MaREI
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Science Foundation Ireland sfi For what's next

EirWind

EirWind Webinar

25th June 2020

This event will begin shortly

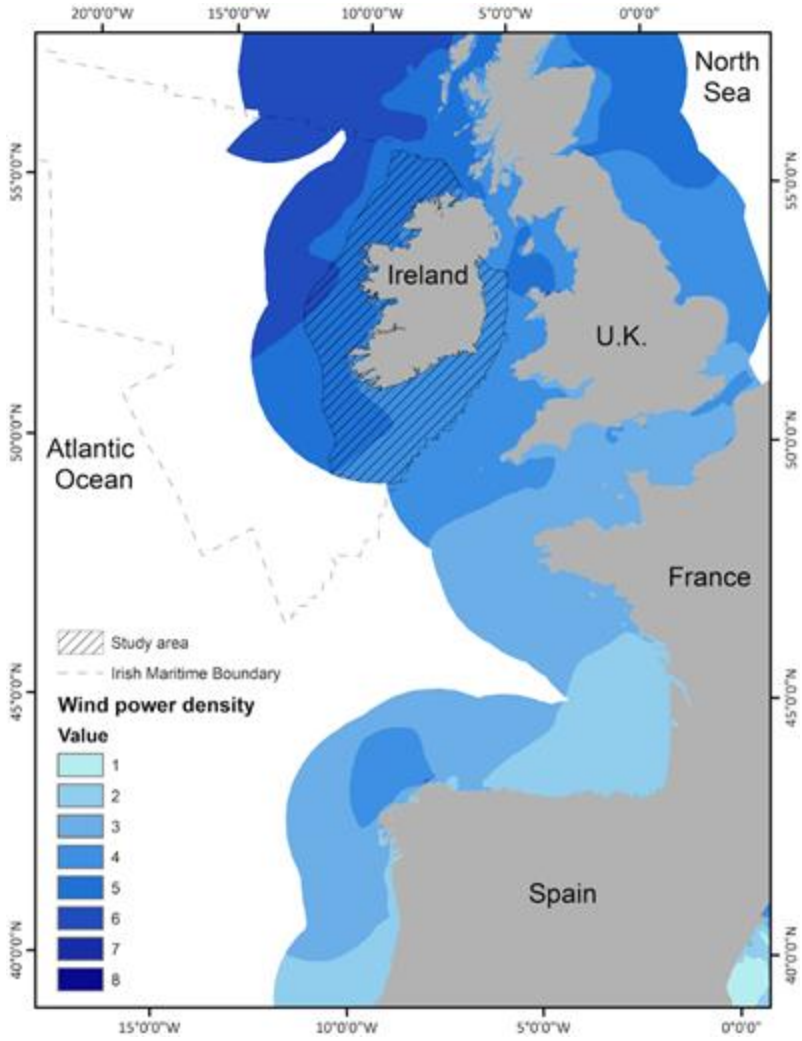
DP ENERGY · equinor · Enerco Energy · Statkraft · Brookfield · edp renewables · sse Renewables · Simply Blue Energy · ENGIE · ESB

Aim of the EirWind project

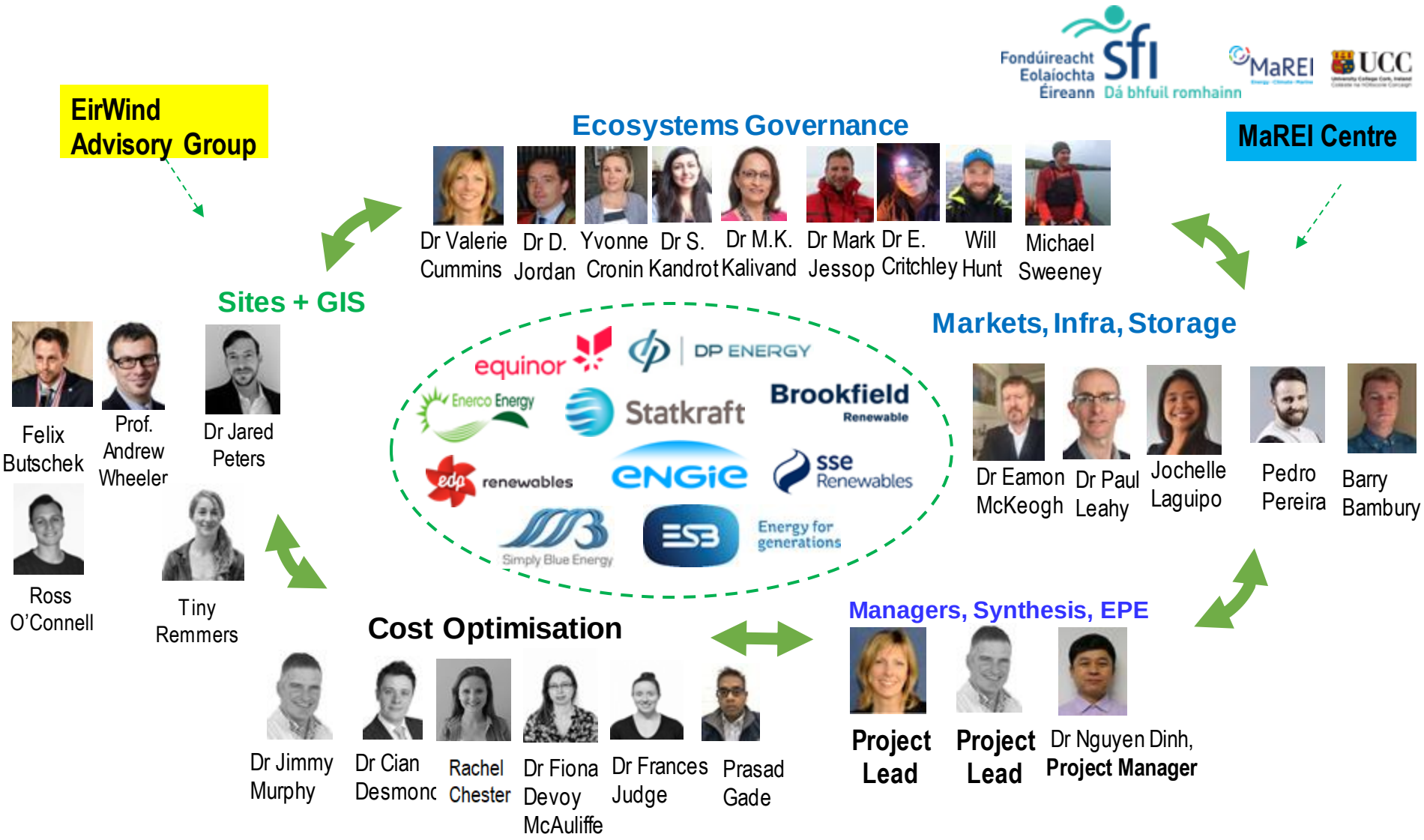
To conduct multidisciplinary research into development pathways (a Blueprint) for offshore wind in Ireland

Context

1. Despite having **one of the best offshore wind resources** in the world, Ireland has been a slow entrant to the sector.
2. From this slow starting position, things are **progressing rapidly**.
3. Ireland has an opportunity to learn from other jurisdictions, to be totally **self-sufficient in energy, and even an energy exporter**.



EirWind Consortium



Project Duration: 1st August 2018 to 31st July 2020

Agenda 25th June 2020:

Introduction Dr Val Cummins

Overview of Studies and Reports Dr Nguyen Dinh

Work Package Reports

WP2 Data Management for Site Evaluation - Dr Jared Peters

WP3 Development Optimisation for Cost Reduction - Dr Jimmy Murphy

WP4 Governance and Biology - Dr Sarah Kandrot

WP5 Markets Infrastructures, Storage and Economic Benefits - Dr Paul Leahy

WP6 Research Synthesis: EirWind Blueprint – Dr Val Cummins

Commentary

Niamh Kenny - DP Energy
Sam Roch-Perks - Simply Blue Energy
Anita Holgersen – Equinor
Martin Finucane - Department of Communications, Climate Action & Environment

Overview of the Project Research & Deliverables

- Quality
- Efficiency
- Practice

Dr Nguyen DINH

EirWind Project Manager, MaREI Centre, ERI, UCC

Cork, June 2020

A Research Process of Quality, Efficiency and Practice

Identify & Design → Implement → Validate → Disseminate

Every 3 - 4 months

Consortium Meeting

(Industry, Research, Technical Advisors from Governmental Agencies)

- Policy updates
- Industry updates
- Deliverable/Progress presentations, Q&A
- Work plan presentations, Q&A
- Laboratory visit, Working lunch
- Invited speakers

Research - Industry interactions

- Online, Individual (Emails/Teams)
- Online, group (Yammer)
- Offline meetings
- Review of research ideas
- Review of draft reports
- Data/Practice

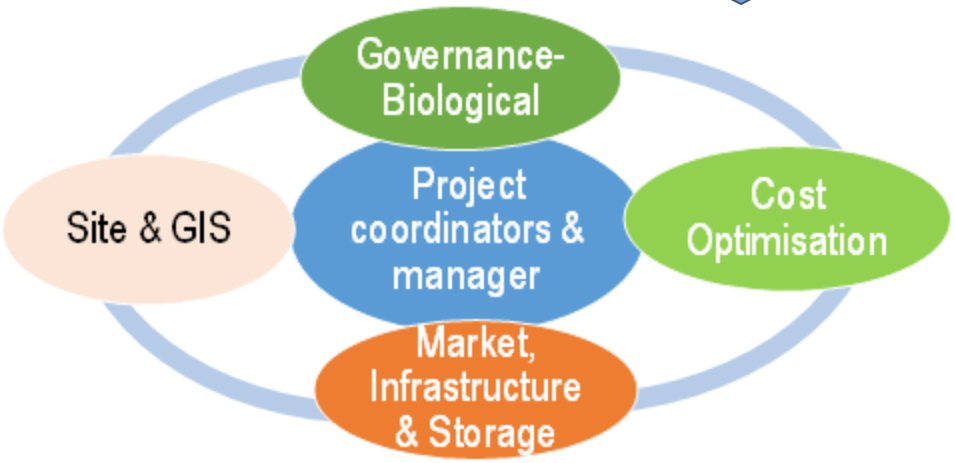
Next Consortium Meeting

(Industry, Research team, Technical Advisors from Governmental Agencies)

Immediately / Peer-review

- Networking events
- Journals/Conferences
- Policy brief/Articles
- Website & Public Media

A multi-disciplinary & interactive environment, fit for capacity building



EirWind background study and reports – June 2020

~ 40 reports from 5 disciplinaries by July

Data and GIS - Speaker Dr Jared Peters

1. Data Resources Assessment—Phase 1 (Data Requirements, Gap analysis and Strategic Plan)
2. Field Measurement Plan 1
3. Data Set Release 1 (Open GIS), in accordance with data standards, and as per the requirements of the industry partners.
4. Field Measurement Plan 2

Cost optimisation - Speaker: Dr Jimmy Murphy

5. Report of scenario building workshops (for each study site)
6. Initial issues on Offshore wind farm development in Ireland.
7. Scenario modelling consultations
8. Modelling tool description (after completion of development) and application to various scenarios at generic site locations on east, south and west coasts.
9. Report on optimization analysis in relation to zone development.

Governance - Speaker: Dr Sarah Kandrot

10. National stakeholder map / directory
11. Recommendations for innovation and best practice in support of approaches to stakeholder engagement in the study areas.
12. Comparative analysis of regulatory regime Ire/Scotland
13. Governance of offshore wind in the Irish Sea
14. Interim report on models for community co-ownership (including best practice in terrestrial and international cases)
15. Stakeholder engagement and perception final report
16. Socio-economic study
17. Study on state bandwidth for offshore wind

Marine Biology

18. Methodology outline and scenario identification on mitigation of impacts of offshore wind farms on seabirds
19. Initial report on methodology for the assessment of seabird vulnerability to offshore wind farms in Ireland
20. Initial results for the assessment of seabird vulnerability to offshore wind farms in Ireland
21. Impacts from Offshore Wind Farms on Marine Mammals and Fish – A review of the current knowledge
22. Final outputs on seabird vulnerability mapping
23. Final report on impacts of offshore wind farms on seabirds and marine mammals

Markets, Infrastructures and Economics - Speaker: Dr Paul Leahy

24. Identification of new and Future Markets
25. Cost/Benefit and risk analysis
26. Infrastructures and Storage
27. System Services
28. Demonstration Pilots design and recommendations
29. Enhanced review of electrolyser and power-to-gas technologies with a focus on variable operation and system services
30. Existing and developing interconnectors and their capacity strategies
31. EirWind Outreach Plan

Pending: Final cost optimization scenarios; Strategic development zone study; Final MICA report; Fisheries co-existence final report; Media Content analysis; Full economics; Recommendations, and Synthesis Blueprint

Where to find EirWind's published deliverable reports, papers?

www.marei.ie/project/eirwind/

⊕ Introduction

⊕ Work Packages

⊕ Deliverables

⊕ Project Outputs

⊕ Gallery

https://www.linkedin.com/company/eirwindproject/

Next presentation: Dr Jared Peters & WP2

Work Package 2: Data management for site evaluation

WP2: Data Management & GIS

Speaker: Dr Jared Peters

Team: Jared Peters, Felix Butschek & Andrew Wheeler
(previous work from Tiny Remmers & Ross O'Connell)

Webinar presentation 25 June 2020

(Cover slide background made from INFOMAR bathymetry data)

WP2 Team

Current

Full project

Andy Wheeler

Full project

Jared Peters

Year two

Felix Butschek

Previous

Year one

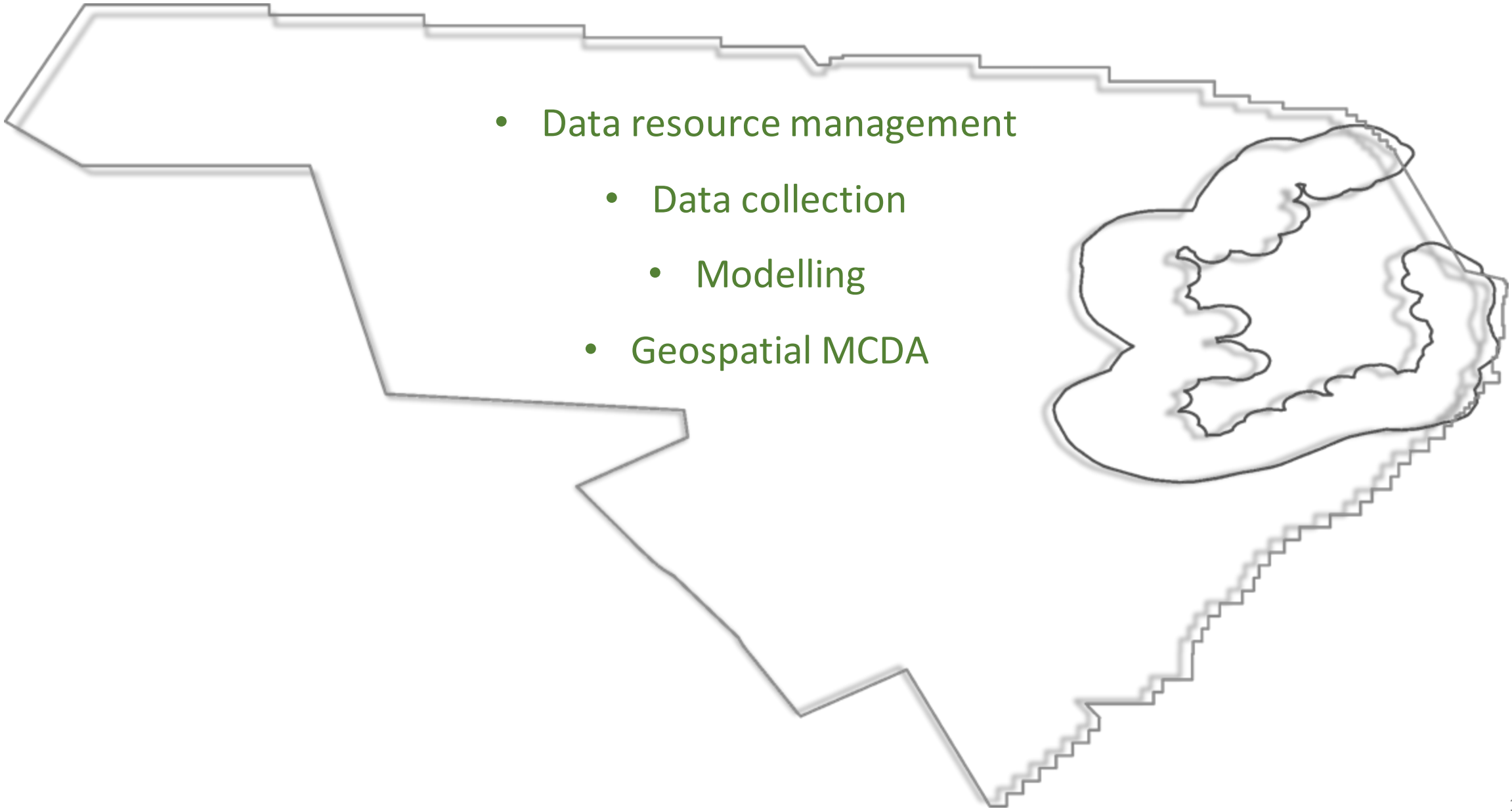
Tiny Remmers

Year one

Ross O'Connell

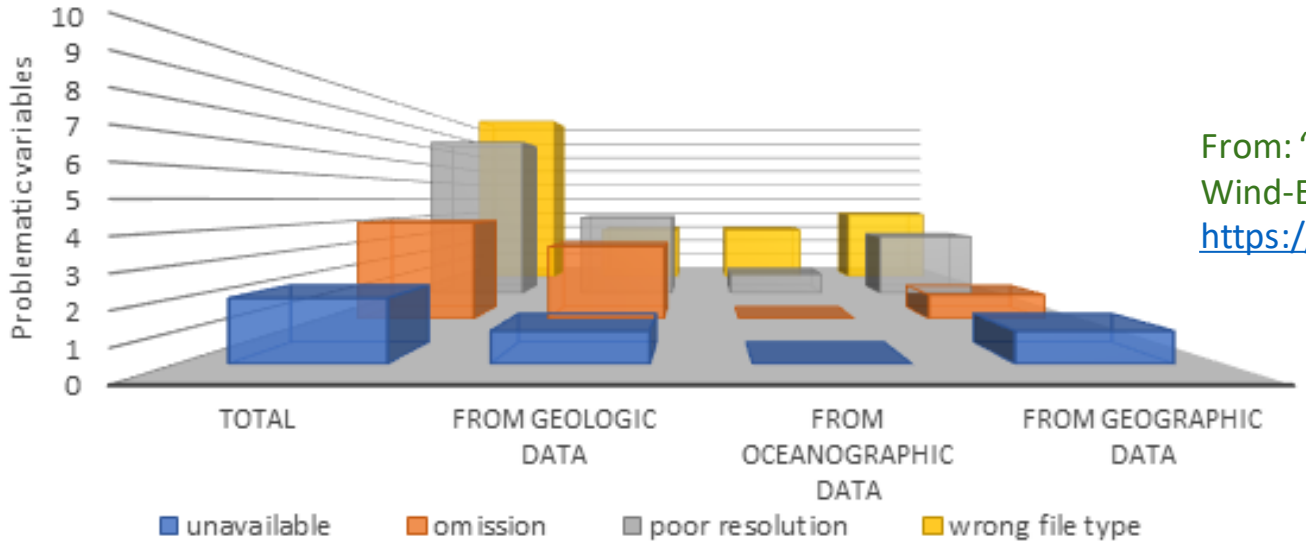
Outline

- Data resource management
- Data collection
- Modelling
- Geospatial MCDA



Data resource management

- Reviews:
  - Initial data availability
  - Secondary review (after 1 year)
  - Systematic review of GIS use



