



Ireland's Strategy for Marine Research, Knowledge and Innovation, 2025-2030

Ocean Knowledge 2030 is Ireland's fourth national strategy for Marine Research, Knowledge and Innovation.

As a multi-stakeholder strategic framework, Ocean Knowledge 2030 provides a shared reference point to strengthen coherence across marine research and innovation activities over the period 2025–2030. Ocean Knowledge 2030 recognises the breadth and diversity of organisations operating across the marine system and is intended to support greater connectivity and alignment while respecting the distinct mandates, priorities, and responsibilities of participating bodies.

Ocean Knowledge 2030 was prepared by the Marine Institute in line with its statutory mandate* to coordinate and promote marine research and development, and in collaboration with the **Marine Research Funders' Forum** (MRFF). Acknowledgement and thanks are extended to the MRFF members and other organisations who contributed to the development of Ocean Knowledge 2030, including:



Bord Iascaigh Mhara	Inland Fisheries Ireland
Commissioners of Irish Lights	InterTradeIreland
Department of Agriculture, Food and the Marine	Irish Naval Service
Department of Climate, Energy and the Environment	Irish Maritime Development Office
Department of Defence	Knowledge Transfer Ireland
Department of Enterprise, Tourism and Employment	Maritime Area Regulatory Authority
Department of Foreign Affairs and Trade	Met Éireann
Department of Further and Higher Education, Research, Innovation and Science	National Biodiversity Data Centre
Department of Housing, Local Government and Heritage	National Maritime College of Ireland
Department of Transport	National Monuments Service
Enterprise Ireland	National Parks and Wildlife Service
Environmental Protection Agency	Northern & Western Regional Assembly
Fáilte Ireland	Research Ireland
Geological Survey Ireland	Southern Regional Assembly
Higher Education Authority	Sustainable Energy Authority of Ireland
	Teagasc
	Údarás na Gaeltachta
	Western Development Commission

The contributions of all individuals and organisations who participated in the public consultation process are also gratefully acknowledged.

* 'to undertake, to co-ordinate, to promote and to assist in marine research and development and to provide such services related to marine research and development, that in the opinion of the Institute will promote economic development and create employment and protect the marine environment' (Marine Institute Act 1991).



CONTENTS

EXECUTIVE SUMMARY	03
1. INTRODUCTION	06
1.1 Context and Setting	06
1.2 Ocean Knowledge 2030 Vision and Objectives	08
1.3 About this Document	08
2. LIVING WITH A CHANGING OCEAN	12
2.1 The Ocean-Climate Nexus: Ocean Physics and Chemistry	12
2.2 Marine Geology, Seafloor and Coastal Change	16
2.3 Marine Biodiversity and Ecosystem Functioning	18
2.4 Offshore and Maritime Cultural Heritage	20
2.5 Ocean Governance and Law	22
2.6 The Ocean's Benefit and Service to Society	26
3. TOWARDS A SUSTAINABLE OCEAN ECONOMY	29
3.1 Sustainable Food from the Ocean	31
3.2 Energy from the Ocean	35
3.3 Greener and Smarter Ports and Shipping	41
3.4 Tourism in Coastal and Marine Areas	44
3.5 Safe and Secure Seas	48
4. ENABLERS FOR OCEAN KNOWLEDGE	53
4.1 Training, Talent and Expertise	54
4.2 Marine Research Infrastructures	57
4.3 Data and Digitalisation	59
4.4 Partnerships, Networks and Connectivity	62
4.5 Research-Industry Collaboration	64
4.6 Funding and Investment	67
5. OPTIMISING IMPLEMENTATION AND IMPACT	71
APPENDIX A	75

GLOSSARY OF ACRONYMS

ABP: An Bord Pleanála

BIM: Bord Iascaigh Mhara

CARO: Climate Action Regional Office

CSO: Central Statistics Office

DAFM: Department of Agriculture, Food and the Marine

DCEE: Department of Climate, Energy and the Environment

DETE: Department of Enterprise, Tourism and Employment

DFAT: Department of Foreign Affairs and Trade

DHLGH: Department of Housing, Local Government and Heritage

DoD: Department of Defence

DoT: Department of Transport

DPEIPSRD: Department of Public Expenditure, Infrastructure, Public Service Reform and Digitalisation

EI: Enterprise Ireland

EPA: Environmental Protection Agency

FI: Fáilte Ireland

GSI: Geological Survey Ireland

ICES: International Council for the Exploration of the Sea

IFI: Inland Fisheries Ireland

IL: Irish Lights

IMDO: Irish Maritime Development Office (Marine Institute)

INS: Irish Naval Service

INSS: Irish National Seabed Survey

IODP: International Ocean Discovery Programme (ocean drilling)

JPI Oceans: Joint Programming Initiative on Healthy and Productive Seas and Oceans

LGMA: Local Government Management Agency

MARA: Maritime Area Regulatory Authority

MaREI: Research Ireland Centre for Energy, Climate and Marine

MÉ: Met Éireann

MI: Marine Institute

MIIN: Marine Ireland Industry Network

MRFF: Marine Research Funders' Forum

MSO: Marine Survey Office

NBDC: National Biodiversity Data Centre

NMS: National Monuments Service

NPWS: National Parks and Wildlife Service

RKI: Research, Knowledge and Innovation

OECD: Organisation for Economic Co-operation and Development

ORE: Offshore Renewable Energy

PPWs: Potentially Polluting Wrecks

SEAI: Sustainable Energy Authority of Ireland

TRL: Technology Readiness Level

UCH: Underwater Cultural Heritage

UnG: Údarás na Gaeltachta

UG: University of Galway

WIID: Wreck Inventory of Ireland Database

EXECUTIVE SUMMARY

The period up to 2030 is a critical time for Ireland as an ocean state with a large maritime area. Ambitious climate targets linked to the planned expansion of Offshore Renewable Energy puts us on a pathway towards a major transformation in how we use our ocean space. Recent and forthcoming national and EU legislation in respect of marine spatial planning, marine protected areas, biodiversity protection and nature restoration will also have major implications for the use and protection of marine space and ecosystems.



At the same time, climate change and the effects of greenhouse gas emissions are resulting in warming seas, rising sea levels, altered ocean chemistry, increasingly frequent extreme weather events and changing biodiversity and ecosystems. Robust data, knowledge and expertise are essential to navigate these environmental, sectoral, policy and legislative pressures and their societal and economic impacts, and to deliver effective policy and management decisions.

Ocean Knowledge 2030 is Ireland's marine research, knowledge and innovation strategy for the period 2025-2030. The strategy identifies some of the most critical marine scientific and societal challenges that Ireland is facing and also the enormous opportunities presented by our extensive maritime domain and its rich resources. It also documents the existing, recent or forthcoming legislation and policy developments, whether at national or EU level, that will require a knowledge-based response and the associated questions that should be the focus of our research programming and investments over the coming six years.

Ocean Knowledge 2030 Vision:

Marine research, knowledge and innovation play a pivotal role in accelerating the transition to a sustainable and climate-neutral blue economy, maintaining a healthy marine environment, and fostering a society that positively coexists with the ocean.

High-level Objectives:

1. Guide, align and coordinate research and innovation investments in line with national, EU and international strategic priorities.
2. Ensure marine and maritime research, knowledge and innovation deliver maximum impact and value to users and stakeholders, while prioritising ocean health and sustainability as foundational principles.
3. Help realise the Impact 2030 action to ‘position Ireland as a leader for marine research and technology’.

Ocean Knowledge 2030 is structured to address firstly the research and knowledge needed to better understand the natural coastal, marine and oceanic environment that surrounds Ireland. It reflects the increasing need to understand how this important environment is being impacted by climate change and human activities and how we can inform and evolve our response to these changes (Chapter 2 – Living with a Changing Ocean). Chapter 3 focuses on Ireland’s ocean economy and identifies the research, knowledge and innovation needs to support economic development and sustainability across five key ocean economy sectoral areas. Chapter 4 looks at the elements of the research, knowledge and innovation system that are key ‘enablers’ to ensure we can progress all aspects of the strategy, addressing systemic aspects such as human capacities, research infrastructures, data, partnerships, funding and research-industry collaboration. Chapter 5 provides an overview of the structures and processes that will be utilised to underpin and monitor the implementation and impact of the strategy, which will be key to measure progress and optimise decision-making and success.

The development of Ocean Knowledge 2030 is the result of a comprehensive and collaborative process that engaged a wide range of stakeholders across the marine research and innovation ecosystem. It has been shaped through extensive consultations with government departments and agencies, researchers, industry, environmental organisations, and the public, while ensuring alignment with national and EU priorities such as those set out in the National Research and Innovation Strategy, Impact 2030. The resulting document is a national strategic framework with 51 actions that will be progressed during the initial two years of the strategy cycle and reviewed/updated with the input of key stakeholders.

Looking ahead to 2030, it is essential that Ireland has access to knowledge, evidence and expertise to address complex and interconnected challenges related to the sustainable management of our oceans and coasts and the development of a sustainable ocean economy. This strategy is central to advancing this national imperative.



1. INTRODUCTION

1.1 Context and Setting

The United Nations has designated the period from 2021 to 2030 as the Decade of Ocean Science for Sustainable Development. This reflects a global acceptance that a healthy and productive ocean is critical for planetary health, and for human health and well-being. Moreover, the Decade recognises the important role of science and knowledge in helping us to achieve “the ocean we need for the future we want”.



This decade is also a critical time for Ireland as an ocean state with a large maritime area. We are on a pathway towards the largest transformation in how we use our ocean space in the history of the State. Ambitious national climate and energy targets require a major transition to renewable sources of energy. A national target of 5GW of installed offshore wind energy in the near-term requires the substantial accommodation of wind farm developments within our maritime area. This will impact on the environment and ecosystems in the vicinity of these developments but also on other established maritime sectors such as seafood production (fisheries and aquaculture), port activities and shipping.

Recent and forthcoming national and EU legislation in respect of marine spatial planning, biodiversity protection and nature restoration will also have major implications for the use and protection of marine space and ecosystems. At the same time, climate change and the effects of greenhouse gas emissions are resulting in warming seas, rising sea levels, altered ocean chemistry, increasingly frequent extreme weather events and changing biodiversity and ecosystems.

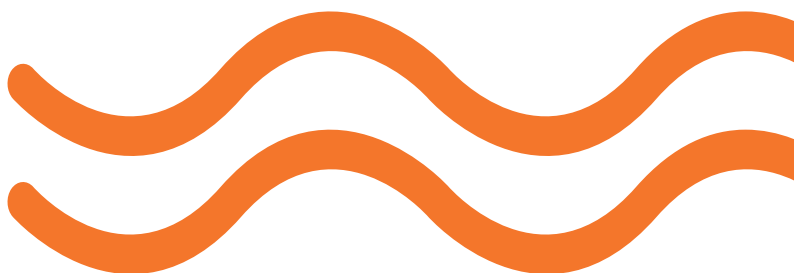
Robust data, knowledge and expertise are essential to navigate these environmental, sectoral, policy and legislative pressures and their societal and economic impacts, and to deliver effective policy and management decisions.

The COVID-19 pandemic demonstrated the critical importance of having the necessary national capacity and knowledge base to address a generational societal challenge. While COVID represented an acute situation and required a rapid mobilisation, it was the establishment of expertise and a robust research base over many preceding years that enabled government policy decisions and actions to be informed by the best available scientific knowledge and advice.

The same principle applies to the management of our vast ocean territory and resources. **The National Marine Research & Innovation Strategy 2017-2021** provided a framework to guide policy-oriented marine and maritime research to optimise the beneficial impact of research and knowledge investments nationally. The building of national capacity across fifteen thematic areas was the central goal of the strategy, which used a 'Research Capability Maturity Model' to define and measure national capability by theme in relation to human capacity, infrastructures and networks.

There has been significant investment in Ireland's marine research and innovation sector over the past three decades. This has not only built considerable capacity and expertise in a wide range of marine and ocean topics, but it has also delivered national infrastructures such as laboratories, research vessels and the world leading, open-access marine maps and databases delivered and maintained by the Marine Institute and Geological Survey Ireland.

Looking ahead to 2030, a further increase in capacity and coordination is required to ensure Ireland has access to knowledge, evidence and expertise to address complex and interconnected challenges related to the sustainable management of our oceans and coasts and the development of a sustainable ocean economy. This strategy is central to advancing these national imperatives.



1.2 Ocean Knowledge 2030 Vision and Objectives

Vision:

Marine research, knowledge and innovation play a pivotal role in accelerating the transition to a sustainable and climate-neutral blue economy, maintaining a healthy marine environment, and fostering a society that positively coexists with the ocean.

High-level Objectives:

1. Guide, align and coordinate research and innovation investments in line with national, EU and international strategic priorities.
2. Ensure marine and maritime research, knowledge and innovation deliver maximum impact and value to users and stakeholders, while prioritising ocean health and sustainability as foundational principles.
3. Help realise the Impact 2030 action to ‘position Ireland as a leader for marine research and technology’.

1.3 About this Document

Ocean Knowledge 2030 is Ireland’s marine research, knowledge and innovation strategy for the period 2025-2030. The strategy has been developed under the coordination of the Marine Institute, in line with its mandate ‘*to co-ordinate, to promote and to assist in marine research and development*¹’. As a national strategic framework, it has been created in partnership with - and is collectively owned by - the multiple government departments, state agencies and other stakeholder bodies that set, inform or implement marine policy and associated policy domains (e.g. environment, economic development, energy, food, natural and cultural heritage, etc.) and/or fund, coordinate and manage marine-related research and innovation.

The strategy identifies some of the most critical marine scientific and societal challenges that Ireland is facing and the enormous opportunities presented by our extensive maritime domain and its rich resources. It also documents the existing, recent or forthcoming legislation and policy developments, whether at national or EU level, that will require a knowledge-based response and the associated questions that should be the focus of our research programming and investments over the coming six years.

¹ Marine Institute Act, 1991

Ocean Knowledge 2030 is a sectoral implementation mechanism that aligns directly with the national research and innovation strategy, **Impact 2030**. It will help to coordinate the actions and investments needed to realise the Impact 2030 action to '*position Ireland as a leader for marine research and technology*'. It also aligns and integrates with a broader suite of sectoral and research and innovation strategies and policies at both national and EU level. It presents a set of targeted actions with associated implementing actors to be advanced over the first two years of the strategy cycle (2025-2026).

Successful implementation of Ocean Knowledge 2030 does not require or depend upon new or additional funding commitments from government. Rather it presents a framework and suite of actions designed to align and target existing funding streams at areas of identified strategic importance. In this way the strategy is a framework to enable a high degree of coordination across the system, reducing duplication and fragmentation, and enabling synergy and cooperation in marine research programming and funding. The focus on impact is also key to ensure that research and innovation investments are delivering knowledge outcomes that result in positive benefits to policy makers, industry, the research community and wider society.

A key implementing mechanism for the strategy is the **Marine Research Funders' Forum**, a forum of government departments, agencies, funders and stakeholders that was established in 2018 under the previous strategy, the **National Marine Research & Innovation Strategy 2017-2021**. A review on the effectiveness and impact of that strategy² was a key starting point to guide the development of Ocean Knowledge 2030. The Marine Research Funders' Forum (MRFF) has played a key role in steering the new strategy and will be an important structure to guide and mobilise action on its implementation.

A national database of marine research investments established in 2020 with data provided routinely by the MRFF partners, is also a key tool to inform research and innovation programming, coordination and investment across the research system.

Ocean Knowledge 2030 is structured to address firstly the research and knowledge needed to better understand the natural coastal, marine and oceanic environment that surrounds Ireland. It reflects the increasing need to understand how this important environment is being impacted by climate change and human activities and how we can inform and evolve our response to these changes (Chapter 2 – Living with a Changing Ocean). Chapter 3 focuses on Ireland's ocean economy and identifies the research, knowledge and innovation needs to support economic development and sustainability across five key ocean economy sectoral areas. Chapter 4 looks at the elements of the research, knowledge and innovation system that are key 'enablers' to ensure we can progress all aspects of the strategy, addressing systemic aspects such as human capacities, research infrastructures, data, partnerships, funding and research-industry collaboration. Chapter 5 provides an overview of the structures and processes that will be utilised to underpin and monitor the implementation and impact of the strategy, which will be key to measure progress and optimise decision-making and success.

² Indecon International Economic Consultants, (2021). **Interim Review of the National Marine Research & Innovation Strategy 2017-2021**, Marine Institute, Ireland

To remain relevant, Ocean Knowledge 2030 will be adaptable in its implementation and aligned with evolving governmental priorities and economic governance framework. Within its implementation framework, priorities, actions and KPIs will be regularly assessed and adjusted to ensure alignment with policy, economic, technological, environmental, and other developments. This implementation approach, coupled with open communication and a commitment to shared goals, will optimise the strategy's impact and allow it to flexibly support new government initiatives, keeping Ocean Knowledge 2030 both resilient and responsive.

