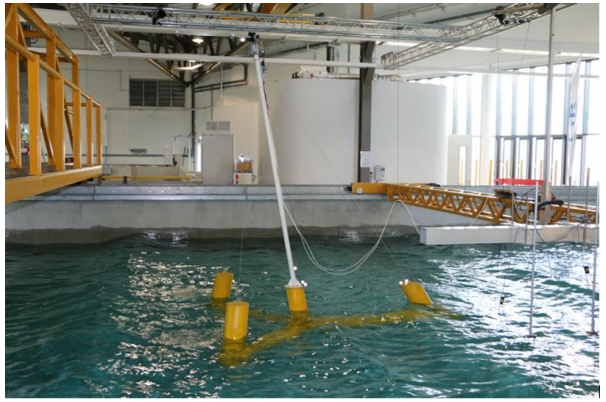
Scope of Work

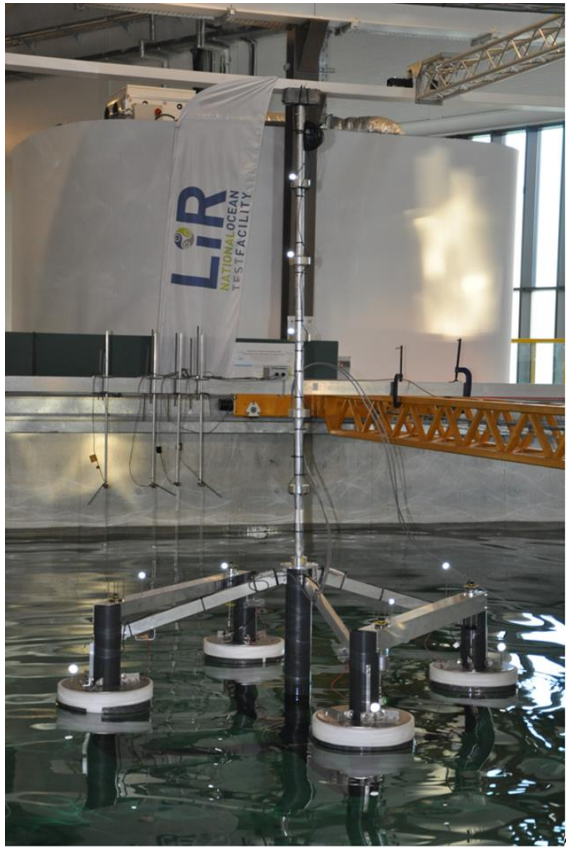
- Floating platform development for research purposes
- Testing of commercial platform designs
- Upgrading Infrastructure and equipment
- Development of new more comprehensive testing methods

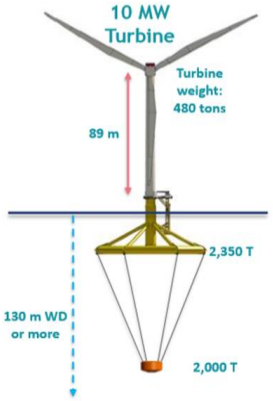
MaREI
Energy · Climate · Marine

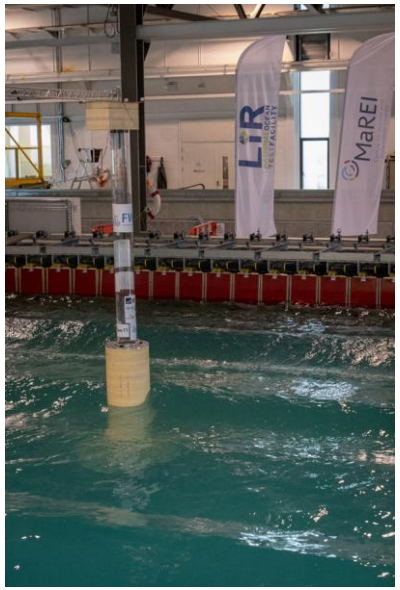
Physical Model Testing

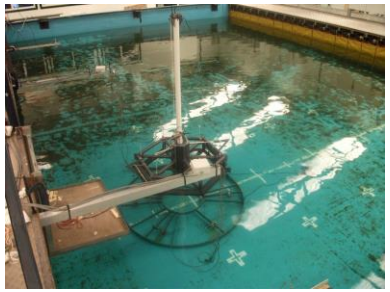












Comment on Floating Platforms Types

Experience in testing different platform types – and hearing the compelling arguments in favour of each type

- Stability, survivability, cost, low mass, integrated design, installation method, mobilisation of local supply chain, platform draught, ease of fabrication, materials used, modular design, scalability, etc.