From: "Policy Brief: Data for Irish Offshore Wind-Energy" (available at https://www.marei.ie/project/eirwind/)

Data resource management

- Reviews:
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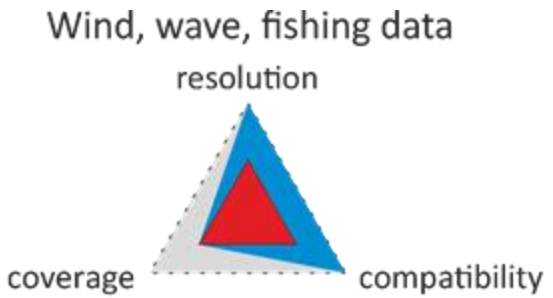
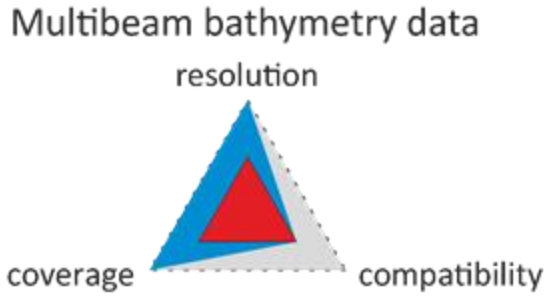
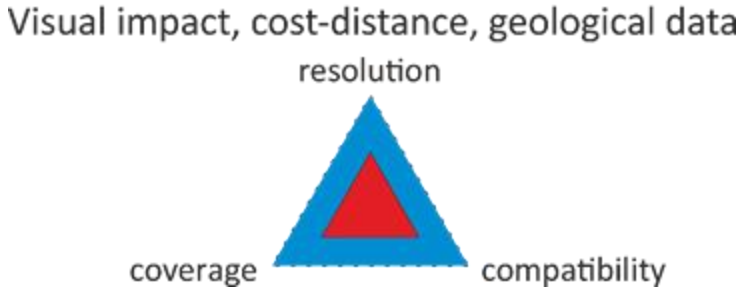






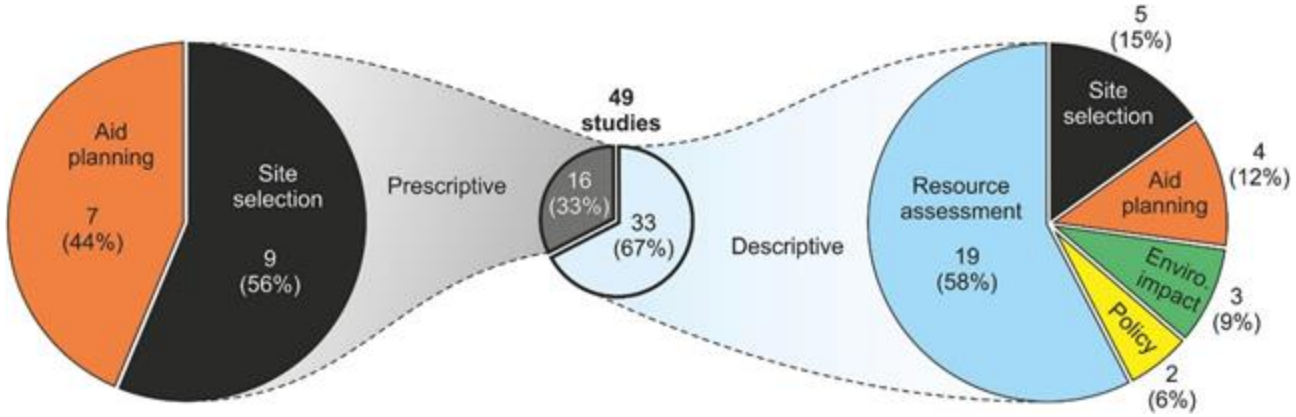
Hard constraints

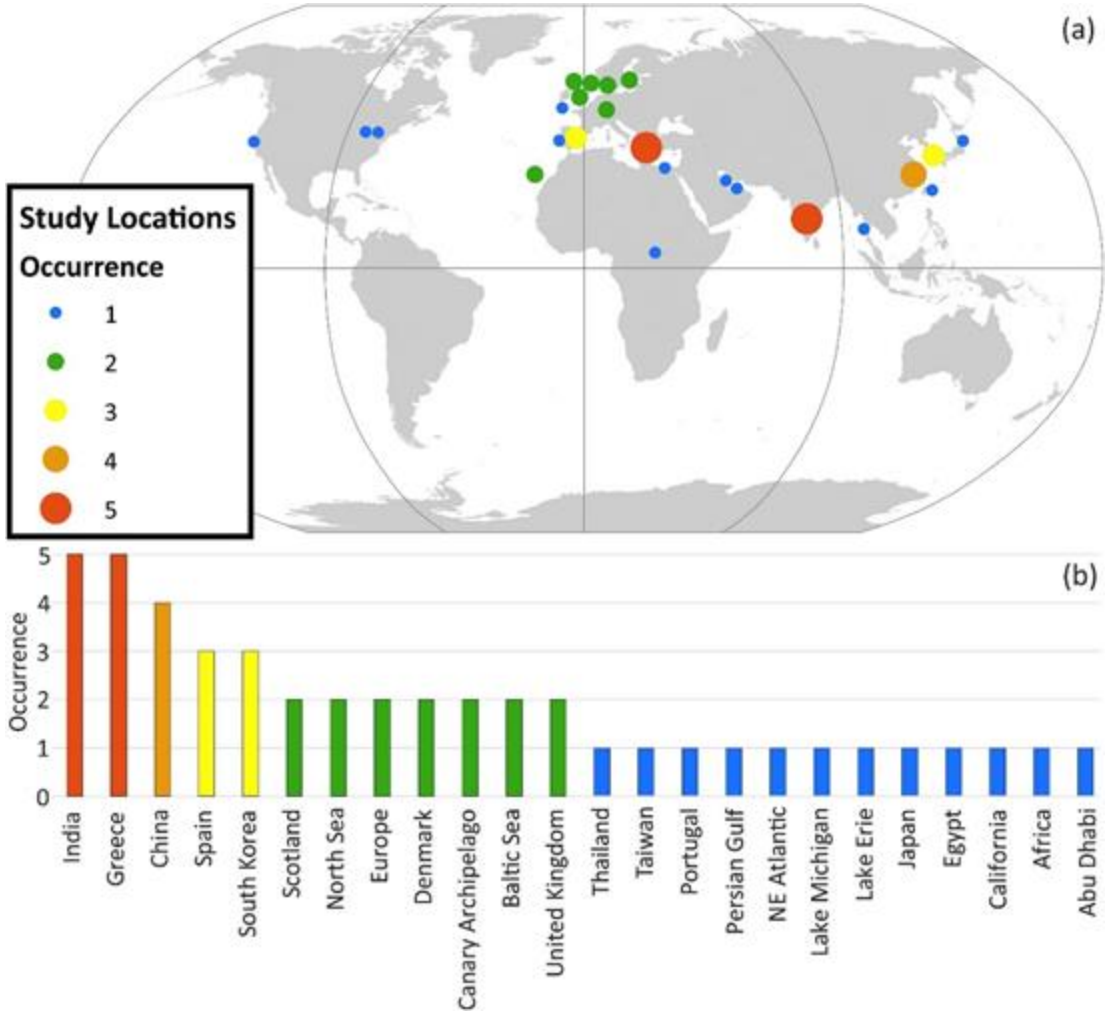
Technical opportunities

Cultural heritage restrictions

Data resource management

- Reviews:
  - Initial data availability
  - Secondary review (after 1 year)
  - Systematic review of GIS use (Peters et al., 2020)

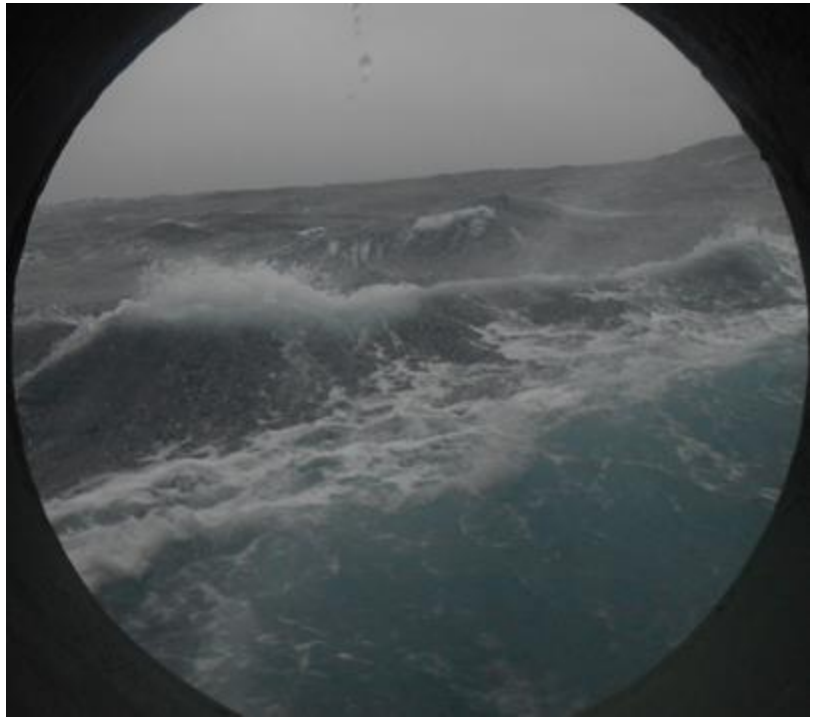




Data collection

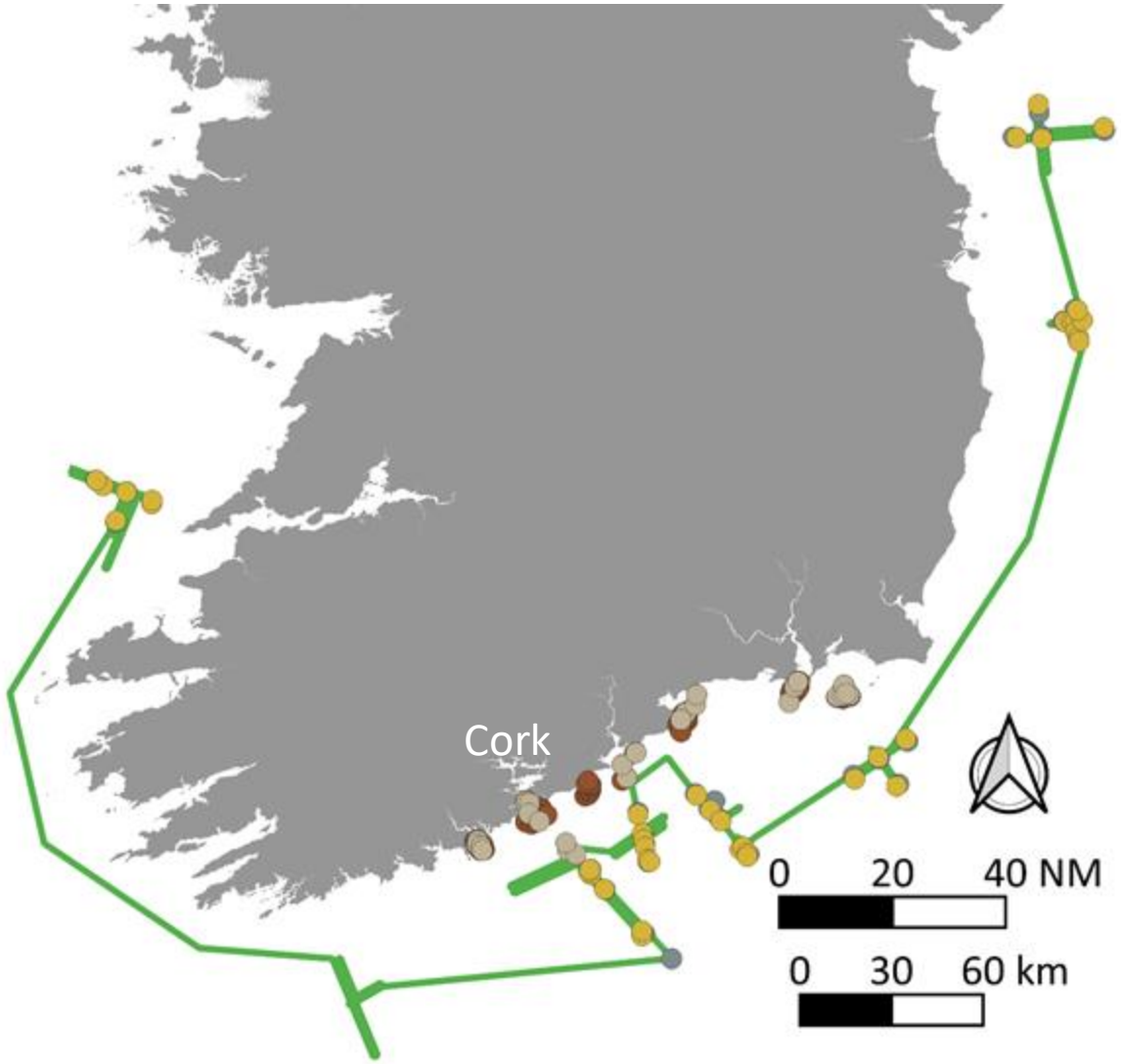
- Three research cruises
  - CV18034
  - CV19023
  - CV19026

- 21 days total offshore



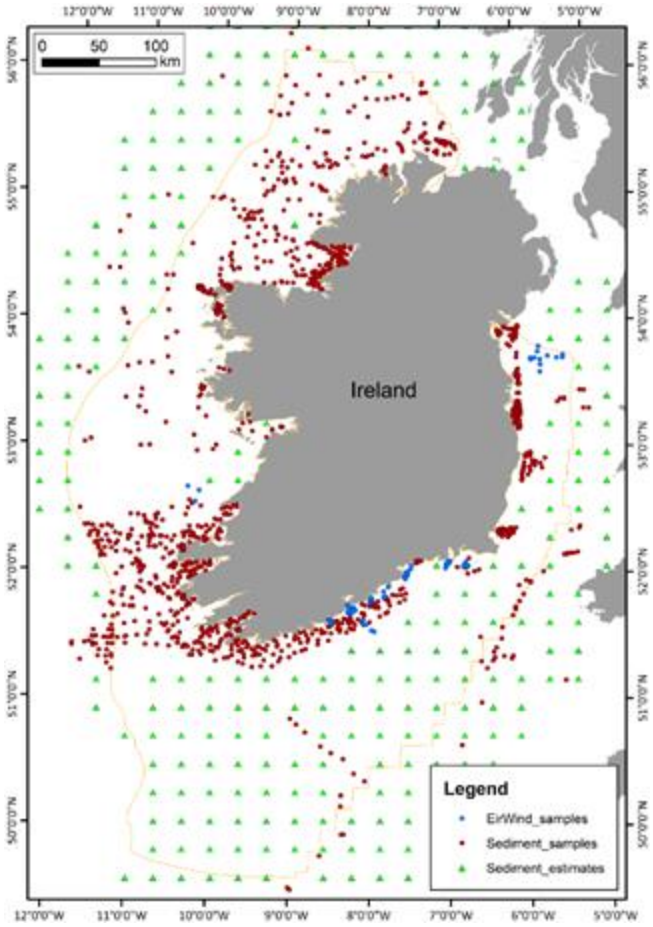
Data collection

- Three research cruises
- Data totals
  - >400 nm multibeam bathymetry
  - ~200 sediment grabs
  - >30 vibrocores

