Interim Review of the National Marine Research & Innovation Strategy 2017-2021

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National Marine Research & Innovation Strategy 2017-2021

The National Marine Research & Innovation Strategy aims to provide a framework within which funding for marine research can be targeted most effectively to areas of strategic importance. It allows research funders, working in partnership with the Marine Institute, to assess the impact and likely return to the state from research investment in marine related research. It is also designed to ensure that state support for marine research results in Irish researchers being able to compete at an international level and participate fully in transnational research projects. The Strategy outlines 16 key implementing actions.

The National Marine Research & Innovation Strategy continues to be implemented as a whole of government strategy. As part of the Strategy's implementing actions a Marine Research Funders' Forum was established as a strategy implementing mechanism in 2018.

The Forum brings together organisations with the aim of enhancing coordination in marine related research funding, whilst also addressing a number of the implementing actions set out in the Strategy.

Further information is available on the Marine Research Funders' Forum webpage.

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Executive Summary

Introduction and Background

This independent review examines the National Marine Research and Innovation Strategy ('MRIS') 2017-2021 and progress towards achieving the goals and implementing actions as set out in the Strategy. Indecon International Research Economics were appointed by the Marine Institute to undertake the assignment following a competitive tender. The review represents an assessment of the progress of the strategy, including a review of implementing structures and any emerging outputs and associated impacts.

The primary goals of the MRIS 2017-2021 were:

- Goal 1: To increase research capability across all 15 research themes;
- Goal 2: To ensure research funding is targeted to match requirements outlined in state policies and sectoral plans; and
- Goal 3: To ensure coherence in the funding of marine research by the various marine research funders.

Summary of Progress towards achievement of MRIS Goal 1

As part of the implementation of the MRIS, a Marine Research Database was compiled which collated data from public funders on competitive funding awarded for marine-related research. This is an evolving database that will be updated as new projects come on stream. This database is used in this review to examine various research activities as part of the MRIS. Over the period of the MRIS up to the end of 2019, over €240 million was awarded in grant aid to support marine-related research in Ireland. It must be noted that state funding for non-competitive investment in research and infrastructure was not included. This database has enabled Indecon to undertake a rigorous analysis of the levels of research maturity across the 15 different MRIS themes.

The first goal of the MRIS is to "raise the research capacity across all themes." Based on the analysis undertaken in Section 3 of the main report, it is unlikely that this goal has been achieved so far. However, there are a number of important caveats that should be considered when interpreting whether this overarching goal has been achieved. The analysis of research capacity in relation to infrastructure is limited by a lack of data on infrastructure that is supported via non-competitive awards. This means that it is difficult to assess the research maturity levels in relation to the infrastructure component. The level of research maturity has increased in more than half of all themes but declined in some themes.

A summary of the key findings in relation to the objective of increasing research capacity is provided in the table below.

Indecon Findings on Research Capacity (MRIS Goal 1)
• European and Exchequer funding is critical for marine research in Ireland. Indecon's assessment suggests that without public funding, the extent of marine-related research would be significantly lower.
• The strategy has facilitated collaborations and is likely to have helped leverage other funding sources. There is, however, a relatively low level of collaboration with enterprise reported in certain research themes (e.g., transport, tourism, climate).
• There have been low levels of funding for new research infrastructure other than that provided by SFI support and the investment in a new research vessel. However, there is a significant gap in the data in relation to existing state infrastructure.

- Significant variation in levels of research capacity across marine research themes are evident.
- The level of research maturity has increased in the majority of research themes but has declined in some themes.
- There may be potential to achieve increased EU funding over time and to build on the success of the Strategy in this area.

Source: Indecon

Summary of Progress towards achievement of MRIS Goal 2

The second goal of the MRIS relates to the targeting of research funding. This targeting should reflect policies and sectoral plans. As discussed previously, this targeting is a secondary goal to the overall goal of increasing research capacity. There does not appear to have been any specific targeting of themes with lower levels of research maturity.

Marine researchers surveyed by Indecon indicated a high degree of awareness of the funding instruments available to support marine-related research. Nearly 80% of researchers also indicated that they were aware of the MRIS objective that marine research should be targeted. This suggests that the funding instruments are well communicated by the research funders. Each of these funders provides different types of funding instruments. SFI has provided a range of funding supports, e.g., block grants through SFI research centres (MaREI, iCRAG & BiOrbic), infrastructure, e.g., ocean observation, and investigator/project awards. In terms of competitive calls, the majority of the other research funders have supported marine-related research through project-specific awards. The Marine Institute's Marine Research Programme also directly support early-stage researchers as well as providing infrastructure supports. SEAI, BIM and MI focus some of their funding on industry awards. There is a notable gap in data in terms of industry awards through Enterprise Ireland.

Indecon's main findings on the focus of investment are presented in the next table.

Indecon Findings on Funding Instruments and Focus of Investment (MRIS Goal 2)

- Nearly 80% of marine researchers are aware of the funding instruments available to undertake marine research in Ireland.
- Over 56% of marine researchers believe that public bodies are effective in co-ordinating marine research.
- Project-specific funding is the typical approach to support marine research. There are small supports for direct fellowship awards and there are some Centre of Excellence awards. Centres of Excellence are much larger funding investments which often cover multiple themes and have multiple funding investments.
- The targeting of funding does not appear to have been directly linked with the levels of research maturity identified in the MRIS. However, there have been some exceptions.
- There is a significant reliance on a small number of funders for certain research themes.
- There may be scope for further leveraging effects through supports for specific projects and infrastructure.

Source: Indecon

Summary of Progress towards achievement of MRIS Goal 3

The third primary goal of the MRIS was to increase coherence in how public funders support marine research. The achievement of this goal was supported by proposed structures that were outlined in the MRIS. The implementation plan that accompanied the MRIS set out 16 actions. A number of the actions have been largely completed. There is, however, a need to establish an inventory of marine research infrastructure as well as examining access to infrastructure. Indecon's analysis shows that there has also been some progress made in increasing collaboration with industry and in establishing international partnerships. The analysis presented in the next table indicates areas where there was good progress as well as elements where progress has been delayed.

Indecon Findings on Monitoring and Implementation of the MRIS (MRIS Goal 3)
• There are a large number of public funders who support marine research in Ireland. • The MRIS set out an implementation plan with 16 different actions and a number of actions set out in the MRIS have not yet been completed. • The MRFF is likely to have supported greater levels of coordination among public funders. • The development of the Marine Research Database will increase transparency and co-ordination of funding awards in the next strategy. • A co-ordinated cross-organisation group to identify infrastructure deficits was not progressed. • There is a need to develop more refined impact indicators involving the integration of impact measures used by individual funders.
Source: Indecon

Recommendations

Indecon's recommendations are designed to support the ongoing progress towards the achievement of the MRIS goals and to inform the preparation and orientation of its successor, post-2021. The recommendations presented in the next table are designed to enhance the impact and effectiveness of the strategy.

Summary of Key Recommendations
1. Reduce the number of research themes for the next strategy
2. Establish the infrastructure requirements needed to enhance marine research
3. Consider the common funding priorities of the MRFF and the establishment of sub-groups
4. Increase investment in promotion and dissemination of research findings
5. Incentivise increased policy relevance for more mature research themes
6. Encourage greater collaboration with enterprise
7. Facilitate greater engagement with EU Programmes for research and innovation by establishing mentoring programmes involving previously successful applicants
8. Develop better impact measures building on measures used by funders
Source: Indecon analysis

1. Reduce the number of research themes for the next strategy

There are currently 15 research themes with a further eight sub-themes within the National Marine Research and Innovation Strategy (MRIS). Many of these themes have been awarded little research funding over the last four years and are at low levels of research maturity. While there is value in many of the objectives of these themes, consolidation into other research themes should be considered. This would assist in the reporting of progress and allow greater scope within themes for a variety of research projects to be supported. It should also be noted there are a number of interlinkages across different research themes and this should be considered in any consolidation of research themes. This could encourage greater integration and cross-collaboration. It may also reduce the risk of researchers working in silos within very specific research themes.

2. Establish the infrastructure requirements needed to enhance marine research

The analysis undertaken by Indecon highlights the relatively low level of new infrastructure investment across the majority of research themes over the period of the strategy. In addition, there is a notable lack of information on the use of existing infrastructure. One of the implementation actions in the MRIS was the establishment of a Marine Infrastructure Providers' Forum. This action has not been progressed and Indecon recommends that this should be taken forward at an early stage of the next strategy. The MRFF group should consider what existing databases (such as the EPA's Water Infrastructure database) might be relevant and how these could be used to create a comprehensive marine infrastructure database.

3. Consider the common funding priorities of the MRFF and the establishment of sub-groups

The Marine Research Funders' Forum (MRFF) brings together a group of research funders, government departments and organisations. Indecon believes that there is scope for the creation of some small ad hoc temporary groups to be formed as a result of discussions at the MRFF meetings. There are likely to be areas of common research interest and this would suggest the merit in establishing ad hoc temporary groups that could support research and provide further impetus for co-funding of research projects. These groups should also explore the opportunities for integrated funding instruments. Indecon is, however, cognisant of the existing structures that have been established to coordinate research funding and do not believe that any new sub-groups should replace these existing structures.

Indecon also believes that there may also be merit in having a longer MRFF session during each year which gives time to discuss key strategic developments. This session could also identify key organisational participants in the main research themes to increase a sense of ownership of the different research themes.

4. Increase investment in promotion and dissemination of research findings

The communication aspect of the next research strategy should be strengthened. This could be achieved in a number of ways, including further expansion of website dissemination of research reports. We note, however, that significant progress in this regard has been made across a large number of research funders. Indecon believes that there would be merit in producing an annual public document that highlights the progress and impact of the strategy. The Marine Institute, as the co-ordinator of marine research in Ireland, should also consider building further linkages with radio, television and other media. These linkages could be used to assist researchers in disseminating their research to a wider audience. While open access is often not high on researchers' priorities,[1] dissemination of research findings is important to maximise the benefits of marine research. Indecon notes that Creating Our Future, a multi-organisation initiative, is being conducted in 2021 to achieve a deeper engagement among citizens, researchers and policymakers. Subject to available

[1] https://eua.eu/resources/publications/888:research-assessment-in-the-transition-to-open-science.html

resources, the organisation of an annual seminar and other initiatives to increase the profile of the MRIS would merit consideration.

5. Incentivise increased policy relevance for more mature research themes

As research maturity increases, the focus should be placed on the policy impact of funded research. There are a number of ways that this may be achieved through modification of existing grant agreements and via the design of new research calls. The latter could include assigning a weighting to projects that have explicit public policy implications. Incentivising and supporting researchers to disseminate their research to key policymakers is recommended. This would assist in ensuring that the research completed supports the development and implementation of evidence-based policy. This could be assisted through small research dissemination grants or the hosting of regular policy symposia. Given the importance of the research informing policy, consideration of a range of measures to enhance policy impact would be desirable. This could also include the facilitation of researchers spending time in a policy environment.

6. Encourage greater collaboration with enterprise

There have been collaborations with industry during the MRIS but this has varied by research theme. Collaborations include industry partners forming part of project teams and also industry-specific research awards. There is scope for increased collaboration with enterprise especially in research themes where research maturity has increased such as renewable energy. This would increase the commercial impacts of the strategy. However, there is a notable gap in the data relating to enterprise collaboration. This should be examined in the context of the next strategy.

7. Facilitate greater engagement with EU Programmes for research and innovation by establishing mentoring programmes involving previously successful applicants

Marine researchers have been successful in securing significant EU supports and this is an important achievement. This suggests a strong foundation on which to increase overall funding. There are a number of ways that this increase could be assisted by the public funders, for example through enhanced investments in ERANet co-funds – these are often a strong "priming tool" to establish a track record in EU collaboration in R&I activities and as a precursor and to augment broader EU proposal engagement. The grant application process for some of the larger European projects can be challenging to navigate. To help address this, supports should be provided involving mentoring sessions with previously successful applicants. This would be particularly important for early-stage researchers who are looking to increase the scope of their research. There may also be potential to provide targeted funding to assist researchers in completing grant applications, such as the funding available through Enterprise Ireland to assist grant writing for EU projects. The costs of such supports would be very small but could assist researchers applying for larger grants.

Many marine research projects in the Interreg programme and Horizon 2020 programme were closely linked with or led by UK partners. This leaves a gap in relationships with potentially strong future research partners in the EU. Similarly, the Interreg Ireland-Wales programme, a less competitive source of research funding, will now cease to exist. Given this changed environment, it will be important to proactively facilitate the building of new European research relationships to access EU consortium funding without dependency on UK partners. Greater links could be developed with the Contact Points for the European Territorial Cooperation Programmes in the Regional Assemblies, who work with many of these EU based successful applicants on a regular basis and understand the requirements of the programmes.

8. Changes should be made to develop better impact measures building on measures used by funders

The current assessment of the MRIS is largely based on the monitoring of inputs and activities rather than impacts. It is important that the impact of funded research is given increased attention. Indecon believes that the next marine research and innovation strategy should outline how impacts will be measured/evaluated.

This is especially important for themes with higher levels of research maturity. In order to examine the various likely impacts of marine-related research, significant effort will be required in designing an evaluation framework that captures the various aspects of research impact. This framework should involve the analysis of quantitative and qualitative data that captures the broader impacts of marine-related research as well as the extent and quality of research outputs.

There are a range of possible KPIs that could be developed to support the monitoring of the next marine research and innovation strategy. These are outlined in Section 6 of the main report. There is no single indicator that can capture the multi-layered impacts of marine research. It must also be noted that a project commenced in October 2020 to address Action 7.6 of Innovation 2020 which will develop a standardised classification of public investment in research. This project will also consider a set of national KPIs to measure the impact of RDI investment. Indecon believes that the next marine research and innovation strategy should review proposed measures (national and EU) and consider how these may assist with monitoring the impact of the strategy.

Overall Conclusions

This interim review suggests that the National Marine Research and Innovation Strategy is aligned with the national objectives set for research and supports the national objectives of the marine sector. As this is an interim review, it is not possible to make definitive conclusions on whether the strategy has delivered on all of the objectives of the MRIS. However, the evidence indicates that the strategy is appropriately structured and has supported the development of research capacity in the marine area.

1. Introduction and Background

1.1. Introduction and Scope

This independent review examines the performance to date of the National Marine Research and Innovation Strategy ('MRIS') 2017-2021. Indecon International Research Economics were appointed by the Marine Institute to undertake the assignment following a competitive tender. The review represents an assessment of the progress of the strategy including a review of implementing structures and any emerging outputs and associated impacts.

The MRIS is supported by a number of public bodies whose funding and investments contribute to supporting the development of Ireland's overall marine research capacity and research needs. The research strategy is based on 15 themes. The level of research funding for marine research is small in the context of national research funding but over the period to the end of 2019 amounted to approximately €240 million in research grant aid. This represents an increase in funding since the Sea Change strategy period. This should be considered in the context of the significant increase in expenditure on Research and Development (R&D) since 2013. Indecon estimates that marine research accounts for around 1.3% of the overall expenditure on Gross Domestic Expenditure on R&D (GERD) in Ireland in 2019. Recent evidence has also shown that Government Budget Allocations for R&D (GBARD) has increased to €869 million in 2020. This represents nearly an 18% increase on 2017 levels.

The overall aim of this review is to assess progress in achieving the three goals of the National Marine Research and Innovation Strategy. These three goals are:

- Goal 1: Raise the research capacity across all themes;
- Goal 2: Research funding should be targeted, within the overall goal of raising research maturity, to topics matching requirements articulated in state policies and sectoral plans; and
- Goal 3: There should be coherence in the approach to marine research by the various state actors involved in funding marine research.

To assess progress against these goals the review includes:

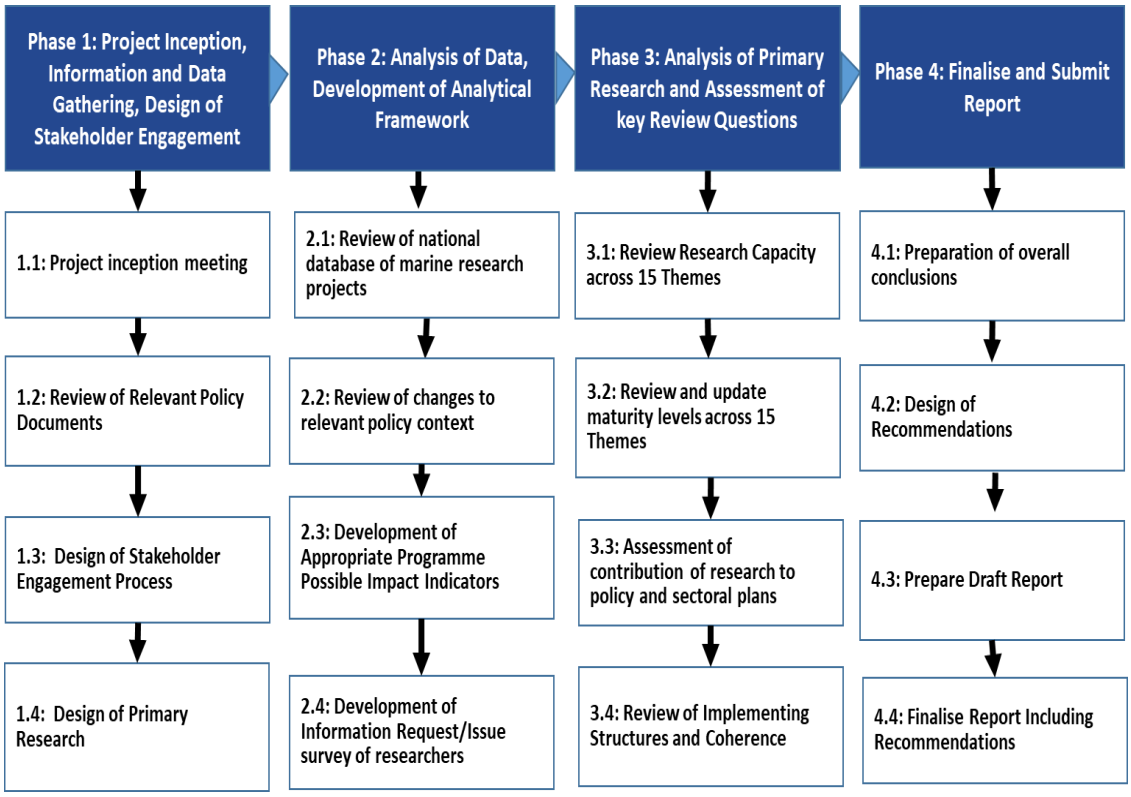
- A review and update of maturity levels across the 15 research themes;
- An analysis of the focus of investment and funding instruments across the 15 research themes;
- Identification of changes in policy that require the focus of funding to be re-visited; and
- A review of the implementing actions and structures.

The review also considers "Impact" metrics that might be used to provide a better understanding of the impact of the strategy. The review also analyses the Marine Research Database that collates information on publicly funded marine research in Ireland.

1.2. Methodology of Review

Figure 1.1 presents a schematic summary of the methodology and work programme applied in completing this study. The methodology applied in this assessment is consistent with international best practice.

Figure 1.1: Methodological Approach



Source: Indecon

The methodological approach examines both quantitative and qualitative sources of evidence to inform the key conclusions of the review. The approach also considers the key evaluation questions and examines how the existing structures align with the successful achievement of the key objectives of the strategy.

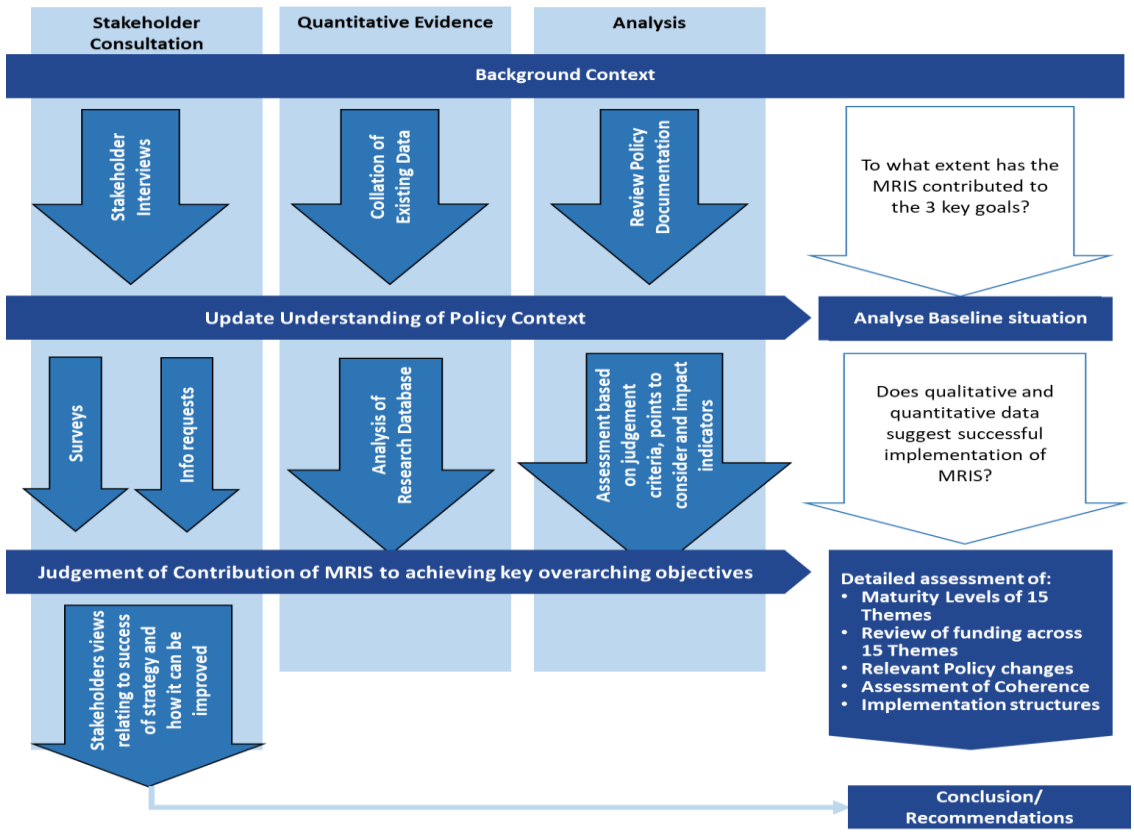
A range of different qualitative and quantitative tools were used in this review including:

- Detailed stakeholder interviews/review of submissions;[2]
- Information Requests/Survey of marine researchers; and
- Analysis of Marine Research Database collected by the Marine Institute in collaboration with members of the Marine Research Funders Forum.

A graphical illustration of how the research analysis has led to the key conclusions and recommendations is shown in Figure 1.2. This graphic highlights the different research inputs that were considered as part of the review and show how they linked to the key evaluation questions that were set out in the requirements for this review.

[2] The survey of marine researchers and the stakeholder submissions are included in the Annexes

Figure 1.2: Link between Methodological Approach and Formulation of Recommendations



Source: Indecon

1.3. Policy Background

The National Marine Research and Innovation Strategy 2017-2021 identifies 15 marine-related research themes. These themes are based on the goals set out in *Harnessing Our Ocean Wealth* which was published in 2012. These themes are listed in the table below. These 15 themes are grouped into three broad areas with a number of sub-themes, as shown in the next table.

Table 1.1: Research Themes in National Marine Research and Innovation Strategy 2017-2021		
A Thriving Maritime Economy	**Healthy Marine Ecosystems**	**Engagement with the Sea**
Bioresources	Biodiversity, ecosystems & food-webs	Ocean literacy & education
Advanced technologies	Pollution & litter	Integrated policy & governance
Subsea resources	Climate change	Information & spatial technologies, analytics and modelling
Renewable energy	Ocean observation and seabed mapping	Engineering
Tourism & leisure		
Transport & logistics		
Security & surveillance		
Source: National Marine Research and Innovation Strategy 2017-2021		

There are a number of National and European policies that are relevant to the National Research and Innovation Strategy, including:

- Harnessing Our Ocean Wealth (2012);
- Innovation 2020;
- Project Ireland 2040;
- Offshore Renewable Energy Development Plan (2014);
- Climate Action Plan (2019);
- EU Green Deal (2020);
- UN Decade of the Ocean (2017);
- National Policy Statement on the Bioeconomy (2018);
- Horizon 2020/Horizon Europe;
- FoodWise 2025 (2015); and
- Programme for Government (2020).

A summary of the key policy documents is outlined in the table below which summarises the various policy and strategic documents that were reviewed in this section. This table also highlights the relevant areas within each document that relate most directly to research and innovation in the marine sector. Further details regarding the policy context are presented in the Annexes.

Table 1.2: Summary of Key Documents Reviewed	
	Key points of relevant to Marine research
Innovation 2020	Action 4.17 – Support progress towards the Harnessing Our Ocean Wealth targets through coordinated marine research and development strategies
Harnessing Our Ocean Wealth	Sets out the vision, goals and actions for Ireland's marine affairs; 5 key actions under the RKTI area – cross-agency collaboration, targeting funding of marine research, complete the INFOMAR seabed mapping programme, improve data availability of marine statistics, support facilities
Project Ireland 2040 – NDP & NPF	More focus at local levels; importance of maritime economy. NPO 42 supports renewable energy
Climate Action Plan 2019	Specific focus on offshore wind; support ocean energy research; supply chain for offshore renewable energy; blue bioeconomy
EU Green Deal	Investing in environmentally-friendly technologies and supporting innovation in industry; Development of a clean energy system is key to the European Green Deal
UN Decade of the Ocean	States that ocean science accounts for a small portion (between 0.04% and 4%) of total research and development expenditures worldwide, and call for an increase in funding in this area
National Policy Statement on the Bioeconomy (2018)	Key actions include promoting coherence within the bioeconomy; support development of bio-based products; targeting EU and private funding
Horizon 2020 / Horizon Europe	Key priorities include: systemic solutions for the prevention, reduction, mitigation and removal of marine pollution including plastics; transition to a circular and blue economy; adaption to and mitigation of pollution and climate change in the ocean; sustainable use and management of ocean resources; development of new materials, new feed and food
Food Wise 2025	Development of CoE for seafood development in Ireland; develop research programme on the potential of marine species as possible high value sources of pharmaceutical, cosmetic and renewable energy products. We note that a successor strategy is currently in development which will have a significant R&I section, which will be of direct relevance to the next marine strategy.
Programme for Government (2020)	Continued emphasis on the sustainable development of the marine sector; programme of R&D in marine sequestration, wave technology, offshore renewables and the bioeconomy. End issuing of new licenses for exploration and extraction of gas and oil.

Innovation 2020 is a key policy document that sets how Ireland will become a global leader in terms of research and innovation. It sets out a number of actions and priorities for marine research including the development of a national marine research and innovation strategy. A mid-term review of Innovation 2020 was undertaken in 2019 and showed that the implementation of I2020 is progressing well. The review also highlighted the need for increased investment to further develop research talent and infrastructure. Similarly, significant additional investment in R&D will be required in order to meet I2020 targets.

Since the mid-term review of I2020, the responsibility for the implementation has been transferred to a new Government Department (Department of Further and Higher Education, Research, Innovation and Science (DFHERIS)). This Department has prepared a submission to the National Development Plan Review to highlight the need for increased investment in R&I. DFHERIS is also leading on the development of the successor strategy to I2020.

1.4. Report Structure

The following section examines the marine research activities that have been supported by public funding across the 15 research themes. Section 3 reviews the levels of research maturity across each of the 15 research themes. In Section 4 the focus of the investment and how this aligns with identified needs is examined. Section 5 considers the implementation of the strategy. Section 6 examines the impact of the strategy. The final section presents Indecon's independent conclusions and recommendations for the remaining period of the current strategy and for the next marine research and innovation strategy.

1.5. Acknowledgements and Disclaimer

We would like to take this opportunity to express our gratitude to the wide range of organisations and individuals who played an important role in, or contributed to, the completion of this review. Particular thanks are due to Niall McDonough, Veronica Cunningham, Jenny O'Leary and Keillan Clancy of the Marine Institute.

We also acknowledge with thanks the very large number of marine researchers who took time from their busy schedules to contribute to this review and responded to Indecon's information request and provided valuable inputs and insights on their experiences with the publicly funded marine research. As part of the review, we undertook a detailed consultation process which included inputs from representatives from DECC, DHLGH, DAFM, SFI, Inland Fisheries Ireland, SEAI, BIM, GSI, NPWS, Met Éireann, InterTrade Ireland, Enterprise Ireland and the EPA. We would also like to thank all members of the Marine Research Funders Forum who provided useful inputs to the review. These stakeholder consultations provided very valuable inputs to the review which we acknowledge with thanks.

The usual disclaimer applies and the views and analyses contained in this report are the sole responsibility of Indecon.

2. Overview of Marine Research Funding

2.1. Introduction

This section examines the relevant inputs and activities relating to publicly funded marine research in the context of the National Marine Research and Innovation Strategy ('MRIS') during 2017-2019. The following analysis is based primarily on the Marine Research Database that has been developed as part of the work of the Marine Research Funders' Forum.

This section lays out the analysis of the levels of research funding activity across the different research themes. This analysis feeds into the specific theme-by-theme review that is undertaken in Section 3. This analysis should be considered in the context of the significant increase in expenditure on research and development since 2013. Indecon estimates that marine research accounts for around 1.3% of the overall expenditure on GERD in Ireland in 2019. Recent evidence has also shown that Government Budget Allocations for R&D (GBARD) has increased to €869 million in 2020. This represents nearly an 18% increase on 2017 levels.

2.2. Funding of Marine Research

As shown in Table 2.1, over €240 million in competitive funding has been committed to marine research over the time period of the MRIS.[3] The figures presented in this report are based on all competitively funded marine research projects that were active between 2017 and 2019. This includes projects that were awarded funding prior to 2017 but were still active on the 1st of January 2017. These projects have been included in the analysis as "pre-2017" projects. However, any projects that were awarded and completed prior to 2017 are excluded from this analysis.