As yet there is not a stand out platform design that on a technical and cost basis puts it clearly ahead of other designs

Possible that other factors could decide selection of platforms for particular sites

Comment on Floating Platforms Types

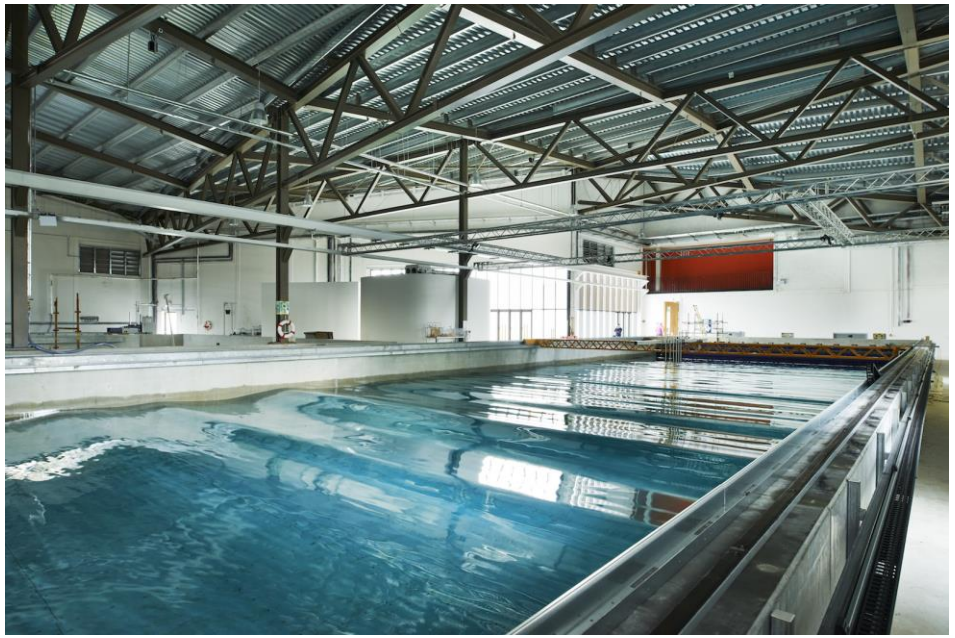
For Ireland

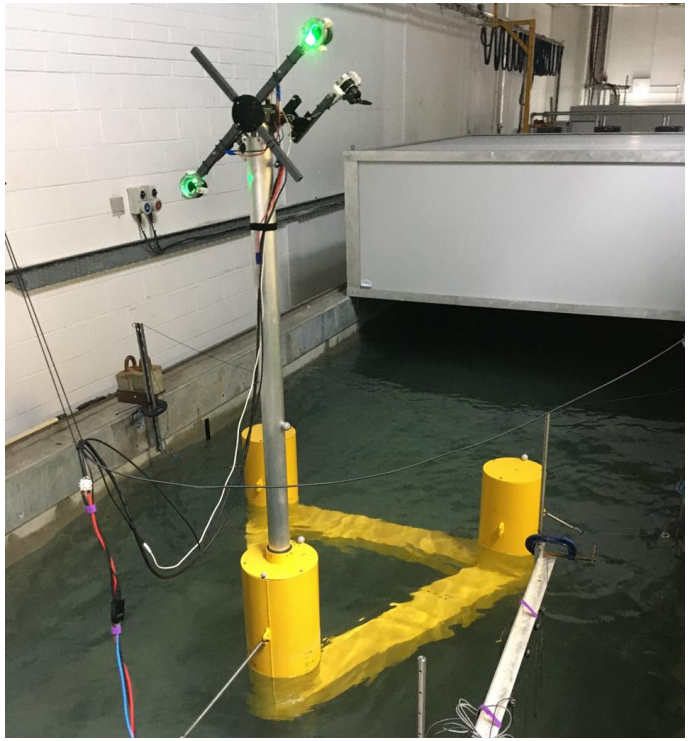
- Floating wind will be deployed in Celtic Sea and Atlantic locations
- Exposed to more severe conditions than any floating wind platform has experienced to date
- Demonstration of operation and survival of platforms in this environment is essential
- Capacity to mobilise the Irish supply chain is also important
  - Use of ports
  - Fabrication of platforms
  - Windfarm components
  - Operational bases