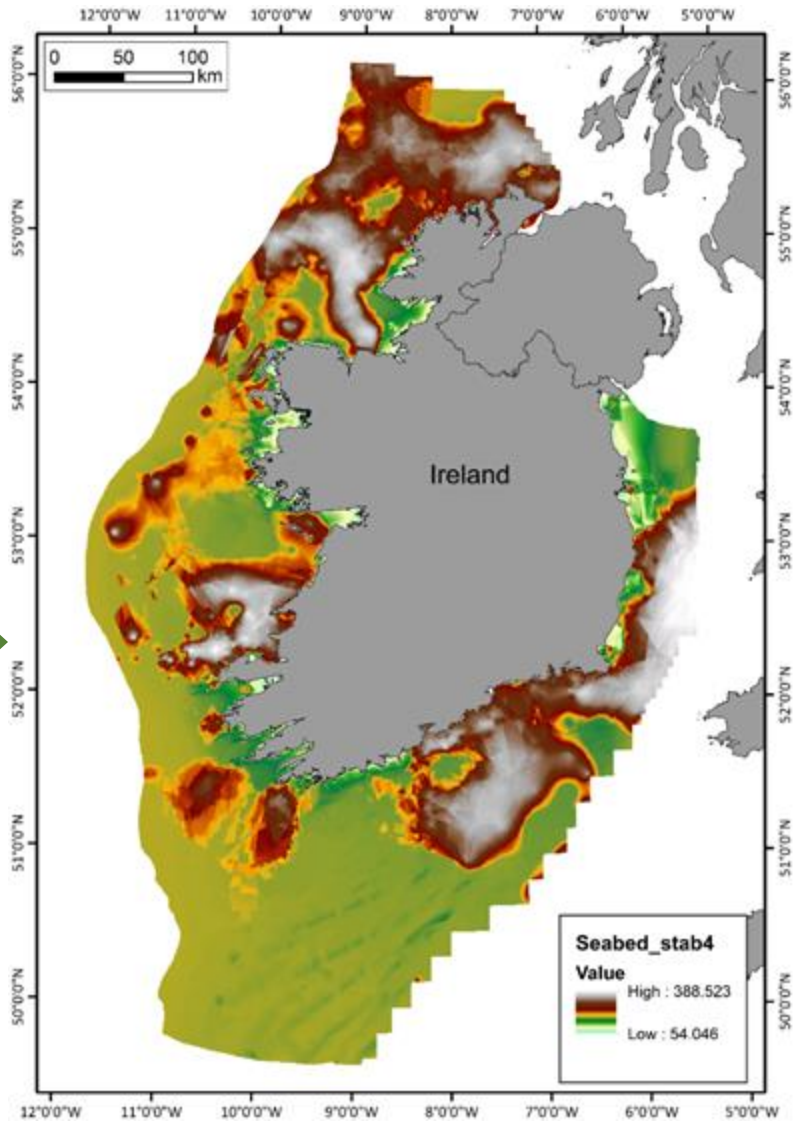


Data modelling

- Seabed (geological) stability

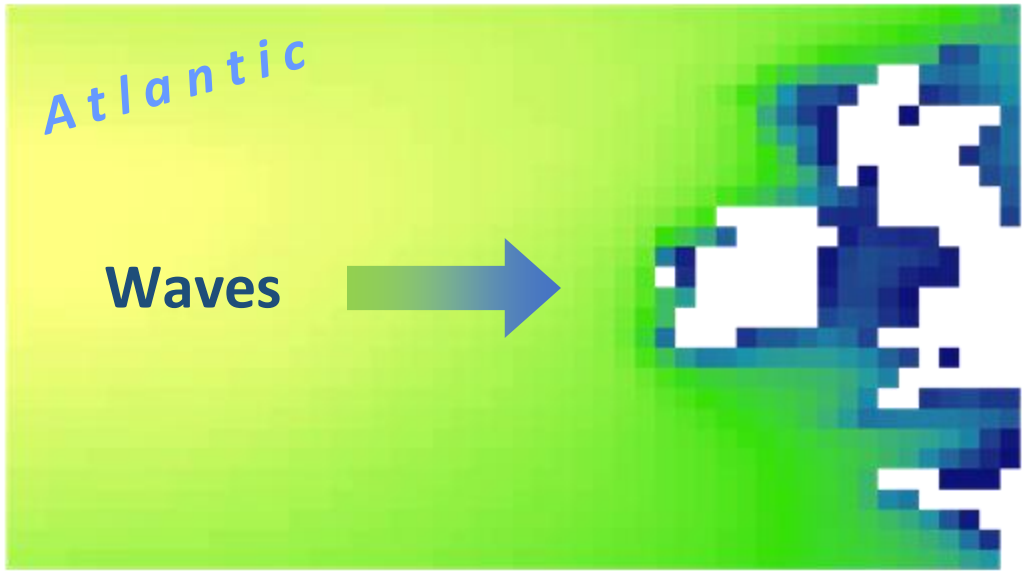


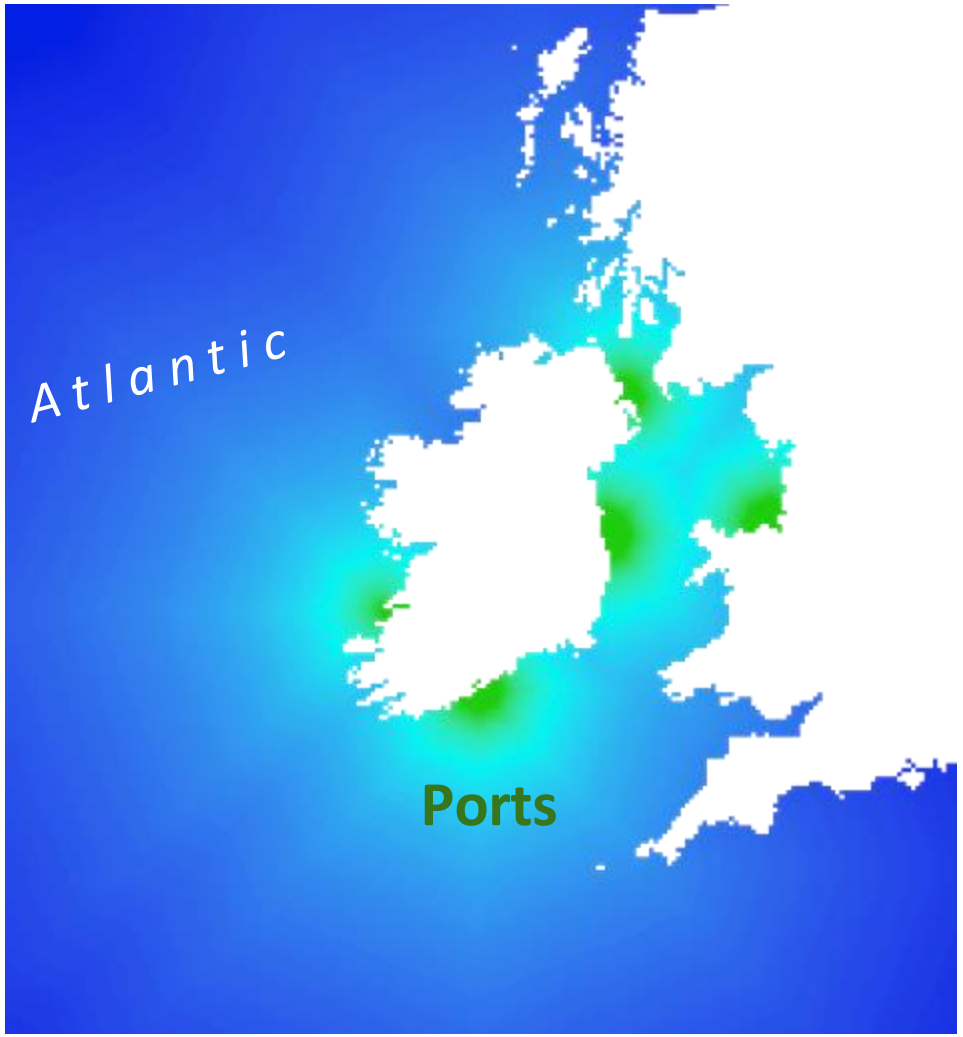
Interpolate



Data modelling

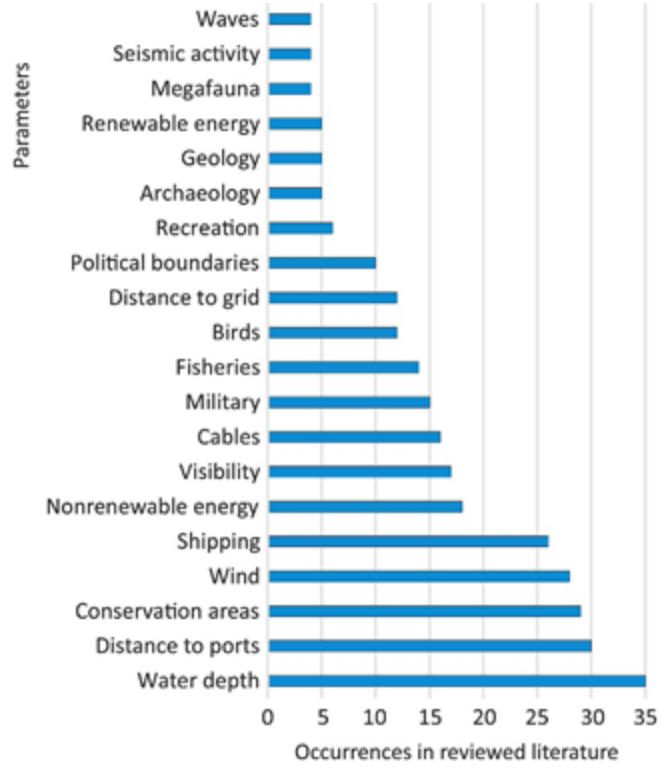
- Seabed (geological) stability
- Visual impact (seascape)
- O&M windows
- Wind resource



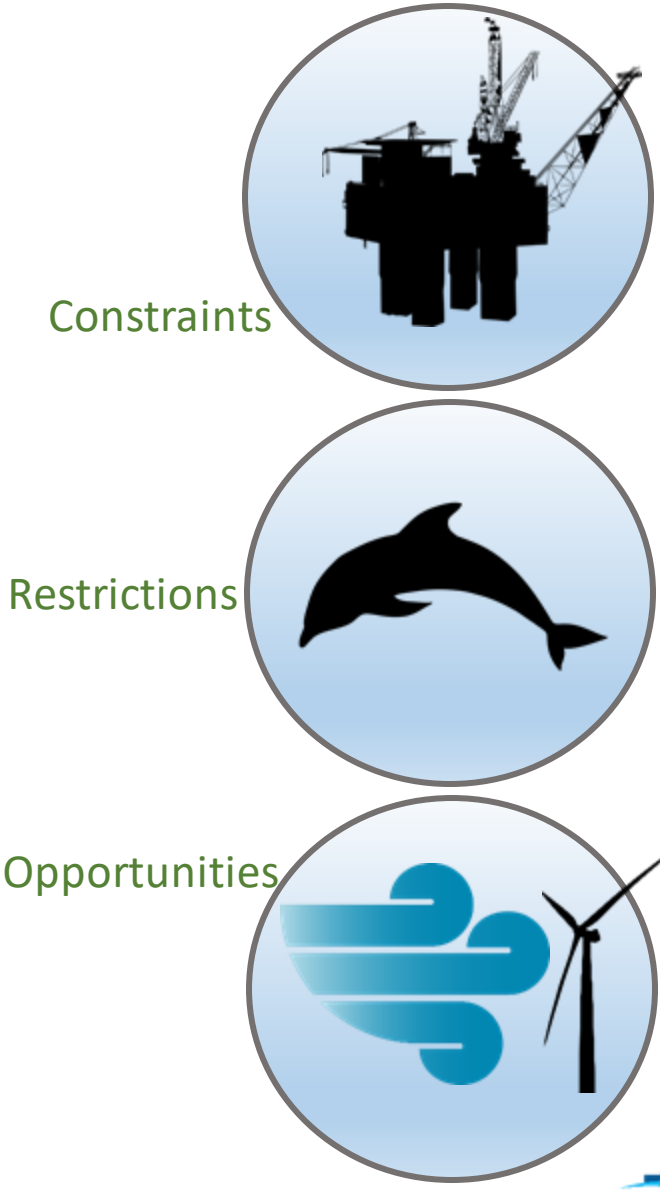


Multi-Criteria Decision Aid (MCDA)

- Define criteria
- Group into distinct GIS models
  - Simplicity for end users
  - Compatibility with previous ORESG MCDA

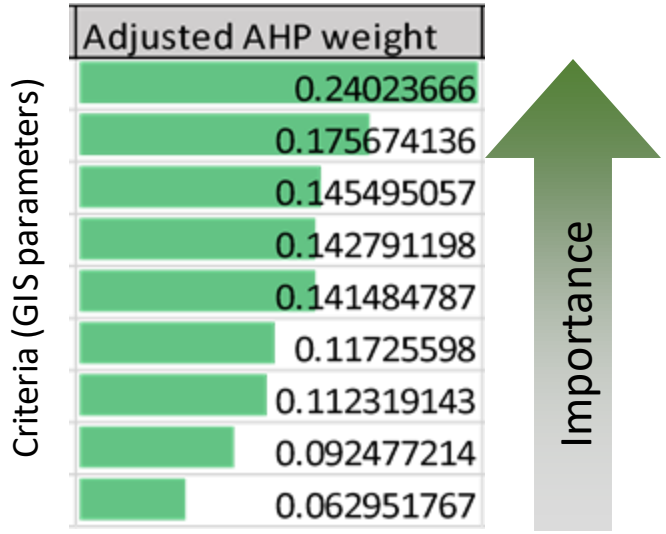


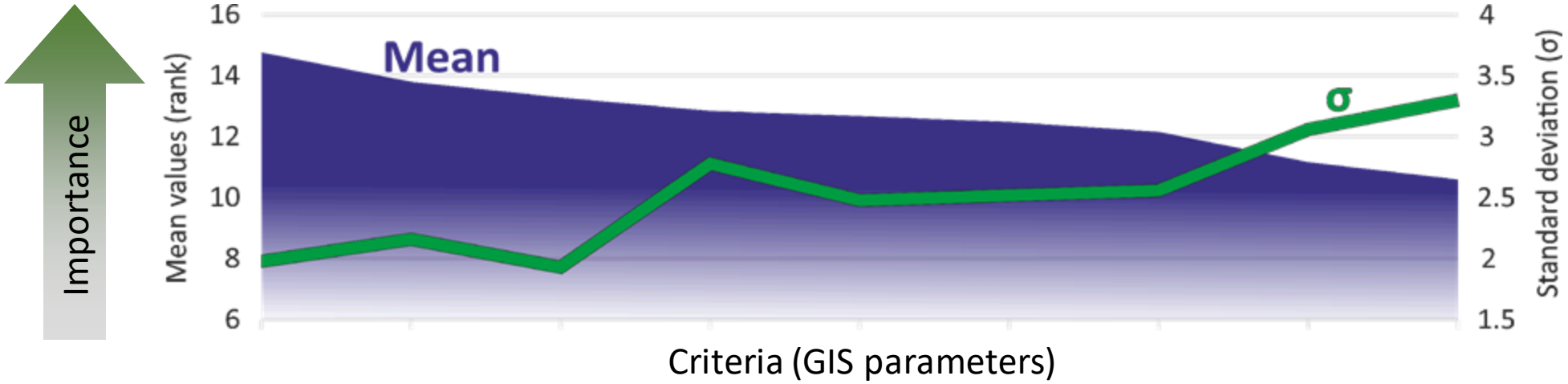
(Modified from Peters et al., 2020)



MCDA

- Weight the criteria
  - Survey experts from industry and academia
  - Analytical Hierarchy Process (AHP)



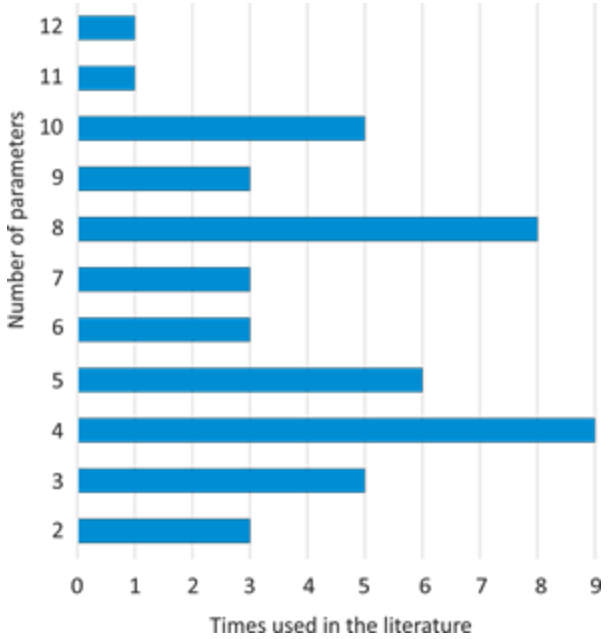


Results summary

Data management

Reviews

- Identified data gaps
- Established standards



(Modified from Peters et al., 2020)

+New data

- Filled gaps with measurements & models

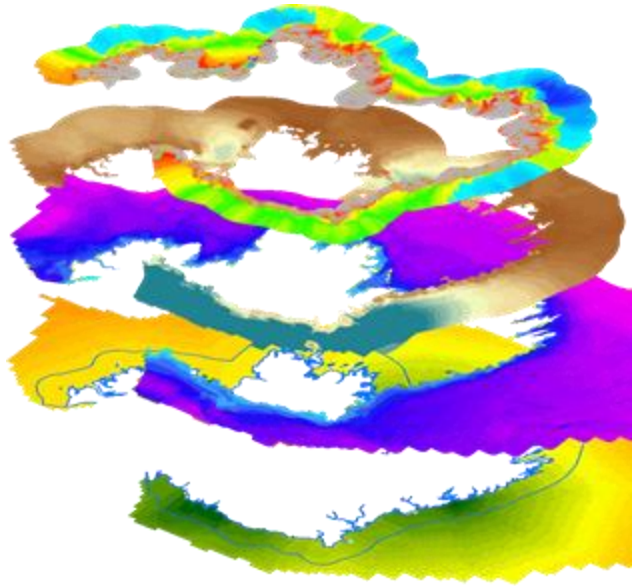
Weighted data

- Expert surveys
- AHP calculations

Adjusted AHP weight
0.24023666
0.175674136
0.145495057
0.142791198
0.141484787
0.11725598
0.112319143
0.092477214
0.062951767

MCDA

- Modular, adjustable
- Weighted, modern
- Produces a map of opportunities



Thank you

Reference:

- Peters, J. L., Remmers, T., Wheeler, A. J., Murphy, J., & Cummins, V. (2020). A systematic review and meta-analysis of GIS use to reveal trends in offshore wind energy research and offer insights on best practices. Renewable and Sustainable Energy Reviews, 128, 109916.

Acknowledgements:

- This research has been partially funded by EirWind's 10 industry partners, Science Foundation Ireland (SFI) under Grant No 12/RC/2302, and University College Cork, Ireland.
- Additional funding: Marine Institute Ship Time Awards CV18034, CV19023, and CV19026. The iCRAG programme (WindEaZ Research Grant; Mar2.2).