Throughout the strategy the term 'research, knowledge and innovation', sometimes abbreviated to 'RKI', is used to encompass the breadth of scope of many of the identified gaps, challenges and proposed actions. 'Research' focuses on the generation of new knowledge through original investigation utilising systematic experimental or empirical methodology, while 'innovation' refers to the application of such knowledge to deliver new solutions, products, or services to real-life challenges, whether in a commercial setting or supporting outcomes in the public interest. 'Knowledge' is included to take account of the enormous bank of existing knowledge that already exists within the system, whether in research or technical publications and reports, or in the expertise of researchers in our academic institutions and public research bodies. As the title suggests, Ocean Knowledge 2030 is about applying knowledge, whether new or existing, to advance Ireland's ambitions in developing a productive and sustainable ocean economy, and in safeguarding and managing our extensive maritime area and marine resources.

End-users, beneficiaries and stakeholders of this strategy include, but are not limited to:

- Government and policy makers who rely on marine data and knowledge for evidence-based decision making and developing policies related to climate action, environmental protection, resource management, and economic development.
- Industry actors, including those in offshore renewable energy, fisheries, aquaculture, and shipping, who use, produce and/or depend upon innovations to enhance sustainability, competitiveness, and economic performance.
- Research and academic institutions who contribute to advancing scientific knowledge and fostering innovation that drives real-world solutions.
- Coastal communities and the public (citizens) who benefit from a healthy marine environment, climate resilience measures, and the long-term sustainability of Ireland's blue economy.
- NGOs and conservation groups who are focused on marine biodiversity and environmental stewardship.

These stakeholders will continue to be engaged throughout the strategy's implementation to ensure that marine research, knowledge and innovation translate into tangible outcomes that align with their needs, deliver public benefit, and support Ireland's climate resilience and sustainability objectives.

The guiding principles for the implementation of the strategy will include:

- Maintaining sustainability and stewardship of marine resources;
- Pursuing scientific excellence and innovation;
- Informing and enabling evidence-based decision making;
- Growing collaboration and partnerships;
- Enhancing stakeholder engagement;
- Fostering climate action and resilience;
- Safeguarding public good and societal impact.





2. LIVING WITH A CHANGING OCEAN

2.1 The Ocean-Climate Nexus: Ocean Physics and Chemistry

The seas and oceans that surround Ireland are part of a global ocean that covers 71% of the earth's surface and is changing on human timescales. Ocean processes, ecosystems and biodiversity are being impacted by human activities and human-induced climate change, most notably the continuing emissions of greenhouse gases (GHG) into the atmosphere. By absorbing more than a quarter of human-generated Carbon Dioxide (CO₂) and about 90% of the heat generated by the effect of greenhouse gases, the ocean has limited the warming of the planet and provided a buffer against the impacts of climate change. But this has come with consequences.



³ IPCC, 2019: Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, et al (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3–35. <https://doi.org/10.1017/9781009157964.001>.

⁴ A sea of change: Europe's future in the Atlantic realm (2021). Report of the European Academies Science Advisory Council (EASAC).

⁵ Nolan, G., Cusack, C., Fitzhenry, D. (Eds.) (2023). Irish Ocean Climate and Ecosystem Status Report. Marine Institute, Galway, Ireland, pp 192.

⁶ Thorne, P. et al, 2023, Ireland's Climate Change Assessment: Synthesis Report. Environmental Protection Agency, Ireland, 36 pp

Since 1993 the rate of ocean warming has more than doubled while marine heatwaves have doubled in frequency since the early 1980s and are increasing in intensity. Global sea level has risen by 0.2m since 1900 and the rate of global sea-level rise is accelerating³. The ocean has undergone increased acidification while ocean deoxygenation is becoming more widespread.

Several studies have suggested that the Atlantic Meridional Overturning Circulation (AMOC), a system of ocean currents, including the Gulf Stream, that transports warm, shallow water northwards and returns cold deep water to the south, has weakened in recent decades. However, this is not yet confirmed as a trend, nor has a similar weakening been observed in the Gulf Stream. Neither is it yet clear how to distinguish any trends from underlying inter-annual to decadal variability. Nevertheless, a weakening of around 20% in the AMOC is expected by the end of this century and collapse remains a possibility in the longer term beyond 2100⁴, with profound implications for Europe's climate.

The Arctic plays a critical role in the stability of the AMOC, as freshwater input from melting sea ice, glaciers, and permafrost can dilute salinity and disrupt the thermohaline processes driving this circulation. Collaborative research on Arctic processes and their influence on ocean physics and chemistry, including monitoring freshwater fluxes and salinity changes, such as that led by the Network of Arctic Researchers in Ireland (NARI), will be essential to inform Ireland's response to these global-scale challenges, which also requires comprehensive risk assessments of potential societal impacts, and public communication strategies to build resilience and preparedness for sudden and high-impact scenarios such as an AMOC collapse. Furthermore, the strong knowledge base produced by the Intergovernmental Panel on Climate Change (IPCC), Arctic Council's Working Groups and other subsidiary and international bodies feed into the recommendations for informed decision-making on priorities in policy and research of this changing ocean dynamic.

The changes in the seas around Ireland in many cases reflect those at regional (NE Atlantic) and global scale and are comprehensively synthesised in Irish Ocean Climate and Ecosystem Status Report 2023⁵. The detailed overview of the current status of climate and climate science in this report, and the EPA's Ireland's Climate Change Assessment Synthesis Report⁶, are of the highest societal and policy relevance.

Global mean figures can mask local and regional trends in key climate and ocean variables. Sea-level around Ireland has risen by 2-3mm per year since the early 1990s. Sea surface temperatures off Ireland's North Coast (Malin Head) were 0.47°C higher over the last 10 years compared to the period 1981-2010, while Irish surface coastal waters have become more acidic since the early 1990s at a rate that is higher than the global average^{3,4}.

In response to these observed ocean and climate changes, substantial progress has been made nationally to advance legislation and to promote actions for climate mitigation and adaptation. The Climate Action and Low Carbon Development Act of 2015 (the Climate Act) subsequently amended in 2021, is the legislative basis for multiple climate plans, policies and new implementation structures, including the annually updated **Climate Action Plan** (CAP), the **National Adaptation Framework**, the **Climate Change Advisory Council**, the **National Framework for Climate Services** (coordinated by Met Éireann) and the establishment of four **Climate Action Regional Offices** (CAROs).

Successful implementation of the growing suite of national climate plans, policies and actions depends on robust scientific research, data and evidence. It is critically important for coastal States like Ireland to support ocean and coastal observing and research programmes and to monitor and understand changes that are taking place at an appropriate scale. Tracking a range of ‘Essential Ocean Variables’ (EOVs) and monitoring our changing coastline is essential to provide the data and evidence needed to inform policy and planning and to enable society and impacted economic sectors to adapt, mitigate and manage climate related impacts.

With the ambitious climate targets, policies and plans that are now in place, it is important that future research and technological innovations are targeted at the most critical knowledge gaps and at building national capacity for the long-term sustainable monitoring of essential ocean (including coastal) and climate variables. Research should be policy- and solutions-focused and address potential mitigation mechanisms such as blue carbon and marine carbon dioxide removal technologies, including research into their relative impacts and benefits.

The Framework to Guide Climate and Climate-Related Strategic Research and Innovation, established under the Climate Action Plan 2024, is a key mechanism to achieve this imperative. There is also a need to coordinate the increasingly complex research system that supports ocean, coastal and climate research across multiple programmes and investments. This will also ensure that Irish-based researchers can compete effectively for international research funding and foster a robust pipeline of research talent and expertise in collaboration with international partners.

Key Actions 2025-2026

Action	Relevant Bodies
1. Ensure ocean and climate research challenges, including those identified in the Irish Ocean Climate and Ecosystem Status Report 2023, are incorporated in the annual Climate Action Plans and the outputs of the forthcoming Framework to Guide Climate and Climate-Related Strategic Research and Innovation.	DCEE, MI, MÉ, GSI
2. Build national capacity in ocean, seabed and coastal modelling, the development of sector-specific digital twins ⁷ , and the advancement of digital products and innovation to underpin national climate and planning policy and the provision of climate services.	MI, MÉ, GSI, DCEE, DAFM, DHLGH, IL
3. Establish an implementation and monitoring framework for the multiple research recommendations made in the Irish Ocean Climate and Ecosystem Status Report 2023 and a mechanism and resourcing to secure future updates of this national assessment at appropriate intervals.	MI, MÉ
4. Advance Ireland's leadership role in international climate-related ocean and coastal research initiatives, including the Horizon Europe Missions, JPI Climate and JPI Oceans, World Meteorological Organisation marine and coastal programmes, and the contribution of Irish experts to the IPCC assessment process.	MI, EPA, MÉ

⁷ In this strategy, digital twins refer to evolving digital models and tools that integrate real-time data and simulations to enhance the understanding, management, and sustainability of marine environments. As the technology advances, these tools will be utilised in diverse ways, from monitoring marine ecosystems to optimising offshore infrastructure, ensuring they meet the needs of the research and operational objectives.

2.2 Marine Geology, Seafloor and Coastal Change

Ireland has a coastline more than 7,500 Km in length and a maritime territory (Exclusive Economic Zone and extended continental shelf) of 488,762 km², seven times its landmass. Since 1999 seafloor morphology and shallow geology has been systematically mapped through INSS and INFOMAR programmes. This a highly valuable state asset that directly addresses many research and innovation challenges, as laid out in Ireland's National Development Plan 2021-2030. Although initial mapping is scheduled for completion in 2026, there is a need to enhance this data resource and maintain and grow expertise in order to build on the requirements of Action MA/24/3 of the Government's Climate Action Plan 2024 and meet Ireland's obligations under SOLAS, the International Convention for the Safety of Life at Sea.

Seafloor composition and sub-seafloor information provide an underlying baseline for chemical, biological and human activity in the ocean, and reflect changes in climate and oceanographic conditions. Further data collection and research is needed to improve understanding of sediment dynamics and transport systems both in open seas and coastal areas.

The biological dimension also plays a crucial role in shaping seafloor and coastal environments. Collaboration between geologists and biologists is essential to fully understand and manage these interconnected systems, such as joint research initiatives to study, for example, the interactions between marine organisms and sediment dynamics, the role of habitats such as coral reefs and seagrass meadows in stabilising coastal zones, and the impact of climate change on both geological and biological processes.

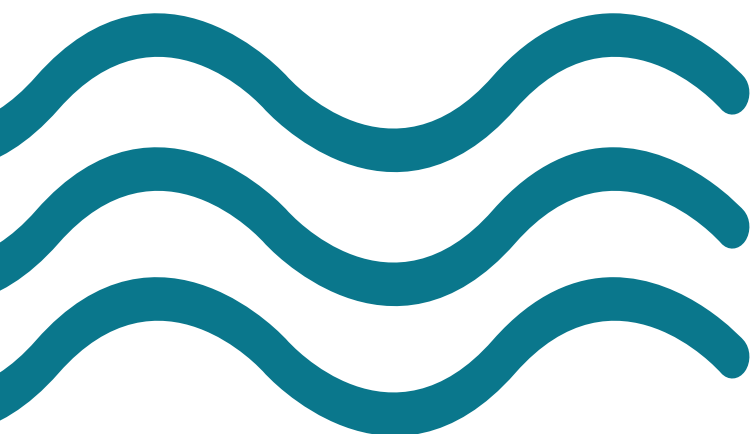
Rising sea levels and more frequent extreme sea level (ESL) events, combined with coastal erosion, are projected to have profound impacts on communities and infrastructure. It is also projected that much of this impact is expected to occur over the next decades and could potentially affect up to 2 million people, all the major cities, and much of the country's industry, infrastructure and utilities⁸. The Department of Housing, Local Government and Heritage established the **National Coastal Change Management Strategy** with a view to coordinated action through an integrated, whole-of-Government approach.

⁸ Report of the Inter-Departmental Group on National Coastal Change Management Strategy



Key Actions 2025-2026

Action	Relevant Bodies
5. Support capacity-building measures to enhance the future pipeline of talent and expertise in the areas of marine geology, geophysics, hydrography and coastal change.	GSI, MI, Research Ireland
6. Build national capacity in ocean mapping, geological and paleoclimate research, coastal behaviour, and the advancement of digital products and innovation to underpin national policies.	GSI, MI, DCEE
7. Advance Ireland's leadership role in international ocean mapping and coastal research, through Horizon Europe, EMODnet and International Ocean Discovery Programme (IODP).	MI, GSI
8. Advance national capacity for <i>in situ</i> , real time coastal and marine data collection and coordination and data life-cycle management in ocean mapping and coastal change.	GSI, MI



2.3 Marine Biodiversity and Ecosystem Functioning

Ireland's marine habitats include deep offshore continental shelves and canyons, and a range of inshore coastal habitats from steep cliff faces to sandy and rocky sea shores, kelp forests, estuaries and salt-marshes. Its marine ecosystems are home to a rich and diverse range of marine mega- and macro-fauna, including 24 species of cetaceans (whales, dolphins and porpoises), two seal species, 24 resident seabirds, 35 species of shark and more than 150 species of marine fish. In addition, our waters and seafloor sediments have abundant smaller invertebrates, algae, plants and micro-organisms which comprise an enormous diversity and biomass and are essential components in marine food webs and ecosystems.

However, the impacts of climate change and human activities pose substantial threats to marine biodiversity and the health and functioning of marine ecosystems. In recent decades, scientists have observed and documented changes in the geographical range and seasonal activities of many marine species resulting in altered species composition and abundance, and biomass production of ecosystems, from the equator to the poles.

In 2020, Ireland published its updated assessment to the EU's **Marine Strategy Framework Directive** (MSFD) which aims to protect and conserve the health of the EU's coasts, seas and ocean. It showed that five out of eleven descriptors had achieved good environmental status (GES) with three descriptors partially achieving GES (an updated assessment was initiated in 2024). Knowledge gaps and challenges remain, however, for the full and effective implementation of the MSFD including, for example, establishing appropriate monitoring methodologies for marine micro-litter.

The European Union's 2030 Biodiversity Strategy sets ambitious targets and commitments for 2030 to designate 30% of our maritime territory as Marine Protected Areas (MPAs), in line with equivalent commitments under the UN Convention on Biological Diversity (Kunming Montreal targets, 2021). Currently, Ireland has designated just under 10% of its maritime area as protected in the form of Special Protected Areas (SPA) and Special Areas of Conservation (SAC). Legislative and policy measures to enable the 30% target to be met are currently under consideration.

The recently agreed EU Nature Restoration Law will add another layer of legislation, aiming to strengthen progress in halting biodiversity loss and in restoring degraded ecosystems. The Horizon Europe Mission, Restore Our Oceans and Waters by 2030⁹, is also an important framework for EU research and innovation to progress science-based measures to protect and restore ecosystems, with measurable targets.

Protecting and conserving our marine biodiversity relies on essential research, data and evidence to understand both baseline conditions and patterns of change linked to climate change, the direct impacts of human activities or to natural variability. Ireland has a well-coordinated research community that is active in national and international research projects and programmes in the area of marine biodiversity and ecosystems research.

The substantial research effort across the Higher Education Institutes is underpinned and augmented by statutory and science-driven marine monitoring programmes carried out by government bodies linked to EU Directives and other international commitments.

These programmes are crucial parts of the evidence base. However, there is potentially a deficit in the pipeline of talent and expertise in the area of marine biodiversity, taxonomy and ecosystems that will be needed to support the step-change in the requirements for scientific advice linked to the development of ORE, the establishment of a substantially larger network of MPAs, and other nature restoration efforts. In that context RDI programmes will be required to support collation of historical baselines and status assessments for many ecosystems which will be key for implementation and delivery of the EU Nature Restoration Law, and MPA designation processes.

Linked to this is the ongoing need for systematic archiving of voucher specimens in recognised repositories, which provides a verifiable record of Ireland’s rich marine biodiversity. This practice supports the accurate identification of species, enables long-term monitoring of ecological changes, and strengthens our capacity to assess the impacts of climate change and human activities on marine ecosystems. By incorporating voucher specimen archiving into biodiversity and taxonomy efforts, Ireland can enhance its ability to meet commitments under the Marine Strategy Framework Directive (MSFD), the EU Biodiversity Strategy, and the Nature Restoration Law, while contributing to global knowledge on marine ecosystem restoration and resilience. It should be part of any planning for long-term marine research infrastructure needs.

Key Actions 2025-2026

Action	Relevant Bodies
9. Support capacity-building measures to enhance the future pipeline of talent and expertise in the areas of marine biodiversity, taxonomy, ecology and ecosystems research.	MI, Research Ireland, NBDC
10. Enhance Ireland’s leadership and participation in the second phase of the Horizon Europe Mission, Restore our Ocean and Waters by 2030.	MRFF, MI

⁹ Protect at least 30% and strictly protect 10% of EU’s sea areas and achieve marine nature restoration targets (incl. degraded seabeds, coastal ecosystems).