It should also be noted that there is a lag between when a project is awarded and when it commences and draws down funding so projects that were awarded in 2019 may not produce research outputs for a number of years.

Table 2.1: Overall Funding for Marine Research in Ireland

€ million	Pre-2017	2017	2018	2019
No of Projects[4]	242	137	108	91
Agreed Grant Aid	118.1	35.6	52.3	34.4
Agreed Total Project Cost	137.5	42.7	57.2	36.7
Average Grant Aid per Project	0.49	0.26	0.48	0.38

Note: Pre-2017 refers to projects that started before 2017 but were still active on the 1st January 2017
Source: Indecon analysis of Marine Research Database

[3] An additional €7m funding has been awarded through the Marine Institute's Ship-time Programme. Further details are available in Section 2.7

[4] This does not include any projects relating to networking which are typically small projects

The MRIS funding support is spread across 15 themes. The number of projects supported, by theme, is shown in Table 2.2. This indicates that renewable energy and bioresources are the research themes which have been awarded the most research funding. The research theme relating to renewable energy accounts for 31% of research funding. The Bioresources research theme accounts for 17% of funding. Six research themes (in terms of grant aid funding) account for only 9% of the overall funding awarded to marine-related research. Compared with the same period of the Sea Change strategy, Bioresources have remained at a very similar level in terms of research funding. The largest increase is in relation to renewable energy where the research funding has nearly tripled compared to the previous strategy.

Table 2.2: Number of Marine Research projects supported, by MRIS Theme

	Number of Projects by Theme[5]			
	Pre-2017	**2017**	**2018**	**2019**
Advanced Technologies	15 (16)	8 (17)	5 (8)	0 (6)
Biodiversity, Ecosystems and Food-webs	28 (11)	15 (13)	13 (3)	18 (4)
Bioresources	41 (20)	36 (13)	26 (13)	15 (6)
Climate Change	9 (1)	13 (2)	7 (2)	9 (2)
Engineering	1 (4)	3 (3)	4 (1)	2 (4)
Information and Spatial Technologies, Analytics and Modelling	16 (13)	6 (11)	3 (6)	1 (5)
Integrated Policy and Governance	8 (9)	7 (10)	4 (4)	3 (4)
Ocean Literacy and Education	2 (4)	1 (1)	1 (1)	1 (2)
Ocean Observation and Seabed Mapping	36 (9)	12 (6)	7 (3)	6 (6)
Pollution and Litter	12 (3)	6 (2)	7 (4)	4 (1)
Renewable Energy	40 (5)	25 (2)	24 (3)	22 (2)
Security and Surveillance	0 (1)	2 (1)	2 (0)	0 (0)
Subsea Resources	13 (7)	9 (6)	4 (1)	9 (2)
Tourism and Leisure	1 (2)	4 (0)	3 (0)	2 (0)
Transport and Logistics	1 (3)	1 (3)	0 (1)	5 (1)

Note: Pre-2017 refers to projects that started before 2017 but were still active on the 1st January 2017
Note: The figures above do not include funding for networking and research dissemination activities.
Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research
Source: Indecon analysis of Marine Research Database

The overall levels of grant funding awarded to each theme, shown in Table 2.3 indicates the funding awarded to renewable energy is significantly larger than any of the other themes. Analysis of secondary themes highlights research themes where there are clear linkages. For example, a significant number of research projects had Advanced Technologies as a secondary theme. This is similar to the Information and Spatial, Technologies, Analytics and Modelling theme. These two themes are cross-cutting and are important in modern multidisciplinary research.

[5] This counts all projects supported by the SFI MaREI Research Centre as one project. This applies to all figures in the report

Table 2.3: Overall Funding for Marine Research, by MRIS Theme				
	Value of Projects by Theme (€ million)			
	Pre-2017	2017	2018	2019
Advanced Technologies	7.4 (26.1)	1.8 (3.4)	3.7 (4.2)	0 (3.3)
Biodiversity, Ecosystems and Food-webs	13.7 (5.7)	4.4 (3)	3 (9.5)	4 (1)
Bioresources	16.7 (13.1)	8.2 (5.8)	9.4 (3.8)	6.3 (2.3)
Climate Change	4.2 (0.5)	3.7 (3.3)	3.7 (2.7)	1.8 (1.2)
Engineering	1.4 (0.9)	0.9 (0.5)	2 (0.1)	2.7 (1.1)
Information and Spatial Technologies, Analytics and Modelling	4.5 (4.9)	0.8 (2.2)	2.4 (1.8)	0.5 (3.7)
Integrated Policy and Governance	2.4 (2.7)	3.4 (3.1)	1 (1.3)	2.3 (0.7)
Ocean Literacy and Education	3.1 (0.7)	0.1 (0)	0.3 (0.1)	0 (0.2)
Ocean Observation and Seabed Mapping	10.4 (7)	1.5 (1.3)	4.1 (3.3)	1.2 (0.8)
Pollution and Litter	2.3 (0.2)	4.2 (0.1)	10.7 (0.8)	1 (0)
Renewable Energy	48.6 (4.9)	4.6 (0.1)	10 (0.5)	10.9 (1)
Security and Surveillance	0 (0.1)	0.3 (0.1)	0.5 (0)	0 (0)
Subsea Resources	1.2 (0.7)	0.8 (0.6)	0.3 (0.1)	0.8 (0.2)
Tourism and Leisure	0.4 (0.4)	1.7 (0)	1.3 (0)	1.8 (0)
Transport and Logistics	0.1 (1)	0.3 (0.8)	0 (0.2)	1.8 (0.3)
Note: Pre-2017 refers to projects that started before 2017 but were still active on the 1st January 2017				
Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research				
Source: Indecon analysis of Marine Research Database				

It is also useful to examine the difference between total project cost and agreed grant aid. Agreed grant aid will be the same as total project cost if the only sources of funding come from Irish or European public funding. Other contributions, such as private contributions, will be added to the grant aid amount to establish the total amount. Such differences are most likely for projects that involve industry collaboration.

Table 2.4: Difference between Agreed Grant Aid and Total Project Cost			
€ million	Agreed Grant Aid (€ million)	Agreed Total Project Cost (€ million)	% Difference
Renewable Energy	74.1 (6.5)	94.95 (6.73)	28.14% (3.5%)
Bioresources	40.6 (24.9)	42.04 (26.55)	3.55% (6.63%)
All other Themes	125.6 (105.4)	137.2 (122.0)	9.2% (15.8%)
Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research			
Source: Indecon analysis of Marine Research Database			

A simple ranking of the different research themes by the number of projects and by the value of projects is shown in Table 2.5. This shows that Renewable Energy and Bioresources are the two highest-ranked research themes. For example, Renewable Energy has the highest number of projects and is therefore ranked as No. 1 on this metric.

Table 2.5: Rankings of Marine Research Topics, by theme

	Ranking by No. of Projects	Value of Projects (Ranking by Agreed Grant Aid)	Value of Projects (Ranking by Total Project Cost)
Advanced Technologies	8 (2)	7 (1)	7 (1)
Biodiversity, Ecosystems and Food-webs	3 (4)	3 (3)	3 (3)
Bioresources	1 (1)	2 (2)	2 (2)
Climate Change	5 (13)	6 (7)	6 (6)
Engineering	11 (8)	10 (9)	10 (10)
Information and Spatial Technologies, Analytics and Modelling	9 (3)	9 (4)	9 (5)
Integrated Policy and Governance	10 (5)	8 (6)	8 (7)
Ocean Literacy and Education	14 (11)	12 (13)	13 (13)
Ocean Observation and Seabed Mapping	4 (6)	5 (5)	5 (4)
Pollution and Litter	7 (10)	4 (12)	4 (12)
Renewable Energy	2 (8)	1 (8)	1 (8)
Security and Surveillance	15 (14)	15 (15)	15 (15)
Subsea Resources	6 (7)	13 (11)	12 (11)
Tourism and Leisure	11 (14)	11 (14)	11 (14)
Transport and Logistics	13 (11)	14 (10)	14 (9)

Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research
Source: Indecon analysis of Marine Research Database

2.3. Analysis of Marine Research Projects Funded

An important aspect of marine research is both the type of funder and the type of bodies that receive funding. This has implications for the level of research capacity across the various research themes. This will be examined further in Section 3. Based on the figures in Table 2.6, the European Commission is the largest funder of marine research and innovation. European Commission funding comes through a variety of channels including Horizon 2020 and Interreg. Outside of these research funds, the European Commission also funds research and innovation activity through structural funds such as the European Maritime Fisheries Fund (administered by Bord Iascaigh Mhara, e.g., through their Knowledge Gateway Scheme and via the Marine Institute, through the Marine Biodiversity Scheme and a number of research surveys at sea carried out, e.g., under the Data Collection Framework). The European Commission also funds research across the widest variety of research themes. It must also be noted that the funding outlined below is awarded following competitive research calls. There may also be other research funding awarded to researchers who are employees of the bodies engaged in marine research.

Table 2.6: Number of Marine Research projects supported, as Lead Funder

LEAD Funder	Number of Projects supported	No. of Themes supported*
Bord Iascaigh Mhara (EMFF)	21	1
Department of Agriculture, Food and the Marine	21	4
Department of Environment, Climate and Communications	2	1
Environmental Protection Agency	26	6
European Commission	188	14
Geological Survey Ireland	29	6
Irish Research Council	50	14
Irish Shelf Petroleum Study Group	8	6
Marine Institute Marine Research Programme (inc. EMFF)	118	13
Science Foundation Ireland (SFI)	65	11
Sustainable Energy Authority of Ireland	48	8

Note:* this includes secondary research themes
Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017
Source: Indecon analysis of Marine Research Database

There are ten main public funders of marine research in Ireland. The largest Irish funder of marine research is Science Foundation Ireland (SFI) who have provided supports to large research centres in line with the National Research Prioritisation exercise and the subsequent Refresh Exercise - Research Priority Areas 2018 to 2023 which was published in March 2018. This resulted in funding to three SFI Centres that have substantial marine elements. The next largest funder is the Marine Institute who manages the Marine Research Sub-Programme, a competitive funding programme across a broad range of marine-related research areas. See Table 2.7 overleaf.

Table 2.7: Overall Funding (Agreed Grant Aid) for Marine Research, by Funder (€ million)					
	Value of Projects				
	Pre-2017	2017	2018	2019	Total
Bord Iascaigh Mhara (EMFF)	0.03	1.61	1.8	0.34	3.78
Department of Agriculture, Food and the Marine	9.87	0.31	0.84	1.31	12.32
Department of Environment, Climate and Communications	2.48	.	.	.	2.48
Environmental Protection Agency	2.26	0.85	1.75	0.66	5.52
European Commission	42.16	24.56	32.12	22.64	121.49
Geological Survey Ireland	1.89	0.19	0.38	0.19	2.66
Irish Research Council	1.31	0.72	0.48	1.12	3.63
Irish Shelf Petroleum Studies Group	.	0.02	0.12	0.39	0.52
Marine Institute Marine Research Programme	10.76	4.44	6.41	3.35	24.97
Marine Institute (EMFF)	.	1.67	1.31	1.56	4.55
Science Foundation Ireland (SFI)	39.07	1.4	4.19	1.64	46.3
Sustainable Energy Authority of Ireland	6.09	0.65	1.04	1.51	9.29
Includes Co-funding** ***Note: Pre-2017 refers to projects that started before 2017 but were still active on the 1st January 2017 ***Source: Indecon analysis of Marine Research Database***					

The majority of marine research projects are led by higher education institutions which account for 52% of all marine research projects. Also significant is the extent to which Irish researchers have collaborated with international institutions on large EU-funded research projects. Over 15% of marine research projects have been led by SMEs. It must be noted that a large number of research projects are led by international organisations. The figures in this analysis only include the funding awarded to Irish based institutions as part of these projects led by international organisations.

Table 2.8: Number of Marine Research projects supported, by Type of Institution				
Type of Organisation (Lead Organisation only)	Number of Projects			
	Pre-2017	2017	2018	2019
Higher Education Institution	156	53	37	52
International	46	46	31	22
Public Body	13	13	13	6
SME	27	25	26	10
Note: Pre-2017 refers to projects that started before 2017 but were still active on the 1st January 2017 ***Source: Indecon analysis of Marine Research Database***				

Around 59% of competitive marine research funding goes to the HE sector. Based on the figures in the table below, around 22% of marine research funding has gone to the SME/MNC sector. As noted previously, this does not include other state research investments. A similar comparable analysis undertaken on a review of the Sea Change strategy shows that the level of funding to public bodies

has remained broadly similar in terms of the overall share of funding. There has been a significant increase in funding awarded to higher education institutions but the share of funding has remained similar. The share of funding awarded to industry has increased significantly during the MRIS.

Table 2.9: Overall Funding (Agreed Grant Aid) for Marine Research, by Type of Institution

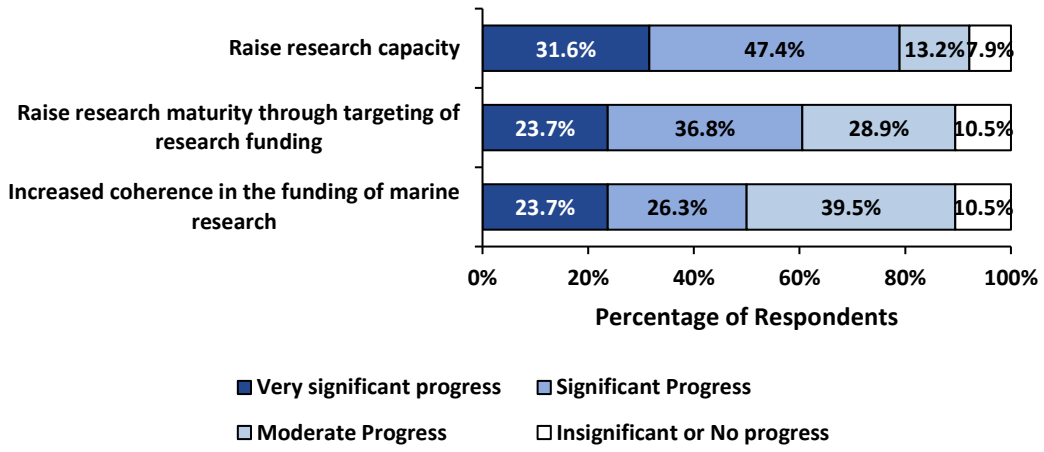
	Value of Projects € million (Agreed Grant Aid)				
	Pre-2017	2017	2018	2019	Total
Higher Education Institution	80.66	17.11	17.93	21.16	136.86
Public Body	12.61	11.96	14.83	5.41	44.81
SME/MNCs	19.36	7.14	18.14	6.47	51.11

Note: There is also a small amount of funding that has been awarded to NGOs and International organisations
Note: Pre-2017 refers to projects that started before 2017 but were still active on the 1st January 2017
Source: Indecon analysis of Marine Research Database

2.4. Human Capacity Development

A key aspect of the MRIS relates to the level of capacity to undertake marine research in Ireland. Research funding can support capacity development including encouraging early-stage researchers to undertake research in various marine research themes. Such activity can increase capacity and enable these early-stage researchers gain experience which can be leveraged to secure larger research grants. As part of this review, Indecon obtained the views of marine researchers on whether the MRIS has had any impact on research capacity in the sector. Nearly 80% of respondents believed that progress towards raising research capacity has been achieved during the MRIS period.

Figure 2.1: Views of Marine Researchers on Capacity



Source: Indecon survey of Marine researchers

Marine-related research funding supported a significant number of postdocs, PhDs, MSc students and research assistants, as shown across a number of HEIs and research centres in Ireland. This element of human research capacity is supported directly (through PhD awards, post-Doc awards, etc.) and indirectly through the funding of research projects and block grants to SFI centres. The establishment of Research Graduate Training Centres is also noteworthy in terms of supporting

early-stage researchers. The number of researchers who availed of funding supports that were targeted at building research capacity are shown in Table 2.10. This shows that 103 researchers have been supported across the different career stages with over 55% of these awards going to PhD researchers.

Table 2.10: Direct Supports for Capacity Development	
Role	**Total**
Principal Investigator	10
Post-Doc	30
PhD Student	57
MSc Student	6
Total	***103***
Source: Marine Research Database	

Human capacity to undertake marine research is also enhanced via supports for specific research projects where the funding is linked to the specific research project rather than specific researchers. The principal investigator decides on the appropriate number of researchers to work on these projects. These research projects are likely to hire different types of researchers to undertake the research. This will be based on the requirements of the project and may involve a multi-disciplinary team. These positions will be based on the researcher ecosystem[6] which is complex and may involve interactions with different funding partners, industry and other support functions. Based on evidence collected from projects leaders of marine research projects, the average marine research project includes 0.23 Principal Investigators, 0.51 post-Docs, 0.35 PhDs and 0.17 MSc students. This implies that typically a PI is involved with approximately four research projects per year.

Table 2.11: Direct Supports for Capacity Development through Project Support		
Role	**Average No. per Project**	**Total (Estimated)**
Principal Investigator	0.23	65
Post-Doc/Research Fellow	0.51	145
PhD Student	0.35	99
MSc Student/Research Assistant	0.17	48
Total		***357***
Source: Indecon analysis based on Marine Research Database and survey of Marine researchers		

[6] See Research by the Irish Universities Association for a more detailed overview of the researcher ecosystem https://www.iua.ie/for-researchers/researcher-career-framework/

Applying these estimates to the total number of projects supported indicates that there were around 430 marine researchers (in whole-time equivalent terms) supported during the period of the MRIS with around 108 researchers supported annually. We note that not all of researchers are likely to be engaged full-time in marine research activity. Accounting for this, it is likely that around 200 researchers have been engaged in marine research annually during the MRIS period.[7] The figures in Table 2.12 also show the estimated annual number of marine researchers that have been supported by public funding.

Table 2.12: Overall Number of Researchers (WTEs) – Estimated using Grossing Factor

	Total
Estimate of WTEs based on survey research	249
Estimated No. of projects undertaken	198
Total No. of Projects undertaken	342
Grossing Factor	1.72
Estimated Total WTEs supported	430
Estimated Total WTEs supported annually	**108**
Source: Indecon analysis of the confidential survey of marine researchers and Marine Research Database	

It is difficult to compare these MRIS figures against comparable figures compiled during the review of the Sea Change strategy. However, it appears that the number of principal investigators and research fellows has increased and the number of PhDs has remained relatively stable.

Another relevant issue is the availability of specialist courses and modules that examine issues of relevance to marine-related research. Some of the courses that are available are listed in Table 2.13. The majority of MRIS research themes have courses that are applicable to research in these themes. Indecon's analysis indicates that there are at least eight master's programmes that are directly related to marine-related research.

[7] This is difficult to estimate with certainty as part-time researchers may spend the rest of their time on other marine-related research projects. However, it is also likely that a significant number of researchers work as part of multidisciplinary teams and a significant portion of their research is not marine related funded research.

Table 2.13: Marine Research - related Courses			
MRIS Theme	**Institute**	**Course (Module)**	**Level**
Bioresources	Bord Iascaigh Mhara	Business in Aquabusiness	Higher Diploma (Level 8)
Bioresources	Bord Iascaigh Mhara	Commercial Diver Training	Level 6
Bioresources	UCD	Global Change: Ecosystem Science & Policy (Management of Sustainable Fisheries)	MSc
Renewable Energy	GMIT	Energy Engineering (Wind & Wave Energy)	B. Eng
Tourism & Leisure	Kerry College of Further Education and Training	Marine Angling Guiding	Level 6
Transport & Logistics	CIT	Nautical Science	BSc
Transport & Logistics	CIT	Supply Chain and Transport Management	Level 7
Biodiversity, Ecosystems & Food-webs	IT Sligo	Environmental Science with Ecology (Aquatic Ecology)	BSc
Biodiversity, Ecosystems & Food-webs	NUIG	Botany and Plant Science (Aquatic Plant Science, Algal Research)	BSc
Biodiversity, Ecosystems & Food-webs	UCC	Marine Biology	MSc
Biodiversity, Ecosystems & Food-webs	NUIG	Marine Science	BSc
Biodiversity, Ecosystems & Food-webs	UCD	Environmental Biology (Bioassessment of Freshwaters, Marine Community Ecology)	BSc
Pollution & Litter	UCD	Water, Waste & Environmental Engineering	MSc
Climate Change	NUIG	Earth and Ocean Sciences	BSc
Climate Change	UCC	Ecology and Environmental Biology (Temperate Marine Biology, Biology of Marine Mammals)	BSc
Climate Change	TCD	Environmental Science	MSc
Ocean Observation & Seabed Mapping	NUIG	Geography and Geosystems	BSc
Ocean Observation & Seabed Mapping	TCD	Geography and Geoscience	BA (Mod)
Ocean Observation & Seabed Mapping	GMIT	Marine Biological Resources	MSc
Integrated Policy & Governance	UCC	Applied Coastal and Marine Management	MSc
Integrated Policy & Governance	NUIG	Coastal & Marine Environments: Physical Processes, Policy & Practice	MSc
Information & Spatial Technologies, Analytics & Modelling	GMIT	Applied Freshwater and Marine Biology	BSc
Information & Spatial Technologies, Analytics & Modelling	GMIT	Applied Marine Conservation	MSc
Engineering	Bord Iascaigh Mhara	Engineer Officer (Fishing Vessel)	Level 5
Engineering	CIT	Marine Electrotechnology	B. Eng
Engineering	CIT	Marine Engineering	B. Eng
Relevant Marine-research modules in ()** ***Source: Indecon analysis			

2.5. Research Partnerships/Collaborations

Networks and research partnerships enable collaborative research. High levels of research maturity suggest that networks exist that link Irish researchers to national and international collaborators. There appears to be a good level of collaboration amongst marine researchers and around half of the projects supported have at least one partner. This is particularly high in research activities under the bioresources themes where 65% of projects had a partner organisation. 38% of projects in renewable energy had a partner organisation. An important feature of marine research is the presence of multi-disciplinary teams that span multiple research organisations. Analysis shows that over half of all marine research projects supported had at least one research partner. This is indicative of mature research networks. There is significant variation across research themes in terms of the presence of research partners. For example, the majority of Advanced Technologies, Biodiversity, Bioresources and Subsea Resources projects have at least one research partner. Many of these partners are international organisations.

Table 2.14: No. of Projects with more than one research performing organisation by Theme

Theme	Number	% of Total
Advanced Technologies	19 (21)	67.9% (44.7%)
Biodiversity, Ecosystems and Food-webs	49 (22)	66.2% (71%)
Bioresources	77 (40)	65.3% (76.9%)
Climate Change	19 (3)	50% (42.9%)
Engineering	5 (8)	50% (66.7%)
Information and Spatial Technologies, Analytics and Modelling	13 (17)	50% (48.6%)
Integrated Policy and Governance	14 (19)	63.6% (70.4%)
Ocean Literacy and Education	3 (1)	60% (12.5%)
Ocean Observation and Seabed Mapping	21 (13)	34.4% (54.2%)
Pollution and Litter	16 (4)	57.1% (40%)
Renewable Energy	42 (6)	38.2% (50%)
Security and Surveillance	3 (0)	75% (0%)
Subsea Resources	26 (13)	74.3% (92.9%)
Tourism and Leisure	9 (1)	90% (50%)
Transport and Logistics	5 (7)	71.4% (87.5%)

Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017
Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research
Source: Indecon Analysis of Marine Research Database

Joint funders typically means that supported research has a shared objective (in different funding programmes) and joint funding leads to the most efficient use of funds. However, it is possible that

such projects with multiple funders may bring together a wider knowledge which may assist the chosen researchers.

Around 10% of marine research projects had more than one funder. The areas where co-funding is most frequent relates to the bioresources and climate change themes. There are significant interlinkages across different research themes which are demonstrated by the number of projects with secondary research themes. Cross-cutting themes such as Advanced Technologies, Information and Spatial Technologies, Analytics and Modelling (ISTAM) and Engineering are likely to be important for other research themes which require multi-disciplinary research teams.

Table 2.15: No. of Jointly Funded Projects by Theme

Theme	Number	% of Total
Advanced Technologies	5 (2)	17.9% (4.3%)
Biodiversity, Ecosystems and Food-webs	18 (5)	24.3% (16.1%)
Bioresources	13 (15)	11% (28.8%)
Climate Change	13 (1)	34.2% (14.3%)
Engineering	1 (1)	10% (8.3%)
Information and Spatial Technologies, Analytics and Modelling	5 (0)	19.2% (0%)
Integrated Policy and Governance	1 (6)	4.5% (22.2%)
Ocean Literacy and Education	0 (0)	0% (0%)
Ocean Observation and Seabed Mapping	10 (3)	16.4% (12.5%)
Pollution and Litter	6 (4)	21.4% (40%)
Renewable Energy	11 (0)	10% (0%)
Security and Surveillance	0 (0)	0% (0%)
Subsea Resources	27 (12)	77.1% (75%)
Tourism and Leisure	0 (0)	0% (0%)
Transport and Logistics	1 (0)	14.3% (0%)

Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017
Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research
Source: Indecon Analysis of Marine Research Database

It is also useful to examine the types of collaborations that have occurred over the course of the MRIS. Some of these are shown in Table 2.16. There have been over 40 projects that have involved collaboration with research organisations based in Northern Ireland. A significant number of collaborative research projects were supported during MRIS. The number of North-South collaborations has increased since the Sea Change strategy. This is important in the context of All-Island research initiatives.

The evidence shows that there was a total of 321 projects (55% of the total) which had at least one partner during the MRIS period. Many of these partners were international research organisations. There were also a significant number of projects that included industry collaboration. The levels of co-operation with industry and international partners represent a welcome feature of the strategy.

Table 2.16: Number of Collaborative Marine Research projects supported

	Number of Projects			
	Pre-2017	**2017**	**2018**	**2019**
North-South Collaboration	22	11	8	3
International	76	61	47	28
Collaborations with Industry	94	59	42	29

Note: Pre-2017 refers to projects that started before 2017 but were still active on the 1st January 2017
Source: Indecon Analysis of Marine Research Database

The value of collaborations to Irish researchers is significant with over €111 million in research funding associated with projects that involve international partners. This represents a noticeable increase in the number of EU-funded projects with Irish partners compared to the previous research strategy. The value of research in the table below relates to the amount received by the Irish-based researchers only. International partners also receive funding for these research projects, but these are not included in the table.

Table 2.17: Value of Collaborative Marine Research Projects

	Value of Projects (Agreed Grant Aid) by Theme (€ million)				
	Pre-2017	**2017**	**2018**	**2019**	**Total**
North-South Collaboration	16.35	2.05	2.98	1.14	22.52
International	46.78	19.16	25.62	19.59	111.15
Collaborations with Industry	24.95	9.72	16.22	15.44	66.34

Note: Pre-2017 refers to projects that started before 2017 but were still active on the 1st January 2017
Source: Indecon Analysis of Marine Research Database

The European Commission is the largest funder of marine research in Ireland, both in terms of the number of projects supported and the value of research funding awarded. The level of funding received from the European Commission represents an important indication of the quality of marine researchers in Ireland and also the levels of research maturity. Also of significance is that Irish researchers have been involved in projects with over 2,000 partners during the course of the MRIS.

Increased research partnerships (national and international) were identified in the MRIS as a key action of the strategy.

Table 2.18: Analysis of EU-funded Projects			
	No. of Projects	**No. of Partners**	**Value to Irish organisation (€ million)**
Advanced Technologies	12 (17)	96 (214)	9.64 (10.58)
Biodiversity, Ecosystems and Food-webs	12 (16)	201 (198)	6.45 (16.6)
Bioresources	43 (14)	703 (181)	16.45 (9.29)
Climate Change	8 (3)	110 (23)	5.64 (6.01)
Engineering	6 (6)	30 (57)	6.57 (1.66)
Information and Spatial Technologies, Analytics and Modelling	8 (16)	185 (326)	3.04 (8.6)
Integrated Policy and Governance	13 (9)	118 (108)	7.3 (2.89)
Ocean Literacy and Education	4 (1)	35 (1)	3.46 (0.53)
Ocean Observation and Seabed Mapping	14 (10)	279 (207)	6.62 (3.41)
Pollution and Litter	17 (0)	134 (0)	16.63 (0)
Renewable Energy	35 (7)	350 (28)	32.52 (5.97)
Security and Surveillance	3 (0)	36 (0)	0.75 (0)
Subsea Resources	0 (0)	0 (0)	0 (0)
Tourism and Leisure	9 (1)	105 (11)	4.79 (0.28)
Transport and Logistics	4 (7)	83 (93)	1.5 (1.7)

Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017
Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research
Source: Indecon Analysis of Marine Research Database

Networking

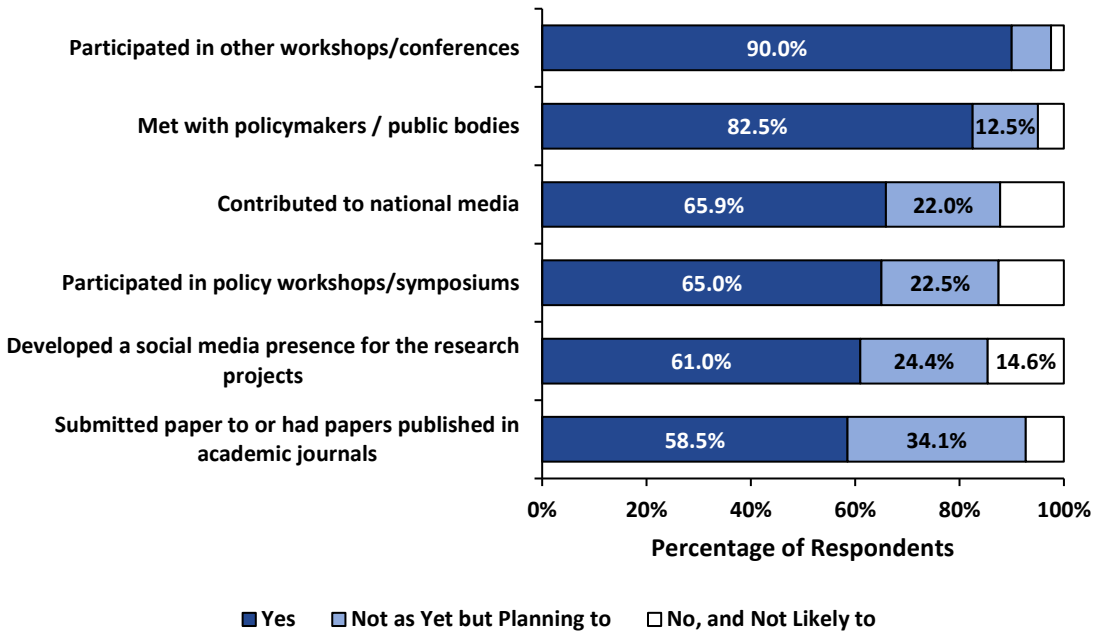
Evidence of research collaborations indicates a high level of research capacity. One approach to this is to support networking through small research grants to attend international conferences or symposia. This is a low-cost way to assist researchers in establishing national and international connections in their field of research. The Marine Institute and other public funders support such networking through direct funding to researchers. Table 2.19 shows that through a specific funding programme administered by the Marine Institute (an annual rolling networking call), 308 marine researchers were supported to attend conferences or symposia since 2017. The largest research themes supported by the Marine Institute's fund were the Bioresources and Biodiversity research themes.