Next presentation: WP3, Dr Jimmy Murphy

WP3: Development optimisation for cost reduction

Speaker: Dr Jimmy Murphy

Team: Fiona Devoy McAuliffe; Frances Judge; Prasad Gade; Rachel Chester

Cost Reduction for Offshore Wind

WP3 Team


Dr Jimmy Murphy


Rachel Chester


Dr Fiona Devoy McAuliffe


Dr Frances Judge


Dr Cian Desmond


Prasad Gade

Dramatic cost reductions in offshore wind in recent years

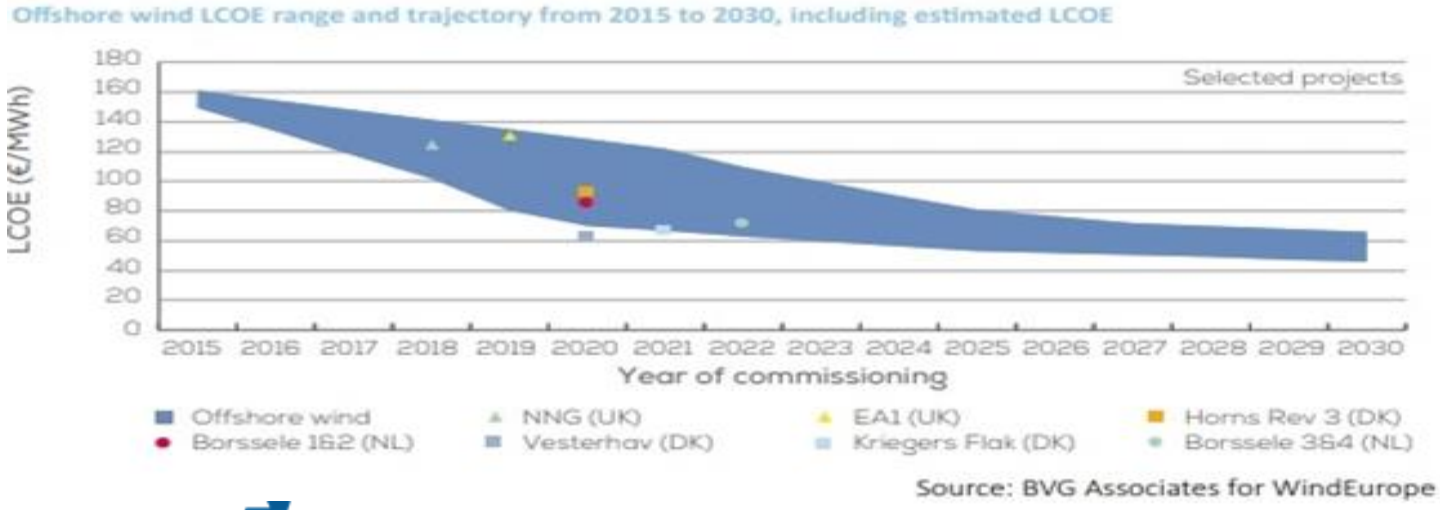
- Larger projects using bigger turbines with higher efficiency
- Reduced cost of capital to finance projects
- Long pipeline of projects - allows supply chain to develop
- Better project management and operational experience
- More optimised logistics

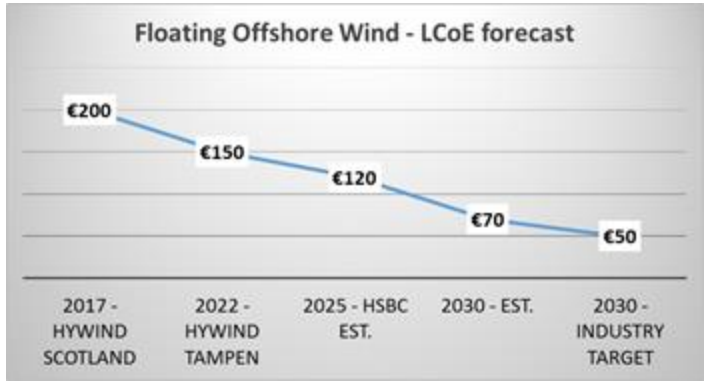
Ireland (Arklow Phase 1 aside), is only now starting journey into exploiting offshore wind so given Irish conditions what potential LCoE values can be expected from different sites located off the east, south and west coasts

Levelised Cost of Energy (LCoE)

LCoE is a measure of lifetime costs divided by lifetime energy production

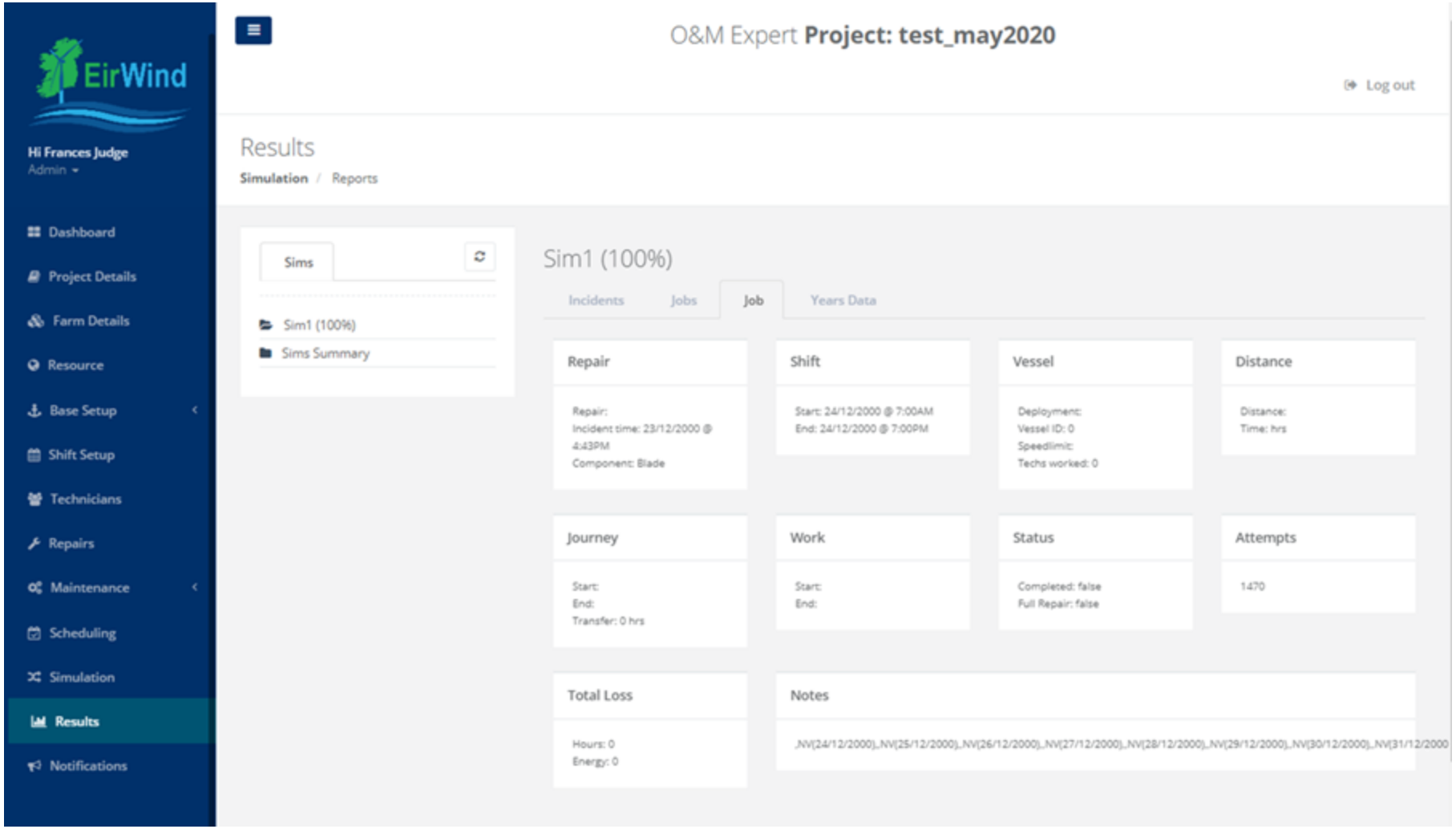
- Development Expenditure (DEVEX)
- Capital Expenditure (CAPEX)
- Operational Expenditure (OPEX)
- Decommissioning Expenditure (DECEX)
- Lifetime Power Production
- Units €/MWh or €/kWh





Modelling Tools – Financial Models

Modelling Tools – O&M Expert



Case Study Details

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

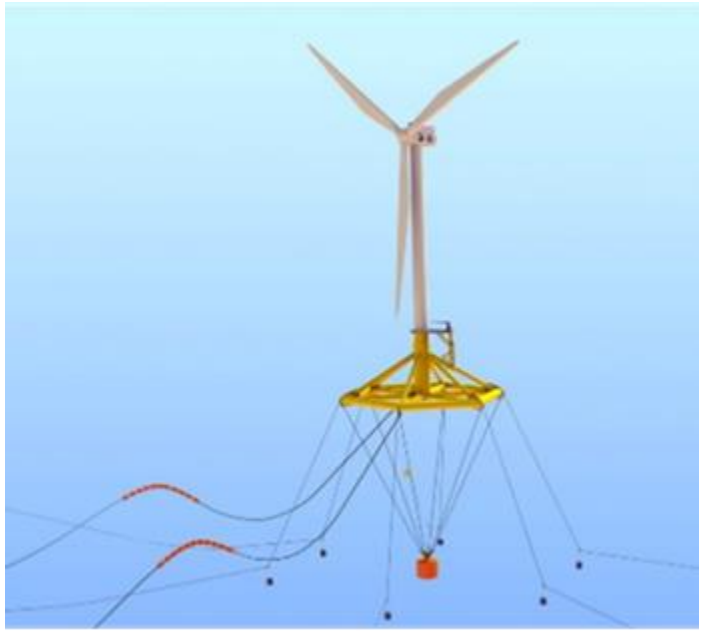
Baseline Results

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%

Optimisation studies - Installation

Optimisation studies – O&M

Cost Optimisations: Floating substructure



Optimisation studies

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

Optimised Results

SITE DESCRIPTION	LCOE (€/MWh)	REDUCTION (€/MWh)	REDUCTION(%)
Irish Sea (Start year: 2025)	65		
Optimised Irish Sea	**58**	**7**	**-10%**
Celtic Sea (Start year: 2035)	74		
Optimised Celtic Sea	**70**	**4**	**-5%**
Atlantic Ocean (Start year: 2035)	108		
Optimised Atlantic Ocean	**84**	**24**	**-22%**

Key findings

- The Irish Sea results show why fixed sites using well established technologies and methods have been prioritised for Offshore Wind development.

- The Celtic Sea, indicates very high potential for floating wind but it will happen over a longer timeline and the floating sector must develop incrementally over time to achieve comparable LCoE values to fixed wind

- The Atlantic Ocean sites are feasible for development but will require further improvements in reliability and the ability to undertake operations in more extreme conditions to reduce the LCoE

- The results show that cost reductions can be achieved by detailed examination and optimisation of each stage in the windfarm lifecycle

Thank You

Acknowledgement

"This has been funded by EirWind's 10 industry partners, Science Foundation Ireland (SFI) under Grant No 12/RC/2302, and University College Cork, Ireland"

Next presentation: WP4 Dr Sarah Kandrot

WP4: Ecosystem Governance and Biology

Eirwind Webinar

Speaker: Dr Sarah Kandrot

WP Leaders: Val Cummins & Mark Jessopp

25 June 2020

WP4: Ecosystem Governance & Biology

Dr Val Cummins
WP Leader and co-PI

Dr Mark Jessopp
Co-WP Leader

Dr William Hunt
Marine mammals

Dr Emma Critchley
Seabird vulnerability

Dr Anne-Marie O'Hagan
Legal & Policy Review

Yvonne Cronin
Social license to operate – Public perception

Gerard Mullally
Social license to operate – Public perception

Dr Mitra Kamidelivand
Social license to operate – Building trust

Dr Sarah Kandrot
Socioeconomic impacts

Dr Declan Jordan
Socioeconomic impacts

Fisheries and Marine Mammals

What? **Environmental Impacts of OWFs on Fisheries & Marine Mammals**

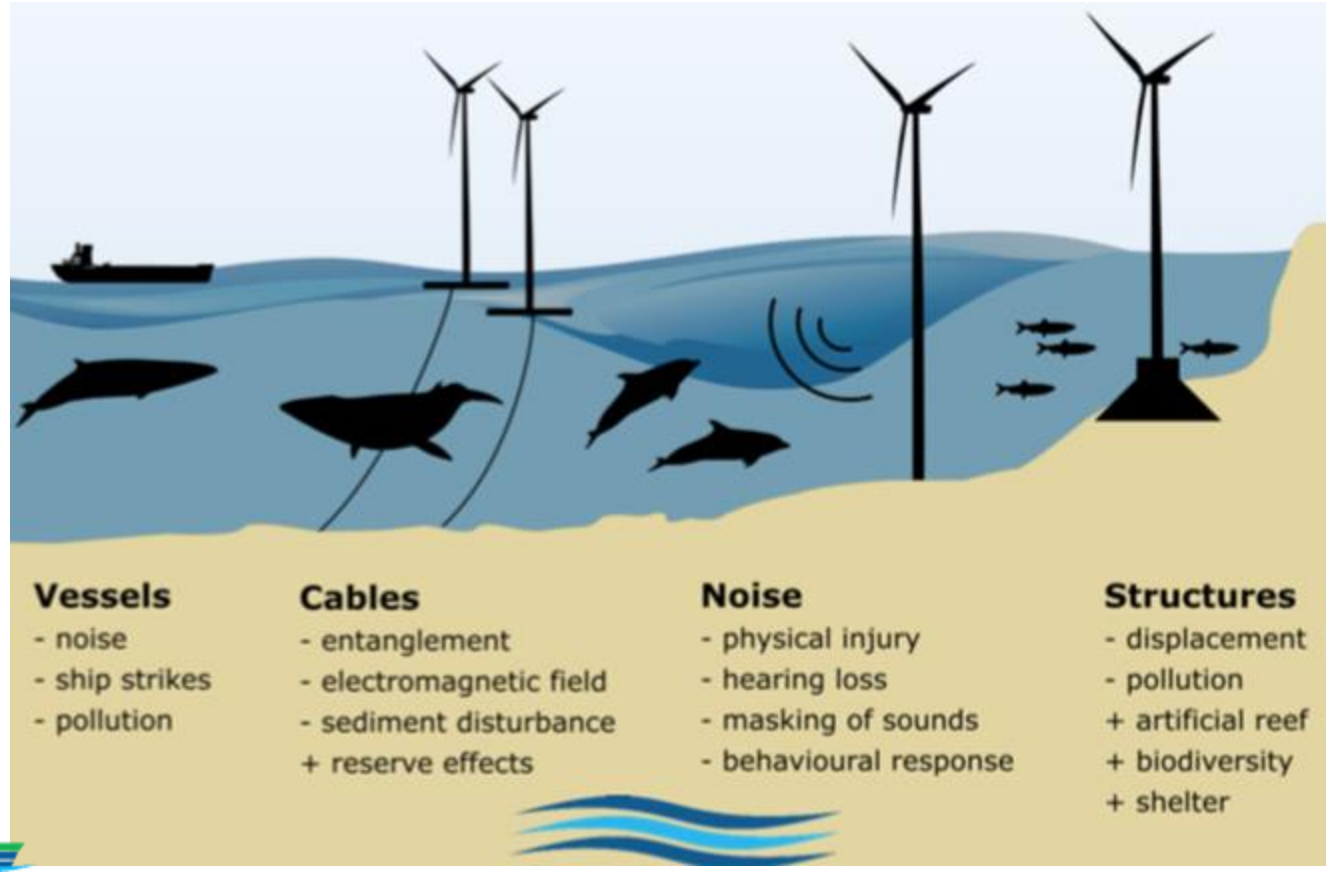
Who? William Hunt

Why?
- Vulnerable to disturbance from noise, vessel traffic, and installations
- Marine mammals protected under Irish and EU legislation

How? Desk based review of current knowledge on impacts and mitigation to inform best practice

Impacts of OWFs on Marine Mammals & Fish

Positive and negative effects



Mitigation measures

- Distribution & abundance data for site selection
- Time-area restrictions
- Sound propagation models
- Restricted fishing activity
- Noise threshold guidelines
- Acoustic deterrent devices
- Noise mitigation systems
- Reduced vessel speed

Seabird vulnerability

What? **Seabird vulnerability to offshore wind**

Who? Emma Critchley

Why?

- Ireland home to birds of international and European importance
- An important aspect of public perception of offshore wind farms

How? Development of seabird vulnerability indices from available observational survey data

Seabird vulnerability

Seabird Collision (CVI) and **Displacement (DVI)** vulnerability indices mapped at the national level

-Irish context, incorporating recently published data

-Account for larger 12MW turbines

-Spatial vulnerability at national scale to **aid broad-scale siting decisions**

-Method can be used for fine-scale analysis as more seabird distribution data become available

Exploring co-existence with fishers

What? **Building Trust to Earn Social License to Operate- Mapping the Benefit Sharing Mechanisms for the Key Stakeholders in Irish offshore wind**

Who? Mitra Kamidelivand, mitra.kamidelivand@ucc.ie

Why? To explore the opportunities around benefit sharing mechanisms for stakeholders in offshore wind, specifically fishers

How?

- Desk-based research to develop recommendations on co-existence and benefit sharing models
- Interviews and questionnaires with key stakeholders

Exploring co-existence with fishers in Ireland

Essential elements for co-existence with fishers

- Trust
- Compensation
- Benefit sharing
- Concerns

''Include people from the fishing communities in the decision-making process''

Exploring co-existence with fishers in Ireland

Interview analysis + best practices

What	Why	When (& how)
Consultation (gathering opinions from stakeholders will help to define the scope of the dialogue)	Creating engagement tools and materials (to make a vehicle for moving towards trust building)	Start now in 2020 (this research has gathered relevant opinions; this topic is already being discussed by fishers)
Dialogue (an exchange of information with a view to fostering trust and Encouraging initiative to work together)	Mutual understanding of trust and co-existence (to set the strategies)	Immediately after consultation (all participants agreed this is the right time to establish both two-way and group dialogues)
Active participation (not just listening and forgetting)	Co-development practices (purposeful in the long-term)	Scheduled meetings after determining the membership of the groupts (e.g., Irish fisheries representatives, energy developers, government, etc.)

