



Research and Innovation for Wave and Tidal Stream in the UK and EU

A 2023 Summary

A Supergen Offshore Renewable Energy Hub Policy Paper prepared
by the Policy and Innovation Group at the University of Edinburgh

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The Policy and Innovation Research Group is part of the Institute for Energy Systems (IES), which is one of the six research institutes within the School of Engineering at the University of Edinburgh. The group combines expertise on technologies, energy system organisations and institutions, and the wider policy and regulatory context for energy. They apply a range of quantitative and qualitative research tools and methods including innovation systems, energy system modelling and scenarios, and transitions management. This leads to preparation of strategy and investment roadmaps for organisations' funding, public and private investment and government departments.

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Supergen Offshore Renewable Energy Hub

The Supergen ORE Hub is a £9 Million Engineering and Physical Sciences Research Council (EPSRC) funded programme which brings together academia, industry, policy makers and the general public to support and accelerate the development of offshore wind, wave and tidal technology for the benefit of society. The Hub is led by the University of Plymouth, and includes Co-Directors from the Universities of Aberdeen, Edinburgh, Exeter, Hull, Manchester, Oxford, Southampton, Strathclyde, and Warwick. The Supergen ORE Hub is one of three Supergen Hubs and two Supergen Network+ created by the EPSRC to deliver strategic and coordinated research on Sustainable Power Generation and supply. <https://www.supergen-ore.net/>

Designed by Martin Budd Design Consultant

Cover image: Prototype testing at Flowave (Source: Mocean)

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EXECUTIVE SUMMARY

The Supergen Offshore Renewable Energy (ORE) Hub and the Policy and Innovation Group of University of Edinburgh has jointly published four reports investigating the potential of ocean energy (focusing on wave and tidal stream) in UK. A short statement of the main findings of each report is as follows:

- A potential of 6GW of wave and 6GW of tidal stream devices could be installed in the UK by 2050 if the Strategic Energy Technology Plan (SET Plan) target¹ is achieved.
- If 6GW of wave and 6GW of tidal stream is deployed by 2050, a potential gross value added (GVA) to the UK economy in the range of £11-41 billion could be achieved.
- If 6GW of wave and 6GW of tidal stream is included in the Great Britain electricity mix by 2050, a potential savings of over £1 billion per annum in dispatch costs could be achieved.
- Sustained policy support in the form of technology push and market pull mechanisms is necessary for cost effective delivery of 6GW of wave and 6GW of tidal stream by 2050 .

This series of analysis has indicated that in order to achieve the socio-economic and power system benefits associated with 6GW of wave and 6GW of tidal stream, an optimum combination of policy support in the form of technology push and market pull mechanisms are crucial. Furthermore, our analysis in the latest report demonstrates that technology push funding support for research and innovation (R&I) is crucial to accelerate cost reduction of energy generation, thereby reducing the total amount of market pull funding required.

Given the importance of technology push funding in supporting R&I, it is vital to understand the current state of R&I in the UK and EU. This will enable UK to shape its R&I funding strategy ensuring an optimal development of the ocean energy sector. This report aims to aid in this policy decision by presenting a detailed analysis of the current research and innovation (R&I) funding and project landscape. This is a collaborative work between the Supergen ORE Hub, the European Energy Research Alliance (EERA) and the European Commission funded SEETIP Ocean² project. The R&I analysis presented here will be the first iteration of analysis and forms the basis in a SEETIP Ocean exercise to update the Strategic Research and Innovation Agenda for Ocean Energy (SRIA), to be completed in early 2024.

The SRIA is a strategic and influential document that outlines R&I areas in the UK and EU ocean energy sector in order to progress towards the SET Plan targets. The SRIA is a collaboration between stakeholders from the government, industry and research institutions in the UK and EU. The UK plays a strategic role in the SRIA through its strong representation of stakeholders from industry and research institutions in the Technology Working Group and also as one of the three lead authors (i.e. University of Edinburgh, TECNALIA, Ocean Energy Europe) of the current SRIA publication.

As of June 2023, around mid-term of the SRIA period (2021-2025), R&I initiatives in the UK and EU that include all projects funded by the European Commission, the UK and European countries are currently found to be on track against the SRIA recommendations with around €496 million of public funding allocated to over 151 wave and tidal stream projects with the following breakdown:

- Within SRIA recommended Priority Topics:
 - €332 million (50% of SRIA recommended budget of €664 million)
 - 108 projects (73% of SRIA recommended 148 number of projects)
- Outwith SRIA recommended Priority Topics³:
 - €164 million
 - 43 projects

¹ To achieve Levelised Cost of Energy (LCOE) of €100/MWh for tidal stream and €150/MWh for wave by 2030

² The Support to SET Plan Implementation Working Group and European Technology and Innovation Platform for Ocean Energy (SEETIP Ocean) is a project funded by Horizon Europe.

³ Although these projects do not fit into the current SRIA Priority Topics, they still contribute to the development of the wave and tidal stream.funded by Horizon Europe.

The UK is currently the biggest single country funder among all European countries, providing a total public funding of €63 million into the wave and tidal stream sectors, contributing to around 12% of total R&I public funding in Europe. The breakdown of UK funding is as follows:

- Engineering and Physical Sciences Research Council (EPSRC): €23 million
- Scottish Government: €18.8 million
- UK Government Innovation Funding:
 - Innovate UK: €3.8 million
 - Horizon Europe Guarantee: €14 million
 - Energy Entrepreneurs Fund: €2.4 million

This analysis demonstrates that a relatively large portion of UK funding is focused on early-stage research with limited funding in higher TRL stages particularly in the tidal stream sector, that is crucial for commercial deployment of the technologies.



Nova T4 on land (Source: Nova Innovation)

1 INTRODUCTION



Magallanes Renovables ATIR installation at EMEC (Source: Colin Keldie)

Section Overview

This report is made up of three main sections and is structured as below.

Introduction: This section gives a brief background of the wave and tidal stream technologies, in particular with an emphasis on activities in the UK. This is followed by an outline of the purpose and context of work.