The figures below do not include networking supports provided by other public funders and these are not currently captured in the Marine Research Database.

Table 2.19: Networking supports funded by Marine Institute (2017-2019)	
	International conferences/ Research Symposia/Meetings
Advanced Technologies	6
Biodiversity, Ecosystems and Food-webs	84
Bioresources	93
Climate Change	34
Engineering	0
Information and Spatial Technologies, Analytics and Modelling	4
Integrated Policy and Governance	16
Ocean Literacy and Education	15
Ocean Observation and Seabed Mapping	19
Pollution and Litter	14
Renewable Energy	12
Security and Surveillance	1
Subsea Resources	6
Tourism and Leisure	3
Transport and Logistics	1
Source: Indecon Analysis of Marine Institute networking data.	

The communication of research outputs is an important factor in maximising the impact of research. Evidence shown in Figure 2.2 shows that the majority of marine researchers intend to disseminate their research findings. Encouragingly, over 80% of marine researchers indicated they had met with or intend to meet with policymakers to discuss the policy implications of their research.

Figure 2.2: Communication Outputs of Marine Researchers



Source: *Indecon confidential survey of marine researchers*

2.6. Industry Collaboration

An important aspect of the MRIS is the level of industry collaboration that is supported. This is a key indicator of research maturity. As shown previously, over 220 funded projects involved some level of industry collaboration. Over €50 million has been awarded to industry participants over the course of the MRIS. There are currently some gaps in the available information on Horizon 2020 awards so the figures may underestimate the overall amount of funding contributed by industry to undertake marine-related research. Indecon also notes a gap in data from Enterprise Ireland which also supports marine research undertaken by industry.[8] There are a number of different areas of industry support and collaboration. There are a number of industry specific research awards which support SMEs to undertake research and development. There is also support from industry to research through collaboration. This is a feature of the SFI research centres where there is often industry collaboration.

[8] Indecon note the gap in EI data but acknowledge that there is data available on one EI funded research project which provided €1.2 million in research supports.

Table 2.20: Analysis of Support to Industry, by Theme			
	No. of Projects	**Funding to Industry (€ million)**	**Average funding per project (€ million)**
Advanced Technologies	13 (20)	4.62 (5.48)	0.36 (0.27)
Biodiversity, Ecosystems and Food-webs	14 (6)	1.78 (10.15)	0.13 (1.69)
Bioresources	36 (9)	7.29 (1.56)	0.2 (0.17)
Climate Change	4 (1)	0.14 (0.05)	0.03 (0.05)
Engineering	2 (7)	1.76 (0.65)	0.88 (0.09)
Information and Spatial Technologies, Analytics and Modelling	8 (7)	1.45 (0.68)	0.18 (0.1)
Integrated Policy and Governance	6 (9)	1.96 (0.96)	0.33 (0.11)
Ocean Literacy and Education	1 (5)	0.28 (0.09)	0.28 (0.02)
Ocean Observation and Seabed Mapping	17 (9)	0.69 (0.78)	0.04 (0.09)
Pollution and Litter	8 (1)	10.6 (0.34)	1.33 (0.34)
Renewable Energy	79 (6)	18.69 (3.74)	0.24 (0.62)
Security and Surveillance	2 (0)	0.14 (0)	0.07 (0)
Subsea Resources	30 (13)	0.37 (0)	0.01 (0)
Tourism and Leisure	2 (0)	0.24 (0)	0.12 (0)
Transport and Logistics	2 (6)	0.61 (0.21)	0.31 (0.04)

Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017
Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research
Source: Indecon Analysis of Marine Research Database

One potential impact of research funding is leverage effects. The leverage effect below indicates the amount of non-grant funding that was contributed to support the various marine-related research projects. This indicates that significant private funding was contributed to renewable energy projects where over 28% of funding came from non-grant aid sources. The second potential leverage impact is where public funding enables researchers to build up sufficient capacity to apply for larger international research grants. Over 80% of marine researchers indicated that the MRIS is likely to have had a significant or very significant impact on the ability of researchers to secure national or international research funding.

Table 2.21: Summary of Non-Grant Aid Funding, by Theme				
	Agreed Grant Aid (€ million)	**Agreed Total Project Cost (€ million)**	**Difference (€ million)**	**% Difference**
Advanced Technologies	12.8 (37)	13.91 (43.78)	1.08 (6.77)	8.4% (18.3%)
Biodiversity, Ecosystems and Food-webs	25.1 (19.2)	26.2 (23.05)	1.06 (3.83)	4.2% (19.9%)
Bioresources	40.6 (24.9)	42.04 (26.55)	1.46 (1.64)	3.6% (6.6%)
Climate Change	13.4 (7.6)	14.81 (9.01)	1.41 (1.37)	10.5% (18%)
Engineering	7 (2.7)	7.38 (2.82)	0.43 (0.15)	6.1% (5.5%)
Information and Spatial Technologies, Analytics and Modelling	8.1 (12.6)	8.15 (13.3)	0.02 (0.68)	0.3% (5.4%)
Integrated Policy and Governance	9.2 (7.9)	9.91 (8.75)	0.75 (0.87)	8.1% (11.1%)
Ocean Literacy and Education	3.5 (1)	3.47 (1)	0 (0.01)	0% (0.7%)
Ocean Observation and Seabed Mapping	17.1 (12.4)	18.02 (14.33)	0.9 (1.93)	5.3% (15.6%)
Pollution and Litter	18.1 (1.2)	21.61 (1.21)	3.51 (0.01)	19.4% (1.2%)
Renewable Energy	74.1 (6.5)	94.95 (6.73)	20.82 (0.2)	28.1% (3%)
Security and Surveillance	0.8 (0.2)	1.05 (0.19)	0.22 (0)	26.6% (0%)
Subsea Resources	3.1 (1.6)	3.68 (1.87)	0.55 (0.3)	17.7% (18.9%)
Tourism and Leisure	5.2 (0.4)	6.77 (0.4)	1.6 (0.05)	31% (14.1%)
Transport and Logistics	2.2 (2.2)	2.2 (2.89)	0 (0.67)	0% (30.1%)

Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017
Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research
Source: Indecon Analysis of Marine Research Database

2.7. Activities relating to Infrastructure

Many research projects are dependent on access to the appropriate infrastructure. An assessment of the level of infrastructure was identified in the MRIS as a key action. The majority of research themes do not have specific infrastructure supports. An exception to that is to the Ocean Observation and Renewable Energy themes which both received close to €5m to support infrastructure purchase. A small number of projects were targeted on infrastructure but of note is that the current research database only collects information on new infrastructure projects that were supported during the MRIS. These projects were funded through competitive calls for infrastructure access or through a specific call under the Marine Institute Marine Research Programme. This does not include any data on existing levels of infrastructure or on existing datasets that may be available for researchers.

There has been significant investment in infrastructure by state organisations including the purchase of a new research vessel and test and demonstration facilities to support aquaculture and renewable energy research. There are also a number of other large scale state investments such as INFOMAR (seabed mapping programme) and the Irish Marine Data Buoy Observation Network (IMDBON)

which provide infrastructure to support research. The data also does not capture infrastructure purchased through project funding or SFI block grants.

It must also be noted that a key investment vehicle for the next decade will be the NDP, which is currently being renewed. As noted previously, DFHERIS have made a submission to this review and outlined the need for a significant increase in capital investment in R&I. This may have a significant impact on the level of infrastructure that is supported in the next marine research and innovation strategy. The overall level of infrastructure supports provided via competitive calls are shown in Table 2.22.

Table 2.22: Infrastructure supports funded (€ million), by Theme

	No. of Projects	Agreed Grant Aid	Agreed Total Project Cost
Advanced Technologies	2 (12)	0.05 (6.32)	0.05 (6.64)
Biodiversity, Ecosystems and Food-webs	3 (4)	0.07 (0.57)	0.09 (0.63)
Bioresources	7	0.79	0.91
Climate Change	7	0.68	0.77
Ocean Observation and Seabed Mapping	5 (0)	4.42	4.44
Renewable Energy	13 (1)	5.26 (0.1)	5.52 (0.13)

Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017
Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research
Source: Indecon Analysis of Marine Research Database

Research capacity based on the availability of infrastructure can also be supported through funding for projects. The number of large projects is shown in Table 2.23 which shows that the renewable energy theme has the most projects worth in excess of €1 million in grant aid. Much of this funding was for technology development/device development.

Table 2.23: Analysis of Large Projects supported, by Theme			
	>€500k<€1 million	**€1-5 million**	**>€5 million**
Advanced Technologies	4 (5)	3 (6)	0 (1)
Biodiversity, Ecosystems and Food-webs	6 (6)	9 (2)	0 (1)
Bioresources	23 (16)	5 (5)	0 (0)
Climate Change	4 (1)	3 (3)	0 (0)
Engineering	1 (0)	3 (0)	0 (0)
Information and Spatial Technologies, Analytics and Modelling	5 (5)	1 (3)	0 (0)
Integrated Policy and Governance	6 (6)	2 (0)	0 (0)
Ocean Literacy and Education	1 (1)	1 (0)	0 (0)
Ocean Observation and Seabed Mapping	2 (1)	6 (3)	0 (1)
Pollution and Litter	4 (0)	1 (0)	1 (0)
Renewable Energy	6 (1)	19 (2)	3 (0)
Security and Surveillance	0 (0)	0 (0)	0 (0)
Subsea Resources	0 (0)	0 (0)	0 (0)
Tourism and Leisure	5 (0)	1 (0)	0 (0)
Transport and Logistics	2 (3)	0 (0)	0 (0)
Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017 ***Note: Figures in brackets reflect projects where the research theme was considered a secondary theme to the research*** ***Source: Indecon Analysis of Marine Research Database***			

The Marine Institute's Ship-time Programme is an important funding mechanism that provides scientists with access to vital marine infrastructure. The annual funding budget is circa €3 million for time on the vessels for research, training and policy support.

Funding awarded through the Ship-time Programme represents a gap in the Marine Research Database and therefore a gap in Indecon's analysis in the tables above. The following table (Table 2.24) presents funding data for the Ship-time programme.

Funding is provided by the Marine Institute through a competitive programme for research and training at sea, utilising the two national research vessels, RV *Celtic Explorer* and RV *Celtic Voyager*, the *Holland I* remotely operated vehicle (ROV) and oceanographic equipment.

This programme also funds policy support services undertaken by the State with respect to requirements under EU/International legislation for fisheries, marine environment, harmful algal blooms, nutrients and climate change data.

Table 2.24: Analysis of Ship-Time Programme			
Year	**2017**	**2018**	**2019**
Research Surveys (number)	8	7	10
Research Surveys (ship-days)	68	85	105
Research Survey (funding)	€679,000	€1,395,000	€1,543,500
Training (number)	13	13	13
Training (ship-days)	57	53	51
Training (funding)	€456,000	€454,000	€433,500
Policy Support (number)	7	4	6
Policy Support (ship-days)	98	51	66
Policy Support (funding)	€1,547,600	€791,600	€1,026,300
Total (number of awards)	**28**	**24**	**29**
Total (ship-days)	**223**	**189**	**222**
Total (funding)	**€2,682,600**	**€2,640,600**	**€3,003,300**
Source: Marine Institute			

2.8. Summary of Findings

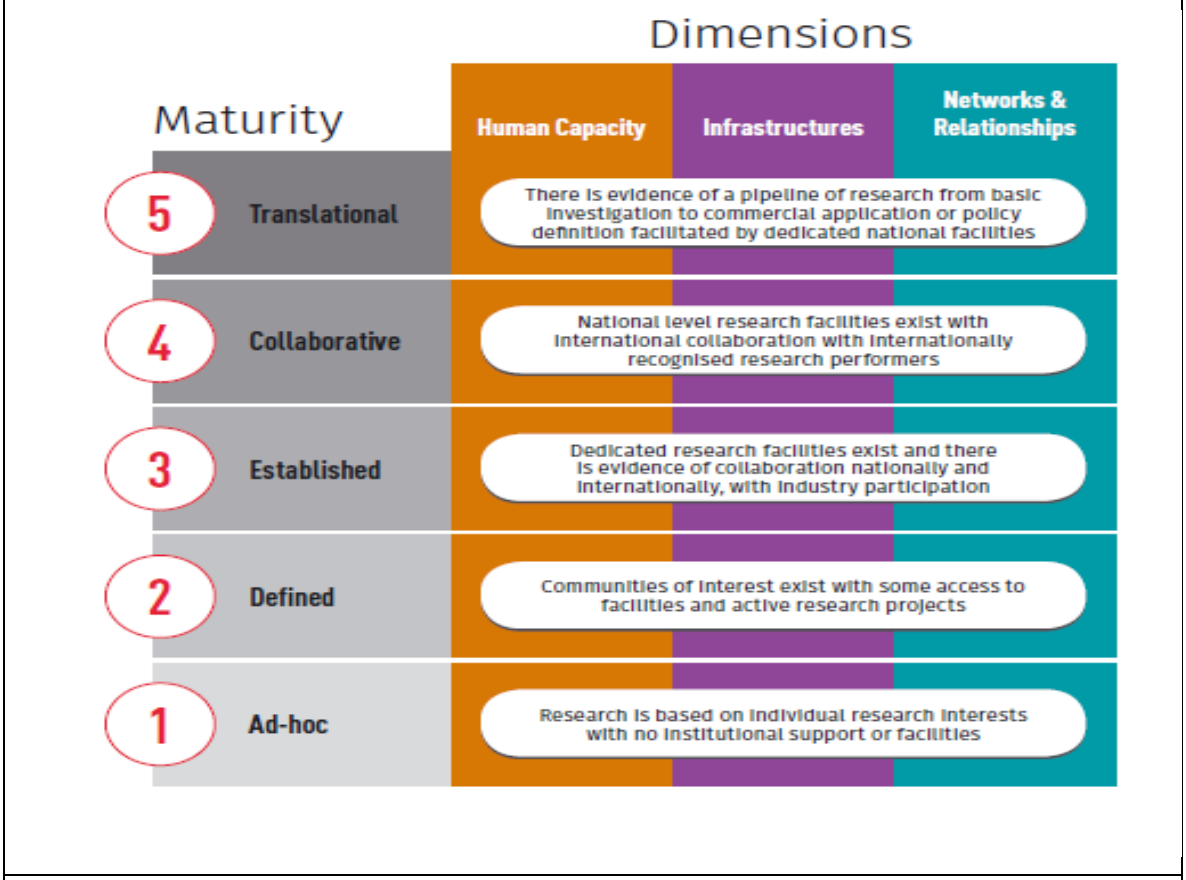
- As part of the implementation of the MRIS, a Marine Research Database was compiled which collated data from public funders on marine-related research undertaken. This database is used in this review to examine various marine-research related activities as part of the MRIS. Over the period of the MRIS, over €240 million was awarded in grant aid to support marine-related research in Ireland. Close to €34 million was provided by other non-grant funding to support 578 marine-related projects.
- The largest research theme relates to renewable energy which accounts for 31% of all research funding. The next largest research theme relates to Bioresources which accounts for 17%. The smallest six research themes (in terms of grant aid funding) account for only 9% of the overall funding awarded to marine-related research.
- A small number of projects were targeted on infrastructure but of note is that the current research database only collects information on new infrastructure projects that were supported during MRIS. This does not include any data on existing levels of infrastructure or on existing datasets that may be available for researchers.

3. Assessment of Research Maturity Levels

3.1. Introduction

As part of this study, Indecon has analysed the current (2020) levels of research maturity in the marine research themes. Indecon has applied a consistent approach to assess the current maturity levels. This approach is based on the research maturity model that was developed as part of the MRIS. A graphical illustration of this research maturity model is shown below. Further details of the model are available in the MRIS.

Figure 3.1: Research Capability Maturity Model



Source: ***MRIS***

3.2. Approach to assessing Maturity Levels

The background papers prepared as part of the MRIS development process included a detailed note on the research maturity model and how it was developed. It is important to consider how this maturity compares with the Technology Readiness Level (TRL) approach that was adopted by the European Commission. The nature of research in the marine sector is such that a broader research capability model is required that goes beyond commercial impacts. The maturity model developed as part of the MRIS process differs significantly from the TRL approach. The TRL approach indicates progression of technology from basic research to commercial application. An immature research

theme based on the MRIS research maturity model would only support research for a few TRLs. In contrast, a fully mature research theme would support research applicable to most, if not all, TRLs.

Indecon's approach to assessing the level of maturity across the 15 research themes is based on identifying research activity in each of the research themes. The MRIS sets out the types of research projects that indicate the different levels of research maturity. This is analysed by each of the five levels of research maturity and the three components of maturity (capacity, infrastructure, networks). The MRIS sets out the types of research supports that are currently provided by public funders that would indicate the different levels of research maturity across the three components. It also describes the types of supports that would indicate the different levels of research maturity. The maturity assessments are based largely on the primary research theme of projects captured in the Marine Research Database. Many projects are likely to have multiple research themes. As shown in Section 2, some themes are more likely to prominent as a secondary theme for research projects.

Much of this data is available from the Marine Research Database. The database does not include information on levels of teaching available in each of these themes. However, Indecon have examined the types of marine-research courses available and how these contribute to the levels of research infrastructure. Some of the key indicators that Indecon used to assess maturity levels are shown in the table below.

Table 3.1: Approach to Assessing Maturity Levels – Key Indicators

Overall Indicators to assess capacity:	Total Funding (Agreed Grant Aid)
	Non-Grant Funding as % of Total Project Cost
	Total Number of projects
	Average Size of Project
	Total Number of defined projects-based awards
	Main Funders
	No. of Different Public Funders
Indicators to assess human capacity:	Number of Researchers (Estimated)
	Number of Research students directly supported
Indicators to assess infrastructure capacity:	No. of Research Centres
	No. of Infrastructure Projects
	Number of Projects >€500k
	Number of Projects >€200k <€500k
	Number of Projects <€200k
Indicators to assess networking capacity:	% of projects involving International Collaboration
	% of projects involving Industry Collaboration
	% of projects involving North-South Collaboration

Source: Indecon Analysis

3.3. Assessment of Current Research Maturity Levels

Bioresources

Some of the key indicators relating to the Bioresources theme are shown in Table 3.11. The different sub-themes (Aquaculture and Biomass Production, Wild Resources, Processing for Food and Other Use and High Value Products) had different levels of research maturity. There are linkages between many of the projects within the Bioresources sub-themes and projects may cover multiple sub-themes.

Overall, the evidence shows that the amount of research funding awarded to this theme is significant with over €40 million being awarded over the course of the MRIS. Aquaculture & Biomass Production accounts for around 33% of this with High Value Products accounting for a further 28%. The other sub-themes account for close to 20% each with research funding of over €7 million each. During MRIS, around 118 research projects have been funded with an average budget size of close to €0.34 million. This research is characterised by a large number of relatively small research awards with only six projects having budgets in excess of €1 million.

The main funder of bioresources research is the European Commission (Horizon 2020, EMFF[9] and Interreg) who account for close to 45% of the research funding. The Department of Agriculture, Food and Marine, the Marine Institute, SFI and SEAI account for the vast majority of the remaining public funding. There are also a large number of public funders who contribute to projects under this theme.

Indecon estimated that around 136 researchers have been supported to undertake bioresources related research during the period of MRIS. There are 19 PhDs supported within the broad bioresources research theme. Overall, 31 projects were supported via Horizon 2020 which amounted to around €13.3 million. There were also three SFI Investigators awards given to bioresources projects and one SFI Future Research Leaders Award. Such awards suggest a relatively high degree of research maturity. Bioresources research has significant industry collaboration with around 31% of projects having some industry participation. As well as this, there have been a significant number of EU-funded projects under this theme which is indicative of research maturity.

Table 3.2: Analysis of Maturity Level - Bioresources	
Total Funding (€ million)	40.58
Non-Grant Funding as % of Total Project Cost	3.5%
Total Number of projects (Primary Theme)	118
Total Number of projects (Secondary Theme)	52
Average Size of Project	0.34
Number of Projects >€500k	25
Number of Projects >€200k <€500k	42
Number of Projects <€200k	51
Total Number of defined projects-based awards	78

[9] The BIM has been designated as an intermediary body of the administration of EMFF grants.

Main Funders	European Commission (45%), DAFM (18%), Marine Institute (14%), SFI (12%)
No. of Different Public Funders	10
Number of Researchers (Estimated)	136
Number of Research directly students supported	19
No. of Research Centres	0
No. of Infrastructure Projects	7
% of projects involving International Collaboration	42%
% of projects involving Industry Collaboration	31%
% of projects involving North-South Collaboration	8%
BIM EMFF and MI EMFF R&I funding is included under EC ***Source: Indecon Analysis***	

Aquaculture & Biomass Production

Aquaculture and Biomass Production accounts for around 33% of the total funding awarded to Bioresources research and 35% of the projects supported. Nearly 80% of the funding comes from European programmes. This is evidence of a relatively high level of research maturity, especially in terms of networks and relationships. Funding for increasing human capacity is provided directly via the Cullen Fellowship Programme and the H2020 CAROLINE research fellowships.

Funding via BIM's EMFF research and innovation programmes such as the Knowledge Gateway Scheme (KGS) often involves a large degree of industry involvement and this is evident in the aquaculture sub-theme. A recent initiative by BIM under the KGS has aimed to identify and address knowledge gaps in aquaculture innovation within Ireland. The programme of work looked for commercially-relevant knowledge (including technology and innovation) in Ireland and across Europe with potential knowledge transfer to the Irish aquaculture sector via expert panels drawn from Irish Marine Agencies, Industry and Research Providers. Over the course of the work 180 research projects of interest were identified which were later short listed to 26 for analysis by the expert panels. In addition to this was the set up the Irish Aquaculture Technology and Innovation Platform (www.IATiP.ie) a Mirror Innovation Platform (MIP) and one of 15 in Europe designed to act as a conduit for information dissemination to the Irish aquaculture sector and also providing networking opportunities and collaboration with other MIPs. Coupled with this was the development of the HATCH Accelerator Programme, (www.hatch.blue/) also under the KGS. This scheme aims to provide support funding to highly innovative start-up companies after a selection process. The two initiatives can dove-tail, in particular where industry-ready research projects identified by the expert panels are subsequently put through the accelerator programme and identified for support under that scheme. The EMFF funded Seafood R&D programme supports research and development projects aimed at developing new or improved products and processes for the sector which are market-led and in collaboration with industry, agencies and recognised Research Performing Organisations (RPOs). Overall, 11 projects were funded across fisheries, processing and aquaculture opportunities. Commercial opportunities were examined within these themes including the development of human and petfood functional ingredients and co-products, development of pet aging and wellness ingredients and the development of novel baits for the shellfish sector. Aside from the EMFF, over €1 million was provided by SFI under the Future Research Leaders programme and two aquaculture projects were also funded through the Disruptive Technologies Innovation Fund (DTIF), which is a €500 million fund established under Project Ireland

2040 and is run by the Department of Enterprise, Trade and Employment with administrative support from Enterprise Ireland.

As noted previously, the Marine Research Database does not capture existing infrastructure that supports research. In relation to aquaculture and biomass production, significant research infrastructure (physical and data) is available. For example, the Marine Institute Newport catchment facilities comprise of a laboratory, administration block, freshwater hatchery, fish rearing facilities, fish census trapping stations, a salmonid angling fishery and a comprehensively monitored freshwater lake and river catchment. Beirtreach Buí is an aquaculture test site near Carna, Co. Galway that allows for the holding of a range of fish, shellfish and seaweed species for research purposes. Linking of the Beirtreach Buí site with the hatchery at the Newport research facility has been ongoing in recent years. BIM and the Marine Institute have also formed a research and development cluster focused on the Beirtreach Buí site, Newport research infrastructure and the Páirc na Mara project being developed by Údarás na Gaeltachta, in order to bring forward initiatives to ensure that the results of aquaculture research are transferred to industry and provide practical support to its sustainable development. Other research infrastructure includes NUI Galway's Carna Research Station, which hosts students (BSc, MSc, PhD) and postdoctoral researchers, and Bantry Marine Research Station. Both have national and international linkages and have been involved in numerous national and EU-funded projects over the period of the MRIS.

Indecon's assessment of the current level of research maturity in Aquaculture & Biomass Production is presented in the next table.

Table 3.3: Overall Assessment of Research Maturity – Bioresources (Aquaculture & Biomass Production)

Aquaculture & Biomass Production	2017 Ranking	Current Estimate
Capacity	Ad hoc	Defined/Established
Infrastructure	Ad hoc	Defined
Networks	Ad hoc	Established
Source: Indecon Analysis		

Wild Resources

Research under the Wild Resources (including fisheries resources) sub-theme accounts for around 20% of Bioresources research. Around 67% of the funding comes from Irish public funding with the remaining 33% coming from the European Commission. There are currently four main Irish public funders that support research under the Wild Resources sub-theme. Funding for increasing human capacity is provided directly via the Cullen Fellowship Programme, the Marine Institute Post-Doctoral Fellowship and the IRC Funding Programme. Two projects were also funded under the SFI Investigator Programme which is indicative of an established or collaborative level of research maturity. One project in this sub-theme was awarded a SFI Starting Investigator Research Grant. This suggests a defined or established human capacity maturity level.

One key focus of research in this sub-theme concerns sustainable fishing. This work is funded under the EMFF through BIM's Sustainable Fisheries Scheme. This funding helped to reduce unwanted catches of fish in demersal trawls targeting fish species. The funding also reduced unwanted catches

of fish in Nephrops fisheries and reduced landings of small Nephrops by showing high survivability of discarded Nephrops. Marine Institute EMFF programmes are also important contributors to this sub-theme as well as activity undertaken directly by Marine Institute scientists

There was one specific infrastructure project funded. However, there may be infrastructure support to Wild Resources research through large projects awards. There was only one research project with a budget of over €1 million. There were also three Horizon 2020 projects under this theme which secured around €1.4 million for Irish researchers. There is evidence that supports to facilitate human capacity have occurred during the MRIS and it is likely that the research maturity level has increased to at least an established level. There is little evidence of increased support for infrastructure within this research theme and it is likely that the research maturity level is defined. There are a small number of projects under Horizon 2020 (often led by an international organisation), which is evidence of the presence of networks to undertake research in this sub-theme. Indecon's assessment of Wild Resources research maturity is presented in the next table.

Table 3.4: Overall Assessment of Research Maturity – Bioresources (Wild Resources)

Wild Resources	2017 Ranking	Current Estimate
Capacity	Established	Established/Collaborative
Infrastructure	Established	Defined/Established
Networks	Established	Established
Source: Indecon Analysis		

Processing for Food & Other Use

A sub-theme within the Bioresources theme is the Processing for Food and other Use sub-theme. This accounts for around 18% of the total funding awarded to Bioresources research and 22% of the projects supported. In the MRIS, it is noted that the level of research maturity for this sub-theme was low and all elements of research maturity were considered to be Ad hoc. Over €7 million was awarded to support research in this area during the period of the MRIS. This funding supported 25 projects, the largest number of projects supported through the EMFF. Projects funded under this programme typically looked at Seafood research and innovation and typically involved public research bodies. Most of the Seafood Research and Innovation Programme projects have involved Teagasc. Human capacity has been supported in this sub-theme through funding from the Irish Research Council. There was also significant support provided by the Department of Agriculture, Food and the Marine through its Food Institutional Research Measure (FIRM) which has supported six projects worth over €3.6 million. Indecon's assessment of research maturity in this sub-theme is presented below.

Table 3.5: Overall Assessment of Research Maturity – Bioresources (Processing for Food & Other Use)		
Processing for Food & Other Use	**2017 Ranking**	**Current Estimate**
Capacity	Ad hoc	Defined
Infrastructure	Ad hoc	Defined
Networks	Ad hoc	Defined
Source: Indecon Analysis		

High Value Products

Another sub-theme relates to how bioresources can be converted into high-value products. This accounts for a larger share of funding around 28% of the total funding awarded to Bioresources research and 22% of the projects supported. Close to €11 million was awarded to Irish-based researchers to undertake research into the high-value products sub-theme. 43% of the research funding came from the European Commission which was distributed across 14 different projects. Many of these projects involved international partners. Over €1.7 million is contributed to this research theme through the Marine Institute Research Programme. This has provided funding for postdoctoral fellowships and specialist infrastructure supports. Four projects, averaging around €0.6 million, were funded through the DAFM FIRM Research Programme. FIRM requires multi-disciplinary teams from multiple research institutions and there is a requirement to widely disseminate the research. This fund aims to develop research and innovation to ensure sustainable food production. A key output of the FIRM is highly trained early-stage researchers at PhD and postdoctoral level to develop future capacity in this sub-theme. A SFI Investigator Award of close to €2 million was awarded to NUI Galway to undertake research into the high-value products associated with bioresources. Such supports typically indicate a high degree of research maturity. Overall, it is likely that the level of research maturity has remained at least the same level as estimated in the MRIS. However, it is possible that there has been an increase in research maturity in relation to human capacity and the existence of networks and partnerships.