A standard guide for the co-existence of commercial fishers and offshore wind developers in Ireland

Public Perception

What?	**Social License to Operate – Public perception**
Who?	Yvonne Cronin, yvonne.cronindalton@ucc.ie
Why?	• To provide a detailed understanding of the distribution of national opinion • To understand what drives positive and negative opinions to inform Industry and Government • To understand what drives opinions to inform educators • To help steer any potential public awareness campaign
How?	Stakeholder mapping Media content analysis National survey of public perception

Stakeholder Mapping & Media Content Analysis

Stakeholder directory

- Government
- Port companies and supply chain
- Research institutions
- Fishing industry
- Oil & gas industry
- Supply chain - marine renewables
- Marine Leisure
- Environmental Associations

Key governance issues and stakeholder engagement concerns identified from interviews with developers

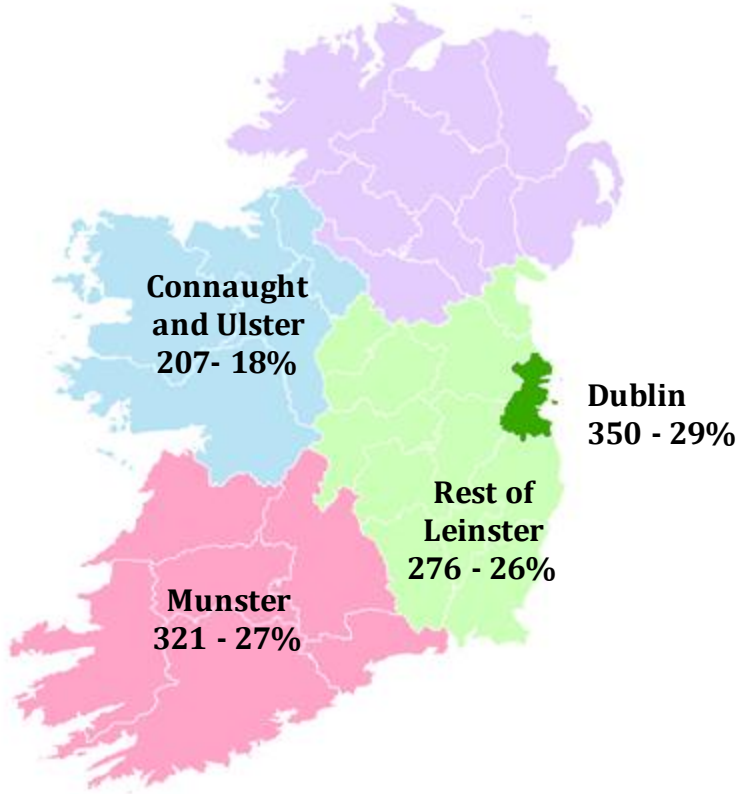
Media Content Analysis

- Primary sources of print news has a significant effect on attitudes towards wind farms
- Significant differences in public attitudes between broadsheet and tabloid readers
  -tabloid readers more likely to object to wind development and less likely to support wind development
- Review of 5 years of broadsheet coverage generally reflects the positive trajectory of the offshore wind sector in Ireland

Public Perception - National Survey

- 87% **would not object** to development of an offshore wind farm in their locality
- 93% **would not object** to development of an offshore wind farm outside of their locality
- High levels of support are influenced by **previous exposure** to wind farms, including holiday makers (40%)
- Those who already have an offshore wind farm in their area are positive about existing and further development…to a point
- Campaigns should be targeted towards local coastal communities
- Early and transparent engagement is key

Geographical distribution of national survey on offshore wind development



Socioeconomic Study

What? **Socioeconomic Study**

Who? Sarah Kandrot, sarah.Kandrot@ucc.ie

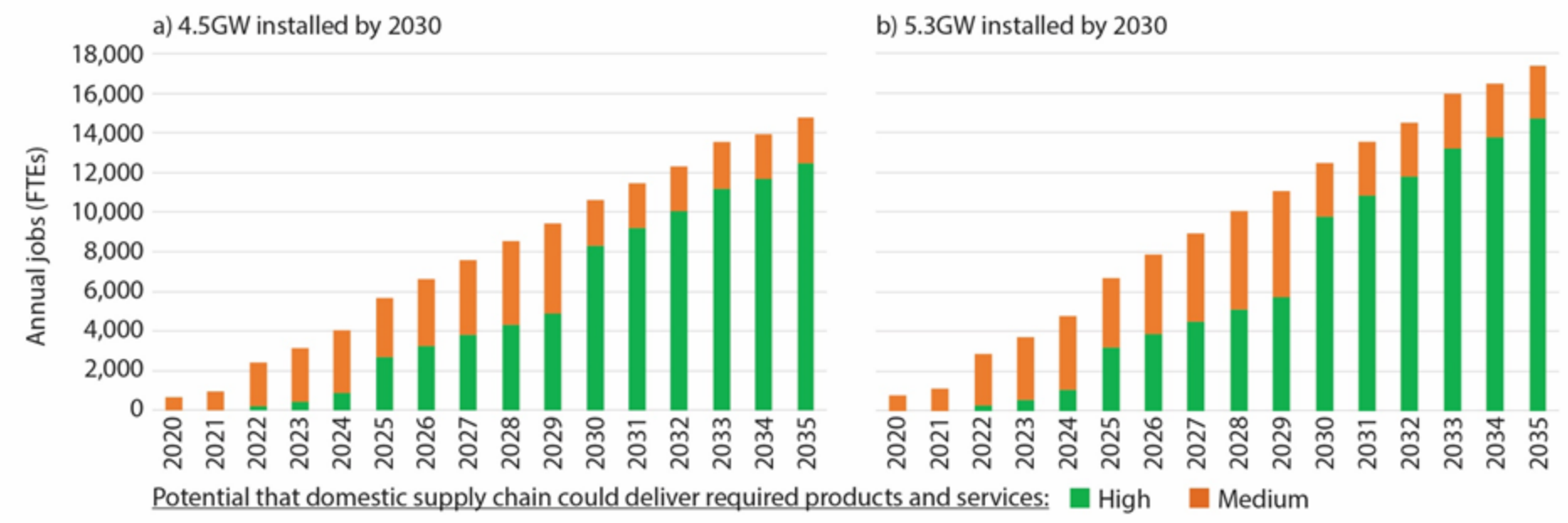
Why?

- To understand the domestic economic value and employment potential of the sector for Ireland
- To inform future policy in relation to the development/growth of an Irish OW supply chain

How?

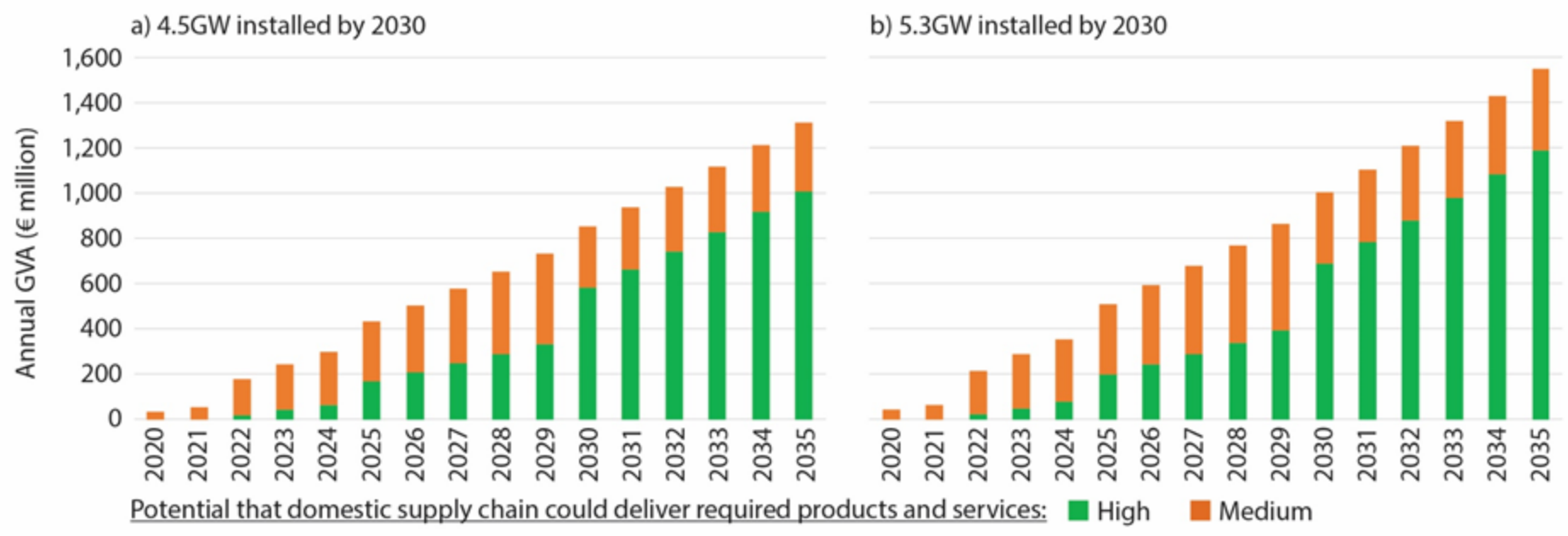
- Development of an economic model to evaluate the domestic economic and employment potential of offshore wind for Ireland

Socioeconomic Study



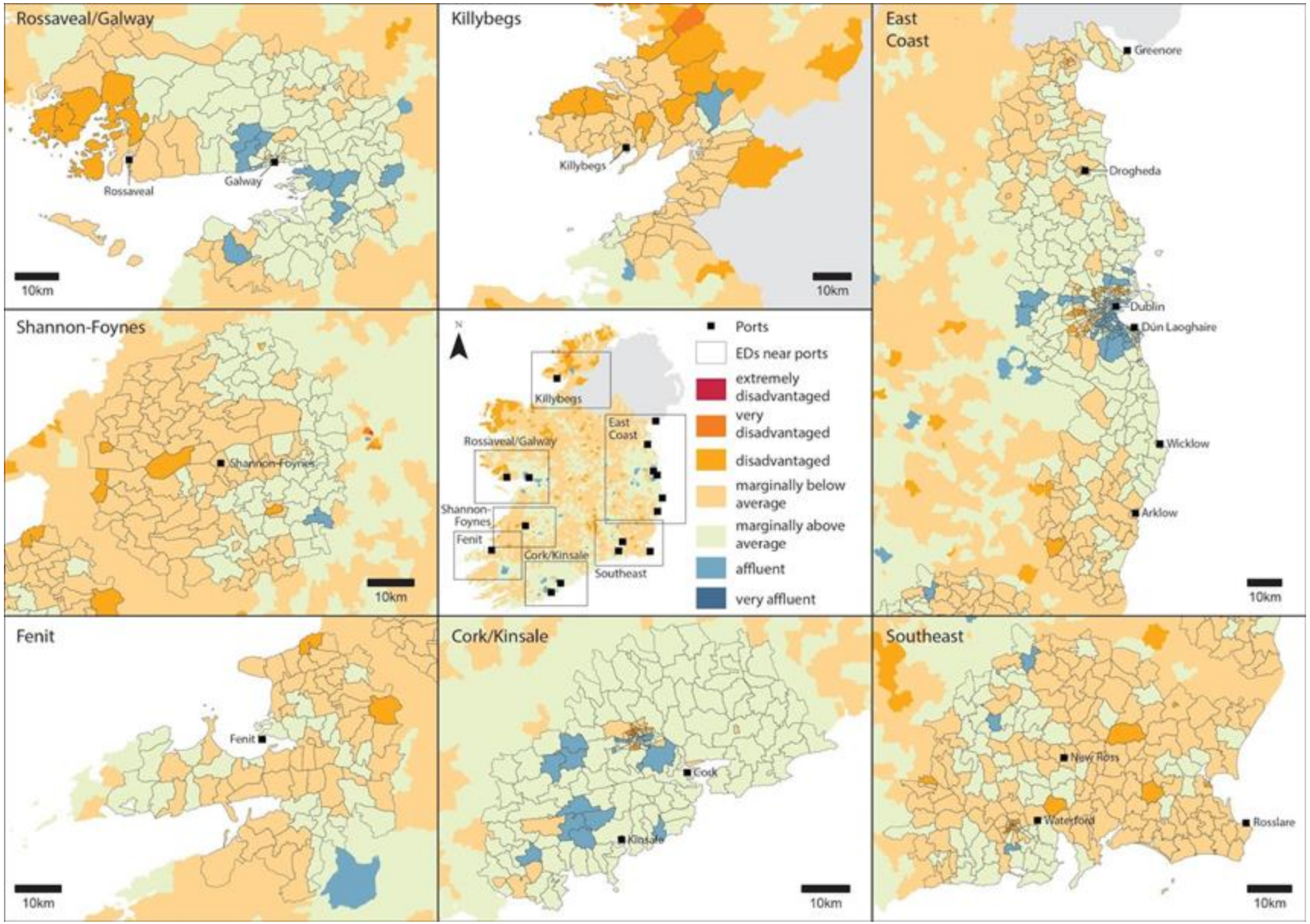
- In 2030, 4.5-5.3GW of domestic offshore wind development would support between **8,316 and 9,795 jobs** in the domestic supply chain
- Equates to between **20,563 and 24,219 person years** of employment for the period 2020-2029
- Potential to create additional jobs, provided the supply chain grows more quickly than anticipated.

Socioeconomic Study



- Offshore wind could generate between **€585m and €689m** in GVA in 2030
- Total GVA impact of between **€1.4bn and €1.6bn** for the period 2020-2029.

Socioeconomic Study



THANK YOU

Acknowledgement

This has been funded by EirWind's 10 industry partners, Science Foundation Ireland (SFI) under Grant No 12/RC/2302, and University College Cork, Ireland

Next presentation: WP5, Dr Paul Leahy

EirWind Workpackage 5 : Storage, Infrastructure and Markets

Bringing Wind Energy from Irish Waters to Markets

Team: Jochelle Laguipo, Pedro Pereira, Barry Bambury, Paul Leahy, Nguyen Dinh, Eamon McKeogh

Speaker: Dr Paul Leahy

EirWind Webinar June 25th, 2020

Offshore Wind: Resource and Domestic Markets

WP 5 Team


Dr Eamon McKeogh


Dr Paul Leahy


Jochelle Laguipo

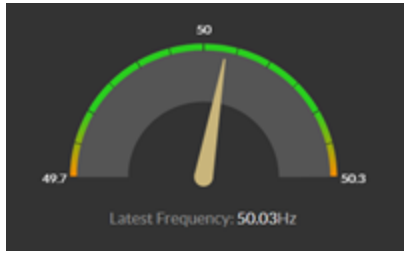

Pedro Pereira


Barry Bambury


Dr Nguyen Dinh

- Climate Action Plan (Government of Ireland, 2019): target of **70%** electricity from renewables by 2030: **4.5 GW** of offshore wind.
- Total potential for offshore wind development:
  - Up to **23 GW** by 2050 without significant adverse effects on the environment. (Eirwind draft synthesis report)
  - **2.5 times** current energy demand!

Offshore Wind: What are the markets?



Present Day:

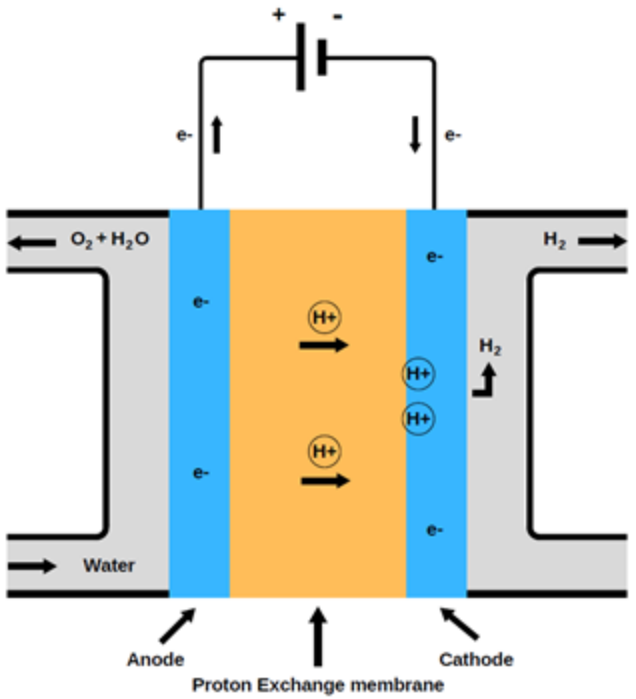
- Domestic electrical energy demand – 42 TWh in 2020
- Export electrical energy markets
  - Via interconnectors
- Capacity payments
  - €40,000 / MW / year (2020)
- System Services contracts
  - Awarded to wind farms

To 2030: beyond the kWh

- More emphasis on system services
- More exports
- kWh market will continue to grow with data centres consuming up to 12 TWh
- **Power-to-Gas**