2.4 Offshore and Maritime Cultural Heritage

Underwater cultural heritage (UCH) within Ireland's maritime area is rich and diverse. Some 18,000 wrecks are recorded in the National Monuments Service's (NMS) Wreck Inventory of Ireland Database (WIID).¹⁰ Wrecks and other underwater archaeological sites and objects provide significant opportunities for research as they are the most abundant type of underwater archaeological site found in our maritime and coastal area¹¹.

A critical tool is the information contained in WIID, and its online companion, the NMS Wreck Viewer, which provides information on the wrecks with known locations. WIID is an essential research tool for archaeologists, historians, developers, planners, marine leisure users, visitors to Ireland and many others. As new discoveries emerge or with the acquisition of new information on existing wrecks, it is also an ever-expanding resource.

Many of these sites also represent a shared heritage, whether it is the flag state or the nationality of those who were on board, or those who lost their lives. This common cultural heritage tells a far greater story than just the site itself. Many sites too, over time, become natural havens for marine life. Research opportunities, therefore, can range from the cultural, natural, social and historical, to development of new technologies to map and investigate.

Underwater heritage sites, including many wrecks found in deeper waters, are continually at risk from the impacts from human activities and climate change. The National Monuments Service is in the process of drafting a National Strategy on the Management and Protection of Ireland's Underwater Cultural Heritage, which will include defined high-level objectives and actions, including a proposal for a future research framework for UCH in Ireland.

Capacity building, particularly within our educational and academic institutions, will be of particular importance. There is also a need to continue expanding on existing collaborative approaches by statutory bodies, not least the continued combining of the data in WIID with the mapping of known wrecks and discovery of new wrecks by INFOMAR.

¹⁰ <https://www.archaeology.ie/underwater-archaeology/wreck-viewer>

¹¹ Advice to the Public on Ireland's Underwater Archaeological Heritage

One of Ireland’s World Heritage properties is Sceilg Mhichíl, an offshore pinnacle of rock rising out of the Atlantic off the coast of County Kerry. Scelig’s Outstanding Universal Value, inscribed in 1996 on UNESCO’s World Heritage List, includes both the cultural and natural heritage. The National Monuments Service’s draft World Heritage Strategy contains a strategic objective to develop a research framework, focused on innovation and international collaboration (Goal 6).¹²

NMS and INFOMAR have undertaken marine mapping to build knowledge of Sceilg’s place within its maritime context. Notably, Ireland’s first marine park, Páirc Náisiunta na Mara, Ciarraí (National Marine Park, Kerry), was established in 2024, covering an area of 280 km² of land and sea. Sceilg is now also located within the newly established marine park which enables a greater focus on conservation and opportunities for research, widening of the potential for understanding the geology, biology, archaeology and seabed morphology located in the waters around it.¹³

Key Actions 2025-2026

Action	Relevant Bodies
11. Support capacity-building measures to enhance future research on Underwater Cultural Heritage (UCH) within the public and private sectors and educational institutions.	NMS, GSI, MI
12. Support existing and develop new research frameworks for UCH and World Heritage marine areas across multiple stakeholders.	NMS, GSI, MI
13. Build on existing and develop new ways of raising awareness of the importance, value and benefit of UCH as a key part of our marine environment, responsible ocean protection and sustainable blue economy.	NMS, GSI, MI

¹² <https://www.gov.ie/en/consultation/bd4cb-public-consultation-on-strategy-for-world-heritage-in-ireland-2024-2034/>

¹³ <https://www.nationalparks.ie/kerry-seas/#:~:text=Our%20Marine%20National%20Park,Heritage%20Property%20of%20Sceilg%20Mhich%C3%ADL>

2.5 Ocean Governance and Law

Ocean governance addresses the legal, planning and policy frameworks that seek to manage and regulate multi-dimensional and interconnected human activities in the ocean space. Ocean governance is applied at multiple geo-political and temporal scales; there is no single policy, institution or actor that has exclusive authority in this realm. There are routine challenges faced by policymakers in Ireland to integrate EU and international commitments into national policy and management frameworks. However, the last five years have seen substantial changes in national policy, planning and legislation pertaining to the usage of maritime space and commercial activities at sea which also have implications for the conduct of marine scientific research and data collection.

The majority of fishery resources fall under the remit of Common Fisheries Policy (CFP). The aim of this policy is to establish environmental, economic and social sustainability within our fisheries and aquaculture industries.

In February 2023, the EU published the Commission's assessment on the functioning of the CFP along with a package of measures to improve the sustainability and resilience of the fisheries and aquaculture sector. The currently ongoing evaluation of CFP will provide an overview on how the Common Fisheries Policy Regulation, its instruments and measures have been performing over the last decade (2014-2024). It will assess whether the general objective of ensuring that fisheries and aquaculture are environmentally sustainable and managed in a way that is consistent with the objectives of achieving economic, social and employment benefits have been met.

Brexit has introduced a substantial challenge for fisheries management. Under the EU-UK Trade and Cooperation Agreement, many Irish vessels operate in UK waters that are no longer subject to the CFP. The uncertainties resulting from the long-term viability and stability of this new framework for fisheries governance mean that planning and preparation for multiple eventualities will be needed, informed by scientific analysis and advice across multiple domains of expertise, including social and economic sciences.



It is imperative to ensure that Ireland's knowledge and research system is able to respond to such evolving governance challenges. Participation of fisheries scientists and domain experts in international science-policy bodies such as ICES and the EU Scientific, Technical and Economic Committee for Fisheries (STECF) is critical to ensure coherent science based management of fish stocks, while research and knowledge needs are addressed through EU groups such as SCAR-Fish. The development of the EU Ocean Pact in 2025 and an associated new Research and Innovation Strategy will be a key avenue for setting research and knowledge goals for sustainable fisheries management and international ocean governance.

In Ireland, the **Maritime Area Planning Act 2021** represents the biggest reform of marine governance since the foundation of the state. This critical piece of legislation brings marine planning and consenting up to date, creating a modernised governance structure to sustainably develop marine resources and manage maritime activities (e.g. Offshore Renewable Energy). Ireland's marine spatial plan, the **National Marine Planning Framework** and **Marine Planning Policy Statement** form a robust policy platform for marine planning which has been operationalised through the establishment of the **Maritime Area Regulatory Authority** (MARA), and the allocation of new powers to An Bord Pleanála and Coastal Planning Authorities under the Act.

Forthcoming legislation on Marine Protected Areas will provide the legal basis for Ireland to meet its EU and international commitments to designate 30% of its maritime area as MPA by 2030. Given the scale of legislative reform, challenges are expected in relation to cross-compliance and conflicts that may arise from complex interactions between legal and policy instruments. In this context, there is a greater need to ensure that Ireland retains and builds its national capacity and expertise in maritime law, ocean governance and integrated marine policy and planning. At the same time, Ireland has responsibilities to contribute to international ocean governance through participation in multiple EU and UN assessments, working and advisory bodies, including initiatives under the United Nations Convention on the Law of the Sea, UN Safety of Lives at Sea, the International Maritime Organisation, the International Seabed Authority and the International Oceanographic Commission of UNESCO.



The 2023 **UN Agreement on Marine Biodiversity Beyond National Jurisdiction**

(BBNJ) is expected to enter into force in the coming years. The BBNJ Agreement, in broad terms, aims to close significant gaps in global ocean governance by providing a framework to enhance protection of the marine environment. A crucial feature of the Agreement is a global mechanism for establishing marine protected areas (MPAs) in areas beyond national jurisdiction, namely the high seas and international seabed. These areas comprise two thirds of global ocean space but only 1% is presently protected by MPAs, far short of what is envisaged by the “30 by 30” target of the Kunming-Montreal Global Biodiversity Framework agreed at the Convention on Biodiversity COP15 in December 2022. In addition to its provisions on MPAs, the Agreement will strengthen the global regime for the conduct of environmental impact assessments (EIAs) for activities that may have an impact on the marine environment in areas beyond national jurisdiction. Furthermore, the Agreement makes provision for a benefit sharing mechanism in respect of marine genetic resources (MGRs) and contains provisions on capacity building and technology transfer to support developing countries.

In 2023, the Government announced its support for a precautionary pause of deep-sea mining on the international seabed, which is regulated by the International Seabed Authority, of which Ireland is a member. Ireland’s position is that no deep-sea mining should take place until such time as a robust regulatory framework is in place to protect the marine environment and the scientific knowledge base is sufficient to allow for informed decision-making. Similarly, the Government’s **Policy Statement on Mineral Exploration and Mining** (December 2022) provided that mining activity should not take place on the Irish seabed until such time as sufficient data is available to adequately assess the potential impacts.

Key Actions 2025-2026

Action	Relevant Bodies
14. Coordinate the necessary research, skills and capacity assessments required to inform the ongoing development of the State's planning, consenting and regulatory functions and the associated mechanism to ensure provision of relevant data and evidence to inform their activities.	DCEE, MARAs, ABP, DAFM, MI
15. Commission a desk-based study to ascertain the national impacts and implications of the BBNJ Agreement, and to examine how Ireland can best contribute to achieving the objectives of the Agreement through marine research, and through related capacity building and transfer of marine technology activities to assist developing countries.	MI, DFAT, DCEE
16. Contribute to BBNJ-related capacity building and transfer of marine technology activities to assist developing countries, including through the provision of training/placement opportunities to scientists from developing countries.	MI, DFAT, DCEE
17. Support and contribute to marine research relating to deep-sea ecosystems and related matters to help to inform the work of the International Seabed Authority, and support and contribute to relevant capacity building activities to assist developing countries.	MI, DFAT, DCEE

2.6 The Ocean's Benefit and Service to Society

There are multiple ways that people benefit either directly or indirectly from the ocean. Marine ecosystem services are the services provided by the processes, functions and structure of the marine environment that directly or indirectly contribute to societal welfare, health and economic activities¹⁴. Ireland's marine resources provide a range of ecosystem services and benefits that include provisioning services, regulation and maintenance services, and cultural services that can have both market and non-market values.

Marine biodiversity, for example, plays an important role in providing ecosystem services such as fisheries, aquaculture, biotechnology and an arena for tourism and recreation. The many shipwrecks and submerged archaeological sites which have been documented and mapped by the National Monuments Service¹⁵ and the INFOMAR¹⁶ programme in Ireland's territorial waters are an important part of our maritime cultural heritage and the object of archaeological study. Our marine environment also provides a number of regulating services such as carbon sequestration¹⁷. Ireland's stock of coastal, shallow water and tidally influenced blue carbon ecosystems such as seagrass beds and saltmarshes are estimated to store at least 9.2 Mt of carbon. The market and non-market values of these services can be quantified in monetary terms but further research is needed to advance consistent approaches in quantifying these ecosystem service monetary values.

The relationships between people and the ocean have been the subject of the ocean literacy movement for more than a decade and national efforts are now coordinated under the **Irish Ocean Literacy Network** (IOLN). About 40% of the Irish population lives within 5km of the coast, and coastal communities and businesses are intimately connected to their coastal and marine landscape and infrastructures but are also on the front line of climate change and extreme weather events. Understanding the attitudes and perceptions of citizens in relation to the role of the ocean in their lives and their own impacts on the ocean is an important field of social study in its own right. Building our national capacity in social and economic research linked to the ocean's relationship with society will be important to enable some of the major developments that are planned over the next decades, including the installation of offshore renewable energy infrastructure.

¹⁴ Austen M.C., et al (2019) **Valuing Marine Ecosystems - Taking into account the value of ecosystem benefits in the Blue Economy**. Future Science Brief 5 of the European Marine Board, Ostend, Belgium. 32pp. ISBN: 9789492043696 ISSN: 4920-43696 DOI: 10.5281/zenodo.2602732

¹⁵ <https://www.archaeology.ie/underwater-archaeology/wreck-viewer>

¹⁶ www.infomar.ie

¹⁷ Cott, G. M., Beca-Carretero, P., and Stengel, D. B. (2021). **Blue Carbon and Marine Carbon Sequestration in Irish Waters and Coastal Habitats**. Marine Institute, Ireland.

¹⁸ Garcia-Soto, C., et al. (2017) **Advancing Citizen Science for Coastal and Ocean Research**. Position Paper 23 of the European Marine Board (EMB), Ostend, Belgium. 112pp. ISBN: 978-94-92043-30-6

¹⁹ <https://exploreyourshore.ie/>

In addition, citizen science is a research methodology which, if used correctly, offers huge potential to further scientific knowledge and to influence the environmental impacts of society through behavioural education. Marine citizen science also empowers citizens to engage constructively in the development and implementation of evidence-based maritime policy¹⁸. Examples of highly successful marine citizen science initiatives already exist in Ireland. Explore Your Shore!¹⁹, an EPA-funded Marine Biodiversity Citizen Science Programme, launched in 2019 by the National Biodiversity Data Centre (NBDC), currently contains over 25,000 photo-validated records of marine intertidal and near-coast species, representing a crucial baseline dataset for many marine species that are data deficient. In 2022 the NBDC published a draft [Marine Biodiversity Citizen Science Strategy](#) to enhance Ireland's Ocean Knowledge by fostering public engagement, better integrating citizen science in policy, enhancing citizen science data flows, and addressing critical data gaps in intertidal and nearshore non-commercial marine species.

Key Actions 2025-2026

Action	Relevant Bodies
18. Advance national coordination and capacity in marine socio-economics, environmental and ecosystem accounting and ocean economy measurement, making further progress towards an ocean economy satellite account for Ireland.	MI, UG, CSO, OECD
19. Establish a biannual 'Ocean Barometer' survey on citizen attitudes and perceptions on ocean health, policies, issues and impacts.	MI, UG
20. Investigate opportunities to enable bottom-up citizen initiatives, complementary to existing funding instruments in this area (e.g. Community Climate Action Programme) and local government interventions and national citizen science strategies such as the draft Marine Biodiversity Citizen Science Strategy (2023-2028).	MI, CAROs, NBDC



3. TOWARDS A SUSTAINABLE OCEAN ECONOMY

Across multiple sectors from seafood production to shipping and ports, or coastal and marine tourism, the future ocean economy will be data and knowledge-driven and employ advanced technology and engineering. This new ocean economy ‘puts science and predictive capabilities to work in a way that can fill critical, fast-rising needs across sectors. This economy is entrepreneurial and environmentally responsible, collaborative and competitive¹⁹.’



²⁰ Spinrad, R.W. (2016). The New Blue Economy: A Vast Oceanic Frontier

The ocean economy is defined as any economic activity that directly or indirectly uses the sea as an input or produces an output for use in a sea-specific activity. It includes a range of established and emerging sectors that provide essential employment in coastal regions. Since 2016, the Marine Institute and the Socio-Economic Marine Research Unit (SEMRU) at the University of Galway have co-produced an annual report on Ireland's Ocean Economy which provides a periodic update and trends analysis on the ocean economy across three main economic indicators: turnover, gross value added (GVA) and employment (full-time equivalents or FTEs).

The 2024 report²¹ provides the most recent figures for the reporting year 2023. In terms of direct impact, the ocean economy generated €6.52 billion in turnover, a GVA of €2.72 billion and supported 38,941 jobs (FTEs). This time-series data tells us that the ocean economy has approximately doubled in size across all three indicators in the fifteen-year period since 2007. While this is positive, there is potential for this steady state growth to be replaced by a much greater rate of growth in the next decade, driven largely but not exclusively by the expansion of offshore renewable energy and associated value chain activity.

There are multiple Research, Knowledge and Innovation (RKI) needs and opportunities, to address critical knowledge gaps, underpin technology development, address policy, planning and governance challenges and underpin innovation in the development of new products, processes and business models.

Here we identify the key RKI priorities that need to be addressed to underpin sectoral growth and development, along with key actions to facilitate progress, in five key sectors:

- Sustainable food from the ocean
- Energy from the ocean
- Greener and smarter ports and shipping
- Tourism in coastal and marine areas
- Safe and secure seas

²¹ Flynn, N., Frost, D., O'Leary, J., and Hynes, S. (2024). Ireland's Ocean Economy, 2024. SEMRU, University of Galway and Marine Institute

3.1 Sustainable Food from the Ocean

The rapid rise in global population and challenges associated with land-based food production mean that food from the ocean is becoming increasingly important for nutrition, livelihoods and global food security. Fisheries and aquaculture products are an important source of protein and can form a crucial component of a healthy diet. The world's consumption of fish or seafood has risen from a per capita average of 9 kg in the 1960s to 20.2 kg in 2022, with an EU average in 2019 of 25 kg per capita. In order to maintain this level of consumption in 2050, aquatic food production would need to grow by 22% globally (14% in Europe) (FAO, 2023)²³.

Recent reports indicate that the ocean could provide six times as much food as it does today, in particular through growth in low-impact, regenerative aquaculture²⁴. Globally, therefore, a key challenge is to reconcile the required increase in production, with challenges such as declining fishery resources, inadequate governance frameworks, illegal unregulated and unreported (IUU) fishing, marine ecosystem degradation, competition for ocean space, and the impacts of climate change.