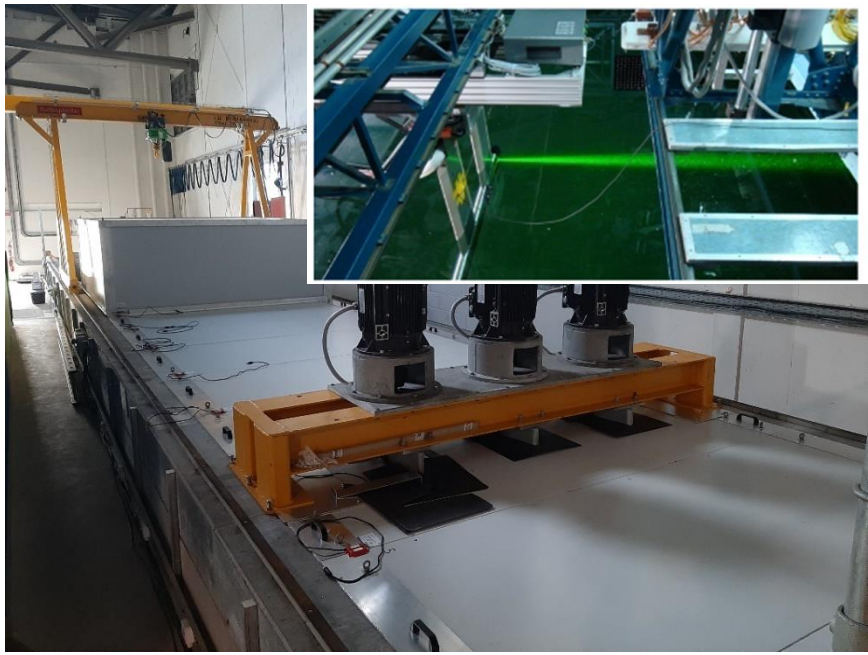
The IEA Task "IDEA" is focused on the sustainable development of floating wind arrays and is a joint venture between MaREI, GDG, NREL and IFPEN (France). The proposal is at the final stage of approval and involved 44 organisations from 17 countries.

Testing Infrastructure and Methods

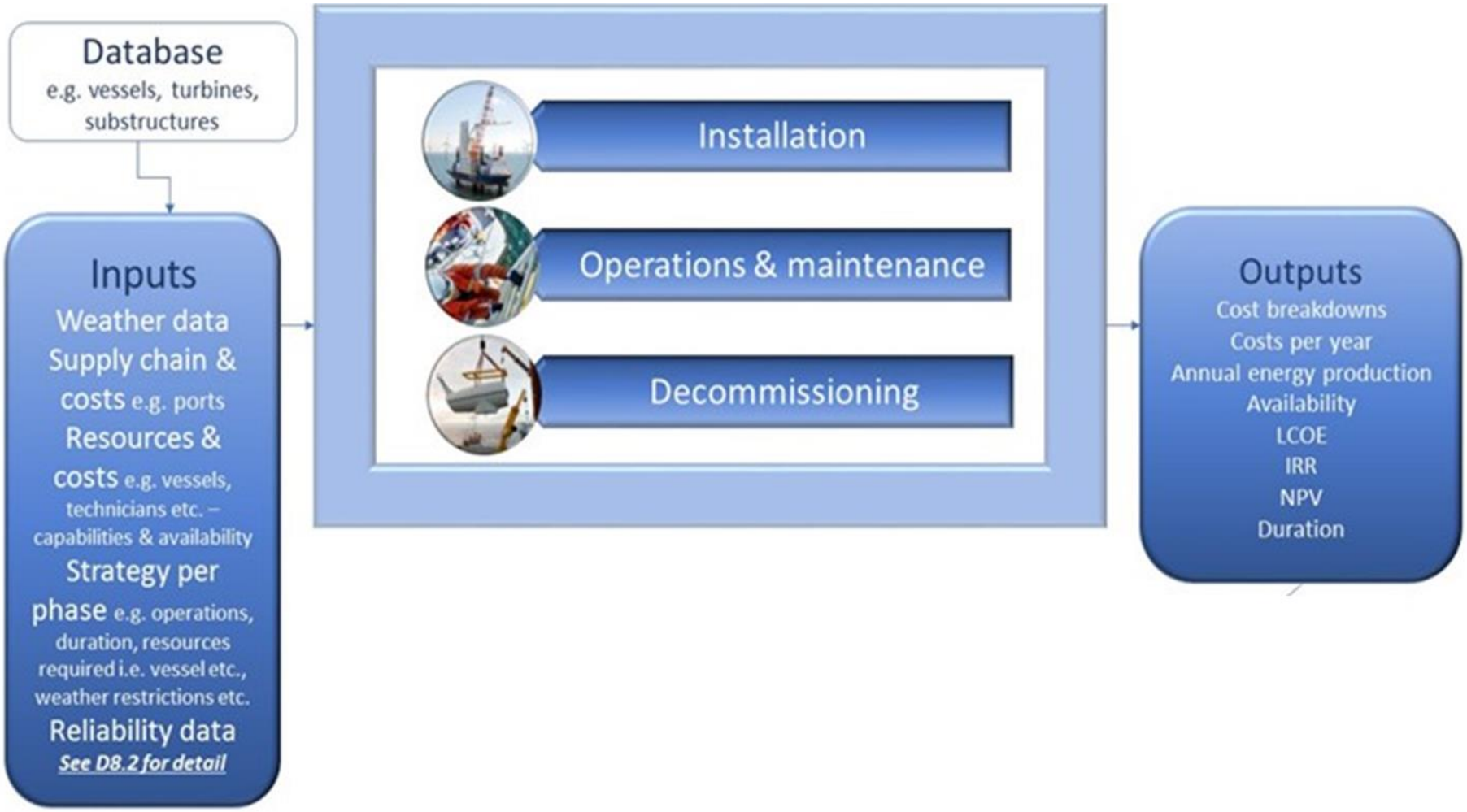
- 4 wave tanks (one with current)
- Hexapod
- S-PIV
- Simulation of wind and current effects on floating technologies – software in the loop