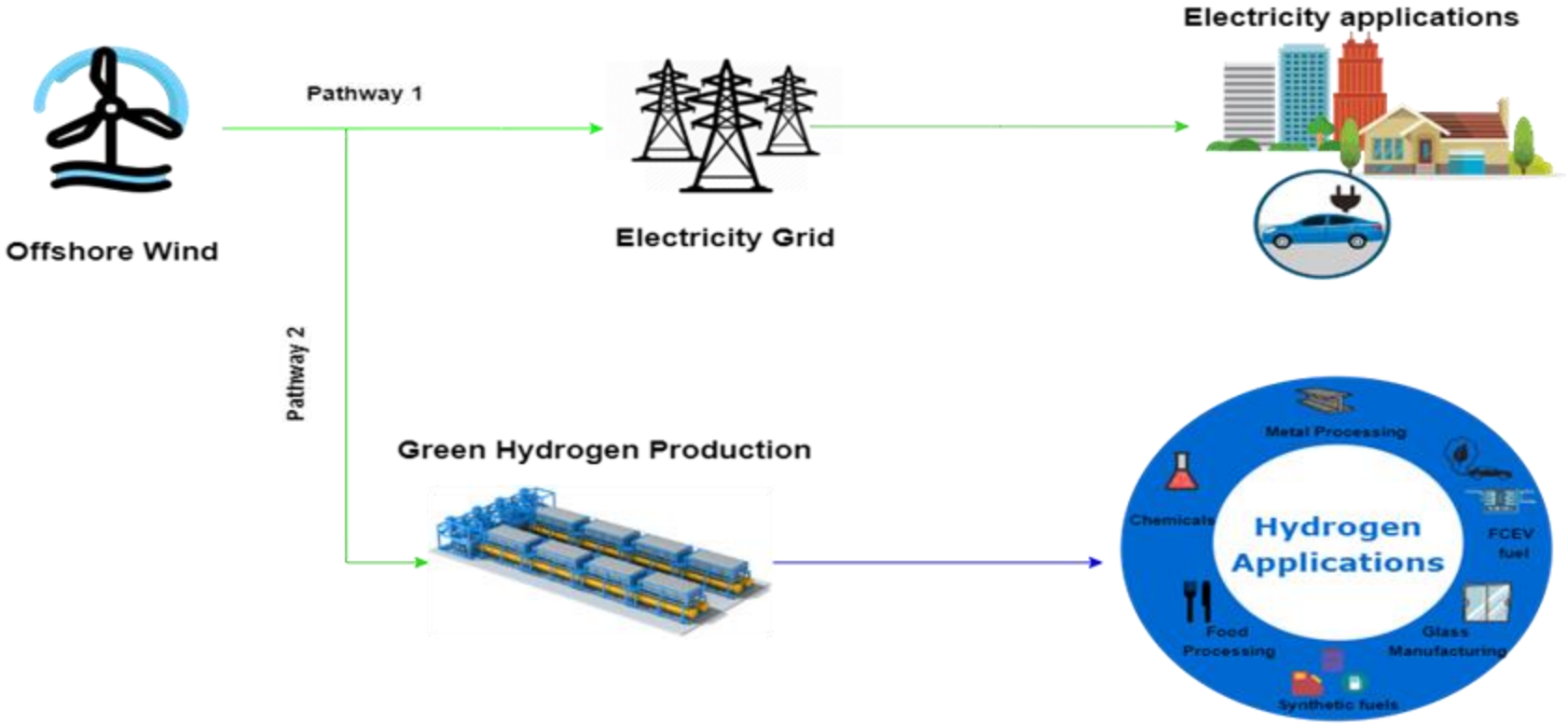
Power-to-Gas: Green H_2 from Electrolysis

- Wind-generated electricity can be converted to **Hydrogen** by electrolysis
- Modern proton-exchange membrane electrolysers are capable of operating under variable conditions at good efficiencies, c. 65%
- Electrolysers are also suitable to provide all grid system services categories



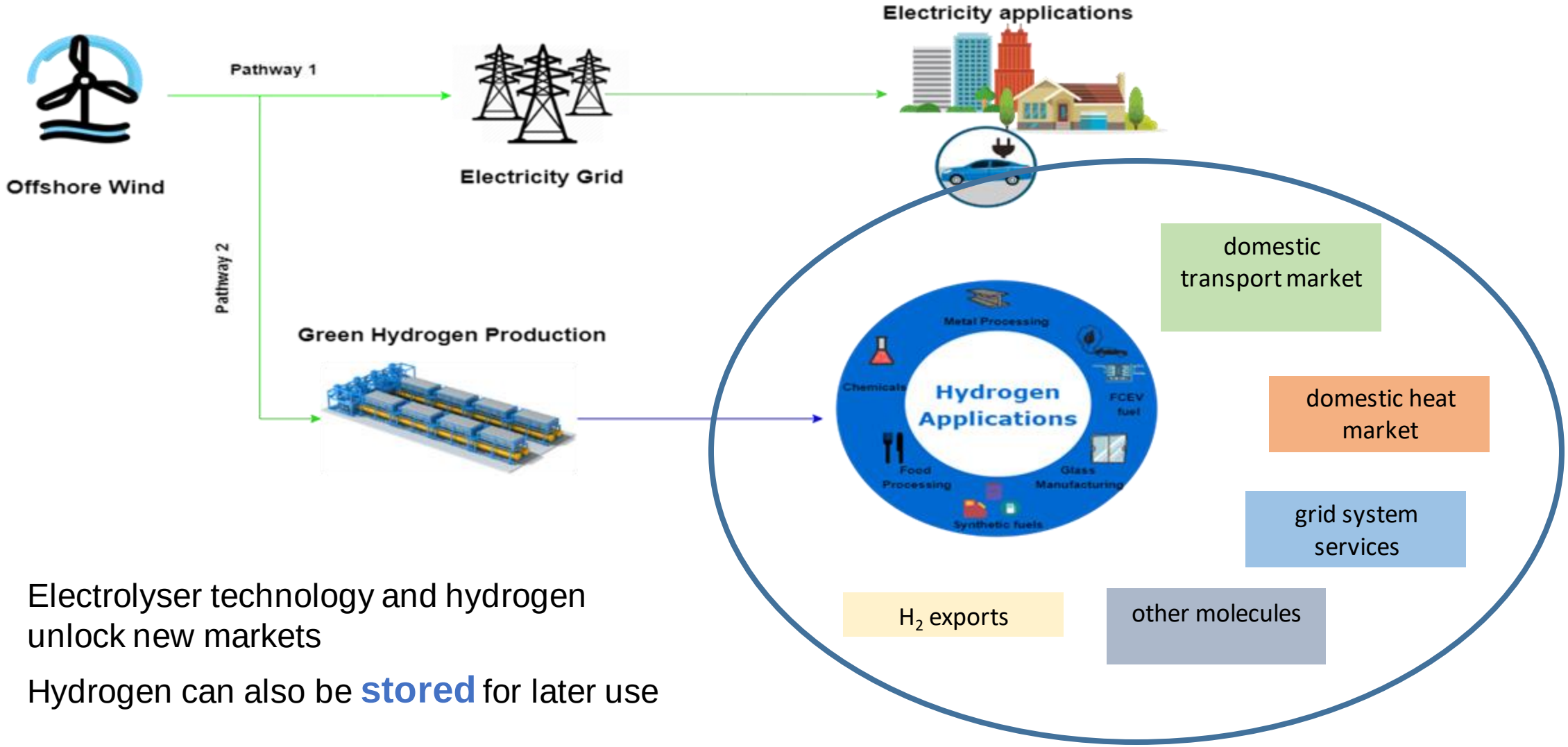
$$2H_2O + energy \rightarrow 2H_2(g) + O_2(g)$$

Coupled Offshore Wind and Hydrogen System



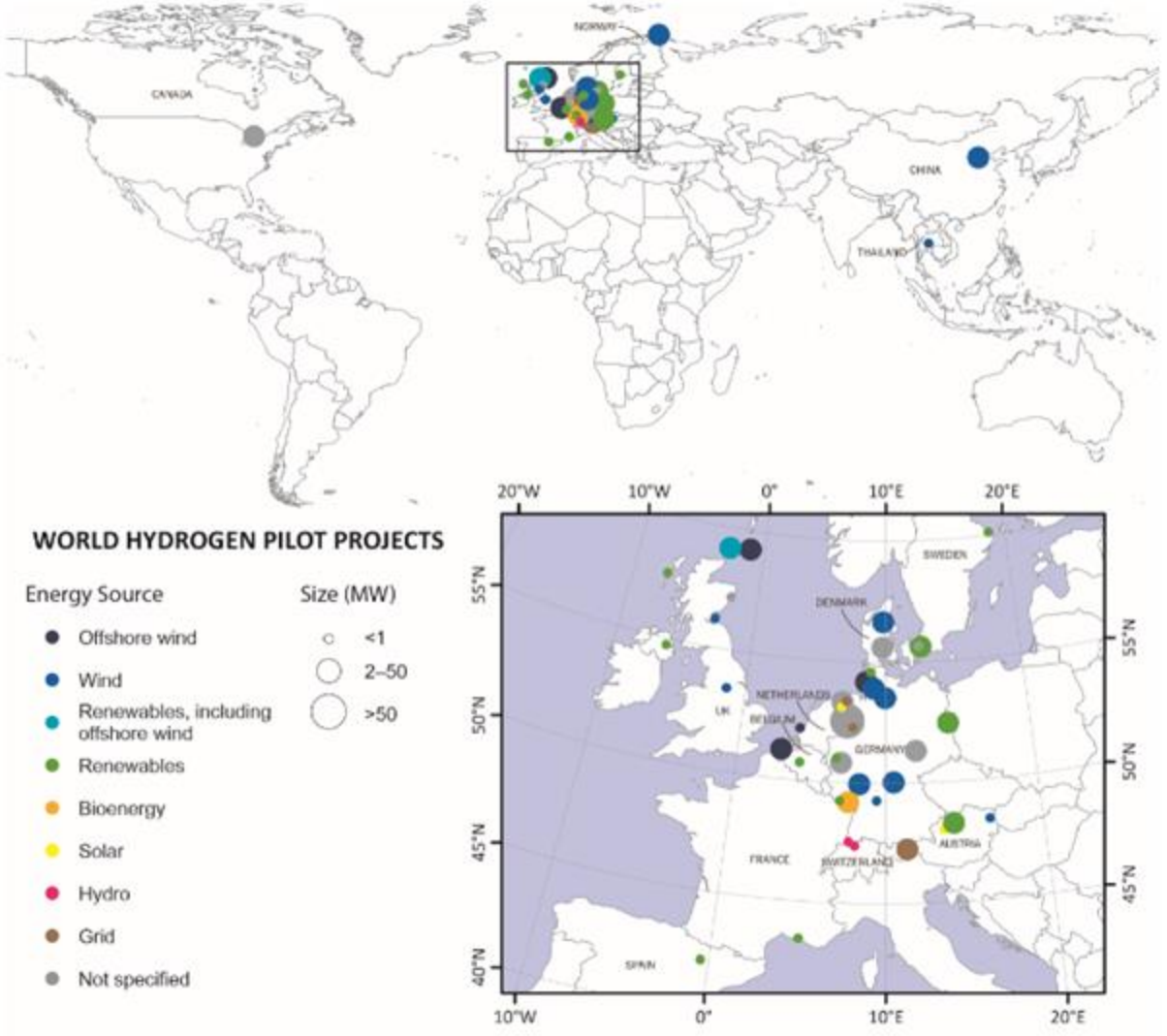
- New investments in technology, infrastructure and storage will be needed to unlock new markets and revenue streams
- We have to move **beyond curtailment** and consider how offshore wind competitiveness can be facilitated by future infrastructural developments

Offshore Wind: Facilitation of New Markets

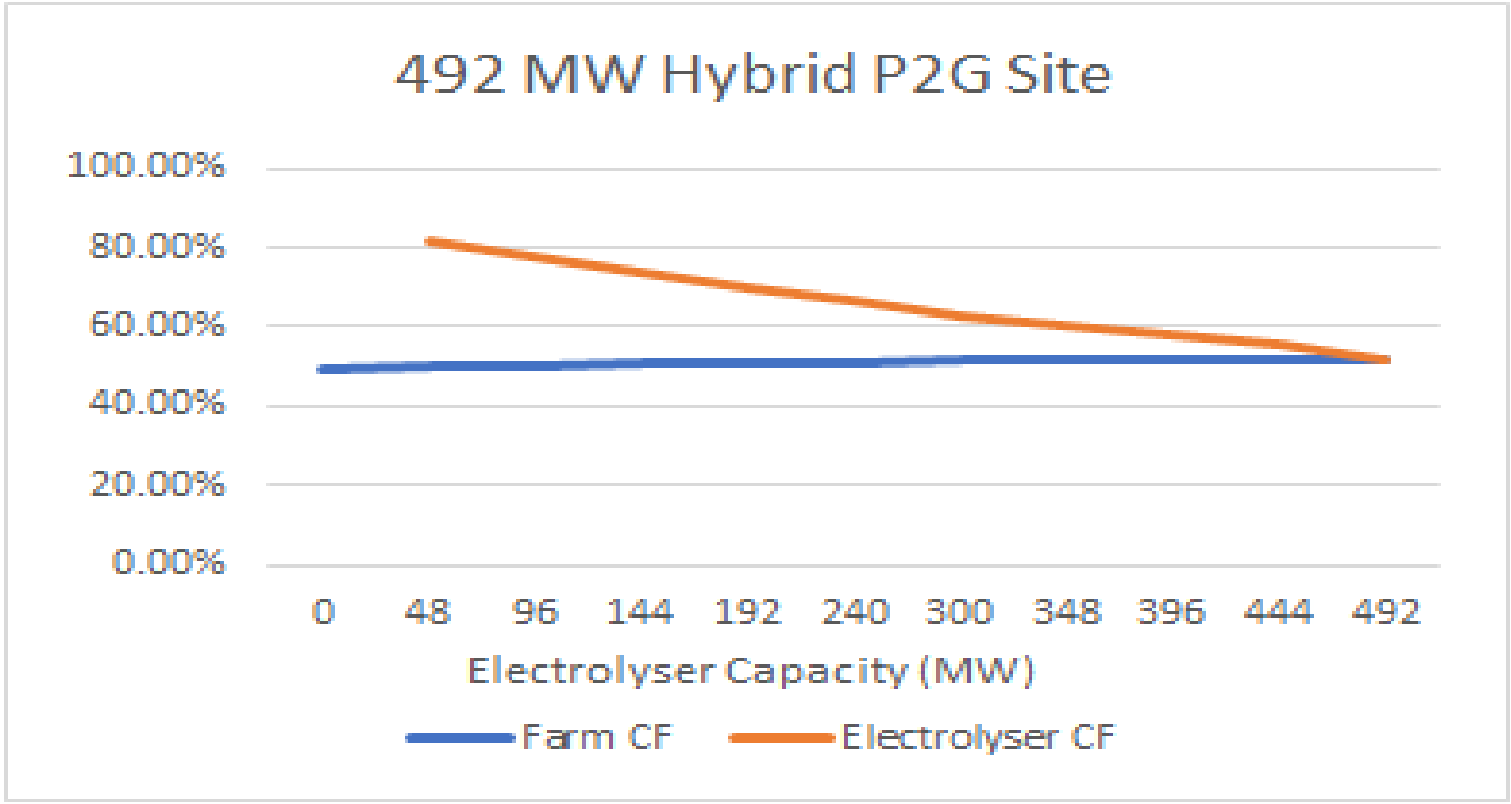


- Electrolyser technology and hydrogen unlock new markets
- Hydrogen can also be **stored** for later use

Pilot/Demonstration Hydrogen Projects Worldwide



Power to Gas Hybrid Site and Excess Production

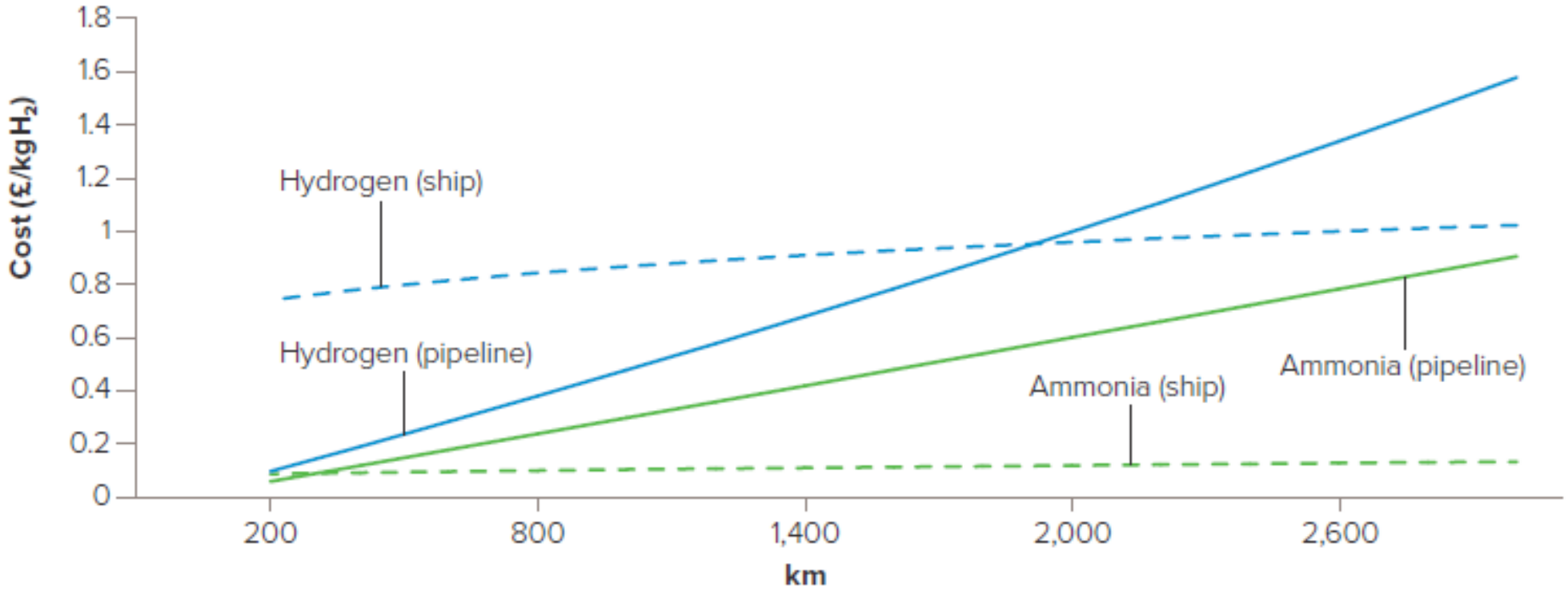


A hybrid wind power to gas (P2G) site can absorb some of the excess production of the windfarm.