Achieving a sustainable supply of safe, secure and nutritious seafood requires a holistic food systems and circular bioeconomy approach, taking account of the full value chain from catch/production to consumption and management of waste streams. The pandemic, and increased geo-political tensions, have interfered with global supply chains and threatened food supply. The increasing focus within Europe on strategic autonomy also supports food sovereignty for EU Member States and emphasises increased importance of local production systems.

The seas around Ireland are among the most productive and biologically sensitive areas in EU waters. Fisheries, aquaculture and seafood processing are established sectors for Ireland's ocean economy, with a combined Gross Value Added (GVA) of €360m in 2022. In the same year, total production (fisheries and aquaculture) of marine fish and shellfish by volume amounted to 309,100 tonnes with a first sale value of €637m. The seafood sector employed approximately 8,145 FTEs with a further 7,528 jobs provided through downstream, value-chain enterprise²⁵, providing important employment opportunities in peripheral regions around the Irish coast.

²³ FAO State of World Fisheries and Aquaculture 2022

²⁴ Costello, C., L. Cao, S. Gelcich et al. 2019. The Future of Food from the Sea. Washington, DC: World Resources Institute. Available online at www.oceanpanel.org/future-food-sea

²⁵ Source: **The Business of Seafood 2023**. Numbers include landings of non-Irish vessels in Irish ports

Seafood forms part of the broader focus on Ireland's ambition to become a world leader in sustainable food systems, as outlined in Food Vision 2030²⁶. Food security and nutrition are key components of Sustainable Food Systems, particularly the link between food and health. In line with national and EU²⁷ and international²⁸ policy objectives, Ireland's seafood sector needs to accelerate its development towards low impact, knowledge-driven, high-tech and climate neutral production, optimising opportunities for equitable employment, innovation, food security, and sustainable economic growth in coastal areas.

A key challenge will be to continue to develop the seafood sector in the context of a rapidly changing use of marine space that will result from the planned expansion of Offshore Renewable Energy (ORE) and meeting EU and international commitments for conservation of marine ecosystems and biodiversity (including the designation of 30% of Ireland's maritime area as Marine Protected Area by 2030).

Research, Knowledge and Innovation (RKI) are central to addressing these complex challenges and to creating opportunities for development of a sustainable and climate-neutral seafood sector. Research impact can be strengthened by embedding co-creation and co-implementation practices, involving industry, coastal communities and other stakeholders.

²⁶ Food Vision 2030 – A World Leader in Sustainable Food Systems

²⁷ EU Farm to Fork Strategy.

https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

²⁸ FAO Blue Transformation Roadmap 2022-2030.

Research, Knowledge and Innovation Priority Areas

New tools, technologies and business opportunities

Continued development and application of new tools and technologies (Aquatech) in support of sustainable seafood production and processing, including land-based Recirculating Aquaculture Systems (RAS), novel feed solutions, biorefinery, digital tools, Artificial Intelligence (AI), marine engineering, fish health and genetics.

Support for marine biotechnological research to enable innovation in the development of high-value non-food products and services (e.g. marine proteins), promoting the use of side streams and other biomass and advancing circular bioeconomy principles.

Investigation and assessment of the potential for lower-trophic level, mesopelagic biomass as a target for fisheries, including understanding of the potential impacts on food chain dynamics, oceanic carbon-cycling and ecosystem functioning and the viability of associated seafood products for domestic and international markets.

Transition to low impact, climate-neutral and sustainable seafood production

Further development of low-impact, non-fed aquaculture, in particular seaweed and molluscs; integrated multi-trophic aquaculture; and opportunities for co-location of aquaculture with other developing offshore activities (e.g. offshore wind developments).

Adaptation of seafood production (capture fisheries and aquaculture) to the impacts of climate change including warming seas, sea-level rise, ocean acidification, extreme weather events and transitioning to a 'green' supply chain (fishing fleets, production, processing, transport, etc.) and a circular blue bioeconomy²⁹.

Increase research, knowledge and expertise on emissions and resource use by the seafood sector balanced against carbon sequestration and other ecosystem service provision by the sector and how this is regulated for optimum outcomes.

Governance aspects and coexistence with other activities

Further development of frameworks for and application of Integrated Ecosystem Assessments in the context of ecosystem-based fisheries management, to inform policy and management decisions taking account of ecological, social and economic factors.

Fish welfare, seafood safety and traceability in support of producers and consumers

Advancing science-based measures to detect, monitor and address fish/shellfish disease and contamination, fish welfare, seafood safety and traceability in support of producers and consumers, as well as enhancing sustainability focus to mitigate any potentially harmful impacts on natural ecosystems (e.g. aquaculture mediated effects).

²⁹ Ireland's Bioeconomy Action Plan 2023-2025

Societal benefit and health aspects of seafood

Increased RKI capacity and activity on the role and importance of seafood in terms of nutrition, health, and well-being both nationally and globally, and the value consumers place on the sustainability of seafood products.

Developing and applying marine economics and socio-economics (including natural capital accounting), social sciences and humanities applications for sustainable seafood sectoral development (e.g. social licence, measurement of economic activity, and links to ecosystem service provision).

Key Actions 2025-2026

Action	Relevant Bodies
21. Design and implement a dedicated RKI programme on ‘Sustainable Food from the Ocean’ with coordinated funding and multi-annual calls linked to the RKI priorities set out above. The programme should target tangible and measurable impacts in advancing all stages of the seafood value chain, taking account of barriers linked to markets and regulation to deliver a world-class seafood production that is sustainable, circular, safe, secure and supporting innovation across the value chain.	MI, DAFM, BIM, Teagasc
22. Align cross-programme opportunities to support research in the blue bioeconomy leveraging national funding mechanisms and EU programmes including the European Maritime Fisheries and Aquaculture Fund, the Sustainable Blue Economy Partnership (SBEP), and Circular Biobased Europe (CBE JU), promoting the transition to sustainable, low-carbon, low impact seafood production.	MI, BIM, Research Ireland, DAFM

3.2 Energy from the Ocean

The EU Green Deal sets Europe on course to be the first climate neutral bloc globally by 2050. This is matched with ambitious targets for climate action and decarbonisation of our energy systems. The revised Renewable Energy Directive (RED III)³⁰ sets a mandatory target of 42.5% renewable energy for the Union by 2030, delivered through a more streamlined consenting process and the designation of renewable acceleration areas. The move away from fossil fuels, initially driven by climate and sustainability factors, is now also an imperative for Europe's energy security in light of the Russian invasion of Ukraine and other global geo-political factors, influencing a move towards greater strategic autonomy for the continent.

In successive Climate Action Plans since 2021, Ireland has matched the ambition of the EU in setting a target to become a zero emissions economy by 2050, with a specific target to reduce GHG emissions to 51% of 1990 levels and a target of 80% renewable electricity by 2030³¹. Our transition to renewable sources of energy will be a substantial component of the change needed to meet these climate targets. The largest and most important arena for building a renewable energy infrastructure is our 490,000 km² maritime area with wind and wave conditions that make it a significant potential resource for energy generation.

Ireland has set specific targets for offshore renewable energy which has required a transformation of our regulatory and planning regime and modification of our governance and institutional arrangements. These targets require that we will achieve 5 GW of offshore wind energy production in the near-term, rising to 20 GW in 2040 and 37 GW by 2050 through the construction of offshore wind developments in our maritime area³². Achieving our 2050 target could enable Ireland to become a net exporter of renewable electricity to our European neighbours.

Building a new offshore energy infrastructure at scale brings with it complex and interconnected technological, environmental and social challenges. The offshore energy transition will be state and plan-led and will require a substantial knowledge and evidence base to aid policy, planning and management. The development of ORE installations may also significantly impact existing maritime activities, including for example, fisheries (commercial and recreational), aquaculture and maritime transport. These sectors are vital for coastal economies, food security, and cultural heritage. Potential conflicts and synergies between ORE and these traditional marine industries (including leisure use) need to be carefully studied and managed.

A major enabler for ORE development is the provision of data and digital products and services to establish baseline conditions, including for example the high-resolution INFOMAR marine maps provided by the Marine Institute and Geological Survey Ireland, as well as DCEE³³. These are critical to de-risk investments, to aid decisions on where to locate developments, and to avoid, minimise and mitigate impacts on the physical and biological components of the offshore ecosystem, as well as potential impacts in other areas including underwater cultural heritage, critical habitats and marine recreational fisheries.

³⁰ https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202302413

³¹ <https://www.gov.ie/en/publication/79659-climate-action-plan-2024/>

³² <https://www.gov.ie/en/publication/0566b-future-framework-for-offshore-renewable-energy/>

³³ <https://www.marineplan.ie>

While technological advances continue to be made, offshore wind energy generation has been at commercial deployment stage for two decades in Ireland. Nonetheless, there remain significant RDI challenges to reduce cost, optimise efficiency and lifecycle and to understand, manage and mitigate impacts on the environment and on other maritime sectors. Prototype technologies for wave and tidal energy have not progressed to commercialisation at the rate that had been anticipated 20 years ago, and there remains a continued need to reinvigorate the advancement of these technologies as well as the potential for other ORE generators in the future.

The national capacity for ORE research was deemed to be at a mature level in the ex-post evaluation of the previous National Marine Research & Innovation Strategy, with a high level of expertise across the RKI ecosystem, support in place for MaREI as a Research Ireland centre, and advanced research infrastructures and a RKI community that is well networked internationally³⁴. Building upon this national capacity will be essential to support further RKI in the future, while integrating EU and international programmes and knowledge, such as the work of the European Space Agency through e.g. satellite-based monitoring, precise positioning, climate data and programmes such as Copernicus and Galileo.

³⁴ Indecon International Economic Consultants, (2021). **Interim Review of the National Marine Research & Innovation Strategy 2017-2021**, Marine Institute, Ireland.

Research, Knowledge and Innovation Priority Areas

There have been many assessments internationally of R&I needs in relation to ORE and offshore wind energy in particular. The European Marine Board identified critical policy and research needs in its 2022 Future Science Brief, *European Offshore Renewable Energy: Towards a Sustainable Future*³⁵. These needs are almost all relevant and applicable to the Irish context. Domestic economic opportunities which have been identified in the sector will be leveraged through strategic plans to promote technological innovation. There are 40 actions set out in *Powering Prosperity: Ireland's Offshore Wind Industrialisation Strategy*³⁶ and 29 actions set out in the *Future Framework for ORE Policy Statement*³⁷, which both include specific RDI-focused actions necessary to the effective delivery of our national targets.

Given the complexity of the challenge to establish an entirely new energy generation system in exposed offshore environments, the R&I needs are multi- and interdisciplinary and cross-sectoral. An aggregated set of R&I priorities is presented here under the four general categories of technological, environmental, governance and planning, and economic and social.

Technology and engineering for generation technologies, station keeping, turbine optimisation and grid integration.

Offshore Wind: Continue support to further advance wind technologies, particularly for floating wind platforms, in relation to anchoring systems and foundation designs suitable for Ireland's challenging offshore environment. Design for optimised offshore wind farm layouts, grid integration, and the impact of offshore wind on marine ecosystems. National supports should be targeted at advancing value chain products and services that offer opportunities for domestic companies to innovate and grow their businesses.

Wave Energy: Consider the support for developing efficient wave energy converters (WECs) that can withstand harsh marine conditions, improve power conversion efficiency, and reduce maintenance costs. Research can also explore the integration of wave energy converters into existing and future offshore infrastructure including wind farm arrays.

Tidal Energy: Support further development of innovative tidal turbine technologies, optimised rotor designs, and advanced monitoring systems. Additionally, research can explore the environmental impact of tidal energy installations and potential strategies to mitigate any negative effects on the receiving environment.

Energy Storage and Grid Integration: Support advanced energy storage systems, grid management solutions to address the connection of offshore renewables to the onshore grid/network and demand-response mechanisms to address the capacity to manage intermittent generation sources with dispatchable types of energy generation to ensure a stable and reliable power supply.

³⁵ Soukissian, T. et al (2023) *European offshore renewable energy: Towards a sustainable future*. Future Science Brief No. 9 of the European Marine Board, Ostend, Belgium. ISSN: 2593-5232. ISBN: 9789464206173. DOI: 10.5281/zenodo.7561906

³⁶ <https://enterprise.gov.ie/en/publications/powering-prosperity.html>

³⁷ <https://www.gov.ie/en/publication/0566b-future-framework-for-offshore-renewable-energy/>

Understanding and managing environmental impacts

Support integrated research and monitoring studies to better understand the impacts (both negative and positive) of ORE installations and infrastructure development on marine biodiversity, ecosystems and habitats, including navigation risk assessment and collision risk, underwater sound, electromagnetic fields, habitat impacts, marine refugia potential, migration pathways, and artificial reef effects and their expected future dynamics in the context of climate change.

Support integrated research to better understand potential impacts of ORE installations and infrastructure development on underwater cultural heritage in areas of scour, erosion, sand movements, and climate change. Similarly, potential impacts (both positive and negative) on marine recreational angling need to be considered within such research.

Knowledge for optimum governance, policy and planning

Investigate alignment and cross-compliance across diverse marine and coastal legislative and planning instruments to integrate ORE within a wider policy environment.

Provide rapid response instruments to support specific knowledge needs for policy proposals being developed by competent government departments and the Offshore Wind Delivery Taskforce³⁸.

Identify and address gaps in national datasets and regulatory processes to inform evidence-based policy and decision making for planning, consenting and environmental permitting to better enable project delivery, identify benefits and mitigate ecological and socioeconomic impacts of ORE.

Economics, socioeconomics, social and cultural aspects

Social and behavioural research to support societal and local community understanding and the social license to operate for essential ORE projects.

Research to track and predict impacts of ORE deployment on other maritime sectors (notably seafood and maritime transport) as well as impacts on other users, while optimising potential co-benefits and minimising potential for conflicts.

³⁸ <https://www.gov.ie/en/publication/c8749-offshore-wind-delivery-taskforce/>

Key Actions 2025-2026

Action	Relevant Bodies
23. Increase and improve national coordination in providing targeted RKI supports to ORE value chain SMEs through existing and new programmes and calls. Maximise the value of research and innovation activities, where relevant, through business coaching, facilitating collaboration and wider enabling support. Ensure close coordination and alignment of different national RKI programmes, and engagement with international, EU and European Space Agency programmes and coordination forums.	SEAI, EI, MI, Research Ireland, DETE, MÉ
24. Accelerate progress on agreed actions under Powering Prosperity (Actions 26, 27, 28) and the Future Framework for ORE (Actions 3, 4) to plan, promote, support engagement with and use of existing marine test and demonstration facilities/sites and explore feasibility of additional marine test site (e.g. for Floating Wind).	SEAI, DETE, DCEE, MI, IL
25. Develop a focused ORE research and innovation strategy for Ireland with clear objectives in support of the sustainable delivery of government targets for ORE. The strategy should build on the ORE Technology Roadmap, address gaps in support and monitor ongoing technology developments and innovations³⁹.	SEAI

³⁹ Action included in the SEAI ORE Technology Roadmap



3.3 Greener and Smarter Ports and Shipping

Maritime transport is responsible for moving 90% of Ireland's external trade⁴⁰. Virtually all sectors of the Irish economy rely on maritime transport within their supply chains. As a result, shipping routes between Ireland and our international markets are critical arteries for trade and Irish ports represent infrastructures of strategic national importance. Ireland's supply chains are also inextricably interconnected with the global supply chain system. The twin shocks of Brexit and COVID-19 resulted in renewed emphasis on improving Ireland's maritime connectivity to international markets, building additional resilience into our ports and shipping services and driving efficiency and competitiveness throughout the maritime industry.

Shipping is one of the least carbon-intensive ways to transport goods, generating 2.9% of global anthropogenic CO₂ emissions in 2018. In the EU, ships generated 13.5% of all greenhouse gas (GHG) emissions from transport in that year, substantially less than road transport (71%) and aviation (14.4%)⁴¹. As a heavy transport sector and one of the most internationalised of industries, sustainability and the need to deliver a better environmental performance is, nonetheless, a key driver of change in the maritime sector.

The 'Fit for 55' package, a set of legislative measures introduced in 2023 under the EU Green Deal, includes the FuelEU regulation, which seeks to transition the EU maritime sector towards carbon neutrality. This transition is already underway and will have significant implications for ship size and design; for ports and shoreside power infrastructure; and for skills and training of existing workers and new entrants to the sector. The inclusion of 2 GW of Green Hydrogen in Ireland's climate targets and the potential for this to be exported in large volumes on vessels specifically constructed or adapted for that purpose, could also open a new opportunity for increased maritime transport business.

The need for the maritime transport sector to transition more broadly to a sustainable, resilient, efficient and digital future is reflected equally in the development needs for Ireland's ports. Ports play a crucial, yet often overlooked, role in facilitating economic growth and prosperity. As an island nation we depend on the quality and efficiency of our port services to a much greater degree than many of our trading partners⁴². There are particular opportunities linked to the development of smart ports, including introducing digital systems and processes for trade and shipping services that increase efficiency, while reducing costs and negative environmental impacts.