Process: This section provides an overview of the methodology used and scope of the analysis.

Analysis results: This section presents a detailed analysis of the R&I topics, amount of public funding, project name, project size and project funders. Gap analyses are conducted on the following:

- UK and EU as a whole
- UK deep dive

1.1 Current Status of Wave and Tidal Stream Technologies

Wave and tidal stream are two important offshore renewable energy sources with important potential role in enabling the UK to achieve its net-zero target through a just transition. The Scottish government, the UK government and the European Commission have provided support in various forms including technology push funding for research and innovation and market pull funding for technology deployment.

Tidal stream and wave energy technologies are currently at different levels of technology maturity. Tidal stream devices have achieved technology convergence with horizontal axis turbines being the mainstream design. Tidal stream technology is currently at multiple device pre-commercialisation stage. Wave energy devices have yet to achieve convergence with a diverse range of designs currently being developed. Wave energy technology is currently at prototype development stage.

A summary of the main commercial scale demonstration projects in the UK are listed below.

Tidal Stream

- SIMEC Atlantis Energy & Andritz Hydro – four 1.5MW turbines installed in Meygen Phase 1, a further 28MW to be delivered under CfD AR4 by 2027 [2].
- Nova Innovation – Shetland Tidal Array (six 100kW turbines) and Nova Tidal Array in Canada (15 turbines upon completion) [3].
- Orbital Marine Power – installed second full-scale prototype of 2MW in 2021 [4], a further 7.2MW to be delivered under CfD AR4 by 2027 [5].
- Magallanes Renovables – installed full-scale prototype of 2MW in EMEC in 2019 [6], a further 5.62MW to be delivered under CfD AR4 by 2026 [5].



SAE Renewables, Orbital Marine Power, Magallanes Renovables (L-R)

Wave

- Mocean Energy – Completed sea-trials of ½ scale prototype (10kW) in 2021, developing the design of a 250kW pre-commercial prototype under the EuropeWave programme [7].
- AWS Ocean Energy – Completed shakedown test of a ½ scale prototype (16kW) in 2022 [8].
- Bombora Wave Power Europe – Currently fabricating a full-scale 1.5MW prototype in Pembrokeshire [9].



AWS Ocean Energy, Mocean Energy, CorPower Ocean (L-R)

1.2 Context of Work

The Supergen ORE Hub and the Policy and Innovation Group of University of Edinburgh has jointly published a series of reports investigating the deployment potential of wave and tidal stream technologies, the socioeconomic and power system benefits associated with the deployment as well as policy mechanisms necessary to unlock the benefits. These are presented in four reports. Main findings from the reports are given below.

Report 1

Based on a whole energy system modelling run by the Energy System Catapult using the Energy Systems Modelling Environment ESME, assuming that the SET Plan cost targets¹ are met by 2030, an optimised future electricity mix in Great Britain will consist of 6GW of wave and 6GW of tidal stream devices by 2050 [10].

Report 2

If the 6GW of wave and 6GW of tidal stream deployment by 2050 is realised, the UK could harness economic benefits in terms of gross value added (GVA) in the range of £11-41 billion. The lower range of GVA benefits (£11 billion) represents a low ambition scenario with a weak domestic value chain and thus low retention rate, while the higher range (£41 billion) represents a mature supply chain where most of the needs of the industry is supplied by a robust domestic supply chain, thus resulting in a higher GVA gain [11].

Report 3

A Great Britain electricity mix with 6GW of wave and 6GW of tidal stream by 2050 would result in the potential savings of over £1 billion in dispatch costs, 24TWh lower peaking dispatch, 5TWh lower battery requirements and 3GWh lower interconnector flows compared with an electricity mix without ocean energy [12].

Report 4

An optimal balance of technology push and market pull policy support is crucial to develop the wave and tidal stream sector. Technology push funding that accelerates energy generation cost reduction through R&I greatly reduces total funding required from market pull support mechanism, thus enabling cost effective deployment of 6GW of wave and 6GW of tidal stream by 2050 [13].

Reports 1-3 detailed the significant opportunities associated with the deployment of 6GW of wave and 6GW of tidal stream in the UK energy mix by 2050. **Report 4** outlined the importance of policy support to achieve the deployment capacity and harness the associated benefits. It highlighted that technology push support for research and innovation (R&I) is crucial to reduce the cost of energy generation thereby reducing the amount of market pull funding support required.



Figure 1 Reports 1-4 (L-R)

Having demonstrated the importance of technology push funding support for R&I, this report, **Report 5** aims to help guide policy decisions on the area where future technology push fundings could be directed based on the current R&I landscape in the UK and EU.

1.3 Aims and Objectives

Given the importance of technology push funding in supporting R&I, it is vital to understand the current state of R&I in the UK and EU. The two main aims of this analysis are as below.

- This analysis shall assist UK's policy decision to shape its R&I funding strategy ensuring an optimal development of the ocean energy sector. This will be achieved by presenting a detailed analysis of the current research and innovation (R&I) funding and project landscape in the UK and EU, which will be mapped against the recommendations of the Strategic Research Innovation Agenda for Ocean Energy (SRIA) [1]. The SRIA is a strategic and influential document that outlines R&I areas in the UK and EU ocean energy sector in order to progress towards the SET Plan targets.
- The R&I analysis presented here will also be the first iteration of analysis and forms a basis to update the current Strategic Research Innovation Agenda for Ocean Energy (SRIA), to be completed in early 2024. This is a collaborative work between the Supergen ORE Hub, the European Energy Research Alliance (EERA) and the European Commission funded SEETIP Ocean project. The UK plays a strategic role in the SRIA through its strong representation of stakeholders from industry and research institutions in the Technology Working Group and also as one of the three lead authors (i.e. University of Edinburgh, TECNALIA, Ocean Energy Europe) of the current SRIA publication.

2 PROCESS

This analysis will present a detailed investigation on the current R&I landscape of the wave and tidal stream technologies in the UK and EU in the following steps.