Techno-Economic Analysis



Techno-Economic Analysis

Case study reference		Irish Sea	Celtic Sea	Atlantic Ocean
Turbine Size	MW	12	12	14
Substructure	Text	XL Monopile	Semi-sub	Semi-sub
Number of turbines	Number	41	83	71
Farm capacity	MW	492	996	994
Farm lifecycle	Years	25	25	25
Start	Year	2025	2035	2035
Discount rate	%	5	6.5	6.5

Techno-Economic Analysis

Case study reference		Irish Sea	Celtic Sea	Atlantic Ocean
Turbine Size	*MW*	12	12	14
Substructure	*Text*	XL Monopile	Semi-submersible	Semi-submersible
Number of turbines	*Number*	41	83	71
Farm capacity	*MW*	492	996	994
Discount rate	*%*	5	6.5	6.5
Costs (NPV)	*€M*	1,927	3,849	4,919
Energy (NPV)	*MWh*	29,790,968	52,053,189	45,535,752
LCoE	***€/MWh***	**65**	**74**	**108**
DEVEX	€/MW	134,842	173,378	173,727
CAPEX (dry)	*€/MW*	*1,756,276*	*2,141,238*	*2,232,424*
Installation	*€/MW*	*475,202*	*656,642*	*1,108,855*
CAPEX (dry & installation)	*€/MW*	2,231,479	2,797,880	3,341,279
OPEX (undiscounted)	*€/MW/yr*	107,040	72,565	94,968
Energy production	*MWh*	52,777,958	106,540,232	92,614,461
Energy production	*MWh/MW*	107,272	106,968	93,174
DECEX	*€/MW*	221,844	164,007	209,354
Salvage revenue	*€/MW*	58,615	116,595	116,915
Availability (time-based)	*%*	88.74%	83.69%	68.91%
Availability (energy-based)	*%*	88.11%	82.58%	68.10%
Capacity factor	*%*	49%	49%	43%

Techno-Economic Analysis

Category	Variable
Technology (All)	Substructure type Fixed - jacket Floating – concrete; semi-spar;
Technology (All)	Increase turbine size (e.g. to 14MW) and reduce number
Installation (Fixed)	Installation Methodology and Vessel fleet Optimisation
Installation (All)	Installation time reduced
O&M (Floating)	Improve OM fleet with higher access for e.g. CTVs up to 2m and SOVs up to 4m
O&M (Floating)	Offshore maintenance strategy versus tow out for major repairs
O&M (All)	Improved reliability

SITE DESCRIPTION	LCOE (€/MWh)	REDUCTION (€/MWh)	REDUCTION (%)
Irish Sea	65		
Optimised Irish Sea	**58**	**7**	**-10%**
Celtic Sea	74		
Optimised Celtic Sea	**70**	**4**	**-5%**
Atlantic Ocean	108		
Optimised Atlantic Ocean	**84**	**24**	**-22%**

Research Collaboration with the UK

Primarily through EU funded projects (H2020 and Interreg, EPSRC/SFI)

University of Edinburgh
Stratclyde University
University of Plymouth
University of Nottingham
University of Exeter
Liverpool John Moore's University
University of Surrey
University of Manchester
University of Swansea

Horizon Europe Call - ***HORIZON-CL5-2021-D3-02-12: Innovation on floating wind energy deployment optimized for deep waters and different sea basins (Mediterranean Sea, Black Sea, Baltic Sea, North-east Atlantic Ocean)***

Thank You