⁴⁰ https://www.imdo.ie/Home/sites/default/files/IMDOFiles/IMDO_Docs/IMDO%20IMTE%20Vol%2020%202023.pdf

⁴¹ European Maritime Transport Environmental Report 2021. European Environment Agency (EEA)

⁴² The National Ports Policy 2013

Ports, in particular regional ports, also provide substantial potential to diversify and to become clusters of blue economy business and activity, enhancing their traditional activities and attracting and hosting new business linked to evolving sectoral demands (e.g. ORE, aquaculture) and associated supply chains. Currently, there is insufficient consensus in the shipping industry in relation to fuels of the future to enable ports to invest in future infrastructure with confidence. Economic and social analysis will be key to inform policy and planning in relation to the growth in regional port capacity, port infrastructure development (e.g. for ORE, alternative fuels), the establishment of Green Shipping Corridors, and the development of ports as blue economy hubs.

The Irish Maritime Transport Economist⁴³ has tracked the development of the industry for more than 20 years and has established the correlation between the growth of the industry and that of the national economy. According to the Ireland's Ocean Economy Report, 2024, Shipping and Maritime Transport was the largest ocean economy sector in 2023 in terms of direct turnover, which amounted to €2.18 billion in that year. The sector generated €612 million in Gross Value Added and directly employed 4,659 FTEs. There are multiple challenges and opportunities for the future development of this critical national sector that will require research, knowledge and expertise. These can be supported through coordinated capacity building measures within the Irish RKI system but also through integrating better and delivering greater impact through participation in EU and international programmes.

Research, Knowledge and Innovation Priority Areas

Research can improve Ireland's responses to complex questions in areas such as maritime economics, management of port infrastructure and investment, digital transformation, the achievement of climate neutrality, and cyber security. The importance of these questions calls for a co-ordinated research response that will ensure the Irish maritime industry remains fit for purpose and knowledge, data and evidence are employed to deliver a competitive advantage across all parts of the maritime transport sector.

Understanding indigenous and exogenous drivers and pressures affecting the sector

Economic, technical and policy analyses to define a baseline understanding of the current status and future development needs of Ireland's maritime transport ecosystem in an international context.

Research to assess potential impacts and implications for maritime transport and port capacity of developments in other marine and maritime sectors, notably the impending rapid development and expansion of Offshore Renewable Energy (ORE).

Green and smart shipping

Developing innovations in ship design, technology, operations and efficiencies to meet sustainability and climate change challenges through cleaner fuels and efficiency, noise and vibration impacts on the environment, pollution (including ballast water and alien species) and impacts of extreme weather conditions on sector operations.

⁴³ Irish Maritime Transport Economist (Irish Maritime Development Office)

There are questions to be answered in relation to the particular fuels and vessel types that will be used in the Irish shipping market. Research is needed to answer these questions and to inform port investments and policy decisions.

Consider expanded opportunities for vessel participation in marine environmental observing programmes such as Voluntary Observing Ship and Ship of Opportunity programmes.

Smart ports

Research and knowledge to inform policy and practice linked to the diversification of business activity for Irish ports and their potential to act as hubs for both primary and related services and activities such as logistics, distribution, training and education, marine technologies, coastal and marine environmental monitoring, and coastal tourism, while taking into account the environmental sensitivity of transitional waters.

Research, knowledge and innovation to inform the advancement of digitalisation across Ireland and Europe's ports and maritime transport system and develop a suite of port performance metrics, unique to the circumstances that prevail in each port. Such analyses will enable evaluation of how ports are delivering and when and if ports need to add capacity.

Economic and social analysis will be key to inform policy and planning in relation to the growth in regional port capacity, port infrastructure development (e.g. for ORE, alternative fuels), and the development of ports as blue economy hubs.

Fostering resiliency across all parts of the sector

Multi-disciplinary research to understand the threats and challenges to successful transition of the maritime transport sector (ports and shipping) and its workforce in the face of climate change and climate action impacts and the transition to a low-carbon, digital future to inform policy and practice, underpinning resilience across all aspects of the sector.

Key Actions 2025-2026

Action	Relevant Bodies
26. Engage with strategic partners in the UK and EU to identify opportunities for joint transnational investments and projects in greener and smarter ports and shipping, leveraging international funding streams.	MI, DoT
27. Undertake a maritime RKI capacity assessment to determine capability within the system and critical gaps in knowledge and expertise that should be addressed through capacity building investments.	MI

3.4 Tourism in Coastal and Marine Areas

Coastal and marine tourism constitutes approximately 50% of all global tourism, equal to US\$4.6 trillion or 5.2% of global gross domestic product (GDP). It is a vital component of the economy of small islands and coastal communities⁴⁴. In 2023 marine and coastal tourism in Ireland generated an estimated turnover of €1.6 billion, a direct GVA of €944 million and employed 21,824 FTEs⁴⁵. It was the second largest marine and maritime sector in terms of turnover (after maritime transport), but by a considerable margin the largest and most important sector in terms of GVA and the employment it provides. A sizeable fraction of these businesses and jobs are located in peripheral coastal regions where alternative employment options can be limited, adding to the sector's importance as a regional economic driver.

The establishment in 2013 of the **Wild Atlantic Way** has demonstrated the potential value of applying innovation in branding Ireland's tourism assets in a manner that has been transformational. Almost 2 million more tourists visited the Wild Atlantic Way in 2023 compared with 10 years earlier, while tourism revenue on the route increased by 59% to €3 billion and jobs by more than 40% in the same ten-year period.⁴⁶ Lighthouses are a good example of coastal infrastructure that has proven to be an important enabler and economic driver for coastal tourism. Great Lighthouses of Ireland (GLI) is a strategic all island tourism initiative developed by Irish Lights in recognition of the need to protect its aids to navigation and lighthouse heritage. Understanding the drivers of success in these initiatives is key to ensuring continued innovation in the tourism sector.

Previous studies by the Socio-Economic Marine Research Unit (SEMRU) at the University of Galway not only provide an important understanding of the sector but also offer definitions that distinguish between coastal tourism, marine tourism and water-based activity tourism^{47,48} (in these reports international cruise tourism is considered a separate maritime sector). This categorisation is important as it enables a systematic approach to understanding the sector as a whole and more targeted supports and interventions to be devised to support the development of each activity.

There are specific characteristics that set tourism in coastal and marine areas apart from other maritime sectors. The sector includes a large number of micro-SMEs and family businesses that must deal with inherent seasonality, challenge in access to labour, insecure employment, and often tight margins. Among other pressures, many of these businesses are increasingly exposed to the impact of climate change and extreme weather events which can directly impact their cost-base, viability and in extreme cases, their survival. Tourism businesses are not generally set up to support

⁴⁴ Northrop, E. et al., 2022. **Opportunities for Transforming Marine and Coastal Tourism: Towards Sustainability, Regeneration and Resilience**. Special report of the High-Level Panel for a Sustainable Blue Economy.

⁴⁵ Ireland's Ocean Economy, 2024. <http://hdl.handle.net/10793/1999>

⁴⁶ **10 Years of the Wild Atlantic Way. A Decade of Transformational Tourism Impact on the West Coast of Ireland.**

⁴⁷ **A Survey of Domestic Coastal and Marine Tourism and Leisure Activity in Ireland.**

⁴⁸ **A Survey of Marine and Coastal Overseas Tourism Activity in Ireland.**

in-house research and innovation in the way, for example, a high-tech start-up might be. Determining the research knowledge gaps and needs can, therefore, be challenging, but there are undoubtedly opportunities for businesses to innovate, to leverage data and information, to apply technologies to reduce costs and increase efficiencies, and to move towards more sustainable and resilient business models. By collaborating and sharing knowledge, businesses and communities can accelerate progress even further.

The mid-term review of the previous National Marine Research & Innovation Strategy (2017-2021)⁴⁹ demonstrated a low level of investment in the theme Tourism and Leisure, one of 15 marine thematic areas covered by the strategy. The national research capability was also reported to be low, with a limited number of active researchers/experts within the national system, and those that were active were not well coordinated or networked internationally. The level of RKI investment was also relatively low, with no dedicated calls or programmes and no national infrastructures or testbeds in place. In short, the level of RKI capacity and investment support of one of our most important marine sectors is minimal, limiting in turn the opportunities for innovation and sectoral development.

Research, Knowledge and Innovation Priority Areas

A core goal for this strategy must be to raise the national capacity and level of investment in RKI supporting coastal and marine tourism. Research in this area is needed to guide policy and planning to support a just and efficient transition towards more low-impact, regenerative tourism. This will require greater coordination between development agencies and research funders and the establishment of specific targets in relation to programming, funding, expertise and capacity build. Some of the key areas where RKI is needed are outlined below.

Increasing resilience

RKI to enable coastal tourism operators to make evidence-based decisions and investments on protecting infrastructure and assets, early warning and appropriate response to extreme weather events and planning for the longer-term impacts of climate change.

Research to understand how unique coastal ecosystems are impacted by and interact with pressures from coastal and marine tourism activities and businesses, combining natural and social science expertise and linking to conservation management-oriented research to support long-term sectoral sustainability.

⁴⁹ Interim Review of the National Marine Research & Innovation Strategy 2017-2021. <http://hdl.handle.net/10793/1692>

Understanding the sector and its drivers

Consumer-focused research to assess views, attitudes and behaviours of domestic and overseas tourists to understand consumer expectations, perceptions and guide innovation in current and future tourism offerings.

Research on marketing Ireland as an attractive tourism destination (e.g. recent 10-year anniversary report on the success and sustainability of the Wild Atlantic Way).

Research to better understand the drivers and pressures facing those operating tourism businesses and their outlook for future development of their businesses.

Further assessment of the economic output of the sector and its constituent activities, at national and sub-national (regional or county level) to guide public policy, governance, planning and investment programmes.

Innovating for new opportunities

RKI to inform the development of new tourism products, for example the further development of eco-tourism and citizen science activities which provide attractive touristic offerings and leverage the value of Ireland's extensive natural capital, and maritime and cultural heritage.

Working with established and emerging sectors to provide tourism opportunities linked to offshore energy installations, aquaculture operations, fisheries, and ports.

Research to understand better the social, cultural and historical connections between Ireland's offshore islands, their distinctive biodiversity and archaeology, and the opportunities they provide for more integrated tourism.

Exploiting marine data, products and services, and new technologies

Using the availability of open access marine data, data products (e.g. visualisation, maps) and services (live data portals) to inform tourism operations (e.g. tidal and wave conditions, areas vulnerable to coastal hazards such as landslides, erosion or accretion).

Use data, data products and data services to enable new or previously unexploited opportunities for example in eco-tourism, wildlife tracking, and maritime heritage, including the extensive information on shipwrecks provided through the INFOMAR seabed mapping programme and the National Monuments Service's Wreck Inventory of Ireland Database (WIID).

RKI to explore the establishment of digital platforms to enable tourism operators and coastal businesses to share knowledge, skills and best practices and enable collaborative product development.

Transition to sustainable zero carbon business models

Solutions-focused RKI to enable marine and coastal tourism providers to reduce the environmental impact of their operations and transition to sustainable business models, in line with the Fáilte Ireland Climate action programme⁵⁰. This can include, for example, the electrification of ground transportation and recreational vessels, reduction of waste streams and improving coordination between operators and co-existence between activities and sectors.

Key Actions 2025-2026

Action	Relevant Bodies
28. Establish a dedicated cross-agency research programme to address key challenges linked to a just and efficient transition to a sustainable, climate-neutral and resilient coastal and marine tourism (in line with broader coordination efforts in coastal policy set out in the report of the Inter-Departmental Group on National Coastal Change Management Strategy ⁵¹).	FI, DETE, IFI
29. Promote the development of a specific work stream on coastal and marine tourism within EU programmes with corresponding support to transnational calls and RKI investment.	MI, IFI
30. Conduct an assessment of the energy usage and needs across marine and coastal tourism and propose viable policy and strategies and measures for reducing sectoral energy use and green-house gas emissions.	MI, FI, MRFF

⁵⁰ <https://www.failteireland.ie/climateactionprogramme.aspx>

⁵¹ Report of the Inter-Departmental Group on National Coastal Change Management Strategy (October 2023)

3.5 Safe and Secure Seas

The period up to 2050 will see a potentially five-fold increase in the usage of Europe's maritime space by offshore installations for energy and food production⁵². This rise in activity will bring with it increased risks to safety of navigation, pollution incident risk, increased demands on search and rescue services, and vulnerability to nefarious interference. Protection of strategic maritime interests, natural and other resources, and maritime infrastructure is fundamental to the sustainable development of a maritime economy and the meaningful assertion of sovereignty as a coastal state. These challenges are being addressed through the development by Government of Ireland's first Maritime Security Strategy in 2025.

The major planned expansion of Ireland's offshore renewable energy sector, in particular, will lead to a significantly greater number of strategically, economically and environmentally important assets and critical national infrastructures off Ireland's coasts that must be protected from harm. If we meet our 2030 and 2050 renewable energy targets, Ireland also has the potential to become a major generator of clean energy for the European continent, raising further the risk of interference, damage or attack by rogue actors.

Even in advance of the large-scale deployment of offshore renewable energy installations, there is an imperative to provide effective oversight and security of existing offshore assets, particularly those on the seabed such as energy pipelines, interconnectors, and power and telecommunications cables⁵³. Ireland's strategic position as a gateway from northern Europe to the Atlantic means that around three-quarters of all telecommunications cables in the northern hemisphere pass through or near Irish waters⁵⁴. The associated security requirements also present legal and governance challenges, as subsea cables generally have shared ownership and are not the property of a single state.

Monitoring the maritime domain – including the air, surface and subsea – is a critical enabler to provide government, state agencies and other organisations with data, knowledge and intelligence to support effective management and decision-making for maritime safety and security purposes. Our maritime space is already subject to substantial monitoring through operational programmes linked, for example, to weather and climate services; EU marine, water and nature directives; intergovernmental commitments such as **OSPAR**; and scientific programmes; but Ireland's capabilities in this area are currently fragmented and are operating in a governance, legal and regulatory environment that is unclear.

⁵² S S Pettersen et al 2023 J. Phys.: Conf. Ser. 2507 012005

⁵³ <https://www.hybridcoe.fi/>

⁵⁴ Robert McCabe & Brendan Flynn (2024) Under the radar: Ireland, maritime security capacity, and the governance of subsea infrastructure, *European Security*, 33:2, 324-344, DOI: 10.1080/09662839.2023.2248001

Addressing maritime threats and vulnerabilities through advanced data analytics, national and international cooperation, and enhancing advanced maritime situational awareness capabilities will be key areas for research, knowledge and innovation. Substantial opportunities exist, both for the state and for private sector actors, in the areas of maritime security, cybersecurity, advanced ocean technologies, offshore engineering, navigation technologies, data exchange and data analytics, metocean monitoring and forecasting, seabed and coastal monitoring, and digital products and services.

Ireland already holds extensive expertise in its technology sector. As of 2024, 16 of the top 20 global tech companies and the top three enterprise software providers are located in Ireland, as well as six of the top ten cybersecurity firms (2021). There is, therefore, an opportunity to leverage the value of these Irish-based technology companies and expertise to apply cutting edge technologies and advancements to multiple safety, surveillance and security challenges. Progress in meeting all of these challenges and opportunities should be supported by RKI across these technical and engineering domains but also in the natural sciences, climate science, ocean policy and governance, marine/environmental economics, social sciences and humanities.

Research, Knowledge and Innovation Priority Areas

Response to cyber and hybrid threats to offshore and coastal infrastructures

Assessments of and response options to cyber and hybrid threats to offshore and coastal infrastructures, essential safety infrastructure and assets to ensure safe navigation, to inform prevention and emergency response planning.

Assessment of threats and response options for the protection of critical national and underwater infrastructure to act as a deterrent or to mitigate potential risks and challenges in the maritime domain.

Advanced computational, modelling and predictive tools

Increased oceanographic modelling and predictive tools and capacities to inform optimum deployment of offshore installations, ship routing, operational and maintenance support and search and rescue.

Enhanced capacity for using big data analytics approaches supported by high-performance computing to inform complex interactions between environmental, climate and sectoral activities.

Managing increasing intensity in the use of marine space

Increased research in the areas of ocean governance, policy and planning, focusing for example on co-use, trade-offs, scenario building and testing to inform decision-making on marine spatial planning, consenting, licencing and co-existence of sectoral activities, maritime safety, surveillance, and search and rescue functions.

Assessment of the cumulative impact of ORE development and offshore wind farms on maritime activities including navigation, safety and sea traffic management.

Harmonisation and interoperability of maritime information and navigation technologies

Exploration of future systems to integrate radio navigation, radio communication and emerging technologies including further harmonisation and interoperability of maritime information and navigation technologies to ensure maritime safety, efficient transport and environmental protection.

RKI focused on understanding the risks and impacts arising from climate change and extreme weather and sea state conditions on surface, water column, seabed and sub-seabed installations, and associated adaptation mechanisms.