Step 1: Establish current R&I landscape

A database of the current R&I projects in the wave and tidal stream sectors in the UK and EU will be established⁴. The database will include all projects currently active in the UK and EU that meets all the criteria in the scope outlined below.

Scope

- Projects that happen in the UK and EU.
- Projects that are active in or after 2022⁵.
- Projects that receive public funding of over €100,000⁶.

All project budgets used for this analysis only include the amount of public funding or grant aid i.e. the amount of private contribution is excluded. The different types of funding are listed below.

Type of Funding

- UK and individual European countries funded
- UK and European countries jointly funded (i.e. OCEANERA-NET⁷)
- European Commission, UK and European countries jointly funded (e.g. EuropeWave)
- European Commission funded (e.g. H2020, HEU, ERDF, EMFF, EMFAF⁸)

Step 2: Categorise and map R&I projects

All the projects identified in Step 1 are categorised into various SRIA Challenge Areas and Priority Topics, and compared against the SRIA recommendations, in terms of project spend (amount of public funding or grant aid) and number of projects. A list of the SRIA Challenge Areas and Priority Topics is presented in Table 1.

Table 1 SRIA Challenge Areas and Priority Topics

Challenge Areas	Priority Topics	W/T
1 Design and Validation of Ocean Energy Devices	1.1 Demonstration of ocean energy devices to increase experience in real sea conditions	W&TS
	1.2 Demonstration of ocean energy technology at array scale	W&TS
	1.3 Improvement and demonstration of PTO and control systems	W
	1.4 Application of innovative materials from other sectors	W&TS
	1.5 Development of novel wave energy devices	W
	1.6 Improvements of tidal blades and rotor	TS
2 Foundations, Connections and Mooring	2.1 Advanced mooring and connection systems for floating ocean energy devices	W&TS
	2.2 Improvement and demonstration of foundations and connection systems for bottom-fixed ocean energy devices	W&TS
3 Logistics and Marine Operations	3.1 Optimisation of maritime logistics and operations	W&TS
	3.2 Instrumentation for condition monitoring and predictive maintenance	W&TS
4 Integration in the Energy System	4.1 Developing and demonstrating near commercial application of ocean energy in niche markets	W&TS
	4.2 Quantifying and demonstrating grid scale benefits of ocean energy	W&TS
5 Data Collection & Analysis and Modelling Tools	5.1 Marine observation, modelling and forecasting to optimise design and operation of ocean energy devices	W&TS
	5.2 Open-data repository for ocean energy	W&TS
6 Cross-cutting Challenges	6.1 Improvement of the environmental and socioeconomic impacts of ocean energy	W&TS
	6.2 Standardisation and certification	W&TS
7 ⁹ Others (Areas outwith SRIA Recommendations)	7.1 Coordination and support actions including knowledge sharing	
	7.2 Analysis and Modelling tools	
	7.3 Development and testing of tidal devices	
	7.4 Testing facilities & infrastructures (Includes building of and access to)	
	7.5 Open sea test sites (includes consenting, building of and supporting access to)	
	7.6 Support for demonstration or consenting of devices and arrays	
	7.7 Co-location of multiple Devices	

⁴ This is the first iteration of database. This is a collaborative work with the SET Plan Implementation Working Group for Ocean Energy (hereafter OceanSET) and supported by the SEETIP Ocean project. The database will be updated at a later stage by OceanSET. This first iteration of the database will be the basis for ETIP Ocean Technology Working Group to update the SRIA from 2026-2030. The database will then be updated annually by OceanSET.

⁵ The recommendation period for the SRIA is 2021-2025. For a more accurate quantification, projects that concluded in 2021 will have most deliverables achieved prior to or on 2021, thus considered as not responding to SRIA recommendations and excluded from this analysis.

⁶ This is to avoid skewing of analysis results with a high number of small projects.

⁷ OCEANERA-NET projects within data boundaries are Joint Call 2019 projects, all without EC co-fund.

⁸ H2020 - Horizon 2020; HEU - Horizon Europe; ERDF - European Regional Development Fund; EMFF - European Maritime and Fisheries Fund; EMFAF - European Maritime, Fisheries and Aquaculture Fund.

⁹ Area 7 are projects that do not fit into the existing SRIA Challenge Areas and Priority Topics.

EMEC wave buoy (Source: EMEC)

Step 3: Conduct gap analysis

A comparison between delivered projects against recommended projects is conducted to identify R&I opportunities in each Priority Topic.

A conceptual diagram of the analysis process is shown in Figure 2.