But – increasing electrolyser capacity may reduce the electrolyser capacity factor

Offshore hydrogen transmission

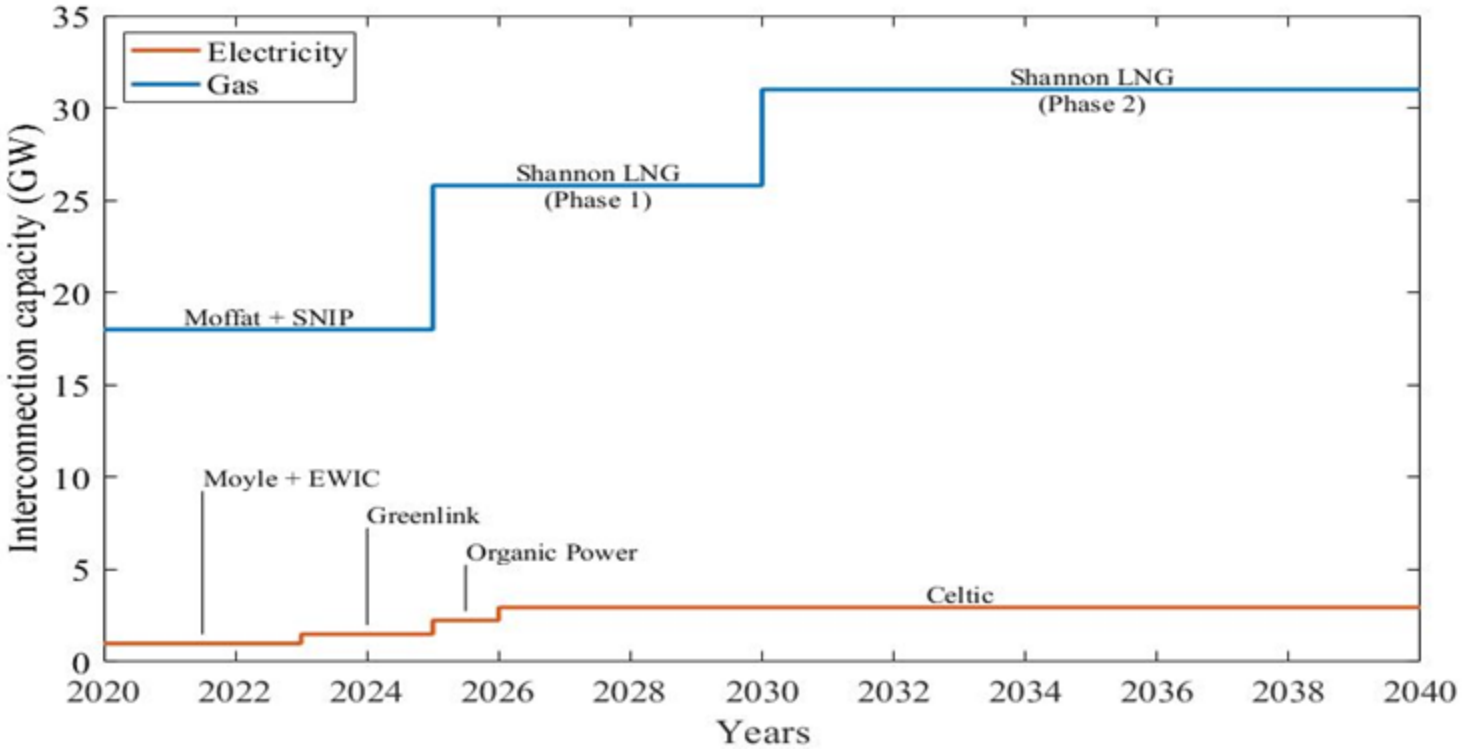
Cost estimates for transport of energy as hydrogen or ammonia by ship and pipeline[35].



Note: Hydrogen transported via pipeline is gaseous and liquefied for shipping. Costs include both the transport and storage required; not the conversion, distribution or reconversion.

https://royalsociety.org/-/media/policy/projects/green-ammonia/green-ammonia-policy-briefing.pdf

Export Markets: Infrastructure



Infrastructure

- Measures to increase blend percentage of H_2 in existing natural gas network are required
- Electrical interconnectors do not always guarantee export markets

Transport Markets

- Roll-out of hydrogen distribution and fuelling stations needs planning and incentives

Services

- Electrolysers will have to demonstrate compliance with grid codes

Technology

- Current projects will reduce uncertainty around offshore performance of hydrogen technology
- Future cost trajectory of electrolysers is downwards, but rate is unknown

Economics

- Levelised cost of hydrogen is key – estimates vary but significant incentives will be required at first to allow green hydrogen to compete with fossil fuels

Thank you

Tractebel / ENGIE offshore hydrogen platform concept

Acknowledgement

This work has been funded by EirWind's 10 industry partners, Science Foundation Ireland (SFI) under Grant No 12/RC/2302, and University College Cork, Ireland

Next presentation: Dr Val Cummins

EirWind Research Synthesis

A Blueprint for Offshore Wind in Ireland

The market opportunity is the critical factor for analysis in the EirWind synthesis

Domestic electricity

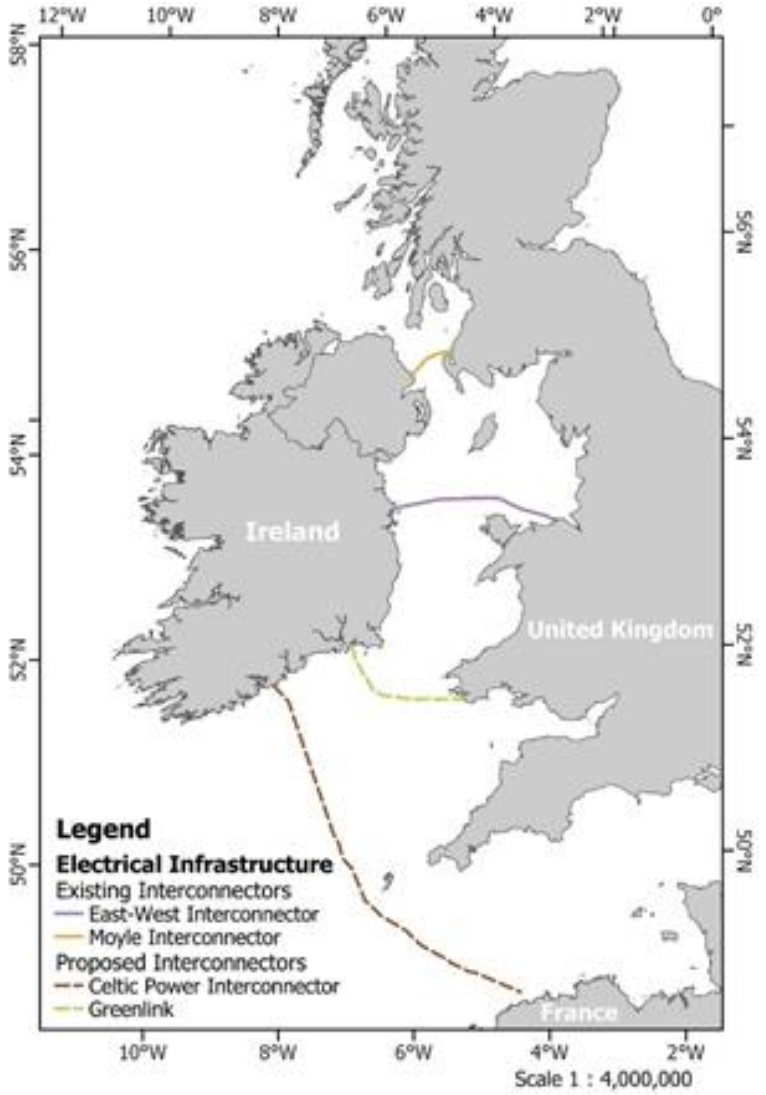
- Strong growth in electricity demand in Ireland inc. data centres (CPPAS) and electric vehicle targets (Eirgrid, 2019)
- Renewable Energy Support Scheme (RESS) – 70% of renewable electricity by 2030 – four auctions from 2020-2027

Electricity export

- Electricity interconnection capacity 2.2GW by 2026

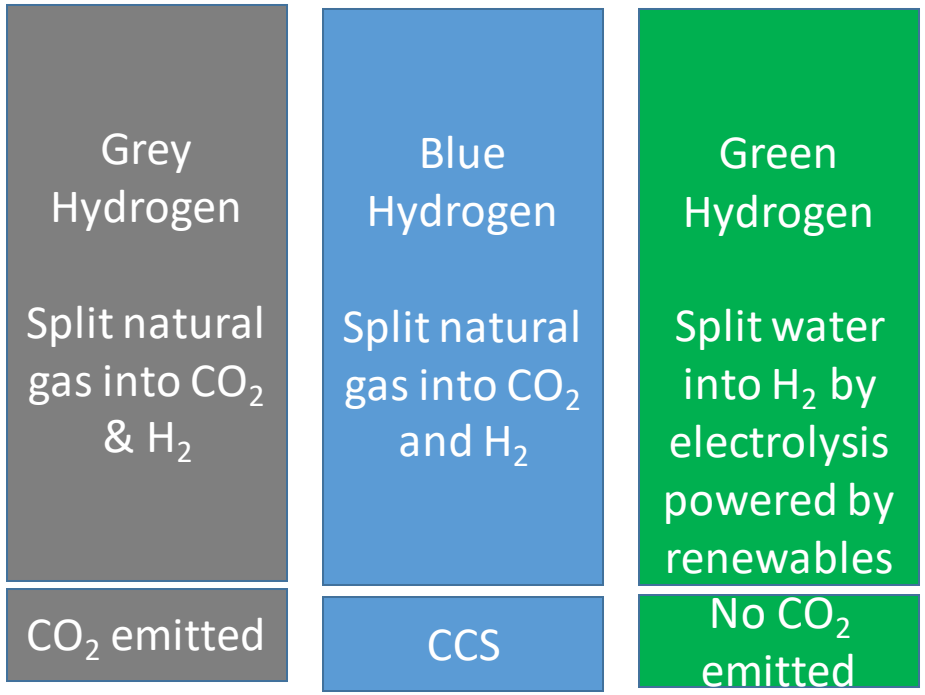
Looking beyond 2030, can the electricity market alone exploit the resource at a scale to maximise the offshore wind opportunity for Ireland?

- A strong argument that electricity is the best vector for energy
- Supergrid early stage technology development
- DCCAE consultation on an options paper on offshore wind (grid) delivery model

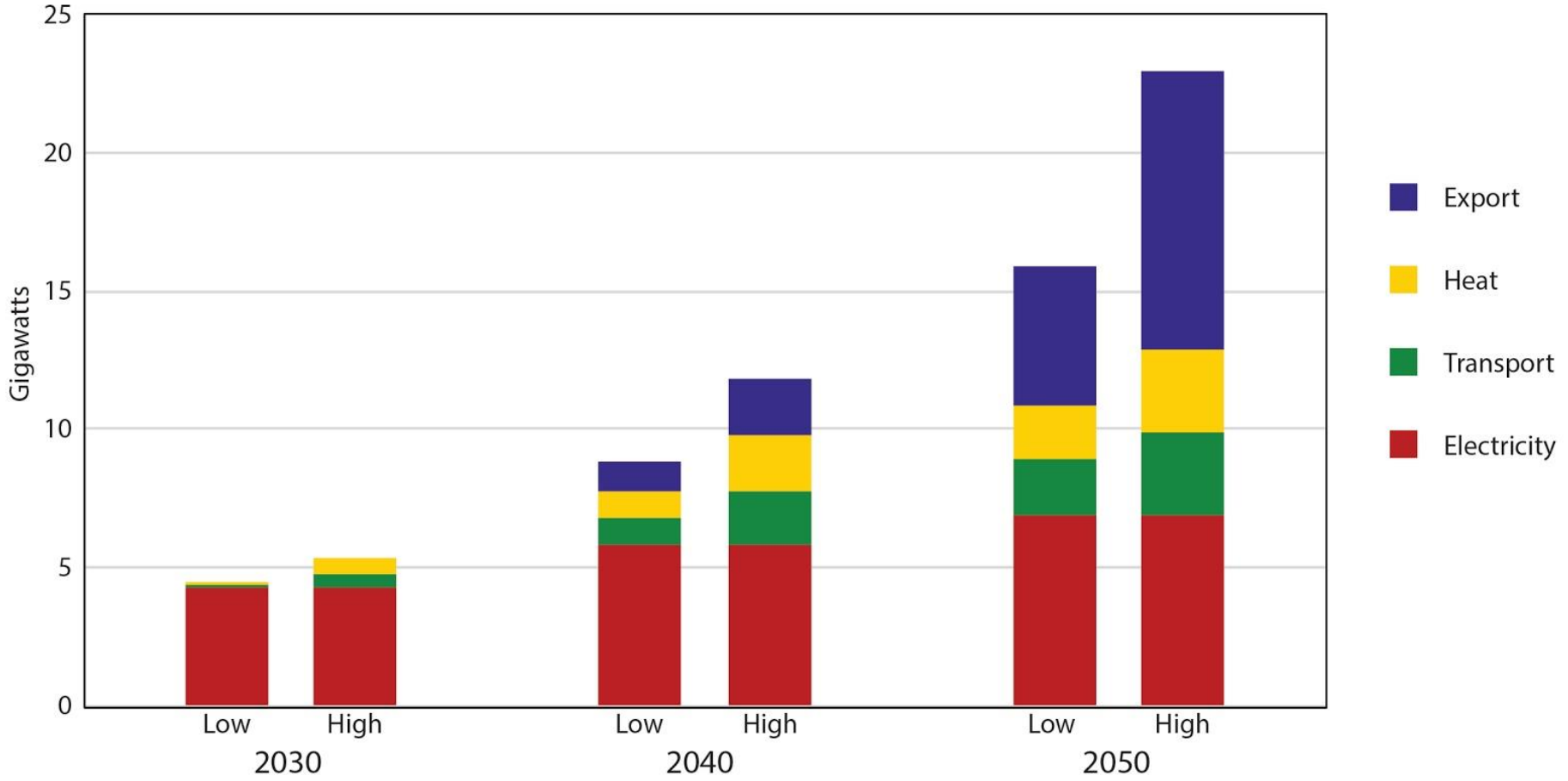


Why Hydrogen?

- More mature innovative technologies
- The cost of producing hydrogen from renewable electricity could fall by 30% by 2030 (IEA, 2019)
- Blue hydrogen opens a door for green hydrogen
- Necessary for at-scale decarbonization of key segments (e.g. fuel cells for transport, gas grid, industrial processes)
- Existing infrastructure, skills and regulations
- Carbon tax will have a critical role in the detailed economic case for Hydrogen replacing oil and gas.

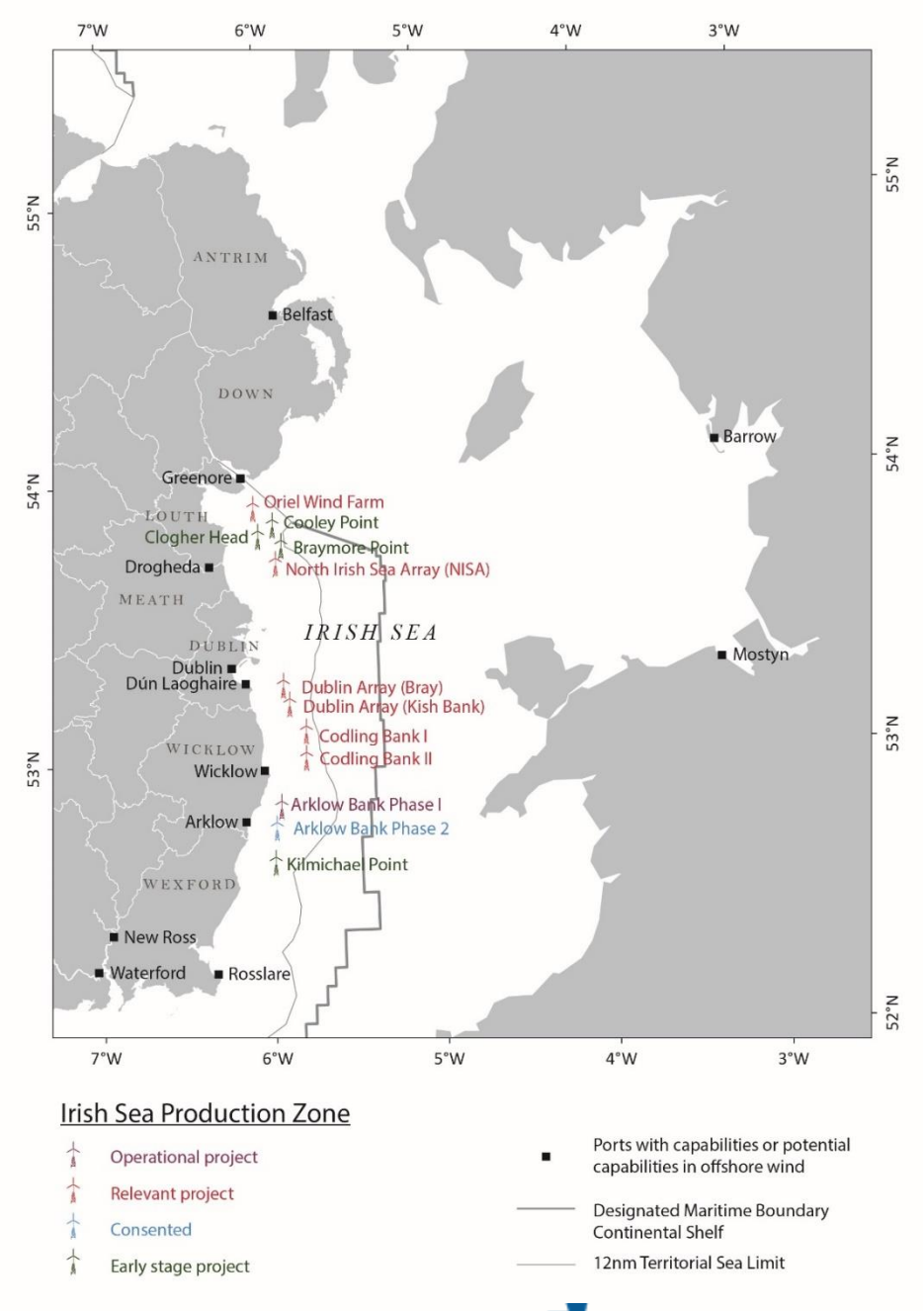


EirWind market targets - high and low scenarios to 2050



Production Zones

Meeting >23GW from three offshore wind production zones



Irish Sea Production Zone

Bottom Fixed -2020-2035

Arklow Phase 2 + Relevant Projects

Climate Action Plan targets 3.5MW by 2030

5GW in the Programme for Government

Circa 5GW to market

LCoE ~€65/MWh* (500MW, 2025)