The SFI BiOrbic Bioeconomy Research Centre undertakes research of direct relevance to this research sub-theme. BiOrbic develops high-value products based on converting residues and waste streams. The marine is one area that is a focus of this research. The development of national clusters supported by Enterprise Ireland is also important to this theme.

Table 3.6: Overall Assessment of Research Maturity – Bioresources (High Value Products)		
High Value Products	**2017 Ranking**	**Current Estimate**
Capacity	Established	Established/Collaborative
Infrastructure	Established	Established
Networks	Established	Established/Collaborative
Source: Indecon Analysis		

Any assessment of research maturity, especially at a broad research theme level, is somewhat subjective. However, based on the evidence presented previously, Indecon believes that the level of research maturity in the bioresources theme is likely to have remained at 2017 levels or improved somewhat. The 2017 levels indicated a relatively high level of research maturity in this theme. The high level of industry collaboration and international partnerships is also likely to indicate high levels of research maturity. There are linkages between the four sub-themes within the bioresources and there is an argument that these sub-themes should be considered together.

Advanced Technologies

Some of the key indicators relating to the Advanced Technologies theme are shown in Table 3.7. There were 28 projects supported where Advanced Technologies was the primary research theme but this theme typically has strong secondary themes. This research theme typically involves the application of technology to other research themes. In this section, Indecon analyses projects where Advanced Technology is the primary research theme. The figures show that the amount of research funding awarded to this theme was over €12.8 million with an average budget size of close to €0.5 million.

The main funder of this research theme is the European Commission who accounts for close to 84% of the research funding. The only other significant funder is the Department of Agriculture, Food and the Marine but this funding was for projects that started prior to the MRIS. Both the Irish Research Council and the Marine Institute have funded four projects in this research theme. However, as mentioned previously, this theme is likely to facilitate advanced research in some of the other marine research themes. Under the 2018 call of the Disruptive Technologies Innovation Fund (DTIF) over €1m was awarded for enterprise-led research focussed on real-time monitoring of water quality parameters (this investment is in addition to the €12.8m included in the table below).

Indecon estimated that around 32 researchers were supported to undertake research into advanced technologies over the course of the MRIS. There are relatively few PhD and postdoc scholarships within this research theme. This theme has largely depended on European Commission funding which has typically funded relatively large research projects. Such projects are likely to include early-stage researchers which is likely to contribute to increasing human capacity. There were also 11 projects (worth around €7.2 million) funded through Horizon 2020 which is indicative of high-level research maturity due to the large amount of international partners as well as the quality threshold to be awarded through this funding stream.

Industry collaboration was evident in around 46% of projects supported and there were a number of awards that were specific to industry. Networks, such as the Marine Ireland Industry Network and emerging clusters are important in this regard. Similarly, around half of all projects in this theme involved international partners. When the size of the projects is considered the share of international partners is much larger with around 80% of the funding going to projects with international partners.

Table 3.7: Analysis of Maturity Level - Advanced Technologies	
Total Funding (€ million)	12.83
Non-Grant Funding as % of Total Project Cost	86.5%
Total Number of projects (Primary Theme)	28
Total Number of projects (Secondary Theme)	47
Average Size of Project	0.46
Number of Projects >€500k	6
Number of Projects >€200k <€500k	9
Number of Projects <€200k	13
Total Number of defined projects-based awards	18
Main Funders	European Commission (76%), DAFM (12%), Marine Institute (8%)
No. of Different Public Funders	6
Number of Researchers (Estimated)	32
Number of Research directly students supported	6
No. of Research Centres	0
No. of Infrastructure Projects	2
% of projects involving International Collaboration	50%
% of projects involving Industry Collaboration	46%
% of projects involving North-South Collaboration	0%
Source: Indecon Analysis	

Our assessment of the current level of research maturity for the Advanced Technologies research theme is shown in Table 3.8. Indecon believes that the level of research maturity in this theme is likely to have some small changes compared to the 2017 levels. As shown above, Advanced Technologies were the secondary theme for many other projects which highlights the importance of this theme in creating research networks and creating multi-disciplinary research themes.

Table 3.8: Overall Assessment of Research Maturity – Advanced Technologies		
	2017 Ranking	**Current Estimate**
Capacity	Established	Established
Infrastructure	Established	Established
Networks	Established	Established/Collaborative
Source: Indecon Analysis		

Subsea Resources

The vast majority of funding for research into Subsea Resources comes through the SFI Research Centre iCRAG. As part of the research centre, around 27 researchers have been funded to complete research relating to the research activities of iCRAG. iCRAG has wider research objectives than just Subsea Resources and covers other research areas relating to applied geosciences. The Irish Shelf Petroleum Studies Group also supported a number of research projects in this research theme. This research theme may contribute to other research themes.

Table 3.9: Analysis of Maturity Level - Subsea Resources	
Total Funding (€ million)	3.13
Non-Grant Funding as % of Total Project Cost	15.0%
Total Number of projects (Primary Theme)	35
Total Number of projects (Secondary Theme)	16
Average Size of Project	0.09
Number of Projects >€500k	-
Number of Projects >€200k <€500k	-
Number of Projects <€200k	35
Total Number of defined projects-based awards	8
Main Funders	SFI (78%); Irish Research Council (5%); ISPSG (17%)
No. of Different Public Funders	4
Number of Researchers (Estimated)	40
Number of Research directly students supported	27
No. of Research Centres	0
No. of Infrastructure Projects	0
% of projects involving International Collaboration	0%
% of projects involving Industry Collaboration	86%
% of projects involving North-South Collaboration	0%
Indecon analysis	

Support through iCRAG is likely to have a positive impact on the levels of research maturity within this research theme. Each of the components of research capability are likely to be at least at the defined stage. It is likely that the human capacity component is established due to the significant number of direct supports to researchers through iCRAG. It should also be noted that the state's capacity in this areas is strong through the involvement by GSI and the Marine Institute in the joint INFOMAR seabed mapping programme.

Table 3.10: Overall Assessment of Research Maturity – Subsea Resources		
	2017 Ranking	**Current Estimate**
Capacity	Defined/Established	Established
Infrastructure	Defined	Defined
Networks	Defined	Defined/Established
Source: Indecon Analysis		

Renewable Energy

Some of the key indicators relating to the renewable energy theme are shown in Table 3.11. These figures show that the amount of research funding awarded to this theme is very significant. Significant non-grant funding (e.g., industry contributions) is also leveraged to support research under this theme. During MRIS, 111 research projects have been funded with an average budget size of close to €0.7 million. This research is characterised by a small number of large research awards with four projects having budgets in excess of €5 million. The main Irish funder of renewable energy research is Science Foundation Ireland (SFI) who account for close to 40% of the research funding. The European Commission and SEAI account for the rest of the funding indicating that research funding is concentrated among three public funders.

The SFI MaREI Research Centre was established in 2013 and focused on developing marine renewable energy research. As this was a fledgling industry at this time, MaREI worked across the entire value chain and with parallel, established maritime industries in order to deliver for this key emerging sector. The Centre's research was designed to align with *EU Integrated Maritime Policy* (IMP – Blue Growth) and the national *Our Ocean Wealth Roadmap* to support the integrated development of maritime activities to support optimal deployment. The centre also collaborated with established maritime industries to identify solutions to mutual barriers and challenges. Phase 1 of MaREI (2013-2019) received close to €20 million in research grant aid which was supplemented by other sources. MaREI Phase 2 (2019-25) projects are focused on Climate, Energy and Marine research to support the delivery of Energy Transition, Climate Action and the Blue Economy. These objectives are consistent with the current National Research Priority Areas (2018-2023) and specifically the Energy, Climate Action and Sustainability Theme and the Priority Areas - Decarbonising the Energy System and Sustainable Living. This represents a move away from the focus on marine renewable energy. The agreed grant aid for MaREI Phase 2 is €19.5 million which runs until 2025.

MaREI has benefitted directly from capital funding to support the construction and operation of Lir – Ireland's National Ocean Test Facility. Lir is the only infrastructure for small- to medium-scale laboratory testing of ocean and maritime systems including offshore wind, wave and tidal energy device development and testing. MaREI has also contributed to the UCC masters on Coastal and Marine Management which is important in developing future research capacity.

Indecon estimates that around 128 researchers have been supported to undertake research into renewable energy over the course of the MRIS. There were also three Horizon 2020 Marie Skłodowska-Curie Awards which is indicative of a high-level research maturity. Overall, 22 projects were supported via Horizon 2020 which amounted to over €20.3 million to Irish partners. There was also one SFI Investigators Award given to renewable energy projects and one SFI Spokes. Such awards suggest a high degree of research maturity. Aside from research centres, 13 infrastructure awards were made to support renewable energy research. Over €4 million was awarded via the SFI Research Infrastructure Programme to support infrastructure. Over €14 million was awarded to renewable energy through the SEAI Ocean Energy Prototype Development Fund. This fund supported 27 SMEs with the majority of these SMEs receiving less than €0.1 million in research support. Three companies have received over €1 million in research grants. These supports are suggestive of a research theme with a high degree of research maturity. Renewable energy research also has a high degree of industry collaboration with around 71% of projects having some industry participation. There is also evidence of a large number of international projects. Two projects under this theme have also benefited from the SFI Industry Fellowships which supports collaboration between the HE and SME sectors. This is evidence of a mature level of research capacity. MaREI are

also currently submitting a proposal to the ESFRI Marinergi Research Infrastructure. If successful, the latter would see MaREI become the co-ordinator of Marine Renewable Energy Infrastructures across Europe. Such an initiative would be a clear sign of a translational level of research maturity.

Table 3.11: Analysis of Maturity Level - Renewable Energy	
Total Funding (Agreed Grant Aid) (€ million)	74.13
Non-Grant Funding as % of Total Project Cost	21.9%
Total Number of projects (Primary Theme)	111
Total Number of projects (Secondary Theme)	12
Average Size of Project	0.67
Number of Projects >€500k	28
Number of Projects >€200k <€500k	14
Number of Projects <€200k	69
Total Number of defined projects-based awards	48
Main Funders	SFI (40%); EU Commission (44%); SEAI (12%)
No. of Different Public Funders	5
Number of Researchers (Estimated)	128*
Number of Research directly students supported	6
No. of Research Centres	2
No. of Infrastructure Projects	13
% of projects involving International Collaboration	37%
% of projects involving Industry Collaboration	71%
% of projects involving North-South Collaboration	7%
This figure is likely to be an underestimate due to the way projects within the MaREI research centre have been reported	
Source: Indecon Analysis	

Indecon's assessment of the current level of research maturity in renewable energy is shown in Table 3.12. It could be argued that the level of research maturity could be higher for renewable energy due to the very significant investment in this research theme. However, the focus of Phase 2 of MaREI is wider than renewable energy and it is possible that this may dilute the research maturity in this theme.

Table 3.12: Overall Assessment of Research Maturity – Renewable Energy		
	2017 Ranking	**Current Estimate**
Human Capacity	Established/Collaborative	Collaborative
Infrastructure	Established	Collaborative
Networks	Collaborative/Established	Collaborative/Translational
Source: Indecon Analysis		

Tourism & Leisure

Another specialised research theme is the Tourism and Leisure theme. The key indicators relating to this theme are shown in Table 3.13. During MRIS, only ten research projects have been funded with an average budget size of close to €0.52 million. The main funder of the Tourism and Leisure research theme is the European Commission who account for close to 93% of the research funding. Another research funder is the Marine Institute which indicates a significant concentration in a small number of funders. Indecon estimates that fewer than 10 researchers were supported to undertake research in this theme. There was one direct support for an early-stage researcher in this theme. There are a number of large projects in this theme. One project funded through the Ireland-Wales Programme 2014-2020 was awarded research funding of close to €1.4 million. There were also three other relatively large projects supported through the Interreg programme which involved a number of international partners. Fáilte Ireland also commission research and in some cases carry out research as part of their operational programmes. However, this data has not been captured in this assessment.

Table 3.13: Analysis of Maturity Level - Tourism & Leisure	
Total Funding - (€ million)	5.17
Non-Grant Funding as % of Total Project Cost	23.6%
Total Number of projects (Primary Theme)	10
Total Number of projects (Secondary Theme)	2
Average Size of Project	0.52
Number of Projects >€500k	5
Number of Projects >€200k <€500k	5
Number of Projects <€200k	-
Total Number of defined projects-based awards	9
Main Funders	European Commission (93%), Marine Institute (7%)
No. of Different Public Funders	2
Number of Researchers (Estimated)	12
Number of Research directly students supported	1
No. of Research Centres	0
No. of Infrastructure Projects	0
% of projects involving International Collaboration	90%
% of projects involving Industry Collaboration	20%
% of projects involving North-South Collaboration	60%
Source: Indecon Analysis	

It is likely that the current level of research maturity is Defined which reflects a number of EU-funded research projects which often include a large number of partners. Some of the projects funded are quite large and involve international collaboration. This means that the networking element of this research may be established rather than defined. Due to the nature of this research theme, consideration should be given as to how this research theme is supported. It is quite different to other themes and may not often have a direct link to marine research.

Table 3.14: Overall Assessment of Research Maturity – Tourism & Leisure		
	2017 Ranking	**Current Estimate**
Capacity	Ad hoc	Defined
Infrastructure	Ad hoc	Defined
Networks	Ad hoc	Defined
Source: Indecon Analysis		

Transport & Logistics

Another marine research theme relates to Transport and Logistics. The key indicators for this theme are shown in Table 3.15. Only seven research projects were funded where Transport and Logistics was the primary research theme. These projects were also typically quite small with an average of €0.3 million. The largest funder is the European Commission through four Horizon 2020 project awards. There were also some specific supports to increase human capacity via the Cullen Fellowship programme and a Post-Doctoral Fellowship that is funded by the Marine Institute. The Irish Maritime Development Office of the Marine Institute also carry out and commission research related to ports, trade and the development of shipping and international shipping services in Ireland.

Table 3.15: Analysis of Maturity Level - Transport & Logistics	
Total Funding (€ million)	2.2
Non-Grant Funding as % of Total Project Cost	0.0%
Total Number of projects (Primary Theme)	7
Total Number of projects (Secondary Theme)	8
Average Project Size (€ million)	0.31
Number of Projects >€500k	2
Number of Projects >€200k <€500k	3
Number of Projects <€200k	2
Total Number of defined projects-based awards	5
Main Funders	European Commission (72%), EPA (6%), Marine Institute (22%)
No. of Different Public Funders	3
Number of Researchers (Estimated)	8
Number of Research directly students supported	2
No. of Research Centres	0
No. of Infrastructure Projects	0
% of projects involving International Collaboration	57%
% of projects involving Industry Collaboration	29%
% of projects involving North-South Collaboration	0%
Source: Indecon Analysis	

Due to the relatively small number of research projects supported in this research theme, it is likely the current level of research maturity is Ad hoc or possibly Defined. This research theme is dependent on the one main funder which creates a dependency. However, this funder is the European Commission and four projects have been funded through Horizon 2020 which indicates some level of research maturity. This is quite a specialist area of research with only a small number of researchers who are likely to be independent of other marine research priorities. Indecon believes that consideration should be given as to how this research theme could be supported within a wider marine research and innovation strategy.

Table 3.16: Overall Assessment of Research Maturity – Transport & Logistics		
	2017 Ranking	**Current Estimate**
Capacity	Ad hoc	Ad hoc/Defined
Infrastructure	Ad hoc	Ad hoc
Networks	Ad hoc	Ad hoc/Defined
Source: Indecon Analysis		

Security & Surveillance

The level of research funding awarded to projects where Security and Surveillance are considered to be the primary research theme is very small (circa €0.2 million). During the MRIS period, there were only four projects supported. Similarly, this theme was the secondary research theme for only two projects which both focused on Advanced Technologies. The main funder of projects in this theme was the European Commission through one Horizon 2020 project and two Interreg projects.

Table 3.17: Analysis of Maturity Level - Security & Surveillance	
Total Funding (€ million)	0.83
Non-Grant Funding as % of Total Project Cost	21.0%
Total Number of projects (Primary Theme)	4
Total Number of projects (Secondary Theme)	2
Average Size of Project	0.21
Number of Projects >€500k	-
Number of Projects >€200k <€500k	3
Number of Projects <€200k	1
Total Number of defined projects-based awards	3
Main Funders	European Commission (95%);
No. of Different Public Funders	2
Number of Researchers (Estimated)	5
Number of Research directly students supported	0
No. of Research Centres	0
No. of Infrastructure Projects	0
% of projects involving International Collaboration	75%
% of projects involving Industry Collaboration	50%
% of projects involving North-South Collaboration	0%
Source: Indecon Analysis	

As discussed above, the level of research funding support to this theme is very small and for this reason, it is clearly in the Ad hoc stage of research maturity. For the next strategy, consideration should be given to how this research theme is supported by the wider marine research priorities.

Table 3.18: Overall Assessment of Research Maturity – Security & Surveillance		
	2017 Ranking	**Current Estimate**
Capacity	Defined	Ad hoc
Infrastructure	Defined	Ad hoc
Networks	Defined	Ad hoc
Source: Indecon Analysis		

Biodiversity, Ecosystems & Food-webs

Some of the key indicators relating to the biodiversity research theme are shown in Table 3.19. This is the third-largest research theme (after renewable energy and bioresources) in terms of funding. Figures shown below indicate that nearly €25 million in research funding has been awarded to this theme. During MRIS, 74 research projects have been funded with an average budget size of close to €0.34 million, which is quite small relative to other research themes.

The main funder of Biodiversity, Ecosystems and Food-webs research is the European Commission which provided 32% of the research funding. This theme is characterised by a large number of public funders who contribute significant funding to this theme. Five funders have contributed over €2.3 million in research funding. Research in this theme is also supported by the Marine Institute biodiversity scheme which is funded via the EMFF.

Indecon estimates that around 85 researchers have been supported to undertake research into this theme over the course of the MRIS. One feature of this research theme is the comparatively large number early-stage researchers who have been supported to undertake research in this theme. The Irish Research Council has awarded over €1.3 million to support 15 postgraduate and postdoctoral scholarships. The Marine Research Programme also directly supported 10 early-stage researchers through the Cullen Fellowship Programme and the Marine Institute Fulbright Fellowship.

There were also six Horizon 2020 Awards which is indicative of research maturity. This included a significant number of international partners and led to €2.1 million in research funding for Irish-based researchers. There were also eight awards made through the EPA Research Programme. This involved a number of SMEs as well as HEIs.

One noticeable feature of this research theme is the share of projects that involved international or industry collaboration. This was quite low and only 19% of projects involved industry. In terms of funding, only €3.9 million was awarded to projects with industry involvement. The low shares may be related to the relatively large number of direct awards to early-stage researchers. However, there are a number of international committees such as ICES that facilitate international collaboration. There is evidence of some significant collaboration and two awards worth €3.4 million through the DAFM Research Stimulus Fund is evidence of this. Overall, it does appear there is scope to increase the level of collaboration within this research theme.

Table 3.19: Analysis of Maturity Level - Biodiversity, Ecosystems & Food-webs	
Total Funding (€ million)	25.13
Non-Grant Funding as % of Total Project Cost	4.1%
Total Number of projects (Primary Theme)	74
Total Number of projects (Secondary Theme)	31
Average Project size (€ million)	0.34
Number of Projects >€500k	14
Number of Projects >€200k <€500k	16
Number of Projects <€200k	44
Total Number of defined projects-based awards	41
Main Funders	European Commission (32%), DAFM (21%), Marine Institute (15%); DECC (12%); EPA (12%)
No. of Different Public Funders	11
Number of Researchers (Estimated)	85
Number of Research directly students supported	27
No. of Research Centres	0
No. of Infrastructure Projects	6
% of projects involving International Collaboration	27%
% of projects involving Industry Collaboration	19%
% of projects involving North-South Collaboration	12%
Source: Indecon Analysis	

Indecon's assessment of the current level of research maturity for Biodiversity, Ecosystems and Food-webs is shown in Table 3.20. Based on the evidence presented previously, Indecon believes that the level of research maturity in this theme is likely to have stayed at similar levels to 2017. However, Indecon notes that the level of infrastructure maturity may have declined over the course of the MRIS period. This is due to the relatively low number of competitive infrastructure awards to this research theme. There is scope for this to increase significantly over the course of the next strategy. As noted previously, there are clear gaps in how the data on infrastructure capacity is collated and thus, Indecon believes that infrastructure research maturity estimates should be viewed with appropriate caution.

Table 3.20: Overall Assessment of Research Maturity – Biodiversity, Ecosystems & Food-webs		
	2017 Ranking	**Current Estimate**
Capacity	Established	Established/Collaborative
Infrastructure	Established	Defined/Established
Networks	Established	Established
Source: Indecon Analysis		

Pollution & Litter

Some of the key indicators relating to the Pollution and Litter theme are shown in Table 3.21. There were 29 projects supported where Pollution and Litter was the primary research theme with the amount of research funding awarded to this theme over €18 million with an average budget size of close to €0.6 million.

The main funder of this research theme is the European Commission who accounts for more than 90% of the research funding. This is mainly through their support for the Ireland-Wales Programme 2014-2020 which accounts for nearly half of all research funding to this theme. This funding is allocated to only one research institution in Ireland. There are two projects supported through Horizon 2020 and three projects supported under the Oceans Microplastics JPI. These JPI projects were co-funded by the Marine Institute. Around €17 million was awarded to Irish-based researchers as part of various Interreg programmes. Both the EPA and the Irish Research Council have also supported projects in this research theme but these supports only accounted for around 4% each. The largest Interreg project involves collaboration with Northern Ireland. This relates to Shared Waters Enhancement & Loughs Legacy SWELL Phase 2 and undertaken in Ireland by Irish Water. The budget to Irish researchers for this project is close to €10 million.

The MRIS has raised awareness of the marine research capabilities in Ireland at EU level, and the MaREI Centre (which focuses on marine renewable energy) has leveraged this position to secure funding from JPI Oceans (EU programme administered by the Marine Institute) for two recent projects relating to marine litter, the ANDROMEDA project and the RESPONSE project. These projects seek to develop analysis techniques for quantifying nano- and microplastic particles and their degradation in the marine environment. The RESPONSE project integrates expertise on oceanography, environmental chemistry, ecotoxicology, experimental ecology and modelling to answer key research questions on the fate and impact of nano- and microplastics.

Indecon estimates that around 33 researchers have been indirectly supported to undertake research into this theme with five researchers directly supported through postgraduate and postdoctoral fellowships. There are a large number of projects involving international partners in this theme and this may have assisted with access to any relevant infrastructure. International collaboration is a key feature of this research theme with around 59% of funding going to projects that involved international collaboration. A large amount of this share relates to one research project through one funding source (Ireland-Wales Programme 2014-2020). It is not clear if this funding source can be matched during the next strategy. Without this, the scale of research into this theme may be greatly reduced. There were some supports for early-stage researchers in this theme through the IRC's CAROLINE Fellowships and other postgraduate awards.

Table 3.21: Analysis of Maturity Level - Pollution & Litter	
Total Funding (€ million)	18.1
Non-Grant Funding as % of Total Project Cost	16.2%
Total Number of projects (Primary Theme)	29
Total Number of projects (Secondary Theme)	10
Average Size of Project	0.62
Number of Projects >€500k	5
Number of Projects >€200k <€500k	7
Number of Projects <€200k	17
Total Number of defined projects-based awards	23
Main Funders	European Commission (92%), Marine Institute (4%), EPA (2%)
No. of Different Public Funders	6
Number of Researchers (Estimated)	33
Number of Research directly students supported	5
No. of Research Centres	0
No. of Infrastructure Projects	0
% of projects involving International Collaboration	59%
% of projects involving Industry Collaboration	28%
% of projects involving North-South Collaboration	14%
Source: Indecon Analysis	

Overall, it is likely that the level of research maturity in this research theme has increased, albeit from a low base. There is still a dependence on a relatively small number of projects but specific supports from multiple funders to early-stage researchers are likely to have increased the human capacity in this theme. Consultations with key stakeholders and researchers highlighted the continued importance of research into this area. The state's capacity in this area was not assessed and as a result, is a gap. It should be noted that activity under the MSFD implementation and the state's response to this is an important aspect not covered in this review. The evolution of a specific Programme of Measures being developed under the MSFD will require additional research.

Table 3.22: Overall Assessment of Research Maturity – Pollution & Litter		
	2017 Ranking	**Current Estimate**
Capacity	Ad hoc	Established
Infrastructure	Ad hoc	Defined
Networks	Ad hoc	Established
Source: Indecon Analysis		

Climate Change

Another important research area included in the MRIS relates to Climate Change, in particular its link with the marine. Over €13.4 million has been awarded to projects that primarily examine this

research theme. Some key statistics relating to the climate change research theme are included in Table 3.23. 38 research projects with an average value of €0.35 million were supported during 2017-2019 where Climate Change was the primary research theme. The largest public funder of research in this area is the European Commission. The rest of the research funding is allocated by the Marine Institute, the EPA, Met Éireann, IRC, SFI and SEAI. There are complementarities in the research objectives of these research funding organisations in this theme and these links should be maintained. During the period of the MRIS, eight projects were funded through the EPA Research Programme.[10] Projects funded under this programme typically have a significant focus on policy-relevant research which indicates a relatively high degree of research maturity. Human capacity research is directly supported by three fellowships funded through the Cullen Fellowship Programme, two Marine Institute postdoctoral fellowships and three scholarships funded by the Irish Research Council. It is also likely that early-stage researchers are supported through specific research projects.

Table 3.23: Analysis of Maturity Level - Climate Change	
Total Funding (€ million)	13.41
Non-Grant Funding as % of Total Project Cost	9.5%
Total Number of projects (Primary Theme)	38
Total Number of projects (Secondary Theme)	7
Average Size of Project	0.35
Number of Projects >€500k	7
Number of Projects >€200k <€500k	9
Number of Projects <€200k	22
Total Number of defined projects-based awards	21
Main Funders	European Commission (47%), Marine Institute (39%), EPA (12%)
No. of Different Public Funders	8
Number of Researchers (Estimated)	44
Number of Research directly students supported	9
No. of Research Centres	0
No. of Infrastructure Projects	8
% of projects involving International Collaboration	45%
% of projects involving Industry Collaboration	14%
% of projects involving North-South Collaboration	7%
Source: Indecon Analysis	

Our assessment of the current level of research maturity for climate change is shown in Table 3.24. Based on available evidence, Indecon believes that the level of research maturity in the climate change theme is likely to have slightly improved. The level of collaboration needed to undertake European Commission funded research is likely to be indicative of at least a defined research level or an established level. Direct supports for early-stage researchers in this research theme are likely to indicate a defined or established level of research maturity in terms of human capacity. The importance of climate change research is likely to continue to increase in importance over the course of the next strategy. Establishing the role of marine research in this broader research theme will be important and will require linkages with other research funders nationally and

[10] Six of these projects were co-funded by the Marine Institute.

internationally. Joint funding of projects between the Marine Institute, Met Éireann and the OPW for example is important in delivering services to the public. This is a welcome development.

It should also be noted that MaREI Phase 2 has a larger focus on climate change which will be relevant to this research theme.

Table 3.24: Overall Assessment of Research Maturity – Climate Change		
	2017 Ranking	**Current Estimate**
Human Capacity	Defined	Defined/Established
Infrastructure	Defined/Established	Established
Networks	Defined	Defined/Established
Source: Indecon Analysis		

Ocean Observation & Seabed Mapping

Research into Ocean Observation and Seabed Mapping is well established in Ireland and there is clear evidence of the existence of capacity and infrastructure to support research into this research theme. There is also likely to be significant linkages with the objectives of other research themes such as Subsea Resources. A selection of key indicators relating to the Ocean Observation and Seabed Mapping theme are shown in Table 3.25. There is significant expertise in relation to Seabed Mapping within the state sector through the INFOMAR project which is a joint venture between the Marine Institute and the Geological Survey of Ireland (GSI) funded by DECC. This project has aims to map Ireland's entire seabed by 2026. Ireland may the first country to complete such a mapping exercise.

Aside from INFOMAR, the amount of research funding awarded to this theme was over €17 million during the MRIS period. This supported 61 research awards and funded eight projects with budgets of greater than €0.5 million. The average project size for this theme was around €0.28 million.

Competitive research funding towards ocean observation and seabed mapping is primarily coming from four main funders. SFI have contributed around €7 million to support research in this area with the European Commission contributing a similar amount. The other main funders are GSI and the Marine Institute who have contributed close to €2 million each during MRIS. This in addition to significant research into this theme by the state bodies.

Indecon estimates that around 70 marine researchers have been supported to undertake research into this theme through project awards with a further 16 researchers supported through postgraduate and postdoctoral fellowships. GSI awarded three postdoctoral fellowships and the Marine Institute awarded two fellowships through the Cullen Fellowship Programme. The IRC also supported five postgraduate and postdoctoral fellowships. This highlights the significant direct supports for early-stage researchers available in this research theme.

There were also 11 Horizon 2020 awards in this research theme. These were largely all led by international research institutions. Two projects were also funded through the SFI Investigators Programme. Such awards suggest a high degree of research maturity. SFI also provided significant funding (€5 million) to support research infrastructure in this theme. The GSI Geoscience Research

Programme supports a large number of small projects to undertake research into this area. Within this programme, GSI have issued two short calls which have supported over 18 small research projects. This has the benefit of involving a large number of organisations in developing research capacity in this theme which may lead to larger awards in the future. It also leads to significant industry collaboration.