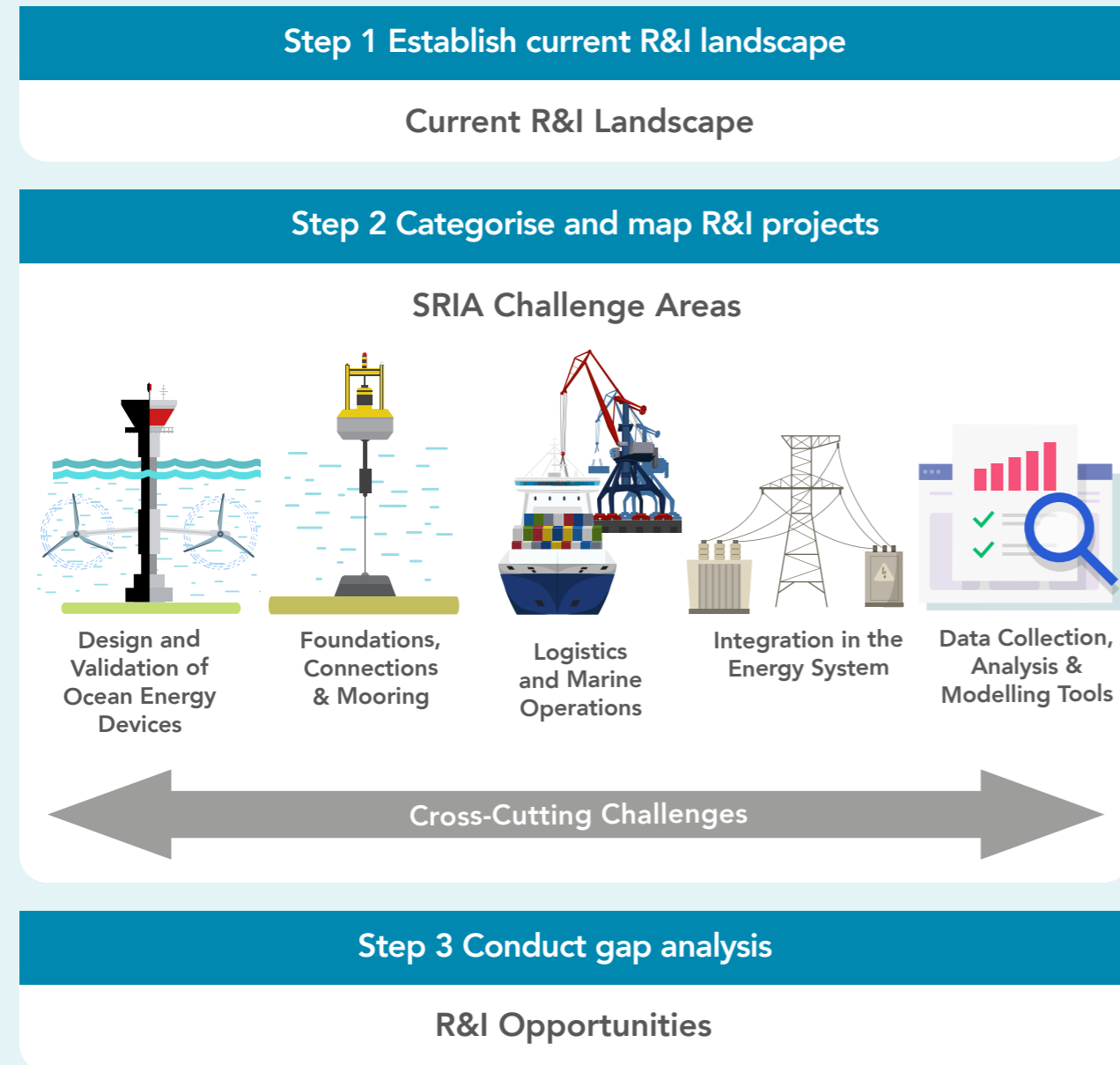


Figure 2 Conceptual diagram of the analysis process

The output of this analysis will assist policy decisions in funding upcoming R&I activities for wave and tidal stream technologies in the UK, which will influence the overall development of the ocean energy sector in both the UK and the EU.

3 A SYSTEMATIC REVIEW OF THE R&I LANDSCAPE IN THE UK AND EU



The Morlais Tidal Energy Zone (Source: Nova Innovation)

Section Overview

This section presents investigation results of the R&I analysis conducted according to the process outlined in Section 2 in steps below.

- Step 1: Establish current R&I landscape in the UK and EU.
- Step 2: Categorise and map R&I projects identified in Step 1 against SRIA Priority Topics.
- Step 3: Conduct gap analysis on the following:
 - UK and EU as a whole
 - UK deep dive

Step 1: Establish current R&I landscape

R&I activities that fulfills the scope of analysis across Europe in the wave and tidal stream sectors are summarised below. The R&I research database is the collation of the OceanSET 2020 database, the European Commission databases, individual country funding databases and details provided through personal communications [14-26].

As of June 2023, the total public funding of all projects and number of projects are:

- €496 million
- 151 projects

The European Commission is the main funder, providing over €364 million (around 73%) support for R&I activities in Europe, as depicted in Figure 3. The UK and France are the biggest individual country funders, with UK contributing around 9% (or 12% including Horizon Europe Guarantee) and France 3% of total funding in the UK and EU.