Circa 89% accessibility

Port Cluster: Rosslare

**Baseline without optimisation*

Celtic Sea Production Zone

Bottom Fixed and Floating

2025-2045

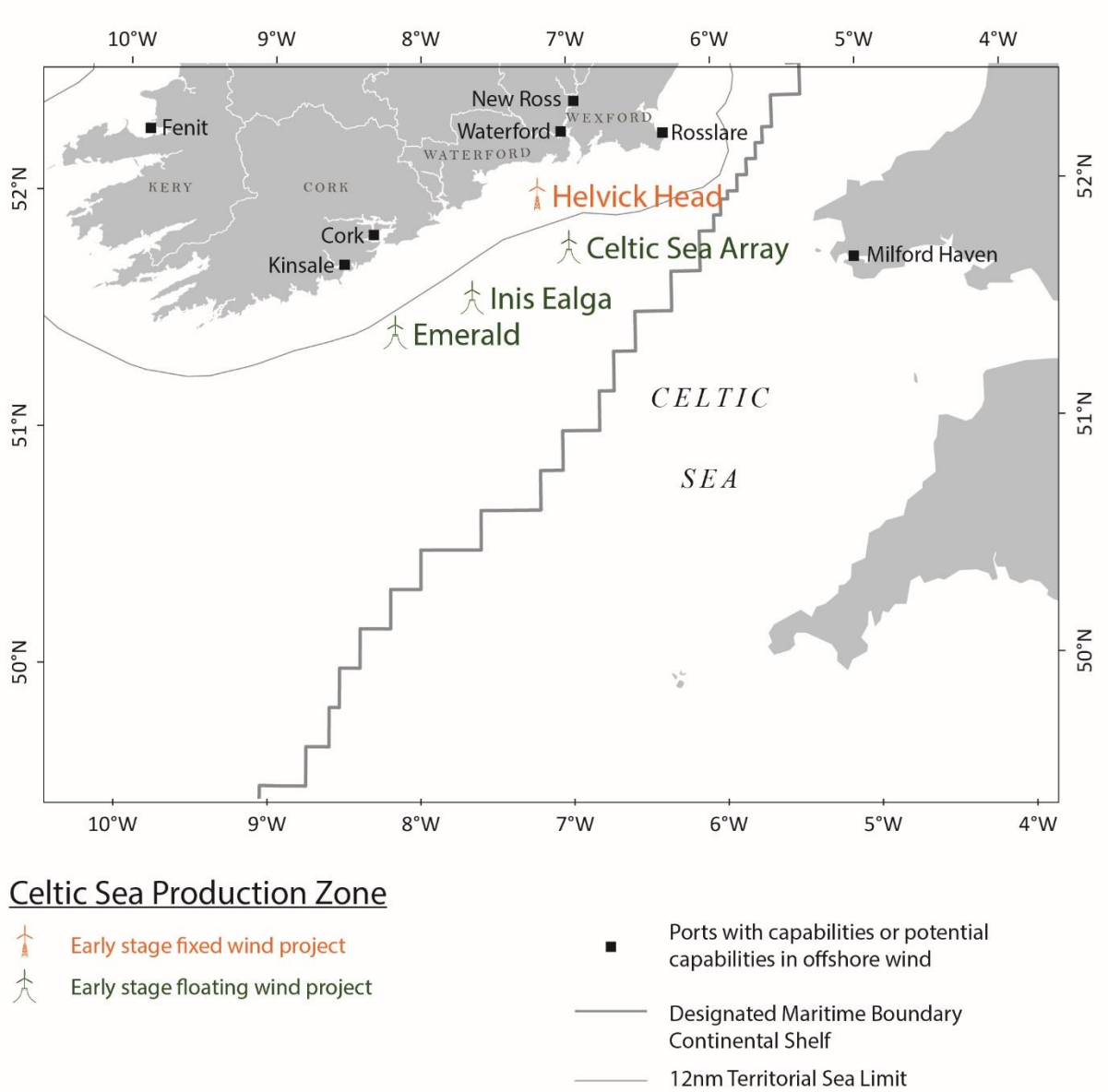
Circa 9GW to market

LCoE ~€74/MWh* (1GW 2035) Floating

Circa 84% accessibility

Route to market imperative

Cork Hydrogen Hub concept (100MW)



Baseline without optimisation

Atlantic Production Zone

Floating Wind plus new technologies (e.g. wave)

2030-2050

Circa 9GW to market

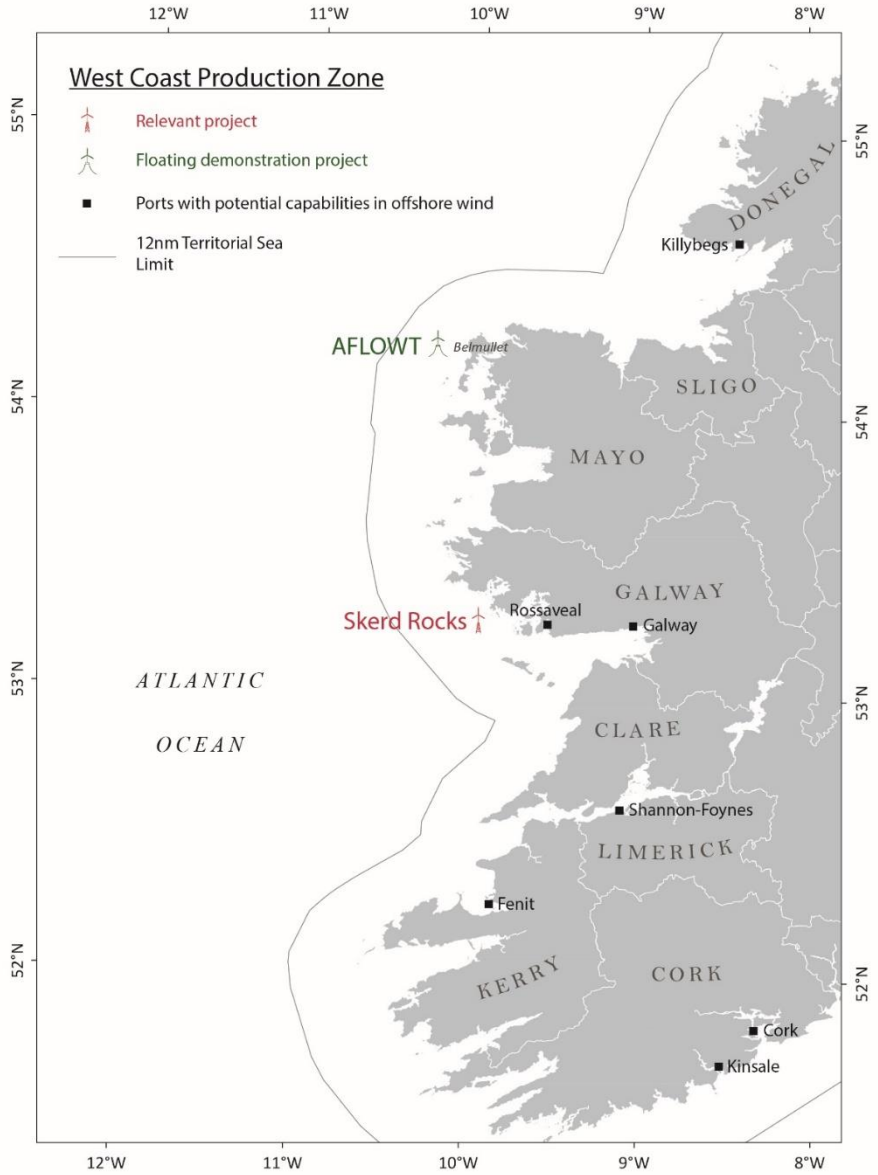
LCoE (~€108/MWh)* 1GW, 2035 Floating

Circa 69% accessibility

Kick starter = strong grid node at Moneypoint

Port cluster: Shannon Foynes Port

Big Prize post 2040 = bulk hydrogen production and distribution at competitive market price



*Baseline without optimisation

Summary of Opportunities and Challenges

Regional Development

Decarbonisation

Community Benefits

€585-€690m in GVA by 2030

Energy Security

Supply Chain

Marine Installation Conservation Areas

8,300-9,700 jobs by 2030

Port Clusters

Centralised v Decentralised Delivery Models

Metocean Conditions

Social Licence to Operate

Data Gaps

Achieving Economies of Scale

Energy Infrastructure Challenges

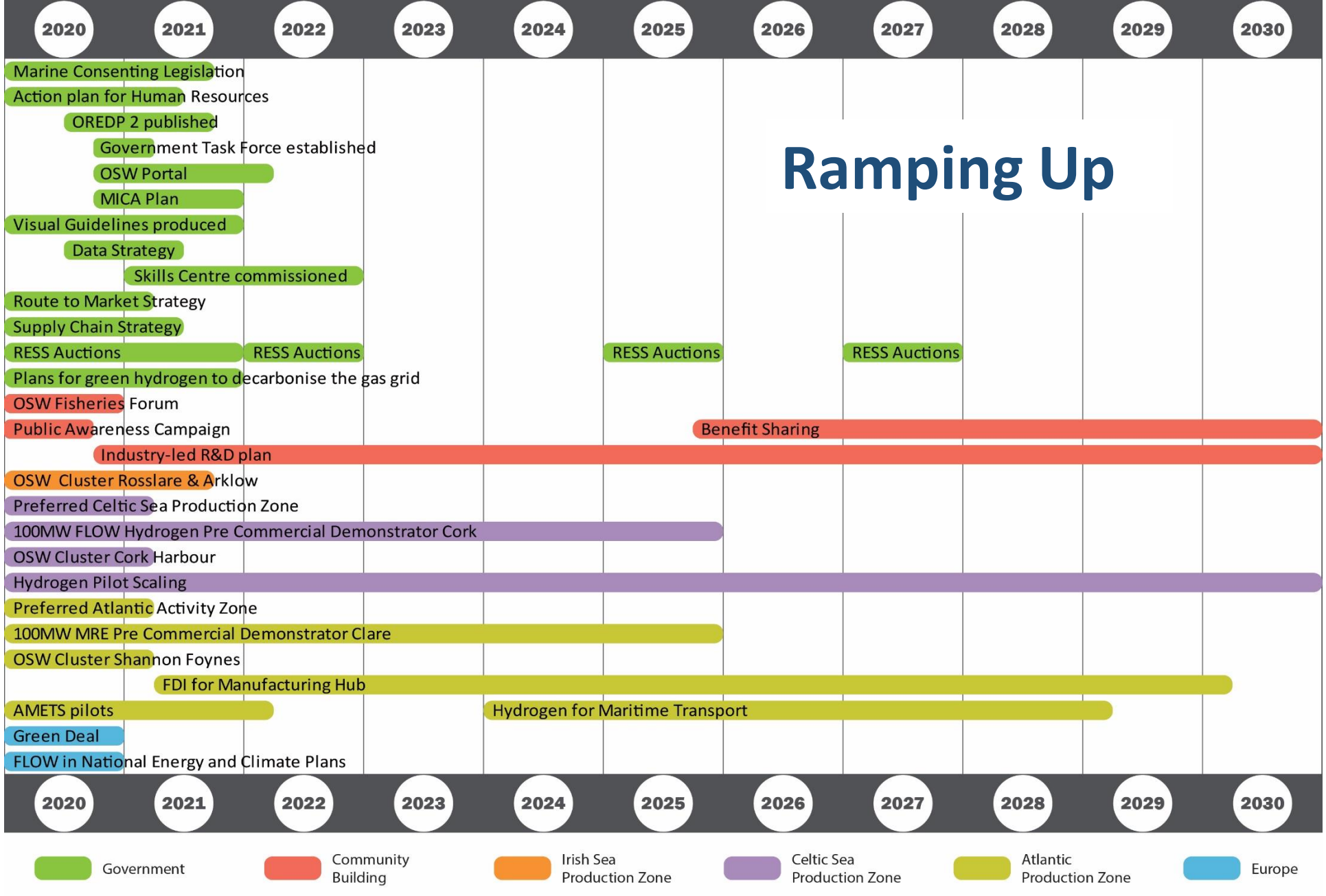
Extra policy makers e.g. DHPLG, DCCAE and more resources for agencies e.g. SEAI

Recommendations for offshore wind in Ireland

Develop a **shared vision** to harness the full potential of Ireland's unmatched offshore wind resource to transform our energy future

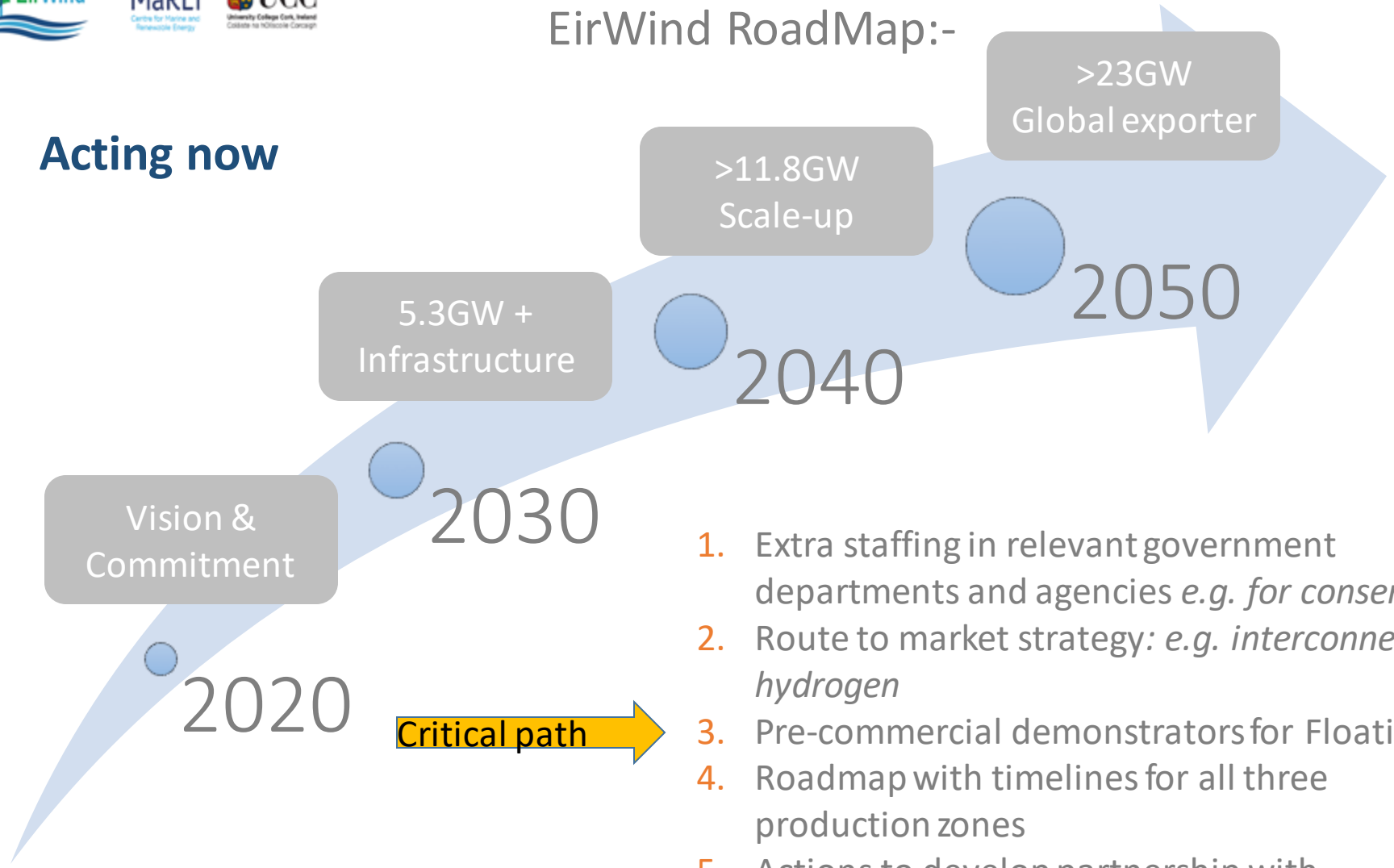
Turbine image source: IEA, 2019

Ramping Up


2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
Marine Consenting Legislation
Action plan for Human Resources
OREDP 2 published
Government Task Force established
OSW Portal
MICA Plan
Visual Guidelines produced
Data Strategy
Skills Centre commissioned
Route to Market Strategy
Supply Chain Strategy
RESS Auctions
RESS Auctions
RESS Auctions
RESS Auctions
Plans for green hydrogen to decarbonise the gas grid
OSW Fisheries Forum
Public Awareness Campaign
Benefit Sharing
Industry-led R&D plan
OSW Cluster Rosslare & Arklow
Preferred Celtic Sea Production Zone
100MW FLOW Hydrogen Pre Commercial Demonstrator Cork
OSW Cluster Cork Harbour
Hydrogen Pilot Scaling
Preferred Atlantic Activity Zone
100MW MRE Pre Commercial Demonstrator Clare
OSW Cluster Shannon Foynes
FDI for Manufacturing Hub
AMETS pilots
Hydrogen for Maritime Transport
Green Deal
FLOW in National Energy and Climate Plans
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
Government
Community Building
Irish Sea Production Zone
Celtic Sea Production Zone
Atlantic Production Zone
Europe

EirWind RoadMap:-

Acting now



1. Extra staffing in relevant government departments and agencies *e.g. for consenting*
2. Route to market strategy*: e.g. interconnectors, hydrogen*
3. Pre-commercial demonstrators for Floating
4. Roadmap with timelines for all three production zones
5. Actions to develop partnership with stakeholders *e.g. fisheries, coastal partnerships*

THANK YOU

To the EirWind research team, consortium and technical advisors

Nguyen Dinh, Michael Sweeney, Yvonne Cronin

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Science Foundation Ireland (SFI) Grant No 12/RC/2302,
and University College Cork, Ireland

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Sam Roch-Perks
Co- Founder and CEO - Simply Blue Energy

Anita H. Holgersen
Business Development Director - Equinor

Martin Finucane
Principal Officer - Dept. Communications, Climate Action and Environment

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Fondúireacht Eolaíochta Éireann sfi Dá bhfuil romhainn

Thank You
For more information:
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