Table 3.25: Analysis of Maturity Level - Ocean Observation & Seabed Mapping	
Total Funding (€ million)	17.12
Non-Grant Funding as % of Total Project Cost	5.0%
Total Number of projects (Primary Theme)	61
Total Number of projects (Secondary Theme)	24
Average Size of Project	0.28
Number of Projects >€500k	8
Number of Projects >€200k <€500k	8
Number of Projects <€200k	45
Total Number of defined projects-based awards	34
Main Funders	SFI (41%), European Commission (41%), GSI (11%)
No. of Different Public Funders	6
Number of Researchers (Estimated)	70
Number of Research directly students supported	16
No. of Research Centres	0
No. of Infrastructure Projects	8
% of projects involving International Collaboration	21%
% of projects involving Industry Collaboration	28%
% of projects involving North-South Collaboration	2%
Source: Indecon Analysis	

Table 3.26 shows our assessment of the current levels of research maturity within this theme. Based on the evidence presented previously, Indecon believes that the level of research maturity in this theme is likely to have improved on 2017 levels. The 2017 levels indicated a relatively high level of research maturity in this theme. As there has been significant investment in infrastructure to support research, Indecon believes that this aspect of research maturity is likely to have moved from established to collaborative. The high level of international collaboration is also likely to indicate high levels of research maturity and it is likely that research maturity meets the collaborative criteria. It is possible that this research theme meets the criteria for a Translational level of research maturity but it is likely that this would require a greater level of investment. Overall, there is significant research undertaken in this research theme which builds on existing research capacity and infrastructure. Aspects that may be considered in the next strategy include the scope for North-South collaboration and increasing Industry participation in this theme.

Table 3.26: Overall Assessment of Research Maturity – Ocean Observation & Seabed Mapping		
	2017 Ranking	**Current Estimate**
Capacity	Established	Collaborative
Infrastructure	Established	Established/Collaborative
Networks	Established	Established/Collaborative
Source: Indecon Analysis		

Ocean Literacy & Education

A selection of the key indicators relating to the Ocean Literacy and Education theme are shown in Table 3.27. As the figures show, this is a small research theme in terms of both projects supported (only five as the primary theme) and research funding awarded (around €3.5 million). One of the seven projects accounts for nearly 71% of total research funding awarded to projects in this theme. Almost 100% of research funding in this theme during the MRIS period has come from the European Commission. Four projects are funded through Horizon 2020. The largest of these projects was funded through the European Research Council Advanced Grant. The most recent call had an approximate budget of €492 million for an estimated number of 209 grants. This highlights the significance of being awarded funding through this process.

Table 3.27: Analysis of Maturity Level - Ocean Literacy & Education	
Total Funding (€ million)	3.47
Non-Grant Funding as % of Total Project Cost	0.0%
Total Number of projects (Primary Theme)	5
Total Number of projects (Secondary Theme)	8
Average Size of Project	0.69
Number of Projects >€500k	2
Number of Projects >€200k <€500k	1
Number of Projects <€200k	2
Total Number of defined projects-based awards	5
Main Funders	European Commission (100%),
No. of Different Public Funders	2
Number of Researchers (Estimated)	6
Number of Research directly students supported	0
No. of Research Centres	0
No. of Infrastructure Projects	0
% of projects involving International Collaboration	60%
% of projects involving Industry Collaboration	20%
% of projects involving North-South Collaboration	0%
Source: Indecon Analysis	

As discussed above, there are only a small number of research institutions that are undertaking research into Ocean Education and Literacy. This creates a dependence on a small number of researchers and limits the scope to establish long-term research networks. There also appears to be few direct supports for early-stage researchers or research infrastructure. This is likely to limit the potential for capacity growth in the next strategy. However, the presence of the Irish Ocean Literacy Network must be noted in relation to this research theme. This network has over 100 members from 40 organisations and supports collaboration in the area. Citizen engagement work is also being undertaken by organisations such as Coastwatch, the Irish Whale and Dolphin Group, Clean Coasts, and the National Biodiversity Data Centre (including the Explore Your Shore Citizen Science initiative to record biodiversities on our coasts).

Overall, it is likely that the level of research capacity has decreased during the course of the MRIS.

Table 3.28: Overall Assessment of Research Maturity – Ocean Literacy & Education

	2017 Ranking	Current Estimate
Capacity	Defined/Established	Defined
Infrastructure	Defined	Ad hoc/Defined
Networks	Defined	Defined

Source: Indecon Analysis

Integrated Policy & Governance

Some of the key indicators relating to the overall Integrated Policy and Governance theme are shown in Table 3.29. This theme is split into four sub-themes, namely Planning and Governance, Socio-Economics, Law and Business Development. Each of these had different levels of research maturity as per the 2017 MRIS. In this section, Indecon considers the research maturity level of these themes individually and collectively.

The evidence shows that the amount of research funding awarded to the overall Integrated Policy and Governance theme was just over €9 million over the course of the MRIS. Planning and Governance accounts for around 72% of this with Socio-Economics accounting for the remaining 28%. The other sub-themes Law and Business Development do not appear to have had any specific project-based research awards during MRIS. This is likely to reflect a gap in the data collected in the National Research Database.

The main funders of this thematic research are the European Commission who account for close to 80% of the research funding. This funding is awarded through Horizon 2020 and the Interreg Programme. The Marine Institute, the EPA and the IRC also provide supports for research under this theme. Specifically, €800,000 of funding over a four-year period was secured from the Marine Institute for the Navigate project on Ocean Law and Marine Governance,[11] an area recognised in the MRIS and in Harnessing Our Ocean Wealth (HOOW) as essential for the sustainable management of our global seas. MaREI has also examined planning and governance aspects relating to renewable

[11] This project was categorised under the Planning and Governance sub-theme. However, it is likely to be also relevant to the Law sub-theme.

energy in Ireland. This is an important enabler of future progress in relation to the implementation of research in this theme.

Indecon estimates that around 25 researchers have been supported to undertake research relating to this theme during the period of MRIS.

Table 3.29: Analysis of Maturity Level - Integrated Policy & Governance	
Total Funding (€ million)	9.17
Non-Grant Funding as % of Total Project Cost	7.5%
Total Number of projects (Primary Theme)	22
Total Number of projects (Secondary Theme)	27
Average Size of Project	0.42
Number of Projects >€500k	7
Number of Projects >€200k <€500k	5
Number of Projects <€200k	10
Total Number of defined projects-based awards	19
Main Funders	European Commission (80%), Marine Institute (16%), EPA (4%)
No. of Different Public Funders	4
Number of Researchers (Estimated)	25
Number of Research directly students supported	3
No. of Research Centres	0
No. of Infrastructure Projects	0
% of projects involving International Collaboration	64%
% of projects involving Industry Collaboration	27%
% of projects involving North-South Collaboration	9%
Source: Indecon Analysis	

The majority of funding within the Integrated Policy and Governance theme relates to Planning and Governance related research. Over the course of the MRIS, 19 projects were supported worth over €6.5 million to Irish-based researchers. The main funder of this research was the European Commission who contributed over 77% of this funding. This funding was awarded through six Horizon 2020 awards and five Interreg awards. There were also a number of fellowships to support early-stage researchers awarded to undertake research in this sub-theme. Overall, it is likely that the level of research maturity within this sub-theme has remained at the established level.

Table 3.30: Overall Assessment of Research Maturity – Integrated Policy & Governance (Planning and Governance)		
Planning & Governance	**2017 Ranking**	**Current Estimate**
Capacity	Established	Established
Infrastructure	Established/Collaborative	Established
Networks	Established	Established
Source: Indecon Analysis		

There were four projects (worth €2.5 million) supported during the MRIS period for the socio-economics sub-theme. Nearly 80% of this funding was awarded to a single project funded through the Horizon 2020 Programme. The remaining funding within this sub-theme came from a specific socio-economics call launched by the Marine Institute. Overall, based on the small number of projects and the dependence on one single project, it is likely that the level of research maturity has decreased over the period of the MRIS. As discussed before, there are unlikely to be any significant infrastructure barriers to undertake research in this area so there should be an emphasis on developing human capacity in this sub-theme.

Table 3.31: Overall Assessment of Research Maturity – Integrated Policy & Governance (Socio-Economics)

Socio Economics	2017 Ranking	Current Estimate
Capacity	Established	Ad hoc/Defined
Infrastructure	Established/Collaborative	Ad hoc/Defined
Networks	Established/Collaborative	Ad hoc/Defined

Source: Indecon Analysis

Information & Spatial Technologies, Analytics and Modelling (ISTAM)

Some of the key indicators relating to the Information and Spatial Technologies, Analytics and Modelling ('ISTAM') theme are shown in Table 3.32. This is a relatively new area of research and has developed considerably over the last ten years. The broad analytical techniques that underpin this research theme have been applied to various themes across the marine sector. However, it must be noted that there is significant potential cross-over with other research areas and evidence of current research capacity is less predictive of future capacity compared to other areas.

There were 26 projects supported where ISTAM was the primary research theme. These projects were awarded nearly €8.1 million in research funding with an average budget size of close to €0.3 million.

The two largest funders of research in this theme are SFI and the European Commission who each accounted for around 41% of research funding awarded during the MRIS period. The Marine Institute, the EPA, GSI and the IRC also fund multiple projects in this theme.

Indecon estimates that around 30 researchers have been supported to undertake research into ISTAM over the course of the MRIS. There were also nine researchers supported directly through PhD and postdoc scholarships within this research theme. SFI contributes to this theme through five different programmes including their Investigator Programme and their US-Ireland R&D Partnership. These types of supports are indicative of a research theme with a relatively high level of research maturity. SFI also supports two industry fellowships within this research theme. There were also eight projects supported through Horizon 2020. There is some evidence of both industry and international collaboration in this research theme.

The state's capacity in this research theme is also noteworthy. This includes the Marine Institute and GSI though their collaborative programme INFOMAR. Also of note is the linkages with other areas such as wild resources, and investments made under the EMFF related to marine spatial planning and management of bioresources.

Table 3.32: Analysis of Maturity Level - Information & Spatial Technologies, Analytics and Modelling	
Total Funding (€ million)	8.13
Non-Grant Funding as % of Total Project Cost	0.3%
Total Number of projects (Primary Theme)	26
Total Number of projects (Secondary Theme)	35
Average Size of Project	0.31
Number of Projects >€500k	6
Number of Projects >€200k <€500k	6
Number of Projects <€200k	14
Total Number of defined projects-based awards	16
Main Funders	SFI (40%), European Commission (41%), Marine Institute (9%)
No. of Different Public Funders	9
Number of Researchers (Estimated)	30
Number of Research directly students supported	9
No. of Infrastructure Projects	1
% of projects involving International Collaboration	35%
% of projects involving Industry Collaboration	31%
% of projects involving North-South Collaboration	8%
Source: Indecon Analysis	

Overall, it is likely that the level of research maturity in this theme has increased over the course of the MRIS. However, it is unclear if this growth relates to the MRIS or is simply a reflection on the increased investment in research in the broad area of data analytics. The significant investment from SFI along with the contribution of Horizon 2020 projects indicates that the research maturity level is relatively high. However, the skills that underpin research in this theme are transferrable and can be easily applied to other research areas. For this reason, it will be important to monitor the levels of research and associated research capacity in this area in the next research and innovation strategy.

Table 3.33: Overall Assessment of Research Maturity – Information & Spatial Technologies, Analytics and Modelling		
	2017 Ranking	**Current Estimate**
Capacity	Established	Established/Collaborative
Infrastructure	Established/Collaborative	Established/Collaborative
Networks	Established	Established/Collaborative
Source: Indecon Analysis		

Engineering

The final research theme that Indecon have reviewed relates to engineering and how this discipline supports marine-related projects. This theme has similarities with the ISTAM theme in that the skills of researchers are not necessarily specific to the marine sector. During the MRIS period, there were only 10 projects supported in this research theme but these were typically large projects with the average funding award being nearly €0.7 million. Four of the ten projects supported had research budgets in excess of €0.5 million with three projects having budgets in excess of €1 million. These large projects were all funded by the European Commission through Horizon 2020 and the Interreg Ireland-Wales Programme 2014-2020. Overall, this is a relatively small research theme that has been successful in being awarded a number of large European-funded projects.

Table 3.34: Analysis of Maturity Level - Engineering	
Total Funding (€ million)	6.96
Non-Grant Funding as % of Total Project Cost	5.8%
Total Number of projects (Primary Theme)	10
Total Number of projects (Secondary Theme)	12
Average Size of Project	0.7
Number of Projects >€500k	4
Number of Projects >€200k <€500k	-
Number of Projects <€200k	6
Total Number of defined projects-based awards	7
Main Funders	European Commission (96%), Marine Institute (3%)
No. of Different Public Funders	5
Number of Researchers (Estimated)	12
Number of Research directly students supported	2
No. of Research Centres	0
No. of Infrastructure Projects	0
% of projects involving International Collaboration	30%
% of projects involving Industry Collaboration	20%
% of projects involving North-South Collaboration	0%
Source: Indecon Analysis	

The relatively small number of the research projects supported in this theme indicates the current level of research maturity is likely to be relatively low. However, it is likely that the level of research maturity has increased since the publication of the MRIS. This reflects the ad hoc nature of marine-related engineering research prior to the publication of the MRIS and the evidence that a small number of researchers have been very successful in winning EU research funding. See table overleaf.

Table 3.35: Overall Assessment of Research Maturity – Engineering		
	2017 Ranking	**Current Estimate**
Capacity	Ad hoc	Defined
Infrastructure	Ad hoc	Defined
Networks	Ad hoc	Defined
Source: Indecon Analysis		

4. Focus of Investment and Funding Instruments

4.1. Introduction

This section considers whether the funding awarded during MRIS was targeted in line with the stated objectives of the strategy. This section also considers the funding instruments used to support the implementation of the strategy.

4.2. Focus of Investment

A summary of the levels of progress across the research themes is shown in Table 4.1. The analysis of maturity levels indicates that the majority of themes increased their research maturity level in terms of human capacity and networks. This indicates that the focus of investment was consistent with the objectives of the MRIS. However, it is likely that a number of themes decreased their level of research maturity over the MRIS period.

Table 4.1: Analysis of Focus of Investment

	Human Capacity	Infrastructure	Networks
No. of Themes that increased	11	7	10
No. of Themes that decreased	3	4	2
No. of Themes remained the same	1	4	3

Source: Indecon Analysis

The first goal of the MRIS is to "raise the research capacity across all themes." Based on the analysis undertaken in Section 3, it is very unlikely that this goal was achieved. There is clear evidence across a number of themes that the level of research capacity remained the same or decreased during the MRIS period. The analysis of research capacity in relation to infrastructure is limited by a lack of data on infrastructure that is supported via non-competitive awards. However, it is still likely that there were a number of research themes where capacity declined. The level of research funding appears to have become more concentrated across certain themes including renewable energy. This research theme has increased its research capacity and has scope for further improvements. The MRIS has 15 different research themes so it is difficult to support increases in capacity across each of these themes. The research capacity of certain themes is dependent on a small number of researchers.

The second goal of the MRIS relates to the targeting of research funding. This targeting should reflect policies and sectoral plans. It is not clear if such targeting was apparent in the research supported. As discussed previously, this targeting is a secondary goal to the overall goal of increasing research capacity. There does not appear to have been any specific targeting of themes with lower levels of research maturity.

These two MRIS goals focused on increased the research maturity of marine research across 15 different research themes. Many of these research themes were very independent of other themes and were often reliant on a small number of researchers. Thus, the presence of so many disparate research themes makes achieving the overall objective of increasing research capacity across all themes very difficult. Indecon believes that the number of themes should be consolidated in the

next strategy and any targets should be cognisant of the very different characteristics of the different research themes.

4.3. Overview of Funding Instruments used to undertake marine research

It is also useful to consider the types of supports that have been provided over the duration of the MRIS. An analysis of the focus of investment and funding instruments across the 15 research themes, taking into consideration the marine research funding data that has been collected in collaboration with the members of the MRFF is described in this section. Table 4.2 shows marine research commitments disaggregated by various types of supports including project-based awards, Centres of Excellence, PhD scholarships, postdoctoral fellowships, infrastructure supports or networking supports.

Amongst these, the highest research commitment was made for projects-based awards with an allocation of just under €170 million. There are research centre (Centre of Excellence) projects[12], each with a large budgetary commitment. There were 72 PhDs supported to undertake marine research directly. In addition to this, early-stage researchers were likely supported through awarded research projects.

Table 4.2: Number of Marine Research projects supported, by Type of Support

Type of Support	Number			
	Pre-2017	2017	2018	2019
Centre of Excellence	3	0	0	0
Project-based	126	79	68	52
PI/Post-Doc/PhD/MSc	68	26	17	29
Infrastructure	12	23	2	7
Industry	12	16	23	7
Other	2	3	0	1

Note: Pre-2017 refers to projects that started before 2017 but were still active on the 1st January 2017
Source: Indecon Analysis of Marine Research Database

It is also important to consider the amount of funding that has been awarded to each of the funding instruments. Around 60% of the funding was awarded to project-specific research. The next largest funding instrument was SFI centres of excellence/research centres. Over €12 million was allocated to infrastructure specific projects. This accounts for around 5% of the overall level of research funding.

[12] iCRAG is also a SFI research centre. However, information is available on the breakdown of projects within this research centre so this breakdown is included rather than the research centre identifier.

Table 4.3: Overall Funding (Agreed Grant Aid) for Marine Research, by Type of Support					
	Value of Projects (Agreed Grant Aid) by Theme (€ million)				
	Pre-2017	2017	2018	2019	Total
Centre of Excellence	24.68*	.	.	.	24.68
Project-based	66.65	29.83	42.85	28.93	168.26
PI/Post-Doc/PhD/MSc	12.07	2.42	3.34	4.9	22.73
Infrastructure	7.35	2.97	2.1	0.18	12.6
Industry	5.47	1.24	4.18	0.87	11.75
Other	0.06	0.05	0	0.04	0.14

**** includes SFI Phase 1 MaREI funding 2013-2019***
Note: Pre-2017 refers to projects that started before 2017 but were still active on the 1st January 2017
Source: Indecon Analysis of Marine Research Database

There are 11 main funders of competitive marine research with the largest funder being the European Commission. The next largest funder is SFI which supports a number of research centres. The Marine Institute, Irish Research Council and the European Commission support a large number of marine research themes. Other important funding partners are focused on specific themes relevant to their mandates.

Table 4.4: Number of Marine Research projects supported, by Funder			
Funder	**Number of Projects supported**	**No. of Primary Research Themes supported**	**Total Funding (Agreed Grant Aid) - € million**
Bord Iascaigh Mhara	21	1	3.78
Department of Agriculture, Food and the Marine	21	3	12.32
Department of Environment, Climate and Communications	2	1	2.48
Environmental Protection Agency	34	6	5.52
European Commission	201	14	121.49
Geological Survey Ireland	34	5	2.66
Irish Research Council	51	12	3.63
Irish Shelf Petroleum Studies Group	8	1	0.52
Marine Institute**	131	12	29.51
Science Foundation Ireland (SFI)	65*	6	46.3
Sustainable Energy Authority of Ireland	48	2	9.29

Note: This includes project co-funding
****This includes all iCRAG projects. GSI a co-funder on some of these projects***
*****Includes Marine Institute EMFF***
Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017
Source: Indecon Analysis of Marine Research Database

The type of support provided by each of the main eleven funding organisations is shown in Table 4.5. These are broken into the five main types of funding instruments. Each of these types of funding instruments supports research maturity in different ways. The figures show that the European Commission is the largest funder overall and the main funder of project-based research.

Table 4.5: Overall Funding (Agreed Grant Aid) for Marine Research, by Type of Support (€ million)											
	BIM	DAFM	DECC	EPA	EC	GSI	IRC	ISP SG	MI	SFI	SEAI
Centre of Excellence	.	.	.	.	.	.	.	.	.	24.68*	.
Project-based	2.56	12.32	2.48	4.9	122.5	1.46	0.06	0.52	16.34	2.49	2.01
PI/Post-Doc/PhD/MSc	.	.	.	0.62	0.07	1.09	3.56	.	7.46	9.84	.
Infrastructure (specific call)	.	.	.	.	.	0.1	.	.	3.41	9.08	.
Industry	1.22	.	.	.	0.84	.	.	.	2.28	.	7.27
**** includes SFI Phase 1 MaREI funding 2013-2019***											
Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017											
Source: Indecon Analysis of Marine Research Database											

Some research funders are likely to have similar objectives. This creates an opportunity for co-funding. Co-funding is more than just a sharing of financial cost as it also brings the different perspectives of the organisations into the oversight of the research. Multiple/joint funders also means that supported research has a shared objective (in different funding programmes) and joint funding leads to the most efficient use of funds.

The majority of research funding organisations share common research objectives. The number of marine research projects that were co-funded during the duration of MRIS is shown in Table 4.6.

Table 4.6: Co-funding Projects		
Funder	**Number of Projects funded as a co-funder**	**Value of Co-Funding (€m)**
Department of Housing, Local Government and Heritage	2	0.31
Environmental Protection Agency	8	0.48
European Commission	15	0.25
Geological Survey of Ireland	8	1.49
Irish Research Council	1	0.06
Marine Institute	13	4.0
Met Éireann	4	0.31
National Parks & Wildlife Service	1	0.18
OPW	1	0.04
Note: This does not include the lead funders of the projects. For example, there are a large number of co-funded projects with SFI as the lead funder.		
Note: Time period relates to marine research projects that were active between 2017 and 2019. They may have been awarded prior to 2017		
Source: Indecon Analysis of Marine Research database		

Over €7m in competitive funding was awarded by funding organisations when acting in the capacity of a project co-funder. The lead funders on the above projects included the Department of the Environment, Climate and Communications, Environmental Protection Agency, Irish Research Council, Irish Shelf Petroleum Studies Group, Marine Institute, Science Foundation Ireland and

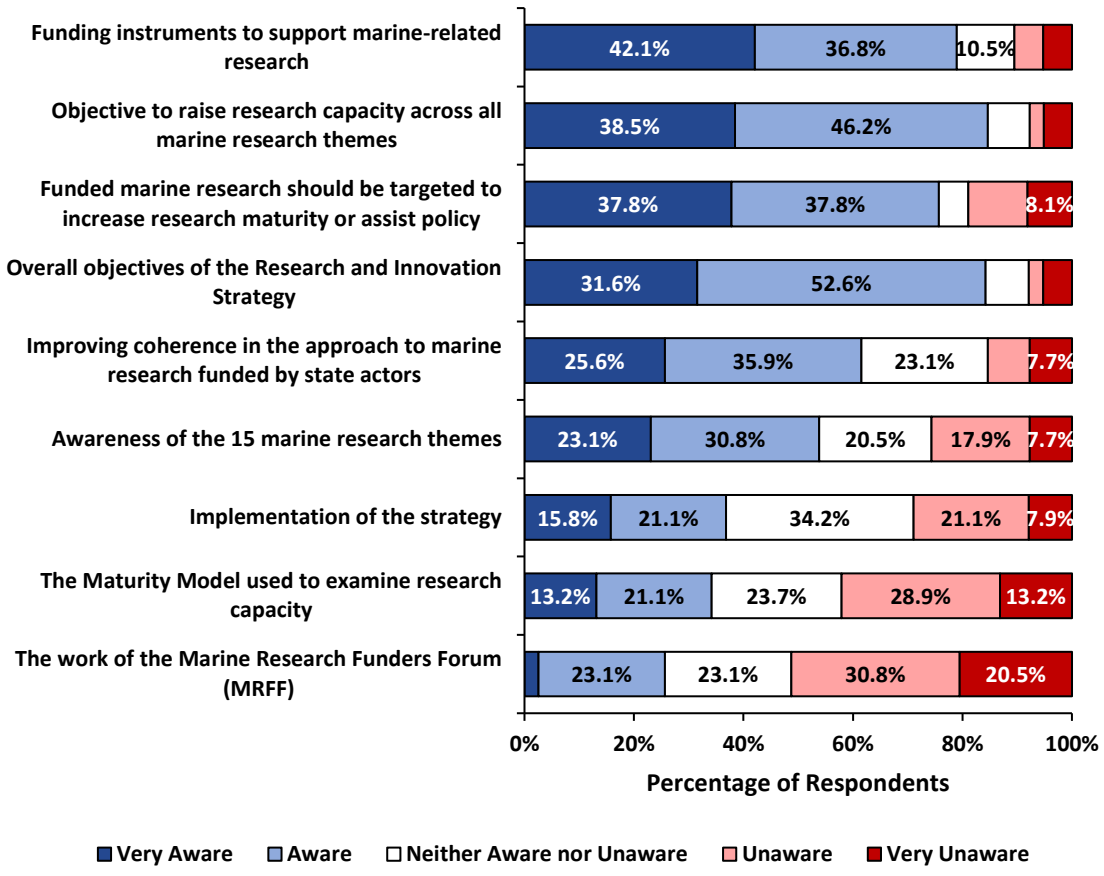
Sustainable Energy Authority of Ireland. When taking into account the lead funders' contributions to these jointly funded projects, over €20m in competitive funding was awarded to marine research.

In addition to the co-funded projects in the above table there were six projects that involved Northern Ireland and international co-funders. Science Foundation Ireland was the lead funder of four awards that involved a co-funding aspect from the Northern Ireland Department for the Economy (3), the US National Science Foundation (2) and the National Natural Science Foundation of China (1). The Department of Agriculture, Food and the Marine also funded two projects with co-funding from the Northern Ireland Department of Agriculture, Environment and Rural Affairs. Irish research organisations were awarded over €3.5m in total for these six projects.

4.4. Analysis of appropriateness of Funding instruments

As part of this review, Indecon undertook a survey of marine researchers. These researchers indicated a high degree of awareness of the funding instruments available to support marine-related research. Around 75% of researchers also indicated that they were aware of the MRIS objective that marine research should be targeted. This suggests that the funding instruments are well communicated by the research funders.

Figure 4.1: Awareness of features of the National Marine Research and Innovation Strategy among Marine researchers



Source: *Indecon confidential survey of marine researchers*

As part of the survey, Indecon also sought the views of researchers on the appropriateness of funding instruments and any possible improvements. Some of the key points made by researchers are shown in Table 4.7. These suggest that there may be merit in considering refinement to some aspects of the funding instruments in order to build on the achievements made to date.

Table 4.7: Views of Marine Researchers on Possible Improvements to the Funding Mechanisms

- Leverage. If we could, for example, join a H2020 call and be able to say we could guarantee x weeks' ship time or similar, this would really help us join proposals. A formal mechanism for allowing/facilitate that would be awesome.
- Support for a number of key careers committed full-time researchers in key laboratories in important areas. We should not have to cycle all researchers on a 3 – 5-year cycle.
- Information Sessions on National and Transnational funding. Workshops on Grant Writing.
- Industry support could be integrated into the call.
- It would be useful to have the postdoc funding stream open to NI research groups.
- Keep the application and the funding as simple as possible- and select a variety of smaller projects. If needed- fund the same concept to two different teams.
- If possible - please could we organise access and training around equipment and data that may be available. These will really create a well-trained cohort of people.
- A requirement for research institutions/companies to deliver demonstration projects at TRL 6.
- Indirect funding models ought to be explored e.g., provide small amounts of funding needed by researchers to apply for, and win, large grants.
- Gap in Irish research funding with respect to schemes that are delivered through the SBIR format. A suitably designed Small Business Innovation Research (SBIR) initiative.
- Funding supports, travel grants, training grants, support for networks. Supports for industry to host researchers.
- Mentoring for large scale funding participation.
- A directory of Irish researchers and their interests to ensure that they can be easily matched with industry.

Source: Indecon confidential survey of marine researchers

4.5. Summary of Findings

- There are a large number of public funders who support marine-related research. The main funders include the European Commission, Science Foundation Ireland, the Marine Institute, Department of Agriculture, Food and the Marine, GSI, IRC, SEAI, EPA, BIM and the Department of Environment, Climate and Communications.
- The European Commission is the largest funder of marine research in Ireland, both in terms of the number of projects supported and the value of research funding awarded. The level of funding received from the European Commission represents an important indication of the quality of marine researchers in Ireland and also the levels of research maturity. Increased research partnerships (national and international) were identified in the MRIS as a key action of the strategy.
- Each of the funders provides different types of funding instruments. SFI focus on research centres but the majority of the other research funders support marine-related research through project-specific competitive call awards. Aside from project-based awards, the Marine Institute and the IRC directly support early-stage researchers whilst SEAI focuses their funding on industry awards.

5. Implementation Actions and Structures

5.1. Introduction

In this section, the implementation of the MRIS is reviewed and what structures have been put in place to support this. As part of this analysis, Indecon has reviewed the documentation of the implementation of the MRIS and undertaken new survey research with marine researchers.

5.2. Review of Implementation Actions

The MRIS set out 16 implementation actions. The completion level of these actions (as at the end of Q3 2020) is outlined in Table 5.2. Some of the completion levels may be open to interpretation. Our approach is based on a traffic light system. Red indicates that the action has not been implemented and is at high risk of not being implemented before the end of the MRIS period. Green means that the action has been completed/ongoing. The majority of the actions are amber which indicates progress towards the implementation of the action but indicates that it not yet clear if the actions will be completed by the end of the MRIS (end-2021).

It must be noted that the MRIS was published following the release of Innovation 2020 which was designed to be the overarching strategy to support research activity in Ireland. Many of the actions outlined in the MRIS are linked to actions set out in the Innovation 2020 implementation plan. There have been four progress reports on Innovation 2020 along with a mid-term review. These reports provide updates on progress against various actions including Action 4.17 (see Table 5.1).