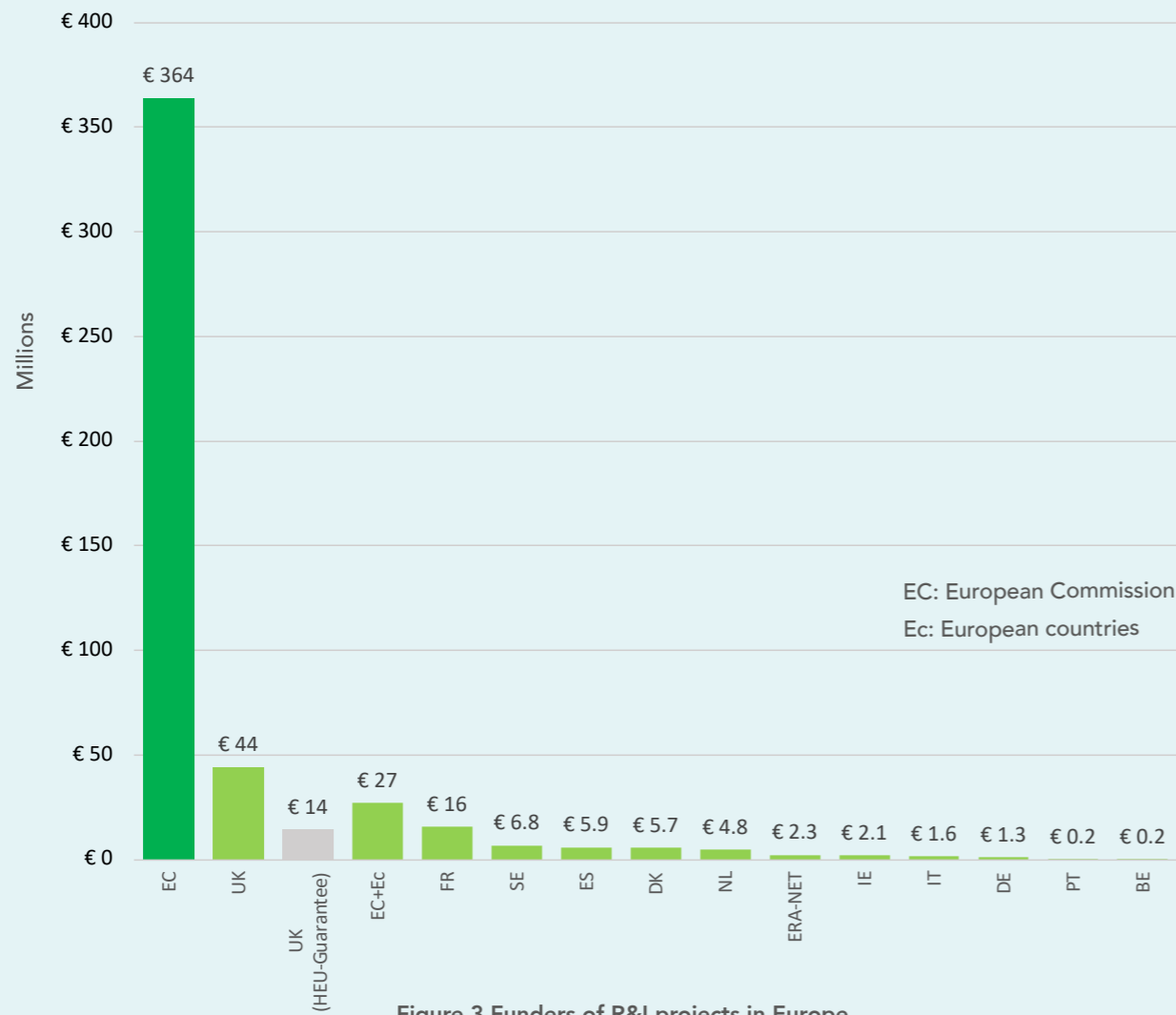


Figure 3 Funders of R&I projects in Europe

Sectorial Breakdown of Projects

An analysis of sectorial breakdown shows that tidal stream receives the highest amount of funding while wave energy has the highest number of projects as shown in Figure 4. Tidal stream projects on average receive more funding per project than wave energy projects, indicating a more mature technology status where projects typically involve larger and/or more devices (array scale) with higher amount of funding.

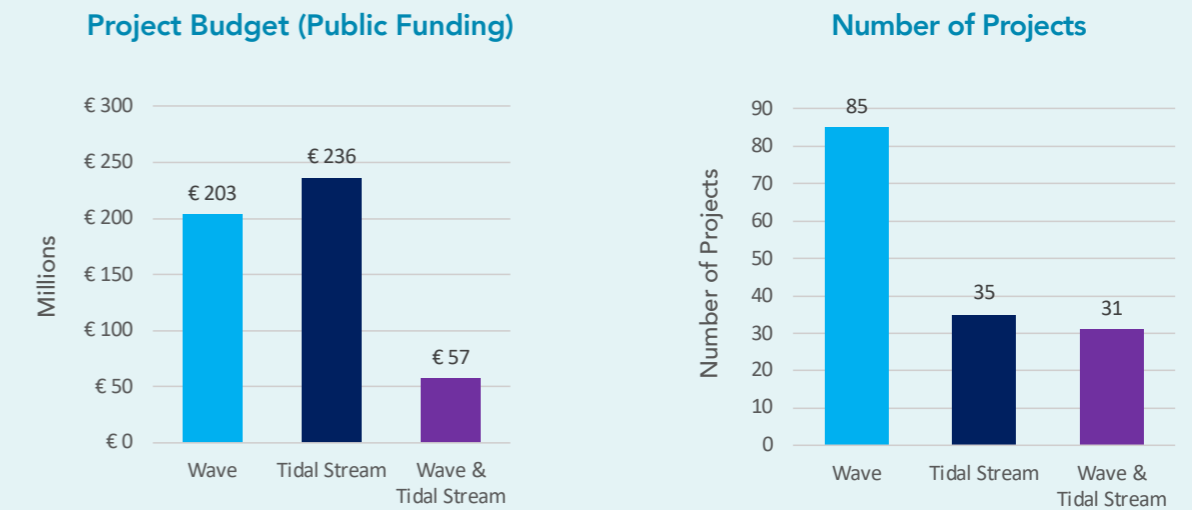


Figure 4 Sectorial breakdown of project budget and number of projects

Project Funders with Sectorial Breakdown

In terms of project funders, a different trend is observed on the sectorial breakdown between projects funded by the European Commission and projects funded by the UK and individual European countries. European Commission funded projects focus more heavily on tidal stream with total funding for tidal stream nearly twice the total funding for wave energy. On the other hand, funding of individual countries generally focus on wave energy, as depicted in Figure 5.