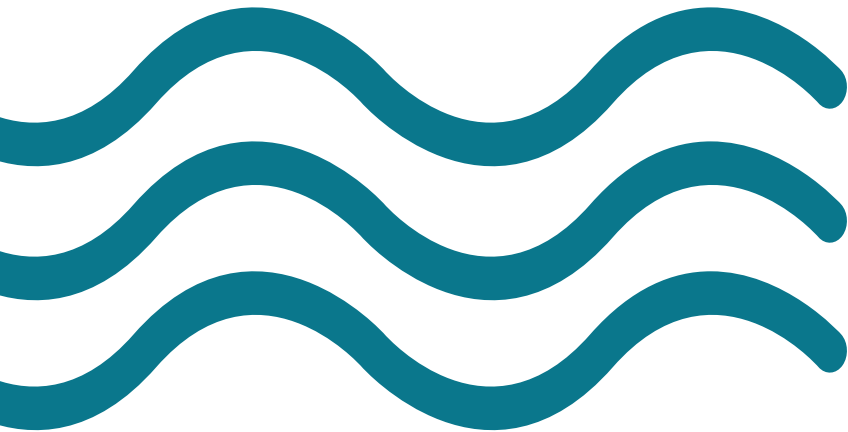
Application to maritime safety and security goals of a shared, data-centric High-Performance Computing (HPC) Platform coupled with federated data spaces with advanced analytical tools that will enable digital twin approaches to addressing maritime safety and security challenges and threats.

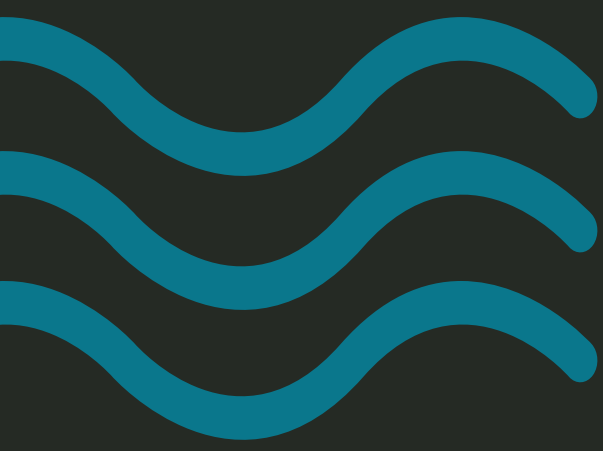
Research to better understand public attitudes towards maritime safety and security threats

Social science and humanities research to better understand public attitudes towards safety and security threats and acceptance of the substantial change in the use of marine space and coastal ports and infrastructures.

Key Actions 2025-2026

Action	Relevant Bodies
31. Evolve and expand the provision of land-based, near- and offshore test and demonstration facilities. Optimise applications and use of existing platforms such as offshore marine observation and data buoys and aids to navigation.	SEAI, MI, IL, INS (DoD), MÉ
32. Assess newly emerging risks and technical mitigations linked to deployment of ORE in Ireland’s maritime area. Develop tools, models and analysis to understand how new wind farm developments will impact on maritime risk.	DCEE, MI, IL, SEAI, MARA





4. ENABLERS FOR OCEAN KNOWLEDGE

Successful implementation of the actions set out in this strategy will require sufficient capacity and capability across the research and innovation system. Impact 2030, as the over-arching national Research and Innovation strategy, addresses a wide range of strategic challenges and goals linking the growth and development of our national research and innovation system, structures and processes to delivery of research excellence and beneficial societal impact. As marine and maritime forms a subset of the broader national R&I effort, many systemic issues addressed in Impact 2030 (e.g. PhD training, challenge-based funding, open research) are fully relevant in the context of achieving the goals of this strategy and will not be repeated here.



Ocean Knowledge 2030 focuses on those aspects of the public R&I system and structures that are specifically relevant to marine and maritime R&I. In particular, there is a need to identify gaps and future needs for an efficient and impactful R&I system linked to marine policy and sectoral demands and to set out a limited set of strategic actions to ensure that these are addressed within the broader framework of Impact 2030. These are framed here as ‘Enablers’ as they are critical to enabling delivery of the Ocean Knowledge 2030 Strategy, and are presented under six headings:

- Training, Talent and Expertise
- Marine Research Infrastructures
- Data and Digitalisation
- Partnerships, Networks and Connectivity
- Research-Industry Collaboration
- Funding and Investment

4.1 Training, Talent and Expertise

Human capacities are critical to underpin an effective and responsive RKI system. Human capacity refers to the development of and access to researchers and domain knowledge and expertise within the system, capable of responding to current and future RKI challenges. This can range from successful internship programmes for third-level students to leveraging the knowledge of leading academics and experts. The COVID-19 pandemic illustrated the importance of building and retaining human capital with critical knowledge and expertise within the national system, both to conduct research needed to address future challenges, and to ensure that there is a knowledge-based response to societal and economic challenges.

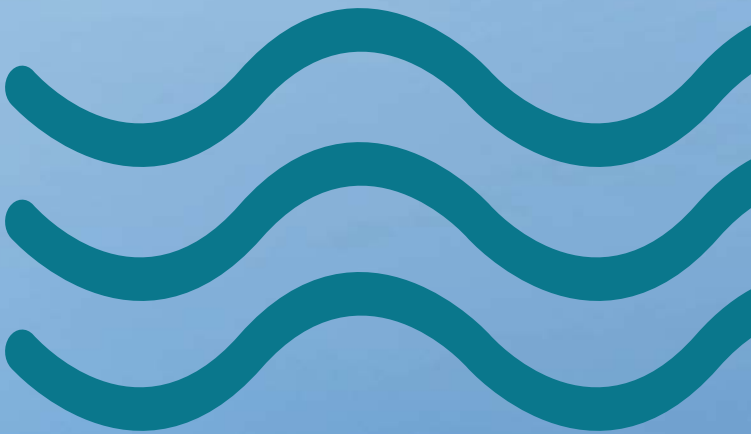
Across multiple marine and maritime sectors, employment, careers and skills opportunities are evolving rapidly, with the planned expansion of offshore renewables as one notable driver. The forthcoming changes in how we utilise our marine space will require multi-disciplinary solutions and graduates with knowledge and skill sets to meet the needs of employers and to solve complex challenges that cut across areas such as marine ecology, marine environment and metocean monitoring and assessment, physical oceanography, marine engineering, maritime law and governance, underwater cultural heritage, data science, social and economic sciences and more. It will also require a greater number of graduates with the right qualifications to meet the growing demand and drive innovation across sectors such as blue bioeconomy, offshore renewable energy, marine engineering, marine ecology or marine archaeology, as well as specialised academic programmes in fisheries and aquaculture, drawing from international best practice, to equip future generations with the skills required for sustainable seafood production and marine biodiversity management.

Our graduates of the future need to be provided with multi-disciplinary training, combining specialist learning in one discipline with a broad understanding of ancillary subject areas that enable problem-solving, innovation and entrepreneurship. Further development of e-learning approaches will enable cost-effective delivery of training programmes at scale and improve access to learning opportunities internationally.

A key consideration is the perception of marine and maritime as a recognised, competitive and attractive career pathway that appeals to school-leavers, graduates and early career professionals alike. Greater national coordination in the provision of placement and internship opportunities within marine companies and public bodies will also be important to give hands-on experience to students in secondary and tertiary education and to guide and inspire their career choices.

Key Actions 2025-2026

Action	Relevant Bodies
33. Investigate opportunities to strengthen and promote career pathways for students and graduates interested in pursuing a career in marine and maritime sectors, with a focus on gender equality, and aspects such as internships and placements, career days, supporting entrepreneurship, online access to training information, and options for a professional marine designation.	MI, BIM, EI, DETE, DCEE, NMCI
34. Examine and advance options for a new cohort-based postgraduate training programme in marine sciences.	MI
35. Develop and deliver, through hybrid and e-learning approaches, further postgraduate level material on seabed mapping and coastal change – to effectively support capacity-building and enhance the future talent and expertise in related marine sciences.	GSI, MI



4.2 Marine Research Infrastructures

The ocean is an exposed and unpredictable research arena that is costly to access. Research infrastructures provide the mechanism for scientists to interact with and study the marine environment and are an essential enabler for marine and maritime research and innovation⁵⁵. *In situ* ocean observing infrastructures such as data buoys, Argo floats, cabled observatories, deepwater moorings, GLOSS⁵⁶ and tide gauges, enable the collection of oceanographic, climate and metocean data and information, underpinning scientific research and evidence-based policy and management. Laboratories, test and demonstration facilities and digital infrastructures are also part of the national stock of marine research infrastructures. The research vessels, the RV *Celtic Explorer*, RV *Tom Crean* (Marine Institute), RV *Keary*, RV *Mallet* (GSI), and a range of smaller inshore vessels are critical to providing access to coastal and oceanic environments for academic and government scientists.

The Marine Institute's *Compendium of Marine Research Infrastructures in Ireland* report (2022)⁵⁷ provides a catalogue of 164 national infrastructures and large equipment owned and operated by 21 different organisations, including government bodies and higher education institutions. A key challenge is to ensure that infrastructures, observing platforms and large equipment are available to researchers in a way that promotes research excellence and impact.

Impact 2030 recognises the importance of research infrastructures as 'a critical element of an enabling R&I environment' and emphasises the need to make them as accessible as possible to researchers across the system. It commits to a number of actions leading to a framework for future capital investment in research infrastructure. It will be important to ensure that the specific challenges and opportunities for future advancement of marine research infrastructures are well reflected in this broader national exercise.

Ireland also engages proactively with EU projects and policy platforms on (marine) research infrastructures which are important to support knowledge exchange and best practice in the development, operation and management of strategically important infrastructures. This includes programmes that provide opportunities for access of Irish researchers to international infrastructure platforms and of overseas researchers to access Irish facilities (examples include European Multi-disciplinary Seafloor Observatory; the International Ocean Discovery (Drilling) Programme⁵⁸; and the Horizon Europe project, Aquarius⁵⁹).

⁵⁵ Data and e-infrastructure are addressed in Section 4.3

⁵⁶ <https://gloss-sealevel.org/> Global Sea Level Observing System

⁵⁷ *A Compendium of Marine Research Infrastructures in Ireland*. Marine Institute, 2022. ISBN 978-1-902895-77-2

⁵⁸ <https://www.iodp.org/>

⁵⁹ <https://aquarius-ri.eu/>

Looking ahead to 2030 some particular challenges include enabling optimum access conditions for researchers to national and international research infrastructures; ensuring that the research infrastructure base takes advantage of technological advancements (e.g. underwater robotics and autonomous underwater vehicles, machine-to-machine learning, eDNA monitoring technology, marine biodiscovery etc.); and ensuring that planning and permitting for test and demonstration facilities enables their rapid deployment in response to identified needs. A notable goal is the development of the planned Offshore Wind Centre of Excellence, a specific action under *Powering Prosperity*⁶⁰.

Key Actions 2025-2026

Action	Relevant Bodies
36. Prepare a draft strategic framework for future needs for marine research infrastructures and their operations as a sectoral contribution to the Impact 2030 national Research Infrastructure framework.	MI, MRFF
37. Advance planning to secure Government approval for a new national marine research vessel to replace the RV <i>Celtic Explorer</i> .	DAFM, MI
38. Maintain a fit-for-purpose national fleet capacity for inshore and shallow draft research.	GSI, DCEE



⁶⁰ Ireland's Offshore Wind Industrialisation strategy:
<https://enterprise.gov.ie/en/publications/powering-prosperity.html>

4.3 Data and Digitalisation

Ireland's national digital strategy, *Harnessing Digital – The Digital Ireland Framework*, was launched in 2022 to drive and enable the digital transition across Ireland's economy and society. Data and digitalisation are central to the delivery of government and public services and to the generation of new opportunities for enterprise and innovation.

An ever-increasing flow of marine data from *in situ* ocean observing platforms, automated sampling and smart sensors provides opportunities to transform the way we study and understand the ocean and offers new approaches for the management of marine resources⁶¹. In addition, the volume and breadth of space (satellite) data, freely available through our membership of both the EU and the European Space Agency, offers significant opportunities. Space enabled technology and datasets can provide policy makers and maritime businesses with critical information and evidence in areas such as navigation, weather, maritime safety and security.

Since the development of the Irish National Seabed Survey (2002-2006) and its successor programme INFOMAR⁶² (2007-2026), Ireland has been leading internationally in the quality and quantity of seabed data and offshore and nearshore marine mapping. These marine programmes were initiated to survey the shelf and coastal waters and to deliver a free, accessible, seamless baseline bathymetry data set to underpin the future management of Ireland's marine resource. This high-quality data has been used to delineate Ireland's marine territory but also to de-risk marine operations and increase safety in areas such as transport, fisheries, offshore energy, and marine telecommunications cables. It has also helped in our understanding of marine ecosystems, coastal change, marine heritage and climate studies impacting vulnerable coastal communities and infrastructure.

While substantial data systems and assets are in place, it is becoming clear that there is a deficit in the required coordination across organisations and programmes both at national level and in terms of Ireland's participation in international data and observation programmes. A coordinated and federated national marine evidence base, with scientifically validated marine data and associated digital capabilities, is now needed to support research, innovation and decision making for marine policy and management (e.g. mapping opportunities and constraints for Designated Marine Area Plans or DMAPs).

⁶¹ Guidi, L., et al. (2020) **Big Data in Marine Science**. Future Science Brief 6 of the European Marine Board, Ostend, Belgium. ISSN: 2593-5232. ISBN: 9789492043931. DOI: 10.5281/zenodo.3755793

⁶² <https://www.infomar.ie/irish-seabed-mapping>

Realising a national, open-access marine evidence base requires access to high-quality marine data from a wide range of sources, combined with the expertise and technologies to analyse, interpret the data and convert it into usable information. This requires data integration; data analyses and product development; data management and quality control; and user-focused visualisation and analyses tools. The application of new data standards and tools (e.g. cloud-optimised data lakes), and enhanced user-focused analytics tools (e.g. 3D spatial tools), allow for this data to be more readily applied to policy making, for marine management and for a broader understanding of our marine environment.

The need for updated technologies (e.g. for collection of benthic imagery), clearer and more robust guidelines (e.g. updates to Epibiota 2016 guidelines), and greater data standardisation is also acknowledged. Addressing these gaps will help ensure that data collection methods are aligned with international best practices, improving the overall quality and usefulness of marine data. Data feedback mechanisms between users, such as Met Éireann, and research and innovation providers, are essential to ensure that data collection processes remain user-driven, responsive, and aligned with evolving needs and priorities. Gaps in the data and information (e.g. data on inshore fisheries) also need to be identified and addressed, while other data which has high potential value e.g. aerial remote sensing data, can be difficult for stakeholders to access and use.

With the increasing application of artificial intelligence tools, there is also potential to better understand what is happening in our marine space through enhanced analysis of “big data” including very large data sets, the enhancement of predictive models, and the analysis of streaming data (e.g. video or acoustics). The adoption of artificial intelligence capabilities is dependent on well-defined processes, artificial intelligence models and underpinning trusted data, as well as robust validation frameworks to ensure that AI-driven outputs are reliable and align with regulatory and scientific standards.

This broadening of access to usable and trusted marine information will become increasingly important for marine planning, licensing and development, for marine operations, for environmental management, and for climate adaptation.

Key Actions 2025-2026

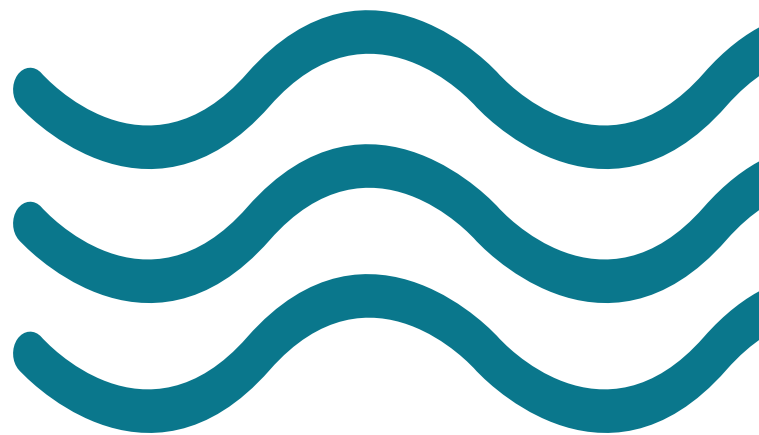
Action	Relevant Bodies
39. Convene a multi-agency forum to examine the full range of national marine and maritime monitoring and observing programmes and capacities, and data holdings for multiple purposes. The forum should identify critical data gaps, synergies, areas for potential cooperation and define a pathway to greater integration, federation, accessibility and use of data and associated products and services for marine environmental, climate monitoring, sectoral activities, safety and security purposes, in line with the Public Service Data Strategy. Links to international data programmes and networks should be considered as an integral part of this work.	DCEE, DHLGH, DAFM, DPEIPSRD, MI, MARA, GSI, EPA, NPWS, IL, MÉ, INS, IFI, OPW, BIM, NMS, others
40. Develop a national Marine Data Service with end-user digital services, an underpinning data hub, with standards, guidelines and quality assurance, enabled through partnership across key organisations.	DCEE, DHLGH, DAFM, MI, GSI, NPWS, MARA, EPA, IL, MÉ, OPW, LGMA
41. Support: (i) further development in the application of Artificial Intelligence (AI) for automated analyses of marine data, predictive models for climate, coastal change, seabed dynamics, oceanography and ecosystems (e.g. flooding, climate, marine operations); (ii) advancement of data visualisation, including development and adoption of increasingly sophisticated toolkits, with related models and multidisciplinary 4-dimensional data presented in user-focused ways and (iii) advancement of innovation in monitoring technologies (e.g. sensors, autonomous systems, and AI).	MI, MÉ, EPA, Research Ireland, GSI

4.4 Partnerships, Networks and Connectivity

Partnerships and networks provide a mechanism for individual researchers, research groups, institutions or the State to participate in and interact with peers and counterparts at multiple spatial scales (sub-national, national, regional/sea basin, EU and international). Across the marine R&I and ocean policy system, there is a complex array of such networks and partnerships, both formal and informal, with a diversity of scope and functions including the exchange of knowledge and best practice, direct collaboration on research projects and programmes, joint training, influencing and setting research policy and agendas, co-funding of research, and/or delivery of tangible products and services to advance common RKI goals.