Table 5.1: Review of Innovation 2020 Progress Updates

Action	Progress Update	Comment on Progress
4.17	1	Overview of requirement for development of MRIS
4.17	2	Update on date for publication of the MRIS
4.17	3	Updates on the progress of implementation of MRIS including the establishment of MRFF
4.17	4	Further updates on implementation of MRIS including analysis of marine research funding

Source: Indecon analysis of Innovation 2020 Progress Reports (1-4)

There were 16 implementation actions outlined in the MRIS. Actions relating to the establishment of the Marine Research Funders Forum (MRFF) have been largely implemented. There is, however, a need to establish an inventory of marine research infrastructure as well as examining access to infrastructure. Indecon's analysis shows that there has also been some progress made in increasing collaboration with industry and in establishing international partnerships. The analysis presented in the next table indicates areas where there was good progress as well as elements where progress has been delayed.

Table 5.2: Status of MRIS Actions		
Action	**RAG Status (Q3 2020)**	**Comment**
1. Establish Marine Research Funders Forum		*This was established during 2018 and has met six times*
2. Define funding instruments and metrics		*Marine Research Database largely completed. More work required on filling gaps (e.g. state capacity, industry – EI)*
3. Build basic research capacity		*Investments made to raise capacity across many different areas*
4. Research Equipment and Small Infrastructure Call		*Call issued in 2017*
5. Establish Marine Infrastructure Providers Forum		*First meeting held in 2018, but no subsequent meetings*
6. Inventory of Marine Research Infrastructures		*Delayed as part of actions due to be conducted by Marine Infrastructure Providers Forum (MIPF)*
7. Scope National Marine Research Infrastructure Access Programme		*Delayed as part of actions due to be conducted by MIPF*
8. Increase opportunities for SMEs to participate in Marine Research		*Progress made with SMEs accounting for approx. 25% of Horizon 2020 funding*
9. Increase awareness of research opportunities amongst SMEs		*Progress made, but MRFF members feel more could be done*
10. Small Business Innovation Research		*SBIR and Marine Institute co-funding launched in 2020*
11. Thematic Research Co-ordination		*Focus of this review. Understanding of cross theme linkages noted as key by members*
12. Re-assess maturity capability for research themes		*Focus of this review*
13. Promote research for economic development		*Members acknowledge more can be done to promote funding, but significant funding made available*
14. Increase national collaboration across range of international research and science partnerships		*Strong progress made with significant funding awarded to collaborative projects in Ireland*
15. Review and share the range of international science partnerships and associations		*All-island projects receiving significant national and international funding*
16. Review the role of marine and maritime activities in Ireland's approach to Smart Specialisation Strategy		*No updated national smart specialisation strategy has been published since 2014*
Source: Indecon Analysis		

Action 1

As shown in Table 5.2, the Marine Research Funders Forum was established in 2018, and they have met six times. The MRFF meets to discuss progress towards the actions in the MRIS, as well as other topics in the area of marine research in Ireland. A new webpage for the MRFF was published in 2020 outlining its participants and functions. This highlights that Action 1 of the MRIS was clearly implemented and this co-ordinating group is important in the implementation of other actions and the design of the next strategy.

Action 2

The development of the National Marine Research Database largely fulfils this requirement. This database has been developed in collaboration with the MRFF and provides detailed data on all marine-related research projects funded during the MRIS period. This is an evolving database and will be updated as new projects come on stream. This database includes data on levels of funding, funding instruments, research partners, industry collaboration, international collaboration, project award date and details on the funding organisations involved. There are still gaps in the database that are currently being addressed. These are outlined in more detail in the next section. The importance of the collection of baseline data on funding of marine research by the various public funders was highlighted in the MRIS. It must also be noted that this action (along with others) was linked to actions set out in Innovation 2020.

Action 3

This action focuses on the development of basic research capacity. At an early stage of the MRIS, a note was circulated to the MRFF which assessed each of the three dimensions of the MRIS (human capacity, infrastructures, networks and relationships) based on the levels of maturity outlined in the MRIS, using the Research Maturity Assessment Model. Investments were made in a number of areas in 2017 and 2018 amongst the themes deemed to have the lowest capacity, suggesting some progress has been made on this action. The issue of understanding linkages across themes was raised with suggestions that this would help the MRFF better understand the capacity levels and build capacity in different themes. There were also significant supports for PhD and early-stage researchers from SFI, IRC, MI, EPA, DAFM and Teagasc. The Marine Institute also specifically targeted low-capacity areas in their early-stage researcher calls. Overall, it is clear that some progress has been made in relation to the implementation of this action. However, it is clear from our review of research maturity levels that some themes still have low levels of research maturity.

Action 4

A research equipment and small infrastructure call was issued in 2017, with awards of between €20,000 and €200,000 available to successful applicants. A total of €2 million in funding was available under the call, with applicants required to show how the equipment would allow research into activities aligned with national policy objectives. As outlined by the Marine Institute the call "*aims to raise the performance of the marine research and innovation community across all areas by enabling the acquisition of specialist equipment*."[13] The evidence indicates that this action was implemented as set out in the MRIS.

[13] https://www.marine.ie/Home/site-area/research-funding/research-funding/marine-infrastructure-call-2017

Actions 5-7

A first meeting of the Marine Infrastructures Providers Forum (MIPF) was held in September 2018. However, no subsequent meetings were held and the associated Actions (6 and 7) were not implemented. Since the publication of the MRIS, the Marine Institute 2018-2022 Strategic Plan was launched. This identified connecting the National Marine Research Infrastructures as a key strategic initiative. As part of this initiative, a convening of a Marine Infrastructures Providers Forum was proposed. Actions 6 and 7 were closely linked to the establishment of the MIPF but currently, these have not progressed. There are some mitigating circumstances for the non-implementation of these Actions. Following the first meeting of the Marine Infrastructure Providers' Forum, the existence of the EPA's Water Research Infrastructure Database was noted. It was agreed that effort is made to ensure that marine research infrastructure was profiled adequately. It also is noted that Action 7 was explicitly outlined in the Marine Institute Strategic Plan.

Significant investment has been made in marine infrastructure but there is also the consideration for ongoing costs for physical infrastructure and whether this is adequately resourced, e.g., operational, maintenance, skilled technicians, etc. The complexity of measuring of levels of infrastructure across the marine research ecosystem highlights the need for a marine infrastructure providers' forum.

Actions 8-10

Almost 25% of R&I Grant Aid was awarded to industry, accounting for approximately €31 million. SMEs were awarded €17.4m of the €48m awarded to Irish-based marine researchers across pillars in the Horizon 2020 Programme between 2014 and 2018. In this period, 38 projects involved at least one Irish SME, and eight large Irish companies were also awarded funding under eight projects. Challenges, however, were noted in quantifying funding to marine SMEs due to commercial sensitivities, defining marine SMEs, and the broad definition of innovation. Additionally, access to finance was highlighted as a particular difficulty for marine SMEs. HEIs were deemed to have other supports available to them, whilst issues such as cash flow were more prevalent for SMEs looking to conduct marine research, according to some members of the MRFF.

Progress has been made in the raising of awareness, but certain areas such as the Small Business Innovation Research (SBIR) Instrument could be promoted more. In 2020, Enterprise Ireland announced a total of €1.14 million in funding under the SBIR with five challenges approved, including €300,000 for innovative solutions to map coastal seaweed resources in Ireland (co-funded by the Marine Institute). The use of SBIR was promoted by Enterprise Ireland (EI) and the Marine Institute and the Marine Institute proposed two projects under the EI SBIR call with one successful proposal, which recently awarded contracts to three Irish consortia, collectively involving four SMEs, two research groups and two industry partners.[14]

There is clear evidence of progress in relation to each of these actions. Significant investment for SMEs provided from DETE/EI (Disruptive Technologies Innovation Fund), SEAI, MI (Industry-Led Awards 2018), BIM, and Údarás na Gaeltachta. However, there remains an issue regarding State Aid and the de minimis threshold of €200,000 over three years being too low. This limits the scope for industry involvement. There is also clear evidence that the SBIR has been supported. However, it is

[14] https://www.marine.ie/Home/site-area/news-events/national-small-business-innovation-research-sbir-contracts-awarded-develop-new

likely that there still remain areas for improvement with regard to industry collaboration and this should be examined in the next strategy period.

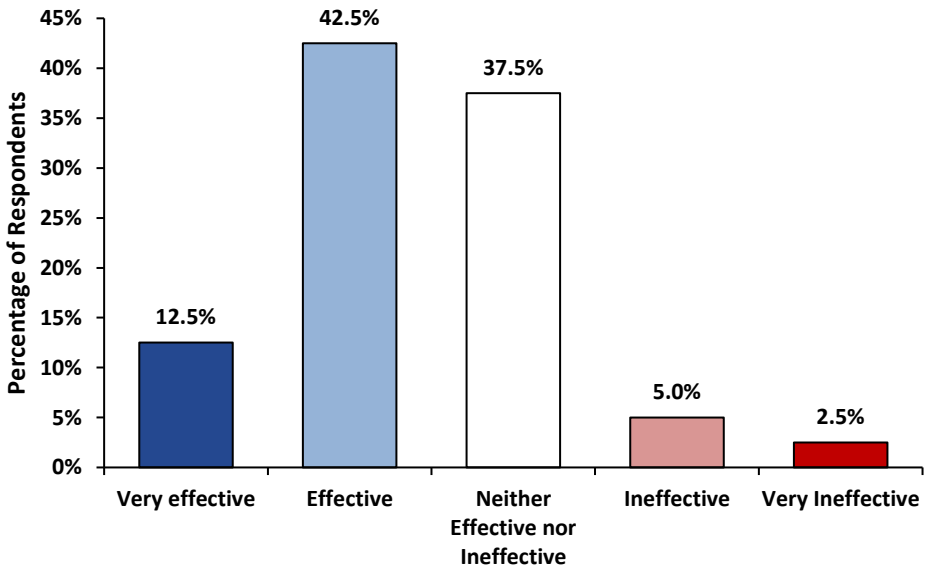
Actions 11-16

It is likely that the majority of these actions will have been implemented by the end of the MRIS. Actions 11 and 12 are covered by the undertaking of this review. Section 4 gives a detailed consideration of the maturity levels and Section 5 has looked at the thematic research co-ordination. As part of the work of the MRFF, the best approach to link effectively to international marine science partnerships was reviewed. This included a look into the potential barriers (including Brexit) preventing or inhibiting all-island collaboration on marine research. There was also significant cross-funder co-ordination established during the MRIS period via the MRFF and the EPA Research Co-ordination Groups. Action 16 relates to the role of marine and maritime activities in Ireland's approach to Smart Specialisation. Indecon notes that the last Smart Specialisation strategy was launched in 2014 and a new strategy is under development.

5.3. Overview of Implementing Structures and effectiveness of co-ordination of funding

It is useful to consider the views of marine researchers when assessing whether the structures supporting the MRIS were appropriate and effective. Most marine researchers indicated they believed that the marine research funding was effectively co-ordinated.

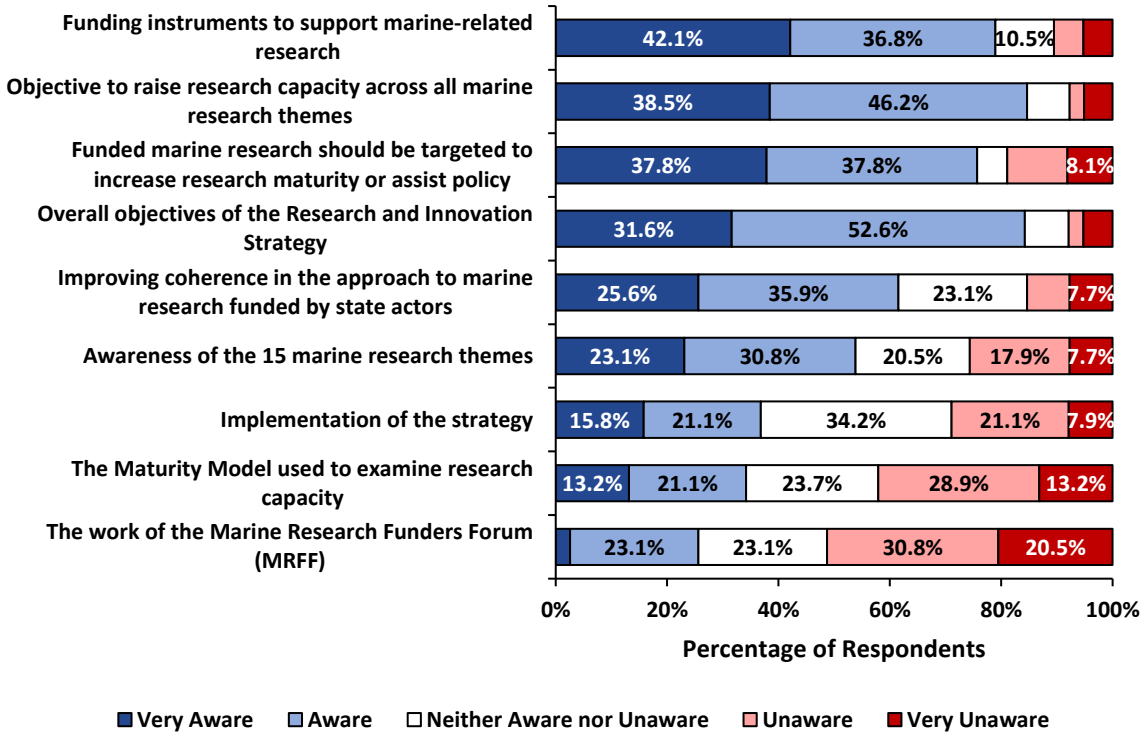
Figure 5.1: Effectiveness of Public bodies in co-ordinating Marine Research



Source: Indecon confidential survey of marine researchers

Figure 5.2 overleaf shows that awareness levels are highest for the main objectives of the MRIS.

Figure 5.2: Awareness of features of the National Marine Research and Innovation Strategy among Marine researchers



Source: *Indecon confidential survey of marine researchers*

As discussed previously, the publication of the MRIS follows on from an action included in the Innovation 2020 implementation plan. This action was based on the recommendations of the Interdepartmental Marine Coordination Group. This group was established in 2009 and supported the development and implementation of the new Marine strategy ("Harnessing Our Ocean Wealth").

5.4. Gaps in the Marine Research Database

The Marine Research Database was developed as part of the implementation of the MRIS. This has collected data on marine-related research projects funded during the MRIS period. As a result, there is valuable data on types of funding awards, funding instruments, funding leverage, contributions by specific funders, industry involvement and international collaborations. However, there are some gaps in the database. These include some gaps in data from certain public funders and an absence of data in certain areas and on impacts. There is also scope for further publication of information relating to specific research projects funded.

It appears, for example, that there are some gaps in relation to knowledge of marine research supported by Enterprise Ireland, Fáilte Ireland, Inland Fisheries Ireland and through SFI centre block grants. This should be considered by the MRFF and the specific funders. For example, 2019 Enterprise Ireland analysis indicates that there are around 56 companies that were marine-related and these companies received around €9.3 million in financial support over the last seven years. This indicates around €1.3 million of annual funding. Details of projects funded under instruments such as the DTIF are also not captured adequately. There is also an issue around the data associated with the SFI Research Centre Grants. These are large projects and information on individual research projects is not readily available.

Although some projects funded via tenders are included in the database, the full extent of marine research and innovation investments via instruments such as tenders (national and EU) is not captured and constitutes a gap to be considered, noting that it can be difficult to capture this type of funding.

Another potential issue with the Marine Research Database is in relation to capturing all marine-related research funded that is carried out in-house in public bodies (for example by the Marine Institute, Geological Survey Ireland, the EPA and Met Éireann). This research is likely to be important in establishing capacity in a number of research themes.

A detailed inventory of the research infrastructure available to support marine-related research was not undertaken during MRIS. This creates a data gap in terms of what the research database currently collects. The database collects information on any new infrastructure projects supported by a public funder. This does not take account of infrastructure that might already exist. It also does not include relevant datasets that may have been compiled as part of previous research projects. These datasets constitute valuable research infrastructure which can support future research. Datasets that support research findings may be published and used for other researchers. This is standard practice in many academic publications.

The current Marine Research Database does not capture information on the networking/research dissemination activities of funded researchers. These activities are typically recorded as part of the monitoring of research contracts by the research funders. These are an important metric of research activity and how engaged funded researchers are with other colleagues, industry and policymakers. This could be amended to the research database and would show how the different research compare in terms of outreach.

5.5. Emerging Issues of relevance for next strategy

There is less than a year left in the current National Marine and Innovation Strategy and there are a number of areas that still need to be addressed. If some of these issues are not addressed, then it is likely that they will be included in the next strategy.

Emerging Issues since the strategy was published

As the National Marine Research and Innovation strategy was published in 2017, there have been a number of recent policy documents that are likely to have implications for the remaining period of the current MRIS and for any future marine research strategy. These include:

- Climate Action Plan, 2019;
- Research Priority Areas 2018-2023;
- New Government Department (DFHERIS) with responsibility for research;

- Programme for Government, 2020;
- Mid-Term Review of Innovation 2020;
- Marine Institute Strategic Plan 2018-2022;
- EU Green Deal;
- Horizon Europe;
- Brexit; and
- Covid-19.

There have been some changes in the "Energy" theme, in response to the urgency to address climate change and sustainability challenges. This theme has progressed and has been renamed "Energy, Climate Action and Sustainability", with the two priority areas updated to "Decarbonising the Energy System" and "Sustainable Living". These changes relate to the Research Priority Areas 2018-2023. Another relevant priority area that was refreshed is the "Food" theme, with the priority area updated to "Smart and Sustainable Food Production and Processing". In this area, the focus for marine-related research is now on the impact of climate change, sea-level modelling and forecasting, carbon sequestration, ecosystem services, food supply chains and sustainability.

The recent Programme for Government (2020) has emphasised the move away from fossil fuels and indicated that no further licences for exploration will be granted. This has some limited implications for some marine research funded during the MRIS. Following on from the new PfG, the responsibility for research and innovation has transferred to a new Government Department (Department of Further and Higher Education, Research, Innovation and Science (DFHERIS)). This Department has prepared a submission to the National Development Plan Review to highlight the need for increased investment in R&I. DFHERIS is also leading on the development of the successor strategy to I2020.

The strategic objectives of the latest Marine Institute Strategic Plan 2018-2022 in relation to research and innovation are fully consistent with the objectives of the MRIS. The key strategic objectives relate to increasing research capacity. The Strategic Plan also highlights the need to secure and manage the intellectual property relating to funded marine research.

There are clear new dimensions that did not exist when the MRIS was launched such as Brexit, COVID-19 and the Climate Action Plan. These will impact the likelihood of some of the key objectives of the MRIS being achieved over the next year. For example, the continuing impact of COVID-19 may limit the availability of research funding in the short term which may have significant impacts on maintaining existing capacity.

There is also likely to be some impact of Brexit on marine research and this will depend on the final Brexit outcome. This may impact on North-South collaboration which has been a notable feature of the current strategy period. The implications of Brexit may pose significant challenges with regard to maintaining existing research collaborations and access to some infrastructures. It is important to maintain these relationships to continue to ensure a consistent approach for marine research across the border and to actively explore new opportunities that might be of benefit for marine research in Ireland.

The views of marine researchers on the likely emerging issues that will influence the next marine research and innovation strategy are shown in Table 5.3. These indicate a number of issues which the next strategy should consider including data analytics and the link to marine-research themes; the link between the marine and the circular economy; climate change and impacts on coastal regions; and microplastics and the impact on water pollution.

Table 5.3: Views of Marine Researchers on Likely Emerging Issues for Next Marine Research and Innovation Strategy
- A deeper understanding of the negative impacts of water pollution is needed, including microplastics. - Focus on the UN SDGs and to coordinate and develop Ireland's contribution to the UNESCO Decade of the Ocean by mapping Ireland's strategy to these international goals. - Sensors, monitoring and analytics will be very important. - More emphasis should be placed on research that can deliver commercial energy projects. - Opportunities for the marine sector to participate in the circular economy. - The climate change situation has become more urgent, with increased storms and floods. This would indicate an increase in the need for ocean climate observations over a broader footprint. - Consideration needs to be given to the fact that there is currently no Marine Development Team to implement certain actions in the MRIS and the delivery of the demonstrator projects and initiatives identified by the Development Task Force.
Source: Indecon Analysis

The views of marine researchers on specific research priorities are likely influenced by their own areas of research expertise. Cognisant of this, a summary of their views is provided in Table 5.4.

Table 5.4: Views of Marine Researchers on Research Priorities for Next Marine Research and Innovation Strategy
- The impacts of pollution on human/animal health - Improved ocean/wave forecasts, modelling and observations - Ireland needs a National Field and Marine Robotics Laboratory capability - Foodborne pathogens of importance in Fish, Shellfish, Seawater - Near-shore impacts of climate change (e.g., flooding, coastal erosion, etc.) - Tidal and wave energy - Eutrophication in light of climate change - Completing nearshore seabed mapping - Biosensors for chemicals of concern / essential ocean variables - Food applications - alternative proteins - Structural Monitoring and advanced analytics - Alternative uses for Marine Renewable Energy, i.e., aquaculture, desalination, ocean observing, mineral recovery - A continuation of renewable energy, engineering, coastal protection, climate change, remote sensing, IT and communication technologies - Transition to a circular and blue economy
Source: Indecon Analysis

With a budget of €95.5 billion, Horizon Europe continues to be an important instrument for Irish marine research, collaboration and partnerships. Horizon Europe is incorporating research and innovation Missions to increase the effectiveness of funding by pursuing clearly defined targets. Amongst the key Mission Areas are "Adaptation to climate change including societal transformation." As part of the Healthy Oceans mission, there is a focus on a number of important issues. Further information is available in Annex 2.

5.6. Summary of Findings

- There were 16 implementation actions outlined in the MRIS. Actions relating to the implementation of the Marine Research Funders Forum (MRFF) have been largely completed. There is, however, a need to establish an inventory of marine research infrastructure as well as examining access to infrastructure.
- Indecon's analysis shows that there has also been some progress made in increasing collaboration with industry and in establishing international partnerships. The analysis indicates that there was good progress on a number of actions but there are also areas where progress has been delayed.

6. Review of Impact Measures

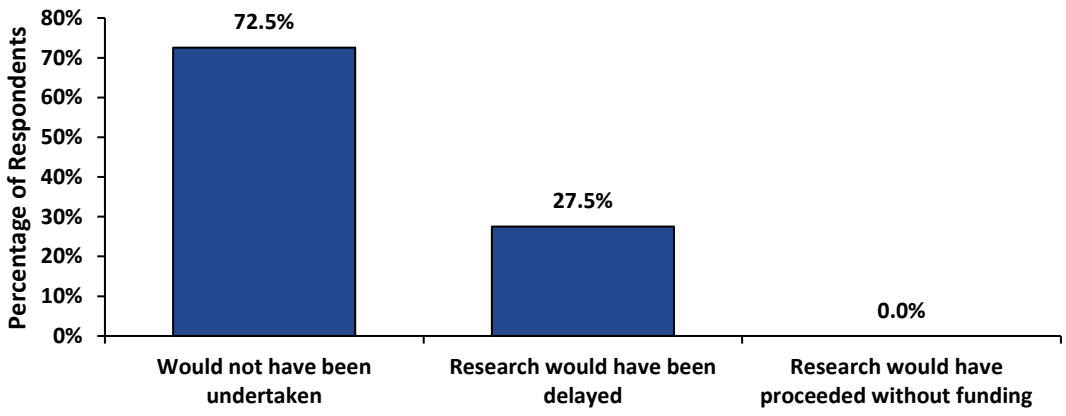
6.1. Introduction

The MRIS focuses on increasing the capacity to undertake marine-related research in Ireland. While there is no formal direct assessment of the impact of marine research supported, the Marine Research Database collects data on the inputs and activities relevant to marine research. In line with the terms of reference, it is important to consider a range of impact metrics to provide a better understanding of the effectiveness and contribution of the MRIS and this is an area where additional work is required.

6.2. Measuring the Impact of the Strategy

Indecon's research indicates that 72% of researchers suggested that the research would not have been undertaken without public funding. This suggests low levels of deadweight[15] in the funding supports.

Figure 6.1: What would have happened in the absence of Public Funding for Marine Research



Source: Indecon confidential survey of marine researchers

New evidence collected by Indecon suggests that one of the important areas of impact is the number of journal articles published. Indecon, however, believes that it would also be important in the future to measure the number of citations by the quality of the publication. Another important area of potential impact is the extent to which the research helps inform effective evidence-based policies. Ways to develop an assessment of the extent to which the research informs evidence-based policies should be examined.

[15] Deadweight refers to "the likelihood that an outcome or benefit would have occurred without the programme" See Gray, A.W. (1995) "A Guide to Evaluation Methods", Published by Gill and MacMillian, ISBN. 071722425

Table 6.1: Details of Articles/Papers Published/In Progress by Respondents			
	Total	**Average**	**Median**
Number of conference papers published	167	5.57	2
Number of journal articles published	258	9.21	3.5
Number of journal articles accepted for publication	57	2.28	1
Number of journal articles submitted but not yet accepted	39	1.44	1
Number of journal articles in progress but not yet completed	95	3.17	2
Note: This is based on marine researchers who responded to Indecon's information request. This represents a sample of marine researchers. ***Source: Indecon confidential survey of marine researchers***			

Indecon research suggests there have been limited commercialisation impacts to date of projects funded in terms of patents and spin-out companies. However, this may change over time and the links between researchers and private companies is encouraging. Evidence from a sample of marine researchers who have been supported suggests that funded projects are likely to contribute 17 patents, five spin-off companies and nine licence agreements by the end of the MRIS. Details on such impact should be monitored as part of the next strategy.

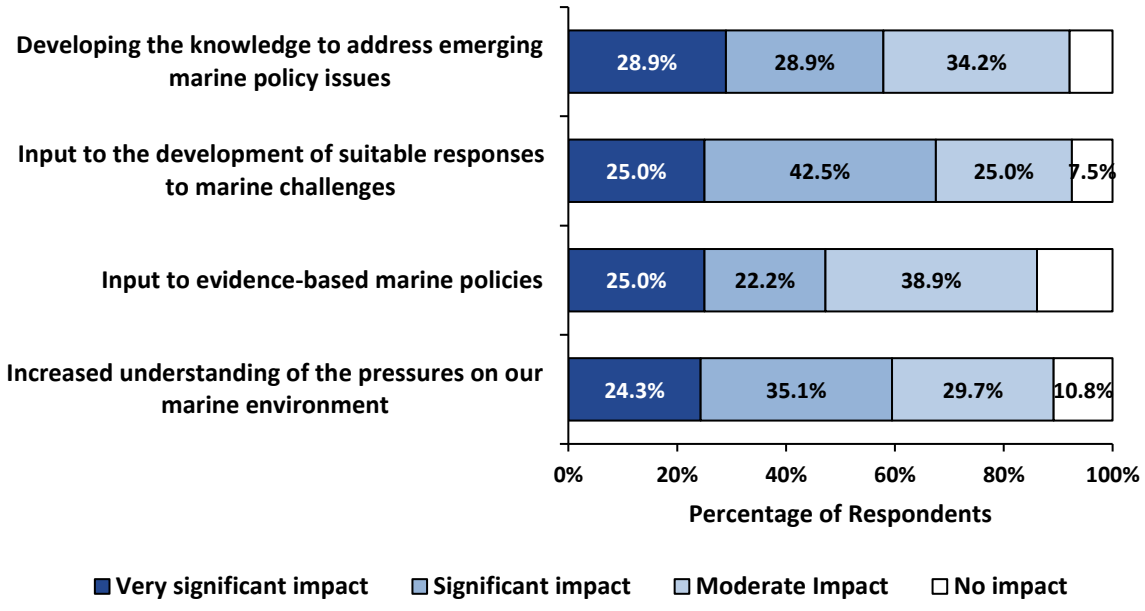
Table 6.2: Commercial impacts, if any, related to the research funded to undertake marine-related research and innovation?		
	Achieved	**Expected (by the end of the project)**
Number of Patents	7	17
Number of Spin-out Companies	2	5
Number of Licence Agreements	2	9
Number of Enterprise Ireland Commercialisation Awards	0	2
Number of Links with Private Companies	142	193
Note: This is based on marine researchers who responded to Indecon's information request. This represents a sample of marine researchers. ***Source: Indecon confidential survey of marine researchers***		

It is important that both qualitative and quantitative measures of impact are developed for the strategy. Examples of qualitative measures are presented in the next table.

Table 6.3: Examples of Qualitative Impact of projects funded under MRIS	
Physico-chemical Cycling of Nutrients and Carbon in Marine Transitional Zone	❑ Address knowledge gaps regarding the impact of multiple environmental stressors on the cycling of nutrients and carbon in Ireland's marine transitional waters ❑ Inform plans such as NMP, NAP, MSFD & Biodiversity National Action Plan with better estimates of the sources and sinks of CO2 and other greenhouse gases (e.g., N2O, CH4) in transitional marine waters
Irish Natural Capital Accounting for Sustainable Environments	❑ Provision of databases to monitor stocks and flows and sectoral natural capital management frameworks ❑ Progress the implementation of natural capital approaches in Irish catchments by undertaking economic impact assessments & modelling the impact of policy change on natural capital
Remote Sensing of Irish Surface Waters	❑ Develop a catalogue of algorithms for detecting changes in water quality in lakes and transitional waters, reducing the need for in-situ sampling programmes ❑ Inform better management and strategic monitoring programmes for WFD and MSFD requirements
Source: EPA Submission to Indecon as part of the Consultation process	

Figure 6.2 indicates that the majority of researchers believe that their research is likely to have a significant impact on developing knowledge on marine policy issues and identifying suitable policy responses.