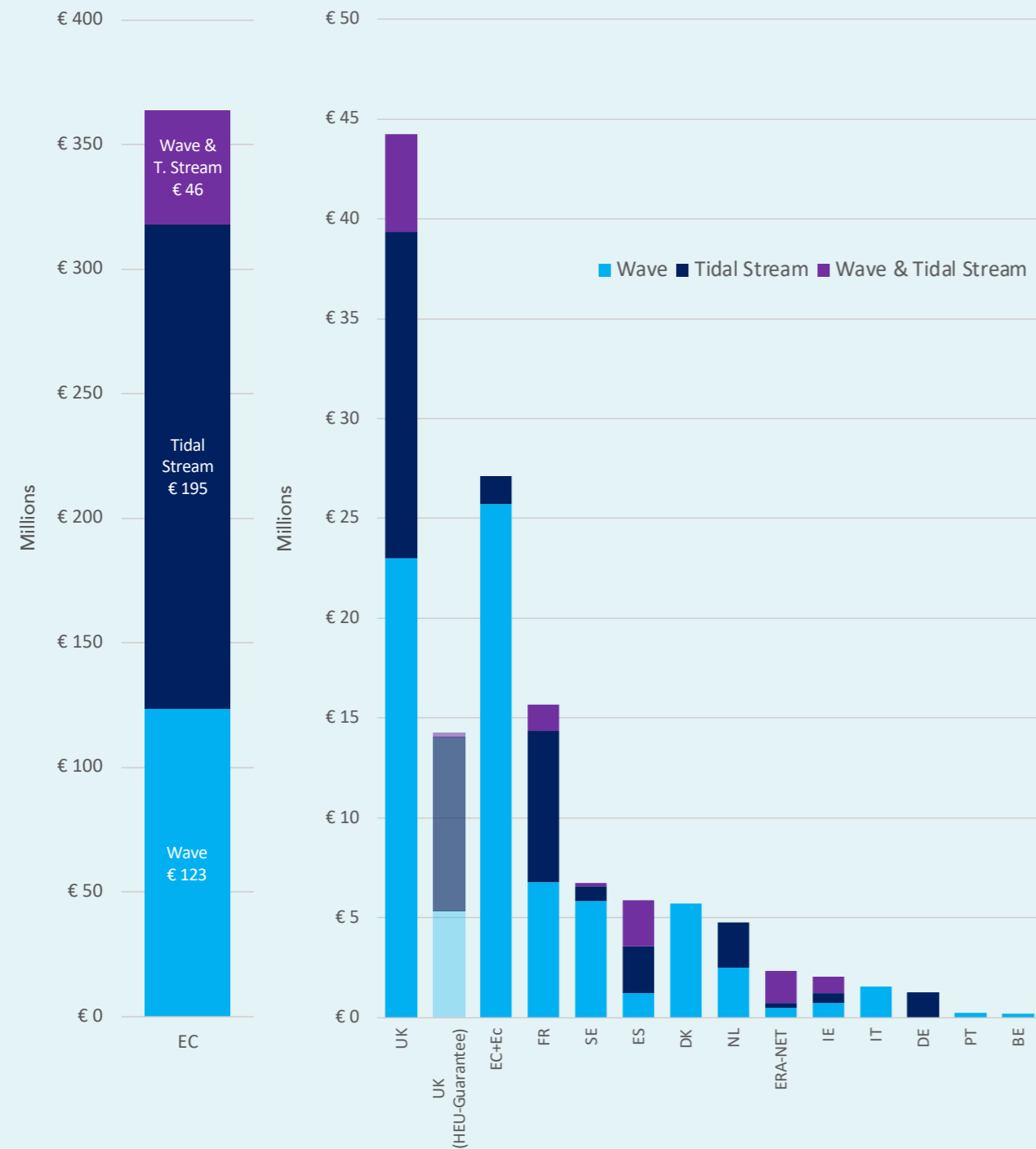


Figure 5 Sectorial breakdown of fundings

Additional observations from the database presented in Figure 5 are presented below.

Tidal Stream

UK and France are the two biggest funders, making up around 80% of non-EC funding in this sector.

The UK funded a total of €16.4 million in 8 projects, consisting of:

- **EPSRC & Supergen Flexible Funding: Total of €10.6 million, 4 projects**
- Innovate UK: Total of €3.4 million, 2 projects
- Energy Entrepreneurs Fund: Total of €2.4 million, 2 projects

In France, tidal stream funding is made up of 2 projects, both involving Sabella as follows:

- PHARES¹⁰: €5.8 million, single project
- SCELPHY: €1.8 million, single project

Wave

In this sector, **joint funding between European Commission and European countries (EC+Ec in Figure 5) is made up of two main programmes:**

- HiWave-5¹¹: €8.5 million, single project
- EuropeWave¹²: €16.2 million, 10 projects

In terms of single country funder, **UK and France remain the two biggest funders.**

In UK, two main funders for wave energy projects are:

- **Wave Energy Scotland: €14.5 million, 7 projects**
- EPSRC: €7.8 million, 8 projects

In France, wave energy funding comes from two projects:

- S3¹³: €4.8 million, single project
- DIKWE¹⁴: €2 million, single project

¹⁰ This is a project to develop on Ushant Island a renewable energy mix of solar photovoltaic, wind and tidal energy, coupled with an energy storage system, a partnership between AKUO energy and Sabella. Project ended in Feb 2023 before demonstration due to authorisation issue.

¹¹ This project is jointly funded by the ERDF and the North Portugal Regional Operational Programme (NORTE 2020).

¹² Match-funded by the EU's Horizon 2020 programme, this is a collaboration between Wave Energy Scotland (WES) and the Basque Energy Agency (EVE) supported by Ocean Energy Europe (OEE).

¹³ A novel wave energy converter using Electro Active Polymers developed by SBM Offshore.

¹⁴ The DIKWE project – being developed by a consortium of French companies including Legendre Group, GEPS Techno, and Ifremer – has seen the deployment of a prototype breakwater equipped with wave energy converters in Sainte Anne-du-Portzic, near Brest.

Step 2: Categorise and map R&I projects

Current projects and the SRIA

In May 2020, the European Technology & Innovation Platform for Ocean Energy, ETIP Ocean published the Strategic Research Innovation Agenda for Ocean Energy (SRIA) [1]. It aims to provide guidance to all funders of innovation by presenting concrete research and innovation actions that will allow ocean energy technologies to progress towards the European Strategic Energy Technology Plan, SET Plan targets¹⁵. The report published in 2020 outlines the priority research, development and innovation challenges that must be focused upon between 2021-2025 (Refer Appendix I for the complete list of SRIA Challenge Areas and Priority Topics). At the conclusion of this period, progress by the sector will be assessed together with a revision of the priority areas which will be reflected in a new and updated SRIA¹⁶ for the period between 2026-2030. This analysis forms the basis of the updating exercise.

The SRIA recommends the following public funding and number of projects between 2021-2025:

- €664 million¹⁷
- 148 projects

As of June 2023, R&I activities active between 2022¹⁸-2025 are as follows:

- €496 million
- 151 projects or activities¹⁹

A comparison between delivered (includes committed projects e.g. Horizon Europe Call 2023 & 2024) projects and SRIA recommendations is shown in Figure 6.