At sea basin, EU and international level, Ireland already participates in numerous networks and partnerships and such participation delivers benefits which can sometimes be explicit and measurable but are often less tangible but no less valuable. The term ‘science diplomacy’ has emerged in recent years to encapsulate the value of international engagement, dialogue and cooperation through science and by scientists (also relevant for non-scientific disciplines). The deployment of Ireland’s political influence and scientific strengths and competencies as an island nation have been used very effectively to date.

It will be critical for Ireland to remain influential in the international arena by ensuring pro-active and targeted participation and leadership by experienced personnel with a clear mandate to act on behalf of the State. Increased recognition of the role and expertise of a national cohort of research and ocean policy professionals based in government departments and agencies is important to ensure that early career professionals see the value of these positions as attractive career opportunities.



Our researchers are key in developing and maintaining influence and cooperation through partnerships and networks at a national and international level and should be provided where possible with programmatic support to travel and participate. Competitive award schemes that provide small sums of money to support travel and networking are often highly impactful in underpinning research cooperation and the building of partnerships. Under Impact 2030, a number of flagship initiatives are included on “All-Island, EU and Global Connectivity” including Ireland’s participation in the European Research Area (ERA). The All-Island and UK-Ireland dimensions are of particular importance given the marine science and management challenges that are shared by neighbouring jurisdictions and the impact of Brexit on the lost opportunities for cooperation through EU programmes such as Interreg.

Key Actions 2025-2026

Action	Relevant Bodies
42. Develop a Shared Island collaborative marine R&I strategy to promote greater cooperation in marine and climate research and to identify and foster new funding opportunities for collaborative research.	MI, MRFF
43. Establish an inventory of marine R&I and ocean policy networks and partnerships and the representatives that participate in an Irish context to enable the full influence and impact of these activities to be better understood and communicated.	MI, MRFF

4.5 Research-Industry Collaboration

Ireland's Ocean Knowledge 2030 Strategy envisions a thriving Sustainable Blue Economy, built on the foundation of marine research, knowledge and innovation. As Ireland seeks to become a global leader in marine R&I, fostering strong linkages between research institutions and industry is crucial for research valorisation, accelerating innovation and bringing new technologies to market, therefore enhancing Irish competitiveness in the global Blue Economy, while attracting investment and creating jobs in coastal regions.

Research-industry collaboration is a cornerstone of a thriving marine innovation ecosystem, already championed in Ireland by the technology gateways such as CREDIT and Research Ireland Centres, such as MaREI, and facilitated through funding mechanisms such as Enterprise Ireland Innovation Vouchers and Partnerships, InterTradeIreland Innovation Boost, as well as the Marine Institute's Industry-led Awards scheme.

The private sector brings practical experience in deploying innovations at scale. By enhancing partnerships between public research institutions and marine industries, this strategy can help bridge the gap between scientific discovery and market applications.

Clusters play a pivotal role in fostering research-industry collaboration, driving innovation, and accelerating the commercialisation of marine technologies. By creating ecosystems where businesses, research institutions, and government bodies interact in close proximity, clusters facilitate the exchange of knowledge, resources, and expertise. In the marine sector, where technologies like offshore energy systems, marine robotics, and sustainable aquaculture systems often require extensive testing and validation, clusters can facilitate access to the necessary infrastructure and networks to move innovations from concept to market.

Successful examples of this model include the Maritime UK South-West⁶³ cluster in the UK and Norway's Ocean Autonomy Cluster⁶⁴, which have proven that proximity between academia and industry encourages dynamic partnerships. These clusters enable businesses, particularly start-ups and SMEs, to leverage testing facilities, share data resources, and engage in joint R&D projects. By doing so, they accelerate technology readiness levels (TRLs) and attract foreign direct investment (FDI) in cutting-edge marine innovations.

Ireland has already laid the groundwork for such collaborative success through the Marine Ireland Industry Network (MIIN)⁶⁵, which brings together companies, research organisations, and state bodies involved in the marine sector. To build on this momentum, formalising a national marine cluster could further support sustained innovation. Such a cluster could potentially facilitate companies with access to marine testbeds, facilitate collaborative research projects, and offer business development services to drive higher TRL development and the commercialisation of marine technologies.

⁶³ <https://maritimeuksw.org/>

⁶⁴ <https://oceanautonomy.no/>

⁶⁵ <https://marine-ireland.ie/>

Marine innovation hubs are also vital for fostering industry-research collaboration, serving as physical and digital spaces where academia, businesses, and government interact to drive technological development and commercialisation. These hubs often bring together researchers and entrepreneurs to work on joint projects, leveraging shared resources such as labs, testbeds, and data infrastructures. By facilitating access to research infrastructure, innovation hubs reduce the barriers to entry for start-ups and SMEs, enabling them to test and validate technologies in real-world conditions. They also create networks for knowledge exchange, enabling businesses to apply cutting-edge academic research to commercial projects in areas such as marine biotechnology/biodiscovery, offshore energy, and autonomous systems and acting as catalysts for public-private partnerships (PPPs).

Structured innovation pathways in the marine sector are essential for transforming research into practical solutions for challenges like sustainable seafood, biodiversity conservation, and ocean energy. These frameworks help Irish researchers and companies transition technologies from R&D to deployment, ensuring stronger collaboration between research institutions and industry. Without clear pathways, delays in adoption could hinder Ireland's Blue Economy growth and sustainability goals. A structured approach ensures marine innovations are both environmentally responsible and commercially viable, advancing Ireland's leadership in marine research and development.

In an era marked by rapid technological advancements and unprecedented environmental challenges, effective marine research and innovation require a strategic approach that anticipates future trends and disruptive technologies. Technology foresight, a systematic exploration of the long-term futures of science and innovation, provides a critical framework for shaping research agendas and guiding public and private investments in marine technologies. By leveraging foresight methods (early identification of weak signals and emerging trends, engaging a diverse panel of marine experts and visionary thinkers in shaping the future of ocean research) Ocean Knowledge 2030 aims to ensure that ocean research remains ahead of emerging challenges while harnessing breakthrough opportunities.

The integration of private sector knowledge into these foresight tools will bridge the gap between research and application, ensuring that innovations not only address long-term societal and environmental challenges but also have the potential for rapid commercialisation and widespread adoption. This approach will align with key international frameworks, such as the European Green Deal and the United Nations Decade of Ocean Science for Sustainable Development, by promoting innovations that enhance both the health of the oceans and the resilience of marine-based industries.

Other mechanisms to strengthen industry-research collaboration in Ireland's marine sector include integration of existing and new funding mechanisms, increasing access to research and innovation infrastructure, increasing co-investment and diversity of public-private partnerships, etc. These are further explored under Enabler 4.6, Funding and Investment.

Key Actions 2025-2026

Action	Relevant Bodies
44. Structure and implement an innovation audit focusing specifically on marine innovation hubs, following a systematic approach, gathering comprehensive data to assess the current ecosystem, identify gaps, and propose solutions for enhancing innovation capacity and establish a need (or otherwise) for innovation hubs with expertise in e.g. marine automation, marine data and monitoring technologies, and smart ports.	MI, MRFF
45. Conduct a feasibility study on the formalisation and development of a national marine cluster, building on the successes of Marine Ireland Industry Network (MIIN) and other related initiatives.	EI, MI, MRFF
46. Use technology foresight methodologies to identify emerging trends and opportunities in marine technology to pinpoint key areas where technology transfer can be accelerated, ensuring that innovations meet commercial realities and global challenges like sustainable ocean resource management. Engage private sector experts to provide insights into market-ready technologies and offer industry-standard adaptation strategies.	MI, MRFF
47. Develop a Marine Technology Knowledge Transfer and Innovation Roadmap as a means of a structured pathway to transition marine innovations from research to market, ensuring industry adoption of new technologies. This holistic roadmap will consolidate the marine R&I and technology development potential and will be facilitating collaboration across all marine industries, as well as helping identify further knowledge transfer and technology transfer needs.	MI, MRFF

4.6 Funding and Investment

Through collaborative funding efforts, commercialisation pathways, and research infrastructure support, Ocean Knowledge 2030 will ensure that Ireland remains at the forefront of global excellence in marine research and innovation while adhering to its core mission of promoting economic development and protecting the marine environment.

Diversified and synergistic funding and investment is vital to facilitate the overall strengthening of the marine innovation ecosystem, creating an enabling environment for enterprise innovation while protecting the marine environment. Additionally, engaging with the broader innovation and enterprise ecosystem ensures that the marine sector benefits from policies, initiatives, investments, and technologies stimulated through other complementary mechanisms (e.g. Enterprise Ireland supports, Marine Ireland Industry Network, and industry-research collaboration led by other organisations), making marine innovation more sustainable, competitive, and impactful.

The Shared Island Initiative, as outlined in the National Economic and Social Council (NESC) report⁶⁶, emphasises the importance of cross-border collaboration in addressing shared challenges, particularly in areas such as climate action, biodiversity conservation, and regional development. For the marine sector, this initiative presents a significant opportunity to foster joint research and innovation efforts that can benefit the entire island, for example through integrated marine ecosystem management, climate resilience projects, and sustainable ocean energy solutions. An all-island marine research and innovation programme could be developed to foster a consistent approach to shared research challenges by aligning supports across both jurisdictions.

⁶⁶ http://files.nesc.ie/nesc_reports/en/157_shared_island_comprehensive.pdf

Central to this endeavour will be the Marine Research Funders' Forum (MRFF), coordinating the multi-stakeholder funding efforts. By acting as a platform that brings together government departments, agencies, and marine knowledge stakeholders, the MRFF will drive a progressive approach to investment and funding, by:

- Coordinating with national and All-Island funding priorities, ensuring that different funding agencies work toward a unified vision. By aligning research funding priorities, commitments and investments across agencies, the Forum can ensure that marine research funding supports both strategic research projects, as well as marine innovation.
- Identifying opportunities to combine national and international funding sources, private and public funds, and generally, collaboration on initiatives targeting research and innovation ecosystem enablers, exploring co-funding opportunities, alternative funding mechanisms and new funding models, thus maximising Ireland's marine research potential.
- Ensuring alignment with and responsiveness to global trends in research and innovation for ocean policy and the blue economy, being sensitive and adaptive to evolving challenges and opportunities, advancing an effective and efficient funding and investment framework.
- Mainstreaming marine innovation into the national and international innovation frameworks, allowing for cross-sectoral collaboration which is essential for addressing complex challenges such as climate change and sustainability.

Analysis of available data clearly indicates that countries with strong investments in marine research and innovation, such as Norway and Denmark, consistently outperform others across various dimensions, including public-private partnerships, R&D output, marine digitalisation, and offshore renewable energy. OECD's The Ocean Economy in 2030⁶⁷ report notes that "consistent and substantial investment in research, innovation, and marine infrastructures drives competitive advantages, particularly in countries with long-term strategies for ocean-related industries".

This data reinforces the importance of strategic investment in driving marine innovation leadership, particularly in emerging sectors. Internationally recognised approaches such as the OECD STIP Compass⁶⁸, provide comparative information and data across research, industry, and government sectors linking this in turn to levels of public budgetary expenditure in the marine sector.

By instituting regular benchmarking, Ireland can identify gaps in investment and adjust its strategies to align with global best practices, ensuring that national policies are responsive to the evolving marine innovation landscape. A benchmarking framework for Ireland would offer transparent, comparative insights into how investment directly correlates with research and innovation performance, ensuring that Ireland leads in marine research and technology.

⁶⁷ https://www.oecd.org/en/publications/the-ocean-economy-in-2030_9789264251724-en.html

⁶⁸ <https://stip.oecd.org/>

Key Actions 2025-2026

Action	Relevant Bodies
48. Pursue further diversification and sustainability of funding and investment mechanisms in targeted marine research (including co-funding and collaborative funding), facilitated by the MRFF, as well as initiating and facilitating access to and engagement with, current and future opportunities through EU and international funding and investment frameworks (including alternative and new models), while ensuring alignment with national, global, sectoral and other relevant policies, objectives and priorities.	MRFF
49. Investigate and pursue opportunities to establish and fund a multi-disciplinary, and multi-institutional national ocean research centre of excellence.	MI, MRFF, Research Community
50. Explore, promote, initiate and coordinate All-Island funding and investment approaches, crucial for shared marine research, marine innovation, and marine knowledge and technological development (e.g. through the All-Island Climate and Biodiversity Research Network, and the North South Research Programme, or a dedicated joint research funding stream).	MRFF
51. Instigate a benchmarking framework for marine research and innovation, tracking the investment and R&I performance of 2-3 comparable marine nations to assess and review Ireland's position as a leader in marine research, knowledge and innovation (baseline and progress). Track past, current and future marine sector budget expenditure data for Ireland to correlate with trends in marine research and innovation.	MI, MRFF



5. OPTIMISING IMPLEMENTATION AND IMPACT

The development of Ocean Knowledge 2030 is the result of a comprehensive and collaborative process that engaged a wide range of stakeholders across the marine research and innovation ecosystem. It has been shaped through extensive consultations with government departments and agencies, researchers, industry, environmental organisations, and the public, while ensuring alignment with national and EU priorities such as those set out in the National Research and Innovation Strategy, Impact 2030, Ireland's National Development Plan 2021-2030 and the European Union's Green Deal and digitalisation agenda.



This consultative process was critical in identifying the key opportunities and challenges facing Ireland's marine sectors and in formulating a strategy that reflects national and international commitments to sustainability, climate action, and a thriving blue economy supporting sustainable jobs across multiple marine and maritime sectors. By integrating diverse perspectives, the strategy is designed to foster a more cohesive and impactful approach to marine research and innovation, with the aim to position Ireland as a leader in the global marine landscape.

As Ocean Knowledge 2030 sets the strategic direction for Ireland's marine research, knowledge and innovation systems from 2025 to 2030, ensuring its successful implementation requires a clear, structured framework focused on tangible outcomes and measurable impacts.

The implementation and impact of Ocean Knowledge 2030 will involve the following core tenets:

- A coherent implementation framework, linked to effective oversight, progress monitoring and evaluation mechanisms;
- Aligning investments and resources;
- Building cross-sectoral synergies, stakeholder engagement and partnerships;
- Maintaining adaptability to evolving challenges and opportunities.

Below is a suggested Monitoring and Evaluation framework designed for effective oversight of the strategy, aligned with international best practices in marine and innovation sectors.

Focus	Implementation Body	Membership
Oversight Level – Strategic Vision and Direction Meets once a year	Marine Research & Innovation Oversight Group	Representatives of relevant Departments
Steering Level – Orchestration, Monitoring of Objectives Meets Biannually (minimum)	Marine Research Fundors' Forum (MRFF)	Participating agencies and departments, chaired by MI
Working level – Action – level Meet as needed	Marine Institute	Ocean Knowledge 2030 Programme Manager and personnel

The complex, multi-dimensional nature of marine challenges means that implementing Ocean Knowledge 2030 requires leveraging synergies across various sectors, including fisheries, offshore renewable energy, coastal tourism, and marine biotechnology and this is reflected within the implementation framework.

Continuous engagement will be vital to this approach, including a broad range of stakeholders, such as the public sector, coastal communities, NGOs, and industry players, throughout the implementation phase. A Programme Manager, based at the Marine Institute, will report and work under the general direction of the MRFF and will facilitate and service the steering activities along with ensuring positive collaboration and engagement with the broad range of relevant stakeholders, both state agencies and private business, driving the delivery of the actions contained in Ocean Knowledge 2030.