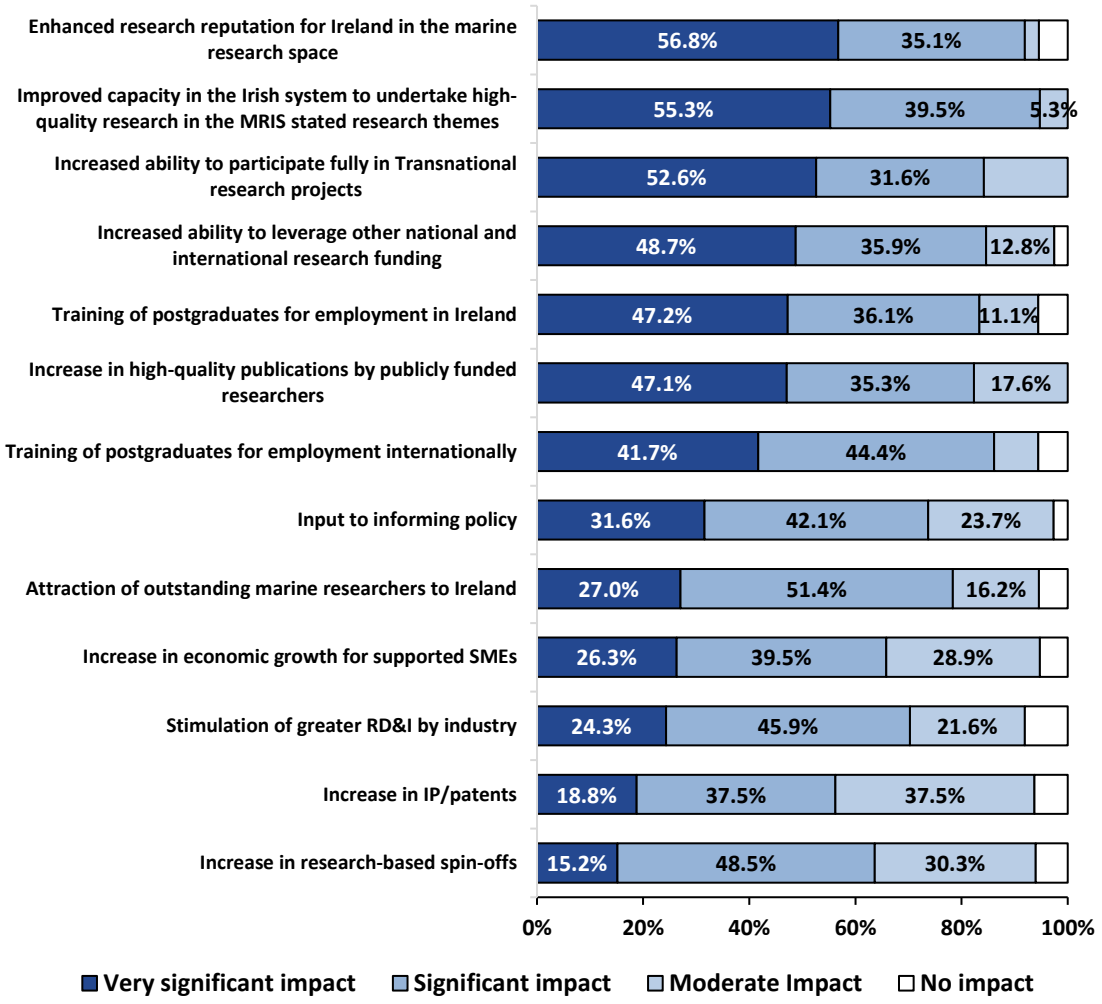
Figure 6.2: Researcher views on Likely Impact of Research on policy development and implementation



Source: Indecon confidential survey of marine researchers

Consultations undertaken by Indecon as part of this review also suggest that MRIS is likely to have had impacts on various aspects of marine research in Ireland. These include enhancing the international reputation in marine research, improving the capacity to undertake this research and increasing the ability to engage in transnational research projects.

Figure 6.3: Researcher views on Likely Impact of Marine Research Funding



Source: Indecon confidential survey of marine researchers

6.3. Designing an Impact measurement framework

Indecon believes that there are a number of metrics that could be used to examine the different aspects of the impact of marine-related research. It is important that impact is assessed as part of a wider framework that includes a number of different quantitative and qualitative metrics.

Although measurement of impact is a difficult task, significant work on this area has been undertaken in Ireland previously by SFI as part of the monitoring of their funded research centres.

There are a number of considerations in the design of any measurement framework including:

- Data collection requirements;
- Current monitoring requirements;
- Identify key areas of potential impact; and
- Current data available.

One useful approach to consider is the SFI approach to research impact[16] which involves eight pillars across three different thematic areas. These pillars reflect different areas of potential impact.

Figure 6.4: SFI Pillars of Research Impact

Source: SFI

This framework is outlined to funded researchers who then are required to fill out an annual impact statement as part of their grant funding process. These impact statements are then collated and examined to establish the overall impact of the funding researchers in that period. This is done across each of the eight pillars.[17]

There are a range of possible KPIs that could be developed to support the monitoring of the next Marine research and Innovation strategy. As noted in this section, there is no one unique indicator that can capture the multi-layered impacts of marine research. It must also be noted that a project got underway in October 2020 to address Action 7.6 of Innovation 2020 which will develop a standardised classification of public investment in research. This project will also consider a set of national KPIs to measure the impact of RDI investment which could be very important in the monitoring of the next marine research strategy.

[16] https://www.sfi.ie/funding/award-management/research-impact/

[17] Further details on best practice in the design of measuring impact is available at link

https://www.smalladvancedeconomies.org/wp-content/uploads/SAEI_Impact-Framework_Feb_2015_Issue2.pdf

6.4. Summary of Findings

- The MRIS focuses on increasing the capacity to undertake marine-related research in Ireland. While there is no formal direct assessment of the impact of marine research-supported, the Marine Research Database collects data on the inputs and activities that contribute to the undertaking of marine research. In line with the terms of reference, it is important to consider a range of impact metrics to provide a better understanding of the effectiveness and contribution of the MRIS and this is an area where additional work is required.
- Indecon's research indicates that 72% of researchers suggested that the research would not have been undertaken without public funding. This suggests low levels of deadweight in the funding supports.
- New evidence collected by Indecon suggests that one of the important areas of impact is the number of journal articles published. Indecon, however, believes that it would also be important in the future to measure the number of citations by the quality of the publication. Another important area of potential impact is the extent to which the research helps inform effective evidence-based policies. Ways to develop an assessment of the extent to which the research informs evidence-based policies should be examined.
- Indecon research suggests there may be limited commercialisation impacts to date of projects funded in terms of patents and spin-out companies. However, this may change over time and the links between researchers and private companies is encouraging. Evidence from a sample of marine researchers who have been supported suggests that funded projects are likely to contribute 17 patents, five spin-off companies and nine licence agreements by the end of the MRIS.
- Consultations undertaken by Indecon as part of this review suggest that MRIS is likely to have had wider impacts on various aspects of marine research in Ireland. These include enhancing the international reputation in marine research, improving the capacity to undertake this research and increasing the ability to engage in transnational research projects.
- There are a range of possible KPIs that could be developed to support the monitoring of the next Marine research and Innovation strategy. As noted in this section, there is no one unique indicator that can capture the multi-layered impacts of marine research. It must also be noted that a project got underway in October 2020 to address Action 7.6 of Innovation 2020 which will develop a standardised classification of public investment in research. This project will also consider a set of national KPIs to measure the impact of RDI investment which could be very important in the monitoring of the next marine research strategy.

7. Conclusions and Recommendations

7.1. Conclusions

This interim review suggests that the National Marine Research and Innovation Strategy is aligned with the national objectives set for research and supports the national objectives of the marine sector. As this is an interim review, it is not possible to make definitive conclusions on whether the strategy has delivered on all of the goals of the MRIS. However, the evidence indicates that the strategy is appropriately structured and has supported the development of research capacity in the marine area. In strengthening the national marine research and innovation strategy there will be a need for ongoing judgement on the balance between investing in basic research and focusing on future strategic needs. This is an issue faced by other government-supported research programmes and allocation to both areas may be required to build high-quality capacity in a number of specific research themes.

The first goal of the MRIS is to "raise the research capacity across all themes." Based on the analysis undertaken in Section 3, it is unlikely that this goal has been achieved so far. However, there are a number of important caveats that should be considered when interpreting whether this overarching goal has been achieved. The analysis of research capacity in relation to infrastructure is limited by a lack of data on infrastructure that is supported via non-competitive awards. This means that it is difficult to assess the research maturity levels in relation to the infrastructure component. The level of research maturity has increased in more than half of all themes but declined in some themes.

The level of research funding appears to have become more concentrated across certain themes including renewable energy. This research theme has increased its research capacity and has scope for further improvements. The MRIS has 15 different research themes so it is difficult to support increases in capacity across each of these themes. The research capacity of certain themes are dependent on a small number of researchers.

The main focus of the MRIS is on developing marine research capacity and the amount of funding awarded has increased significantly since the last research and innovation strategy. This is likely to have increased research capacity in the sector. However, the increase in research funding has varied significantly across the different research themes. Many research themes may have suffered a decline in funding since the last strategy.

European and Exchequer funding is critical for marine research in Ireland. Indecon's assessment suggests that without public funding the extent of marine-related research would be significantly lower. There are relatively low levels of private investment in this sector and this creates the need for public investment. Ireland has an ambition to be an EU Innovation Leader, however, a major increase in public investment in R&I (~50%) is needed to achieve this.

The National Marine Research and Innovation Strategy has facilitated collaborations and is likely to have helped leverage other funding sources. There is, however, a relatively low level of collaboration with enterprise in certain research themes. This collaboration is considered in the research capability model through the existence of research networks. As discussed previously, there have been low levels of funding for new research infrastructure other than that provided by SFI support. This is a weakness of the research maturity but may also reflect significant data gaps in relation to the existence of state infrastructure. There may be potential to achieve increased EU funding over time and to build on the success of the Strategy in this area.

The second goal of the MRIS relates to the targeting of research funding. This targeting should reflect policies and sectoral plans. It is not clear if such targeting was apparent in the research supported. As discussed previously, this targeting is a secondary goal to the overall goal of increasing research capacity. There does not appear to have been any specific targeting of themes with lower levels of research maturity. There is a significant reliance on a small number of public funders for certain research themes. Many of the research themes are dependent on European Commission funding.

Based on new primary research undertaken by Indecon, 80% of marine researchers supported were aware of the funding instruments that were available to undertake marine research. The majority of marine researchers believe that public funders are effective in co-ordinating marine research.

The typical approach to support marine research is based on project-specific funding. There are small supports for direct fellowship awards and there are some centre of excellence awards. There are also some specific industry awards. There may be scope for further leveraging effects through supports for specific projects and infrastructure.

These two MRIS goals focused on increasing the research maturity of marine research across 15 different research themes. Many of these research theme were very independent of other themes and were often reliant on a small number of researchers. Thus, the presence of so many disparate research themes makes achieving the overall objective of increasing research capacity across all themes very difficult. Indecon believes that the number of themes should be consolidated in the next strategy and any targets should be cognisant of the very different characteristics of the different research themes.

The third goal of MRIS is to ensure that there is coherence in the approach to marine research by the various public funders. Indecon believes that there has been significant progress made in achieving this goal over the course of the MRIS. This has involved greater collaboration between public funders and increased transparency in the research supported by the various funders. There are a large number of public funders who support marine research in Ireland and many of these funders focus on specific research areas which are consistent with their organisation's strategic plans.

As part of the MRIS, an implementation plan with 16 different actions was proposed. Research by Indecon suggests that a significant proportion have been or are likely to be completed by the end of the MRIS period. These include the establishment of a Marine Research Funders Forum (MRFF) which has helped assist co-ordination of research activity. The development of the Marine Research Database will increase transparency and co-ordination of funding awards in the next strategy. This aligns with the work of the National Open Research Forum (NORF), which was established in 2017 to drive the Irish agenda for open research and deliver on Action 4.7 of Innovation 2020 to support national and European open-access policies and principles. There is a need to develop more refined impact indicators involving the integration of impact measures used by individual funders. Work is underway on this as part of the wider research system in Ireland.

Despite the progress observed during the MRIS period, there are still a number of implementation actions that are unlikely to be completed by the end of the MRIS. Many of these relate to the establishment of a Marine Infrastructure Providers Forum.

The publication of the Marine Research Database is a welcome initiative and provides insight into the scale and type of marine research that has been completed or is currently being undertaken in Ireland. However, there remains a number of data gaps in relation to industry supports and the level of marine research infrastructure across the different research themes.

7.2. Recommendations

Indecon's recommendations are designed to support the ongoing progress towards the achievement of the MRIS goals and to inform the preparation and orientation of its successor, post-2021. The recommendations are presented in the next table and are designed to enhance the impact and effectiveness of the strategy.

Table 7.1: Summary of Key Recommendations
1. Reduce the number of research themes for the next strategy
2. Establish the infrastructure requirements needed to enhance marine research
3. Consider the common funding priorities of the MRFF and the establishment of sub-groups
4. Increase investment in promotion and dissemination of research findings
5. Incentivise increased policy relevance for more mature research themes
6. Encourage greater collaboration with enterprise
7. Facilitate greater engagement with EU Programmes for research and innovation by establishing mentoring programmes involving previously successful applicants
8. Develop better impact measures building on measures used by funders
Source: Indecon analysis

1. Reduce the number of research themes for the next strategy

There are currently 15 research themes with a further eight sub-themes within the National Marine Research and Innovation Strategy (MRIS). Many of these themes have been awarded little research funding over the last four years and are at low levels of research maturity. While there is value in many of the objectives of these themes, consolidation into other research themes should be considered. This would assist in the reporting of progress and allow greater scope within themes for a variety of research projects to be supported. It should also be noted there are a number of interlinkages across different research themes and this should be considered in any consolidation of research themes. This could encourage greater integration and cross-collaboration. It may also reduce the risk of researchers working in silos within very specific research themes.

2. Establish the infrastructure requirements needed to enhance marine research

The analysis undertaken by Indecon highlights the relatively low level of new infrastructure investment across the majority of research themes over the period of the strategy. In addition, there is a notable lack of information on the use of existing infrastructure. One of the implementation actions in the MRIS was the establishment of a Marine Infrastructure Providers' Forum. This action has not been progressed and Indecon recommends that this should be taken forward at an early stage of the next strategy. The MRFF group should consider what existing databases (such as the EPA's Water

Infrastructure database) might be relevant and how these could be used to create a comprehensive marine infrastructure database.

3. Consider the common funding priorities of the MRFF and the establishment of sub-groups

The Marine Research Funders' Forum (MRFF) brings together a group of research funders, government departments and organisations. Indecon believes that there is scope for the creation of some small ad hoc temporary groups to be formed as a result of discussions at the MRFF meetings. There are likely to be in areas of common research interest and this would suggest the merit in establishing ad hoc temporary groups that could support research and provide further impetus for co-funding of research projects. These groups should also explore the opportunities for integrated funding instruments. Indecon is, however, cognisant of the existing structures that have been established to coordinate research funding and do not believe that any new sub-groups should replace these existing structures.

Indecon also believes that there may also be merit in having a longer MRFF session during each year which gives time to discuss key strategic developments. This session could also identify key organisational participants in the main research themes to increase a sense of ownership of the different research themes.

4. Increase investment in promotion and dissemination of research findings

The communication aspect of the next research strategy should be strengthened. This could be achieved in a number of ways, including further expansion of website dissemination of research reports. We note, however, that significant progress in this regard has been made across a large number of research funders. Indecon believes that there would be merit in producing an annual public document that highlights the progress and impact of the strategy. The Marine Institute, as the co-ordinator of marine research in Ireland, should also consider building further linkages with radio, television and other media. These linkages could be used to assist researchers in disseminating their research to a wider audience. While open access is often not high on researchers' priorities,[18] dissemination of research findings is important to maximise the benefits of marine research. Indecon notes that Creating Our Future, a multi-organisation initiative, is being conducted in 2021 to achieve a deeper engagement among citizens, researchers and policymakers. Subject to available resources, the organisation of an annual seminar and other initiatives to increase the profile of the MRIS would merit consideration.

5. Incentivise increased policy relevance for more mature research themes

As research maturity increases, the focus should be placed on the policy impact of funded research. There are a number of ways that this may be achieved through modification of existing grant agreements and via the design of new research calls. The latter could include assigning a weighting to projects that have explicit public policy implications. Incentivising and supporting researchers to disseminate their research to key policymakers is recommended. This would assist in ensuring that the research completed supports the development and implementation of evidence-based policy.

[18] https://eua.eu/resources/publications/888:research-assessment-in-the-transition-to-open-science.html

This could be assisted through small research dissemination grants or the hosting of regular policy symposia. Given the importance of the research informing policy, consideration of a range of measures to enhance policy impact would be desirable. This could also include the facilitation of researchers spending time in a policy environment.

6. Encourage greater collaboration with enterprise

There have been collaborations with industry during the MRIS but this has varied by research theme. Collaborations include industry partners forming part of project teams and also industry specific research awards. There is scope for increased collaboration with enterprise especially in research themes where research maturity has increased such as renewable energy. This would increase the commercial impacts of the strategy. However, there is a notable gap in the data relating to enterprise collaboration. This should be examined in the context of the next strategy.

7. Facilitate greater engagement with EU Programmes for research and innovation by establishing mentoring programmes involving previously successful applicants

Marine researchers have been successful in securing significant EU supports and this is an important achievement. This suggests a strong foundation on which to increase overall funding. There are a number of ways that this increase could be assisted by the public funders, for example through enhanced investments in ERANet co-funds – these are often a strong "priming tool" to establish a track record in EU collaboration in R&I activities and as a precursor and to augment broader EU proposal engagement. The grant application process for some of the larger European projects can be challenging to navigate. To help address this, supports should be provided involving mentoring sessions with previously successful applicants. This would be particularly important for early-stage researchers who are looking to increase the scope of their research. There may also be potential to provide targeted funding to assist researchers in completing grant applications, such as the funding available through Enterprise Ireland to assist grant writing for EU projects. The costs of such supports would be very small but could assist researchers applying for larger grants.

Many marine research projects in the Interreg programme and Horizon 2020 programme were closely linked with or led by UK partners. This leaves a gap in relationships with potentially strong future research partners in the EU. Similarly, the Interreg Ireland-Wales programme – a less competitive source of research funding, will now cease to exist. Given this changed environment, it will be important to proactively facilitate the building of new European research relationships to access EU consortium funding without dependency on UK partners. Greater links could be developed with the Contact Points for the European Territorial Cooperation Programmes in the Regional Assemblies, who work with many of these EU based successful applicants on a regular basis and understand the requirements of the programmes.

8. Changes should be made to develop better impact measures building on measures used by funders

The current assessment of the MRIS is largely based on the monitoring of inputs and activities rather than impacts. It is important that the impact of funded research is given increased attention. Indecon believes that the next marine research and innovation strategy should outline how impacts will be measured/evaluated. This is especially important for themes with higher levels of research maturity. In order to examine the various likely impacts of marine-related research, significant effort

will be required in designing an evaluation framework that captures the various aspects of research impact. This framework should involve the analysis of quantitative and qualitative data that captures the broader impacts of marine-related research as well as the extent and quality of research outputs.

There are a range of possible KPIs that could be developed to support the monitoring of the next marine research and innovation strategy. These are outlined in section 6 of the main report. There is no single indicator that can capture the multi-layered impacts of marine research. It must also be noted that a project commenced in October 2020 to address Action 7.6 of Innovation 2020 which will develop a standardised classification of public investment in research. This project will also consider a set of national KPIs to measure the impact of RDI investment. Indecon believes that the next marine research and innovation strategy should review proposed measures (national and EU) and consider how these may assist with monitoring the impact of the strategy.

Annex 1 Research Maturity Model

Key Dimensions of the Research Capability Model

		Dimensions		
		Human Capacity	Infrastructures	Networks & Relationships
Maturity	"Translational"	There is evidence of a pipeline of research from basic investigation to commercial application or policy definition facilitated by dedicated national facilities		
	"Collaborative"	National level research facilities exist with international collaboration with internationally recognised research performers		
	"Established"	Dedicated research facilities exist & there is evidence of collaboration nationally & internationally, with industry or policy maker participation		
	"Defined"	Communities of interest exist with some access to facilities and active research projects		
	"Ad-hoc"	Research is based on individual research interests with no institutional support or facilities		

Specific Examples of Different Levels of Research Capacity

		DIMENSIONS		
		Human Capacity	Infrastructures	Networks & Relationships
MATURITY	**Level 5: Translational** There is evidence of a pipeline of research from basic investigation to commercial application or policy definition facilitated by dedicated national facilities	Industry based researchers involved in Product Development Lifecycles Researchers participating in legislatively based, or ministerial appointed, fora that inform legislation or regulation	Nationally funded research centres Postdoctoral Training EU "Best in class" research infrastructures National Test & Demonstration Facilities, including end-user population for real-world feedback	Networks of interest featuring high levels of industry or policy-making participation IP frameworks available Consistent leadership roles in international standard setting forums Consistent leadership roles in international inter-governmental mandated scientific organisations.
	Level 4: Collaborative National level research facilities exist with international collaboration with internationally recognised research performers	International Research Awards, e.g. ERC Research Awards International Travel Awards, e.g. Fulbright International Research Contracts e.g. EU Tender Awards Regular development or refinement of methods, techniques or processes that inform regulation	Nationally available equipment or platforms (e.g. equipment pools) Postgraduate training Participation in EU infrastructure networks National Test and Demonstration facilities Postdoctoral training	Inter-institutional research cluster/centres Industry collaboration in research including industry funding Industry participation in research theme definition Funding from policy-making organisations
	Level 3: Established Dedicated research facilities exist and there is evidence of collaboration nationally and internationally, with industry participation	Established Principal Investigator Position(s) PI Led Research Teams with Postdoctoral Researchers	Purpose build lab space/purpose bought equipment Dedicated data infrastructures or repositories Postgraduate teaching modules and/or courses	Multiple teams concurrently participating in Framework/H2020 projects Industry or sectoral policy-maker led research themes Regular national conferences/workshops with some international participation
	Level 2: Defined Communities of interest exist with some access to facilities and active research projects	Multiple Project Based PI Appointments Active PhD Level Research Projects Undergraduate courses with established lecturers	Defined undergraduate training "Allocated" general purpose lab space or equipment, evidence of institutional commitment through capital spending	National Workshops Inclusion in Framework/H2020 ids Recognised community of interest
	Level 1: Ad-Hoc Research is based on individual research interests with no institutional support or facilities	No dedicated facilities, general purpose equipment etc. No dedicated training or education associated with the field	No dedicated facilities or general purpose equipment etc. No evidence of commitment through capital spending	No nationally organised/hosted workshops No associations, networks of interest Collaboration is based entirely on one-to-one or personal relationships

Source: MRIS

Annex 2 Review of Relevant National and European Policies

Harnessing Our Ocean Wealth ('HOOW')

Harnessing Our Ocean Wealth, published in 2012, set out the vision, goals and actions for Ireland's marine affairs. It stresses the importance of the ocean as a national asset in terms of energy, food, health and technology, with Ireland estimated to generate 1.2% of GDP from its ocean economy, and 1% of its workforce. The overall vision of the strategy is: "*Our ocean wealth will be a key element of our economic recovery and sustainable growth, generating benefits for all our citizens, supported by coherent policy, planning and regulation, and managed in an integrated manner.*"[19] This vision is underpinned by three main goals which are: to focus on a thriving maritime economy; achieve healthy ecosystems; and increase engagement with the sea. The importance of research, knowledge, technology and innovation (RKTI) is highlighted as one of the key enablers for achieving the strategy's targets. There are five key actions (21-25) under the RKTI area, including:

- *Continue to fund strategic marine RTDI (industry, policy and discovery research) through cross-government/agency collaboration across a range of national and international funding mechanisms.*
- *Provide direction and focus for expenditure of marine research funding where appropriate through the relevant action plans for priority areas being developed by the Prioritisation Action Group.*
- *Complete the INFOMAR seabed mapping programme, to provide data, products (e.g. databases, charts, physical habitat maps) and services (marine decision support tools) as critical inputs to maritime spatial planning and enablers of infrastructural development, research, education and value-added products.*
- *Strengthen the collation of marine socio-economic data to ensure the timely availability of marine socio-economic statistics, providing an evidence-base for policy and decision making, economic forecasting and scenario planning.*
- *Support existing and new test-beds/facilities for demonstration and commercialisation purposes that promote Ireland as a test-bed for renewable energy technologies and ICT (SmartOcean) focusing on the development of innovative technologies that support real-time information gathering (e.g., for security, surveillance, environmental monitoring).*

The most recent review of progress indicated that as of the end of 2018 over €100 million in funding had been provided to over 300 awards over the lifetime of the National Marine Research and Innovation Strategy 2017-2021. A Marine Research Funders' Forum was also established to enhance coordination amongst marine related research. The Marine Institute awarded over €9m in new investment under the Marine Research Programme in 2018, with eight marine renewable energy projects awarded funding. Significant progress was made under the INFOMAR project with almost 12,000 km^2 of seafloor mapped as of the end of 2018.[20]

[19] https://www.ouroceanwealth.ie/sites/default/files/sites/default/files/Publications/2012/HarnessingOurOceanWealthReport.pdf

[20] https://www.ouroceanwealth.ie/sites/default/files/Publications/harnessing_our_ocean_wealth_-_review_of_progress_2018-web.pdf

Innovation 2020

Innovation 2020 was published by the Department of Enterprise, Trade and Employment[21] (DETE), and is Ireland's strategy for research and development, science and technology. Its vision is for Ireland to become a "*Global Innovation Leader driving a strong sustainable economy and a better society."*[22] The strategy aims to achieve this through building a strong research base, increasing investment in research and development, protecting and transferring knowledge, ensuring quality education, amongst other actions. In relation to marine research, the strategy outlines the importance of open access to scientific publications/research, such as *Rian,* a web-based portal collecting research from universities and institutions such as the Marine Institute. Innovation 2020's specific action (Action 4.17) with regards to the marine is to "*Support progress towards the Harnessing Our Ocean Wealth targets through coordinated marine research and development strategies.*" This action is underpinned by the publication of the National Marine Research and Innovation Strategy, and the implementation of recommendations of the Interdepartmental Marine Coordination Group, Development Task Force which was focussed on research translation and development.

In the Mid-Term Evaluation of Innovation 2020, it is noted that the National Marine Research and Innovation Strategy 2017-2021 was published in 2017. It must also be noted that a project got underway in October 2020 to address Action 7.6 of Innovation 2020 which will develop a standardised classification of public investment in research. This project will support the development of a standardised categorisation scheme for tracking public investment in R&D. This project will also consider a set of national KPIs to measure the impact of RDI investment.

Project Ireland 2040 – Building Ireland's Future – National Planning Framework

The National Planning Framework sets out the plans for shaping the country's development until 2040. One of the key elements of the plan is a strengthened and more environmentally focused planning at local levels. This includes a greater focus on marine areas and land-sea interface. The plan highlights the importance of the sea to Ireland with a sea:land ratio of 10:1. The plan states that "*Our marine environment is a national asset that yields multiple commercial and non-commercial benefits in terms, of, for example, seafood, tourism, recreation, renewable energy, cultural heritage, and biodiversity.*"[23] The plan notes the need for data and research to provide an evidence base for planning into the future, in relation to sustainable use of resources, maximising the potential of the maritime economy, planning for climate change and the development of renewable energy offshore. One of the National Policy Objectives (42) is "*To support, within the context of the Offshore Renewable Energy Development Plan (OREDP) and its successors, the progressive development of Ireland's offshore renewable energy potential, including domestic and international grid connectivity enhancements.*"

In terms of spatial planning, Ireland is divided into three regions: The Southern; the Northern and Western; and the Eastern and Midland Regional Assembly areas. It is the role of the Regional

[21] It must be noted that the research function of DETE has now moved to the new Department (DFHERIS)

[22] https://dbei.gov.ie/en/Publications/Publication-files/Innovation-2020.pdf

[23] http://npf.ie/wp-content/uploads/Project-Ireland-2040-NPF.pdf

Assemblies to provide leadership and to identify regional development objectives and coordinating initiatives that support the delivery and implementation of national planning and economic policy. National Policy Objective 2 of the National Planning Framework "*Building Stronger Regions: Accessible Centres of Scale*" identified the need to prepare and implement a Regional Spatial and Economic Strategy (RSES) for each of the three Regional Assemblies to set out a strategic development framework for the Regions and provide a focus around the various National Policy Objectives and National Strategic Outcomes of the NPF. The RSES supports the Regions to be first movers in the marine economy including investment and support for Ireland's Tier 1 and Tier 2 Ports (vital in the context of their role post-Brexit and as drivers for Marine Sectors under the NMPF), fishing harbours, coastal towns and villages and research and innovation sectors, especially in areas of Offshore Renewable Energy, Marine ICT and Biotechnology.

Offshore Renewable Energy Development Plan (2014)

The Department of the Environment, Climate and Communications (DECC) Offshore Renewable Energy Development Plan is a framework for the sustainable development of Ireland's offshore renewable energy resource. It states that "*The overarching objective of the Government's energy policy is to ensure secure and sustainable supplies of competitively priced energy to all consumers."*[24] Harnessing clean, renewable energy is crucial to achieving this objective, with the three goals of the framework as follows:

- *Ireland harnesses the market opportunities presented by offshore renewable energy to achieve economic development, growth and jobs;*
- *Increase awareness of the value, opportunities and societal benefits of developing offshore renewable energy; and*
- *Offshore renewable energy developments do not adversely impact our rich marine environment and its living and non-living resources.*

Research and development are highlighted as an important part of the process, with an increase in Exchequer support for ocean research, development and demonstration outlined as key to achieving the goals of the plan.

Climate Action Plan 2019 – To Tackle Climate Breakdown

The Climate Action Plan 2019 outlines the challenges faced by climate disruption including extreme weather events. It stresses the important of decarbonisation, and the support and promotion of research and innovation to meet the climate challenge. Amongst the actions outlined in the plan there is a subsection on offshore renewables which contains three actions, outlined below:

- *Facilitate the development of Offshore Wind, including the connection of at least 3.5 GW of offshore wind, based on competitive auctions, to the grid by 2030. We will establish a top team to drive this ambition;*
- *Support the ocean energy research, development and demonstration pathway for emerging marine technologies (wave, tidal, floating wind) and associated test infrastructure; and*
- *Support innovation enterprise hubs and the supply chain for offshore renewable energy.*

[24] https://www.dccae.gov.ie/documents/20140204%20DCENR%20-%20Offshore%20Renewable%20Energy%20Development%20Plan.pdf

Through initiatives such as the Clean Oceans Initiative mentioned in the plan, there is an aim to support the development of the blue bioeconomy. The initiative aims to collect, reduce and reuse marine litter in order to clean up the marine environment.