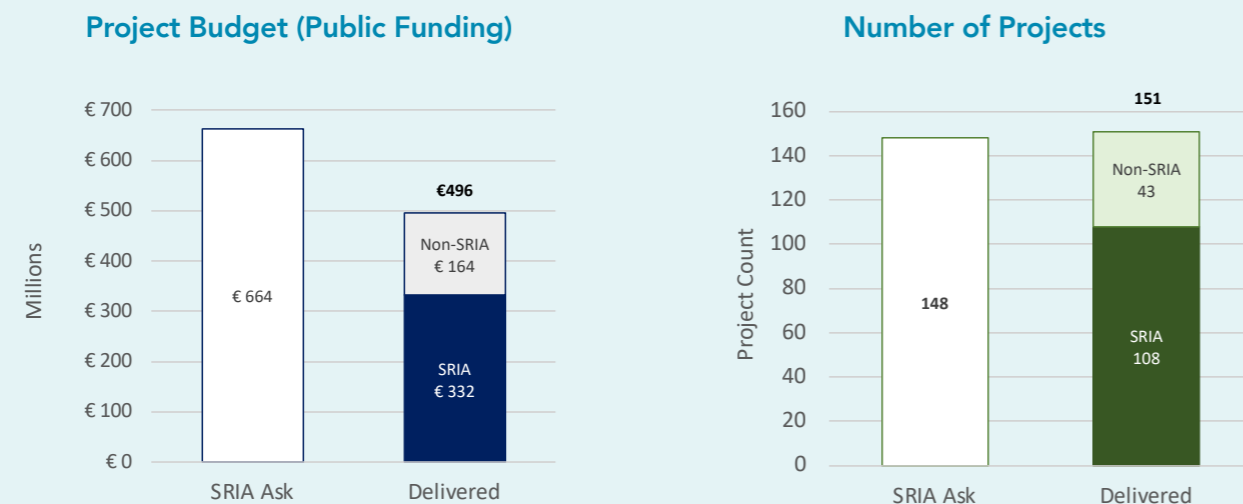


Figure 6 Comparison between SRIA recommendation and current projects

These delivered (and committed) projects fall into 2 categories:

- Within SRIA recommendations:
 - €332 million (50% of €664 million)
 - 108 projects (73% of 148 projects)
- Outwith SRIA²⁰ recommendations (Area 7 in Table 1)
 - €164 million
 - 43 projects

As of June 2023, at around mid-term of the SRIA period, the UK and EU R&I initiatives achieve over 50% of the recommendations in terms of public funding budget and over 70% in terms of number of projects. This shows that:

- R&I initiatives in Europe are on track against the SRIA recommendations.
- R&I projects on average have smaller project budget compared to SRIA recommended budget.

High Level Overview of SRIA Mapping

This section will map the current delivered (and committed²¹) projects against SRIA recommendations, with the following notes:

- Projects are allocated to Priority Topics as best possible using available information.
- Projects that address multiple Priority Topics are split evenly across the relevant Priority Topics.
- Not all projects fit into existing SRIA Priority Topics. Projects that do not fit are categorised into "Other Areas" (Area 7).

¹⁵ €100/MWh for tidal stream and €150MWh for wave energy by 2030.

¹⁶ This analysis, in collaboration with the OceanSET activities under the SEETIP Ocean project, will form the basis for the updating of SRIA.

¹⁷ This is the total public funding of EU + member states (67% of €991 million) excluding *Priority Topic 1.7 Development of other ocean energy technologies* which is out with the scope of this analysis.

¹⁸ For a more accurate quantification, projects that concluded in or before 2021 will have most deliverables achieved prior to or on 2021, thus considered as not responding to SRIA recommendations and excluded from analysis.

¹⁹ Budget for a single project that fulfils a few priority topics were equally divide between each priority areas to account for contribution in each priority topic thus counted as activity instead of project.

²⁰ Although these projects do not fit into SRIA Priority Topics, they still contribute to the development of the wave and tidal stream R&I.

²¹ These are Horizon Europe Project Calls for 2023 and 2024

Figure 7 and Figure 8 shows delivered projects (including committed e.g. HEU Calls 2023 & 2024) against SRIA recommendations in both project budget (public funding) and number of projects. Sectoral breakdown of projects within each Priority Topic can be found in APPENDIX II.