Ocean Knowledge 2030 implementation activities will align with relevant **Regional Enterprise Plans'** working group fora, reflecting the **Smart Specialisation Strategy for Innovation 2022-2027**, helping to foster and encourage innovation and enterprise in coastal regions that support local economies through job creation, particularly in emerging marine sectors such as offshore wind, aquaculture and green shipping, as well as with the National Development Plan 2021-2030 which acknowledges the research and innovation as a key economic and social differentiator.

The ultimate success of Ocean Knowledge 2030 will depend on its ability to inform policy and create positive societal outcomes. An effective implementation framework begins with defining Key Performance Indicators (KPIs) that are aligned with national and international goals (including Impact 2030 System Impact review outcomes⁶⁹) and this strategy will be accompanied by an implementation and impact framework that will detail specific metrics that will help capture progress and impact of Ocean Knowledge 2030. Regular monitoring and reporting against these KPIs will help ensure that Ocean Knowledge 2030 is achieving its intended impact and will allow for course corrections where necessary. Ongoing progress monitoring will take place at working level, within the action sub-groups, by implementation partners, in ongoing liaison with the Programme Manager. An informal progress report will be made to the MRFF twice per annum, ensuring the steering of the strategy. An annual progress report will be published to report on the advancement of the Ocean Knowledge 2030 strategic objectives and actions, along with a progress presentation being presented at oversight level.

Given the dynamic nature of marine environments and the evolving landscape of marine research, Ocean Knowledge 2030 must remain adaptable. Interim progress reviews will be essential to reassess priorities, adjust actions and KPIs, and ensure alignment with new economical, technological, environmental and other developments, as well as evolving governmental policies and priorities, always ensuring alignment. This continuous feedback loop will allow the strategy to remain relevant and impactful.

⁶⁹ Improve how R&I impact is defined, driven and monitored. <https://hea.ie/assets/uploads/2017/04/Impact-2030-Progress-Report-May-23.pdf>

At the end of the strategy's term in 2030, an ex-post evaluation will be undertaken, to ensure that best practices and lessons learned generated during its implementation are effectively captured to inform future strategies, as well as reflecting on its impact. The formal evaluation will assess effectiveness, determining whether the strategy achieved its goals, and efficiency, examining how resources were utilised and evaluate the relevance of the strategy in addressing the evolving needs of the R&I marine sector and stakeholders and the external environment.

The frequency and mechanisms for monitoring and reporting are summarised in the table below:

Progress Monitoring Frequency	Mechanism	Medium
Ad-Hoc/ongoing (Working Level)	Action Sub-Groups	Informal discussions (meetings and roundtables)
Twice a year (Steering level)	MRFF	Progress presentation at the Forum
Once a year (Oversight Level)	Marine Research & Innovation Oversight Group	Progress presentation with the Oversight Group
Once a year (Public)	Programme Manager, with inputs from MRFF and Oversight Group	Written report publication
Once every 2 years (action term review)	Programme Manager, with MRFF and input from Oversight Group	Progress presentation to MRFF and Oversight Group including supplement to the written progress publication.
At the end of Strategy term (2030)	External Evaluator	Evaluation Report for open publication

APPENDIX A

Key Actions 2025-2026

Action	Relevant Bodies
Living with a Changing Ocean	
The Ocean-Climate Nexus: Ocean Physics and Chemistry	
1. Ensure ocean and climate research challenges, including those identified in the Irish Ocean Climate and Ecosystem Status Report 2023, are incorporated in the annual Climate Action Plans and the outputs of the forthcoming Framework to Guide Climate and Climate-Related Strategic Research and Innovation.	DCEE, MI, MÉ, GSI
2. Build national capacity in ocean, seabed and coastal modelling, the development of sector-specific digital twins ⁷ , and the advancement of digital products and innovation to underpin national climate and planning policy and the provision of climate services.	MI, MÉ, GSI, DCEE, DAFM, DHLGH, IL
3. Establish an implementation and monitoring framework for the multiple research recommendations made in the Irish Ocean Climate and Ecosystem Status Report 2023 and a mechanism and resourcing to secure future updates of this national assessment at appropriate intervals.	MI, MÉ
4. Advance Ireland's leadership role in international climate-related ocean and coastal research initiatives, including the Horizon Europe Missions, JPI Climate and JPI Oceans, World Meteorological Organisation marine and coastal programmes, and the contribution of Irish experts to the IPCC assessment process.	MI, EPA, MÉ

⁷ In this strategy, digital twins refer to evolving digital models and tools that integrate real-time data and simulations to enhance the understanding, management, and sustainability of marine environments. As the technology advances, these tools will be utilised in diverse ways, from monitoring marine ecosystems to optimising offshore infrastructure, ensuring they meet the needs of the research and operational objectives.

Action	Relevant Bodies
Marine Geology, Seafloor and Coastal Change	
5. Support capacity-building measures to enhance the future pipeline of talent and expertise in the areas of marine geology, geophysics, hydrography and coastal change.	GSI, MI, Research Ireland
6. Build national capacity in ocean mapping, geological and paleoclimate research, coastal behaviour, and the advancement of digital products and innovation to underpin national policies.	GSI, MI, DCEE
7. Advance Ireland's leadership role in international ocean mapping and coastal research, through the Horizon Europe, EMODnet and International Ocean Discovery Programme (IODP).	MI, GSI
8. Advance national capacity for <i>in situ</i> , real-time coastal and marine data collection and coordination and data life-cycle management in ocean mapping and coastal change.	GSI, MI
Marine Biodiversity and Ecosystem Functioning	
9. Support capacity-building measures to enhance the future pipeline of talent and expertise in the areas of marine biodiversity, taxonomy, ecology and ecosystems research.	MI, Research Ireland, NBDC
10. Enhance Ireland's leadership and participation in the second phase of the Horizon Europe Mission, Restore our Ocean and Waters by 2030.	MRFF, MI
Offshore and Maritime Cultural Heritage	
11. Support capacity-building measures to enhance future research on Underwater Cultural Heritage (UCH) within the public and private sectors and educational institutions.	NMS, GSI, MI
12. Support existing and develop new research frameworks for UCH and World Heritage marine areas across multiple stakeholders.	NMS, GSI, MI
13. Build on existing and develop new ways of raising awareness of the importance, value and benefit of UCH as a key part of our marine environment, responsible ocean protection and sustainable blue economy.	NMS, GSI, MI

Action	Relevant Bodies
Ocean Governance and Law	
14. Coordinate the necessary research, skills and capacity assessments required to inform the ongoing development of the State's planning, consenting and regulatory functions and the associated mechanism to ensure provision of relevant data and evidence to inform their activities.	DCEE, MARA, ABP, DAFM, MI
15. Commission a desk-based study to ascertain the national impacts and implications of the BBNJ Agreement, and to examine how Ireland can best contribute to achieving the objectives of the Agreement through marine research, and through related capacity building and transfer of marine technology activities to assist developing countries.	MI, DFAT, DCEE
16. Contribute to BBNJ-related capacity building and transfer of marine technology activities to assist developing countries, including through the provision of training/placement opportunities to scientists from developing countries.	MI, DFAT, DCEE
17. Support and contribute to marine research relating to deep-sea ecosystems and related matters to help to inform the work of the International Seabed Authority, and support and contribute to relevant capacity building activities to assist developing countries.	MI, DFAT, DCEE
The Ocean's Benefit and Service to Society	
18. Advance national coordination and capacity in marine socio-economics, environmental and ecosystem accounting and ocean economy measurement, making further progress towards an ocean economy satellite account for Ireland.	MI, UG, CSO, OECD
19. Establish a biannual 'Ocean Barometer' survey on citizen attitudes and perceptions on ocean health, policies, issues and impacts.	MI, UG
20. Investigate opportunities to enable bottom-up citizens' initiatives, complementary to existing funding instruments in this area (e.g. Community Climate Action Programme) and local government interventions and national citizen science strategies such as the draft Marine Biodiversity Citizen Science Strategy (2023-2028).	MI, CAROs, NBDC

Action	Relevant Bodies
Towards a Sustainable Ocean Economy	
Sustainable Food from the Ocean	
21. Design and implement a dedicated RKI programme on ‘Sustainable Food from the Ocean’ with coordinated funding and multi-annual calls linked to the RKI priorities set out above. The programme should target tangible and measurable impacts in advancing all stages of the seafood value chain, taking account of barriers linked to markets and regulation to deliver a world-class seafood production that is sustainable, circular, safe, secure and supporting innovation across the value chain.	MI, DAFM, BIM, Teagasc
22. Align cross-programme opportunities to support research in the blue bioeconomy leveraging national funding mechanisms and EU programmes including the European Maritime Fisheries and Aquaculture Fund, the Sustainable Blue Economy Partnership (SBEP), and Circular Biobased Europe (CBE JU), promoting the transition to sustainable, low-carbon, low impact seafood production.	MI, BIM, Research Ireland, DAFM
Energy from the Ocean	
23. Increase and improve national coordination in providing targeted RKI supports to ORE value chain SMEs through existing and new programmes and calls. Maximise the value of research and innovation activities, where relevant, through business coaching, facilitating collaboration and wider enabling support. Ensure close coordination and alignment of different national RKI programmes, and engagement with international, EU and European Space Agency programmes and coordination forums.	SEAI, EI, MI, Research Ireland, DETE, ME
24. Accelerate progress on agreed actions under Powering Prosperity (Actions 26, 27, 28) and the Future Framework for ORE (Actions 3, 4) to plan, promote, support engagement with and use of existing marine test and demonstration facilities/sites and explore feasibility of additional marine test site (e.g. for Floating Wind).	SEAI, DETE, DCEE, MI, IL
25. Develop a focused ORE research and innovation strategy for Ireland with clear objectives in support of the sustainable delivery of government targets for ORE. The strategy should build on the ORE Technology Roadmap, address gaps in support and monitor ongoing technology developments and innovations³⁹.	SEAI

³⁹ Action included in the SEAI ORE Technology Roadmap

Action	Relevant Bodies
Greener and Smarter Ports and Shipping	
26. Engage with strategic partners in the UK and EU to identify opportunities for joint transnational investments and projects in greener and smarter ports and shipping, leveraging international funding streams.	MI, DoT
27. Undertake a maritime RKI capacity assessment to determine capability within the system and critical gaps in knowledge and expertise that should be addressed through capacity building investments.	MI
Tourism in Coastal and Marine Areas	
28. Establish a dedicated cross-agency research programme to address key challenges linked to a just and efficient transition to a sustainable, climate-neutral and resilient coastal and marine tourism (in line with broader coordination efforts in coastal policy set out in the report of the Inter-Departmental Group on National Coastal Change Management Strategy ⁵¹).	FI, DETE, IFI
29. Promote the development of a specific work stream on coastal and marine tourism within EU programmes with corresponding support to transnational calls and RKI investment.	MI, IFI
30. Conduct an assessment of the energy usage and needs across marine and coastal tourism and propose viable policy and strategies and measures for reducing sectoral energy use and green-house gas emissions.	MI, FI, MRFF
Safe and Secure Seas	
31. Evolve and expand the provision of land-based, near- and offshore test and demonstration facilities. Optimise applications and use of existing platforms such as offshore marine observation and data buoys and aids to navigation.	SEAI, MI, IL, INS (DoD), MÉ
32. Assess newly emerging risks and technical mitigations linked to deployment of ORE in Ireland's maritime area. Develop tools, models and analysis to understand how new wind farm developments will impact on maritime risk.	DCEE, MI, IL, SEAI, MARA

⁵¹ Report of the Inter-Departmental Group on National Coastal Change Management Strategy (October 2023)

Action	Relevant Bodies
Enablers for Ocean Knowledge	
Training, Talent and Expertise	
33. Investigate opportunities to strengthen and promote career pathways for students and graduates interested in pursuing a career in marine and maritime sectors, with a focus on gender equality, and aspects such as internships and placements, career days, supporting entrepreneurship, online access to training information, and options for a professional marine designation.	MI, BIM, EI, DETE, DCEE, NMCI
34. Examine and advance options for a new cohort-based postgraduate training programme in marine sciences.	MI
35. Develop and deliver, through hybrid and e-learning approaches, further postgraduate level material on seabed mapping and coastal change – to effectively support capacity-building and enhance the future talent and expertise in related marine sciences.	GSI, MI
Marine Research Infrastructures	
36. Prepare a draft strategic framework for future needs for marine research infrastructures and their operations as a sectoral contribution to the Impact 2030 national Research Infrastructure framework.	MI, MRFF
37. Advance planning to secure Government approval for a new national marine research vessel to replace the RV <i>Celtic Explorer</i> .	DAFM, MI
38. Maintain a fit-for-purpose national fleet capacity for inshore and shallow draft research.	GSI, DCEE

Action	Relevant Bodies
Data and Digitalisation	
39. Convene a multi-agency forum to examine the full range of national marine and maritime monitoring and observing programmes and capacities, and data holdings for multiple purposes. The forum should identify critical data gaps, synergies, areas for potential cooperation and define a pathway to greater integration, federation, accessibility and use of data and associated products and services for marine environmental, climate monitoring, sectoral activities, safety and security purposes, in line with the Public Service Data Strategy. Links to international data programmes and networks should be considered as an integral part of this work.	DCEE, DHLGH, DAFM, DPEIPSRD, MI, MARA, GSI, EPA, NPWS, IL, M��, INS, IFI, OPW, BIM, NMS, others
40. Develop a national Marine Data Service with end-user digital services, an underpinning data hub, with standards, guidelines and quality assurance, enabled through partnership across key organisations.	DCEE, DHLGH, DAFM, MI, GSI, NPWS, MARA, EPA, IL, M��, OPW, LGMA
41. Support: (i) further development in the application of Artificial Intelligence (AI) for automated analyses of marine data, predictive models for climate, coastal change, seabed dynamics, oceanography and ecosystems (e.g. flooding, climate, marine operations); (ii) advancement of data visualisation, including development and adoption of increasingly sophisticated toolkits, with related models and multidisciplinary 4-dimensional data presented in user-focused ways and (iii) advancement of innovation in monitoring technologies (e.g. sensors, autonomous systems, and AI).	MI, M��, EPA, Research Ireland, GSI
Partnerships, Networks and Connectivity	
42. Develop a Shared Island collaborative marine R&I strategy to promote greater cooperation in marine and climate research and to identify and foster new funding opportunities for collaborative research.	MI, MRFF
43. Establish an inventory of marine R&I and ocean policy networks and partnerships and the representatives that participate in an Irish context to enable the full influence and impact of these activities to be better understood and communicated.	MI, MRFF

Action	Relevant Bodies
Research-Industry Collaboration	
44. Structure and implement an innovation audit focusing specifically on marine innovation hubs, following a systematic approach, gathering comprehensive data to assess the current ecosystem, identify gaps, and propose solutions for enhancing innovation capacity and establish a need (or otherwise) for innovation hubs with expertise in e.g. marine automation, marine data and monitoring technologies, and smart ports.	MI, MRFF
45. Conduct a feasibility study on the formalisation and development of a national marine cluster, building on the successes of Marine Ireland Industry Network (MIIN) and other related initiatives.	EI, MI, MRFF
46. Use technology foresight methodologies to identify emerging trends and opportunities in marine technology to pinpoint key areas where technology transfer can be accelerated, ensuring that innovations meet commercial realities and global challenges like sustainable ocean resource management. Engage private sector experts to provide insights into market-ready technologies and offer industry-standard adaptation strategies.	MI, MRFF
47. Develop a Marine Technology Knowledge Transfer and Innovation Roadmap as a means of a structured pathway to transition marine innovations from research to market, ensuring industry adoption of new technologies. This holistic roadmap will consolidate the marine R&I and technology development potential and will be facilitating collaboration across all marine industries, as well as helping identify further knowledge transfer and technology transfer needs.	MI, MRFF
Funding and Investment	
48. Pursue further diversification and sustainability of funding and investment mechanisms in targeted marine research (including co-funding and collaborative funding), facilitated by the MRFF, as well as initiating and facilitating, access to and engagement with, current and future opportunities through EU and international funding and investment frameworks (including alternative and new models), while ensuring alignment with national, global, sectoral and other relevant policies, objectives and priorities.	MRFF
49. Investigate and pursue opportunities to establish and fund a multi-disciplinary, and multi-institutional national ocean research centre of excellence.	MI, MRFF, Research Community
50. Explore, promote, initiate and coordinate All-Island funding and investments approaches, crucial for shared marine research, marine innovation, and marine knowledge and technological development (e.g. through the All-Island Climate and Biodiversity Research Network, and the North South Research Programme, or a dedicated joint research funding stream).	MRFF
51. Instigate a benchmarking framework for marine research and innovation, tracking the investment and R&I performance of 2-3 comparable marine nations to assess and review Ireland's position as a leader in marine research, knowledge and innovation (baseline and progress). Track past, current and future marine sector budget expenditure data for Ireland to correlate with trends in marine research and innovation.	MI, MRFF



An aerial photograph of the ocean with white-capped waves breaking against a deep blue background. The perspective is from directly above, showing the intricate patterns of the water's surface.

OCEAN **KNOWLEDGE 2030**