EU Green Deal

The European Green Deal sets out the plan to make the EU's economy sustainable. It aims to develop a resource-efficient economy in which:[25]

- *there are no net emissions of greenhouse gases by 2050;*
- *economic growth is decoupled from resource use; and*
- *no person and no place is left behind.*

The EU aims to achieve this by investing in environmentally-friendly technologies and supporting innovation in industry, amongst other actions. The development of a clean energy system is key to the European Green Deal, as 75% of the EU's greenhouse gas emissions were from the production and use of energy, as of the end of 2018. Amongst other actions the EU aims to promote innovative technologies and increase cross-border and regional cooperation to achieve the aim of a decarbonised energy system.

UN Decade of the Ocean

The United Nations declared that the decade from 2021 to 2030 would be the Decade of Ocean Science for Sustainable Development. It is a call for "*nations to work together to generate the global ocean science needed to support the sustainable development of our shared ocean*."[26] They state that ocean science accounts for a small portion (between 0.04% and 4%) of total research and development expenditures worldwide, and call for an increase in funding in this area. The UN states that one of the core objectives of the decade is "*to improve the scientific knowledge base through capacity development to regions and groups that are presently limited in capacity and capability,*" with the building of partnerships and sharing of knowledge key to achieving this.

National Policy Statement on the Bioeconomy (March 2018)

The National Policy Statement on the Bioeconomy outlines the vision for bioeconomy in Ireland, as well as the framework for achieving goals set out in Project Ireland 2040. The key actions of the statement are:[27]

- *promoting greater coherence between the many sectors of the bioeconomy;*
- *strengthening the development of promising bio-based products and growing the relevant markets for them; and*
- *accessing funding available at EU level as well as leveraging private investment.*

The statement also discusses the recent funding provided through SFI for a Bioeconomy Research Centre (BiOrbic) in 2017, which aims to explore possibility in the conversion of marine resources and residues from food production into higher value products.

[25] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[26] https://www.oceandecade.org/

[27] https://www.gov.ie/en/press-release/3d585e-national-policy-statement-on-the-bioeconomy/

Horizon 2020

The EU's Horizon 2020 framework document outlines the key societal challenges facing the EU and other countries, including the development of clean and efficient energy, climate action and facilitating marine research and the bioeconomy. It states that at least 60% of the total Horizon 2020 budget will be related to sustainable development, with the majority aimed at climate and environmental challenges.[28]

Horizon Europe

Horizon Europe is the EU's key funding programme for research and innovation with a budget of €95.5 billion. It tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth. The programme facilitates collaboration and strengthens the impact of research and innovation in developing, supporting and implementing EU policies while tackling global challenges. It supports creating and better dispersing of excellent knowledge and technologies. It creates jobs, fully engages the EU's talent pool, boosts economic growth, promotes industrial competitiveness and optimises investment impact within a strengthened European Research Area.

Under Pillar II (Global Challenges and European Industrial Competitiveness) the main opportunities for marine and maritime related research are within Cluster 5 (Climate, Energy and Mobility) and Cluster 6 (Food, Bioeconomy, Natural Resources, Agriculture and Environment).

Horizon Europe is incorporating research and innovation Missions to increase the effectiveness of funding by pursuing clearly defined targets. Amongst the key Mission Areas are "Adaptation to climate change including societal transformation," and Healthy Oceans, Seas, Coastal and Inland Waters. The programme stresses the importance of healthy oceans and other waters, stating that they are the source of life on Earth, and the planet's life support system, supplying fresh water, renewable energy and various societal, cultural and economic benefits. As part of the Healthy Oceans mission there is a focus on a number of important issues including:

- systemic solutions for the prevention, reduction, mitigation and removal of marine pollution including plastics;
- transition to a circular and blue economy;
- adaption to and mitigation of pollution and climate change in the ocean;
- sustainable use and management of ocean resources; and
- development of new materials including biodegradable plastic substitutes, new feed and food.

Horizon Europe also supports European partnerships in which the EU, national authorities and/or the private sector jointly commit to support the development and implementation of a programme of research and innovation activities. The goal of European partnerships is to contribute to the achievement of EU priorities, address complex challenges outlined in Horizon Europe and strengthen the European Research Area (ERA).

For the marine sector, the most immediately relevant intervention under Cluster 6 is the European Partnership for "a climate neutral, sustainable and productive Blue Economy". The objective of the initiative is to target the objectives of the Clean Planet for All, the Green Deal and EU blue policies towards a climate-neutral, sustainable and productive Blue Economy that preserves biodiversity by

[28] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0808&from=EN

2030. It will support digital technologies, observation, circular economy, ecosystem-based management and renewable energy. It will foster alignment of regional, national and European research and innovation programmes combining financial and in-kind resources, infrastructures, building on transnational sea basin research initiatives.

Programme for Government 2020

As part of the current Government formation, a new programme for government was launched. This includes a large number of intended actions with some of these of specific relevance to the marine research sector. These are summarised as follows:

- Continue to sustainably develop the marine sector by building on existing partnerships to optimise our assets for the benefit of tourism and broader economic development.
- Promote "Seafest" which is a significant marine and tourism event in the national calendar.
- A programme of research and development to assist Ireland meeting its climate change targets, including in the bioeconomy, in marine sequestration, in green hydrogen, in wave technology, in developing floating offshore wind turbines to take advantage of the Atlantic coastline.
- A major drive to realise the immense potential of Ireland's offshore renewables.
- Continue and expand the Clean Oceans Initiative to collect, reduce and reuse marine litter and clean up our marine environment.
- End issuing of new licenses for exploration and extraction of gas and oil.

Food Wise 2025

Food Wise 2025 is a 10-year vision for the Irish agri-food sector which sets out the practical ways in which a number of growth targets can be achieved. It was published by the Department of Agriculture, Food and the Marine in July 2015. The key growth targets include:

- Increasing the value of agri-food exports by 85% to €19 billion.
- Increasing the value added in the agri-food, fisheries and wood products sector by 70% to in excess of €13 billion.
- Increasing the value of Primary Production by 65% to almost €10 billion.
- The creation of an additional 23,000 direct jobs in the agri-food sector all along the supply chain from primary production to high value-added product development.

The key target in relation to the marine sector concerns increasing the value added in the agri-food, fisheries and wood products sector by 70%. This vision includes a number of specific actions to develop the research capacity in the marine sector including:

- Creation of a virtual multi-campus centre of excellence for seafood development in Ireland;
- Develop a "SMART Nutrients" research programme to support high value products from seafood; and
- Develop further research programmes on the potential of marine species of fish, shellfish and seaweed as possible high value sources of pharmaceutical, cosmetic and renewable energy products.

We note that a successor strategy is currently in development which will have a significant R&I section, which will be of direct relevance to the next marine strategy.

Sustainable Healthy Agri-food Research Plan (SHARP)

SHARP, which was launched in 2015, is a strategic combined research programme for the development of the 'Sustainable Food Production and Processing' and 'Food for Health' priority areas of the National Research Prioritisation Exercise (NRPE).[29] This programme establishes the key research and innovation targets of stakeholders, to be met by the agri-food industry in order to provide sustainable, eco-friendly food sources for the future which do not deplete our natural resources. The agri-food industry in Ireland covers both land and water-based food production processes, hence food production and processing in the marine industry comes under the remit of the SHARP programme.[30]

Biodiversity Strategy for 2030

The Biodiversity Strategy for 2030, published in 2020, has been adopted by the EU Commission as a means to building resilience within ecosystems to environmental threats such as climate change, forest fires, food insecurity and disease.[31] A number of actionable targets are identified to be delivered by 2030. These include a large expansion of protected land and sea areas, a commitment to binding nature restoration targets, and ensuring sufficient funding is in place for protection measures.

Farm to Fork Strategy

The Farm to Fork Strategy is central to the European Green Deal and seeks to transform food systems to be fairer, healthier and more environmentally sustainable. The marine sector will play a large role in this strategy, as oceans can provide more sustainable sources of food. They may also be fruitful in terms of their access to alternative proteins, which would reduce dependence on more environmentally-damaging proteins such as those incorporated in mass meat production. Furthermore, the EU will increase restrictions to combat illegal fishing and overfishing in a bid to promote sustainable management of marine resources and improve overall marine governance and management.[32]

Birds and Habitats Directives

Under the Habitats Directive, Ireland is required to set up Special Areas of Conservation (SAC) in order to protect and conserve 60 different habitats and 25 different species.[33] In addition, the Directive instructs that Ireland must provide special protection to bats, otters, whales, dolphins and the Kerry slug. A number of marine habitats are included in the Directive, namely sea cliffs, deep sea reefs, sand dunes and large bays. Moreover, marine species which require SAC include salmon, otters, grey and common seals, porpoises and mussel. The Birds Directive includes much of the same requirements for the protection and conservation of bird populations and habitats.

[29] https://www.ouroceanwealth.ie/ga/node/325

[30] https://doksi.net/en/get.php?lid=23237

[31] https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en

[32] https://ec.europa.eu/food/sites/food/files/safety/docs/f2f_action-plan_2020_strategy-info_en.pdf

[33] http://igi.ie/assets/files/Directives%20Seminar/9_O'Keeffe_Habitats.pdf

Prioritised Action Framework (PAF) for Ireland 2021-2027

The PAF is a strategic framework which aims to give an overview of the measures to be taken for implementation of the EU-wide Natura 2000 network, which was founded in 1992. The Natura 2000 programme specifies a network of natural protection areas across the EU, derived from the Habitats Directive. The PAF specifies the green infrastructure and financial requirements of implementing the programme in Ireland, in order to *"maintain and restore natural habitats and species of EU importance, whilst taking account of economic, social and cultural requirements and regional and local characteristics."*[34] The PAF sets out the priority financing needs for the marine and coastal sector, suggesting annual costs of €570,000, with one-off costs amounting to around €324,800. There are 154 Special Protection Areas (SPAs) in Ireland, which cover a total distance of around 5,894km^2. Of this, marine areas comprise 1,717km^2.

Marine Strategy Framework Directive (MSFD)

The MSFD, published in 2016, is a piece of European legislation targeted at protecting the marine environment. It *"requires the application of an ecosystem-based approach to the management of human activities, enabling a sustainable use of marine goods and services."*[35] Each Member State is required under the Directive to:

- Provide a description for what that state considers to be a healthy and sustainable sea ('Good Environmental Status');
- Continually monitor and review the quality of their Maritime area under the framework of the Good Environmental Status; and,
- Ensure that action, determined by the assessment of the sea quality, is taken by 2020 to maintain (or achieve) the status of Good Environmental Status.

National Biodiversity Action Plan (NBAP)

The NBAP 2017-2021 comprises a wide array of policies, objectives and activities for Irish biodiversity, to be undertaken across the broad spectrum of government, civil society and the private sector. The objective of the plan is to ensure Ireland achieves its Vision for Biodiversity, which states that *"biodiversity and ecosystems in Ireland are conserved and restored, delivering benefits essential for all sectors of society and that Ireland contributes to efforts to halt the loss of biodiversity and the degradation of ecosystems in the EU and globally."*[36] The marine environment comprises one of the seven objectives set out under the NBAP, seeking to *"conserve and restore biodiversity and ecosystem services in the marine environment".* Two key targets are identified:

- Substantial progress being made to ensure that marine waters are considered ecologically safe and sustainable.
- Fish stock yields to reach a level of maintenance, or even restored to levels which ensure maximum yield (no later than 2020).

[34] https://www.npws.ie/sites/default/files/files/Prioritised-Action-Framework-(PAF)-for-Natura%20-2000-in-Ireland.pdf

[35] https://www.marine.ie/Home/site-area/areas-activity/marine-environment/marine-strategy-framework-directive

[36] https://www.npws.ie/sites/default/files/publications/pdf/National%20Biodiversity%20Action%20Plan%20English.pdf

Energy Security in Ireland 2020 Report

This report describes Ireland's situation with respect to energy security. Energy security is described as *"uninterrupted access to reliable, affordable forms of energy."*[37] which is essential for the running of the economy and providing good standards of living. In terms of the maritime sector, despite a recent push towards offshore exploration of natural gas, the report suggests that exploration activity remains low.

Marine Planning and Development

Ireland's National Marine Planning Framework, due to be published in 2021, will provide a long-term framework for effective management of marine activities and more sustainable use of Ireland's marine resources. The Framework and related legislation, the Maritime Area Planning & Development Bill (previously the Marine Planning and Development Management Bill), are important decision making tools for regulatory authorities and policy makers into the future.

The purpose of the Bill is to put in to law a new regime for the maritime area which will streamline policies under the remit of a single principle of consent. This regime *"will replace all existing State consent regimes."*[38] One 'Maritime Area Consent' policy will cover issues of occupation of the Maritime Area while one development consent policy will cover planning permission.[39] Anyone wishing to develop in the Maritime area will be required to apply to the Minister for a Maritime Area Consent (MAC).

A summary of the key policy documents is outlined in the table below which summarises the various policy and strategic documents that were reviewed in this section. This table also highlights the relevant areas within each document that relate most directly to research and innovation in the marine sector.

Summary of Key Documents Reviewed

[37] https://www.seai.ie/publications/Energy-Security-in-Ireland-2020-.pdf

[38] https://www.gov.ie/en/publication/91aab-the-marine-planning-and-development-management-bill/

[39] Ibid.

	Key points of relevant to Marine research
Innovation 2020	Action 4.17 – Support progress towards the Harnessing Our Ocean Wealth targets through coordinated marine research and development strategies
Harnessing Our Ocean Wealth	Sets out the vision, goals and actions for Ireland's marine affairs; 5 key actions under the RKTI area – cross agency collaboration, targeting funding of marine research, complete the INFOMAR seabed mapping programme, improve data availability of marine statistics, support facilities
Project Ireland 2040 – NDP & NPF	More focus at local levels; importance of maritime economy. NPO 42 supports renewable energy
Climate Action Plan 2019	Specific focus on offshore wind; support ocean energy research; supply chain for offshore renewable energy; blue bioeconomy
EU Green Deal	Investing in environmentally-friendly technologies and supporting innovation in industry; Development of a clean energy system is key to the European Green Deal
UN Decade of the Ocean	States that ocean science accounts for a small portion (between 0.04% and 4%) of total research and development expenditures worldwide, and call for an increase in funding in this area
National Policy Statement on the Bioeconomy (2018)	Key actions include promoting coherence within the bioeconomy; support development of bio-based products; targeting EU and private funding
Horizon 2020 / Horizon Europe	Key priorities include: systemic solutions for the prevention, reduction, mitigation and removal of marine pollution including plastics; transition to a circular and blue economy; adaption to and mitigation of pollution and climate change in the ocean; sustainable use and management of ocean resources; development of new materials, new feed and food
Food Wise 2025	Development of CoE for seafood development in Ireland; develop research programme on the potential of marine species as possible high value sources of pharmaceutical, cosmetic and renewable energy products. We note that a successor strategy is currently in development which will have a significant R&I section which will be of direct relevance to the next marine strategy.
Programme for Government (2020)	Continued emphasis on the sustainable development of the marine sector e.g. through marine spatial planning; programme of R&D in marine sequestration, wave technology, offshore renewables and the bioeconomy

Emerging Issues since the strategy was published

As the National Marine Research and Innovation strategy was published in 2017, there have been a number of recent policy documents that are likely to have implications for the remaining period of the current MRIS and for any future marine research strategy. These include:

- Climate Action Plan, 2019;
- Research Priority Areas 2018-2023;
- New Government Department (DFHERIS) with responsibility for research;
- Programme for Government, 2020;
- Mid-Term review of Innovation 2020;

- Marine Institute Strategic Plan 2018-2022;
- EU Green Deal;
- Horizon Europe;
- Brexit; and
- Covid-19.

There have been some changes in the "Energy" theme, in response to the urgency to address climate change and sustainability challenges. This theme has progressed and has been renamed "Energy, Climate Action and Sustainability", with the two priority areas updated to "Decarbonising the Energy System" and "Sustainable Living". These changes relate to the Research Priority Areas 2018-2023.

Another relevant priority area that was refreshed is the "Food" theme, with the priority area updated to "Smart and Sustainable Food Production and Processing". In this area, the focus for marine-related research is now on the impact of climate change, sea level modelling and forecasting, carbon sequestration, ecosystem services, food supply chains and sustainability.

The recent Programme for Government (2020) has emphasised the move away from fossil fuels and indicated that no further licences for exploration will be granted. This has some limited implications for some marine research funded during the MRIS.

The strategic objectives of the latest Marine Institute Strategic Plan 2018-2022 in relation to research and innovation are fully consistent with the objectives of the MRIS. The key strategic objectives relate to increasing research capacity. The Strategic Plan also highlights the need to secure and manage the intellectual property relating to funded marine research.

Annex 3 Survey of Marine Researchers

CONFIDENTIAL INFORMATION REQUEST TO MARINE RESEARCHERS RE NATIONAL MARINE RESEARCH AND INNOVATION STRATEGY 2017-2021

Indecon International Research Economists have been appointed by the Marine Institute to undertake an independent review of the National Marine Research and Innovation Strategy ('MRIS') 2017-2021. As part of our analysis, we believe it is critical to obtain inputs from researchers who undertake research in the marine sector in Ireland. We would, therefore, be very appreciative if you could complete the Information Request below.

All information will be treated as confidential and in accordance with the Marine Institute Privacy Policy (which is available on the Marine Institute website) and our obligations under Data Protection Law. All information collected will be aggregated with the responses from other respondents.

Background Details of the Research Group/Organisation

1. Please indicate the name of the institution and research group where you are based:

   _____

   _____

2. Please indicate your estimate of the number of whole-time equivalent researchers supported by ongoing and new awards from various public bodies to undertake marine-related research for your project(s). These projects should be national or international marine-related projects that were active or have begun since the 1st January 2017:

	Principal Investigator	Research Scientist/Fellow	Post-Doc	PhD Student	Other
Total					
Male					
Female					

Details of project(s) funded relating to Marine research in Ireland 2017-2020

3. What MRIS Research themes did these projects relate to? Also, please indicate what percentage of funding came from private sources?

	1 project	2 projects	3 or more projects	% of funding secured from private sector
Bioresources	❑	❑	❑	
Advanced Technologies	❑	❑	❑	
Subsea Resources	❑	❑	❑	
Renewable Energy	❑	❑	❑	
Tourism & Leisure	❑	❑	❑	

Transport & Logistics	❑	❑	❑	
Security & Surveillance	❑	❑	❑	
Biodiversity, Ecosystems & Food-webs	❑	❑	❑	
Pollution & Litter	❑	❑	❑	
Climate Change	❑	❑	❑	
Ocean Observation & Seabed Mapping	❑	❑	❑	
Ocean Literacy & Education	❑	❑	❑	
Integrated Policy & Governance	❑	❑	❑	
Information & Spatial Technologies, Analytics and Modelling	❑	❑	❑	
Engineering	❑	❑	❑	

Views and awareness of the National Marine Research and Innovation Strategy ('MRIS') 2017-2021

4. How aware are you of various aspects of the National Marine Research and Innovation Strategy?

	Very Aware	**Aware**	**Neither Aware nor Unaware**	**Unaware**	**Very Unaware**
Overall objectives of the Research and Innovation Strategy	❑	❑	❑	❑	❑
Objective to raise research capacity across all marine research themes	❑	❑	❑	❑	❑
Funded marine research should be targeted to increase research maturity or assist policy	❑	❑	❑	❑	❑
Improving Coherence in the approach to marine research funded by state actors	❑	❑	❑	❑	❑
Funding instruments to support marine-related research	❑	❑	❑	❑	❑
Awareness of the 15 marine research themes	❑	❑	❑	❑	❑
The Maturity Model used to examine research capacity	❑	❑	❑	❑	❑
Implementation of the strategy	❑	❑	❑	❑	❑
The work of the Marine Research Funders Forum (MRFF)	❑	❑	❑	❑	❑

5. How effective are the national marine research funders in co-ordinating marine research and innovation activity in Ireland?

Very effective	Effective	Neither Effective nor Ineffective	Ineffective	Very Ineffective
❑	❑	❑	❑	❑

Increasing research capacity and targeting of research funding

Research maturity and capacity in the MRIS is assessed across three areas. Human capacity refers to having sufficient capacity to participate in collaborative research. Infrastructure is important to ensure that research can be supported. Capacity in relation to Networks relates to the connectivity of Irish researchers both nationally and internationally. The following questions consider these components of research maturity separately.

6. What impact has the MRIS had on **human capacity** of various Research and Innovation themes outlined in the strategy?

	Very significant impact	Significant impact	Moderate Impact	No impact	Don't know
Bioresources	❑	❑	❑	❑	❑
Advanced Technologies	❑	❑	❑	❑	❑
Subsea Resources	❑	❑	❑	❑	❑
Renewable Energy	❑	❑	❑	❑	❑
Tourism & Leisure	❑	❑	❑	❑	❑
Transport & Logistics	❑	❑	❑	❑	❑
Security & Surveillance	❑	❑	❑	❑	❑
Biodiversity, Ecosystems & Food-webs	❑	❑	❑	❑	❑
Pollution & Litter	❑	❑	❑	❑	❑
Climate Change	❑	❑	❑	❑	❑
Ocean Observation & Seabed Mapping	❑	❑	❑	❑	❑
Ocean Literacy & Education	❑	❑	❑	❑	❑
Integrated Policy & Governance	❑	❑	❑	❑	❑
Information & Spatial Technologies, Analytics and Modelling	❑	❑	❑	❑	❑
Engineering	❑	❑	❑	❑	❑

7. What impact has the MRIS had on **infrastructure and technical support** levels of various Research and Innovation themes outlined in the strategy?

	Very significant impact	Significant impact	Moderate Impact	No impact	Don't know
Bioresources	❑	❑	❑	❑	❑
Advanced Technologies	❑	❑	❑	❑	❑
Subsea Resources	❑	❑	❑	❑	❑

Renewable Energy	❑	❑	❑	❑	❑
Tourism & Leisure	❑	❑	❑	❑	❑
Transport & Logistics	❑	❑	❑	❑	❑
Security & Surveillance	❑	❑	❑	❑	❑
Biodiversity, Ecosystems & Food-webs	❑	❑	❑	❑	❑
Pollution & Litter	❑	❑	❑	❑	❑
Climate Change	❑	❑	❑	❑	❑
Ocean Observation & Seabed Mapping	❑	❑	❑	❑	❑
Ocean Literacy & Education	❑	❑	❑	❑	❑
Integrated Policy & Governance	❑	❑	❑	❑	❑
Information & Spatial Technologies, Analytics and Modelling	❑	❑	❑	❑	❑
Engineering	❑	❑	❑	❑	❑

8. What impact has the MRIS had on **networks** of various Research and Innovation themes outlined in the strategy?

	Very significant impact	**Significant impact**	**Moderate Impact**	**No impact**	**Don't know**
Bioresources	❑	❑	❑	❑	❑
Advanced Technologies	❑	❑	❑	❑	❑
Subsea Resources	❑	❑	❑	❑	❑
Renewable Energy	❑	❑	❑	❑	❑
Tourism & Leisure	❑	❑	❑	❑	❑
Transport & Logistics	❑	❑	❑	❑	❑
Security & Surveillance	❑	❑	❑	❑	❑
Biodiversity, Ecosystems & Food-webs	❑	❑	❑	❑	❑
Pollution & Litter	❑	❑	❑	❑	❑
Climate Change	❑	❑	❑	❑	❑
Ocean Observation & Seabed Mapping	❑	❑	❑	❑	❑
Ocean Literacy & Education	❑	❑	❑	❑	❑
Integrated Policy & Governance	❑	❑	❑	❑	❑
Information & Spatial Technologies, Analytics and Modelling	❑	❑	❑	❑	❑
Engineering	❑	❑	❑	❑	❑

9. Please provide any evidence or additional comments to support your answers

Informing Policy and Dissemination of Research

10. Have you undertaken any of the following activities to highlight the marine research supported by public funding?

	Yes	Not as Yet but Planning to	No, and Not Likely to
Participated in other workshops/conferences	❑	❑	❑
Met with policymakers / public bodies	❑	❑	❑
Submitted paper to or had papers published in academic journals	❑	❑	❑
Participated in policy workshops/symposia	❑	❑	❑
Contributed to national media	❑	❑	❑
Developed a social media presence for the research projects	❑	❑	❑

11. Please indicate details on any conference papers/publications arising from funding provided to undertake marine research.

Conference papers / Publications				
Number of Conference papers published	**Number of Journal Articles Published**	**Number of Journal Articles Accepted for Publication**	**Number of Journal Articles Submitted but not yet accepted**	**Number of Journal Articles in progress but not yet completed**

12. Please indicate your views of the likely impact if any of your research project on the following areas of policy development and implementation.

	Very significant impact	Significant impact	Moderate Impact	No Impact	Don't know
Developing the knowledge to address emerging marine policy issues	❑	❑	❑	❑	❑
Input to evidence-based marine policies	❑	❑	❑	❑	❑
Increased understanding of the pressures on our marine environment	❑	❑	❑	❑	❑
Input to the development of suitable responses to marine challenges	❑	❑	❑	❑	❑

Views on the Impact of Marine Research

13. Please indicate whether you believe the research project(s) would have proceeded or not if public funding was not provided?

Research would have proceeded without funding	Would not have been undertaken	Research would have been delayed
❑	❑	❑

14. Please indicate your views on whether public funding for marine research and innovation is likely to have has a significant impact or not in the areas specified below.

Assessment of Impact of Publicly Funded Marine Research					
	Very significant impact	Significant impact	Moderate impact	No impact	Don't know
Improved capacity in the Irish system to undertake high-quality research in the ***MRIS*** stated research themes	❑	❑	❑	❑	❑
Increased ability to leverage other national and international research funding	❑	❑	❑	❑	❑
Increased ability to participate fully in Transnational research projects	❑	❑	❑	❑	❑
Input to informing policy	❑	❑	❑	❑	❑
Attraction of outstanding marine researchers to Ireland	❑	❑	❑	❑	❑
Increase in high-quality publications by publicly funded researchers	❑	❑	❑	❑	❑
Increase in economic growth for supported SMEs	❑	❑	❑	❑	❑
Increase in IP/Patents	❑	❑	❑	❑	❑
Increase in research-based spin-offs	❑	❑	❑	❑	❑
Training of postgraduates for employment in Ireland	❑	❑	❑	❑	❑
Training of postgraduates for employment internationally	❑	❑	❑	❑	❑
Enhanced research reputation for Ireland in the marine research space	❑	❑	❑	❑	❑
Stimulation of greater RD&I by industry	❑	❑	❑	❑	❑

Partnership and Collaboration

15. Please indicate your views on the impact, if any, of publicly funded marine research on partnerships and collaboration?

Assessment of Publicly funded Marine Research Impacts					
	Very significant impact	Significant impact	Moderate impact	No impact	Don't know
Encouraged researchers to engage with government and non-government stakeholders	❑	❑	❑	❑	❑
Increased collaboration between Irish-based researchers in the areas of fisheries, renewables energy and biosciences	❑	❑	❑	❑	❑
Increased collaboration between Irish-based researchers and international researchers in the areas of fisheries, renewables energy and biosciences	❑	❑	❑	❑	❑
Improvement in working relationships between researchers from different organisations	❑	❑	❑	❑	❑
Increased collaboration with enterprise sector	❑	❑	❑	❑	❑

Increased trans-disciplinary collaboration	❑	❑	❑	❑	❑
Facilitated Joint Transnational Calls (e.g. JPIs, ERAnets)	❑	❑	❑	❑	❑
Increased use of citizen science in research	❑	❑	❑	❑	❑
Impact on North-South marine research collaboration	❑	❑	❑	❑	❑

Commercial Activities

16. Please specify the commercial impacts, if any, related to the research funded to undertake marine-related research and innovation?

	Achieved	Expected (by the end of the project)
Number of Patents		
Number of Spin-out companies		
Number of Licence Agreements		
Number of Enterprise Ireland Commercialisation Awards		
Number of links with private companies		

Overall Progress

17. Please indicate your assessment of the overall progress of the MRIS in achieving the three main goals of the strategy.

Assessment of Overall Progress				
	Very significant progress	Significant Progress	Moderate Progress	Insignificant or No progress
Raise Research Capacity	❑	❑	❑	❑
Raise Research Maturity through targeting of research funding	❑	❑	❑	❑
Increased coherence in the funding of marine research	❑	❑	❑	❑

18. Please indicate any suggestions you have on metrics which could be used to measure the broader impacts of the MRIS.

_____
_____
_____

Future Priorities and Suggestions for Changes in Strategy

19. Please indicate your views on any marine-related research areas that should be included in the next research and innovation strategy:

_____
_____

20. What supports or mechanisms could be provided to researchers in the next strategy?
    _____
    _____
    _____

21. Please indicate any views you have on emerging issues since the strategy was published in 2017 which should be incorporated into the next strategy: (Please use additional space as required)
    _____
    _____
    _____

22. Please specify any other potential improvements which you think could be made in the overall MRIS for supporting researchers and applied marine policy-relevant research in Ireland including any potential improvements in the funding process or other areas: (Please use additional space as required)
    _____
    _____
    _____

Other Comments

23. Please indicate below any further comments you may have concerning the National Marine Research and Innovation Strategy (please use additional space if necessary):
    _____
    _____
    _____

Thank you. We are very grateful to you for your valuable assistance with the above.

All information will be treated as strictly confidential and will be aggregated with the results from other marine researchers. No individual information will be released to the Marine Institute or any parties.

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