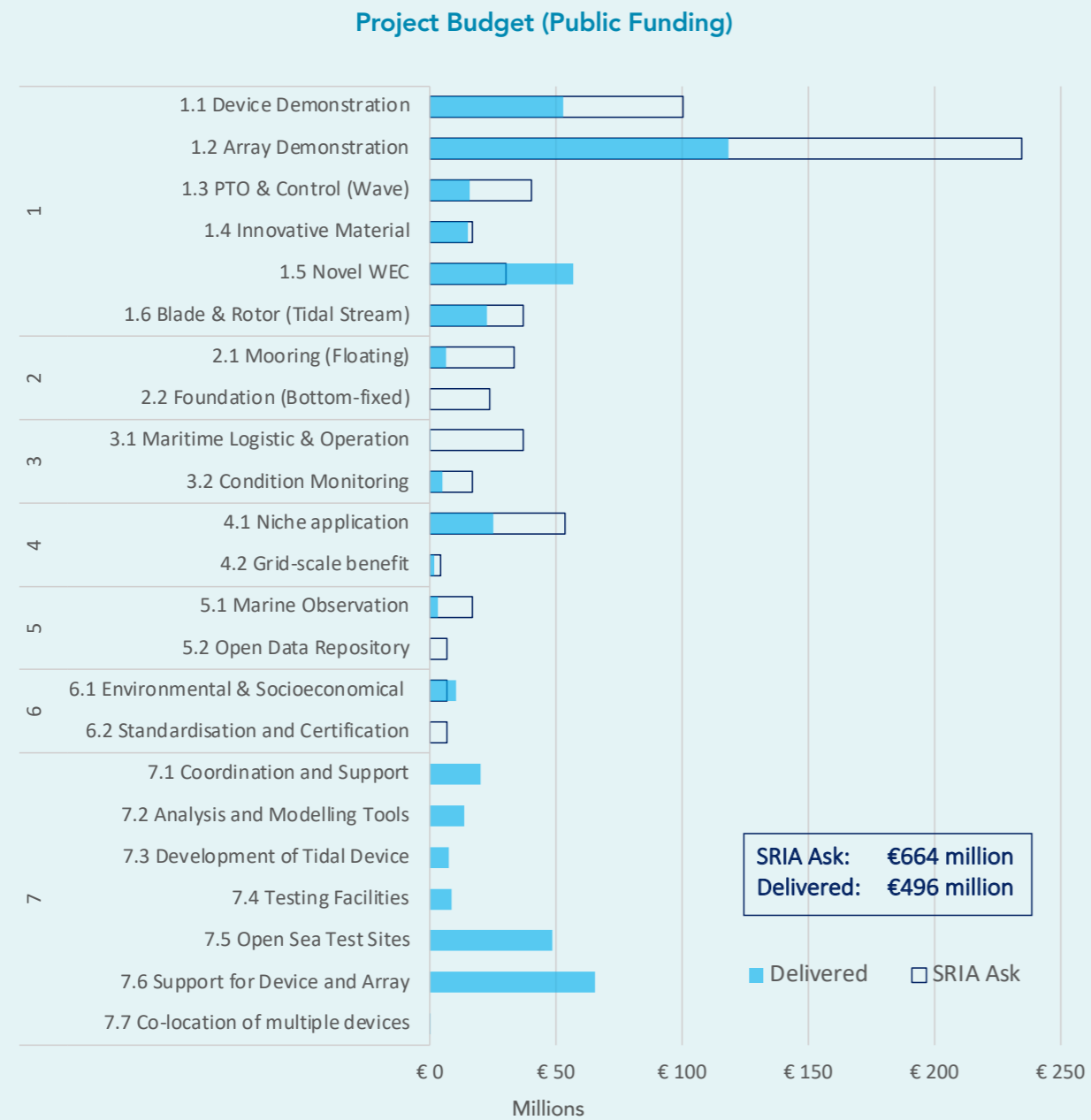


Figure 7 Comparison of total budget between delivered projects and SRIA recommendations

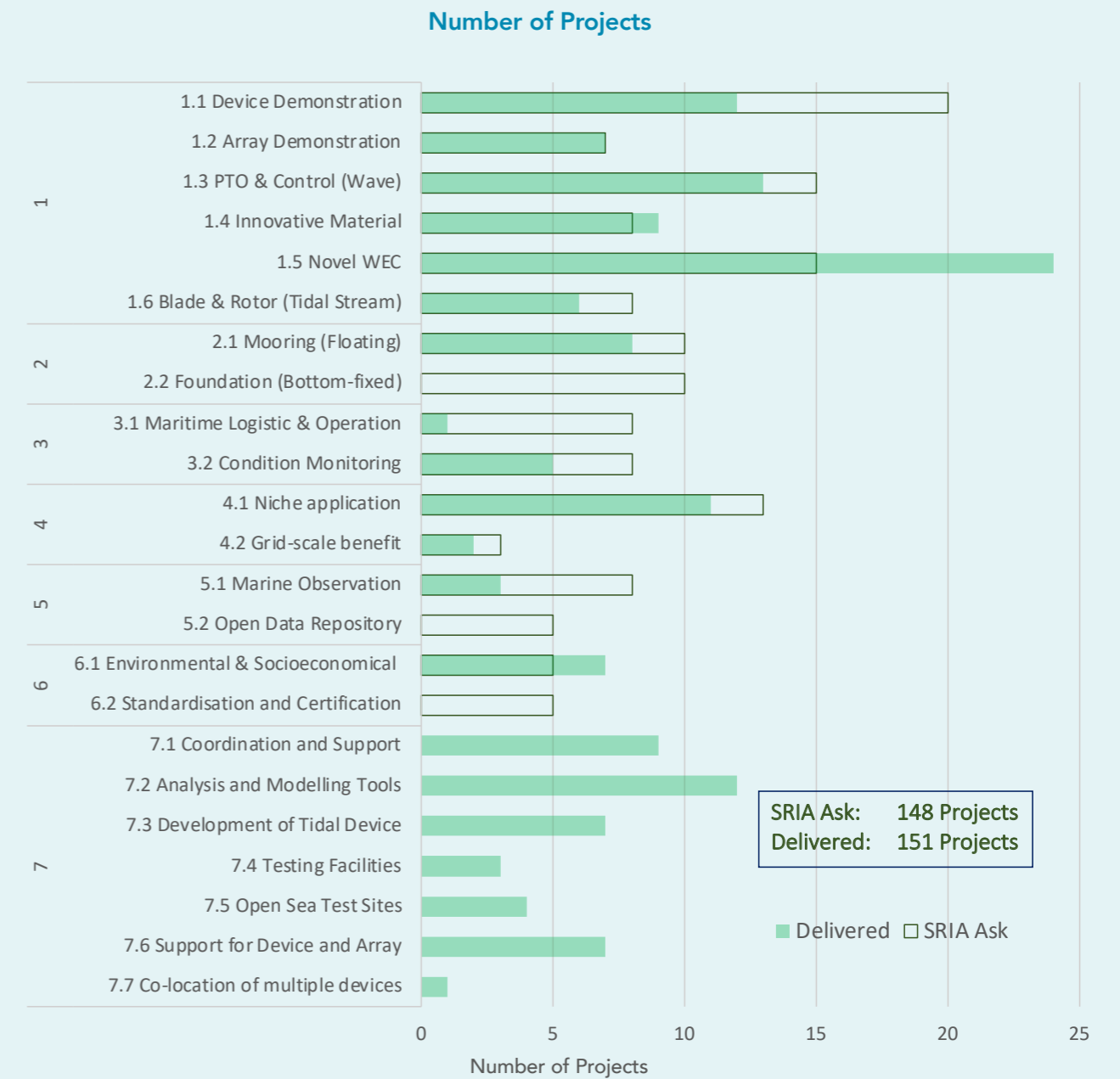


Figure 8 Comparison of number of projects between delivered projects and SRIA recommendations

Some observations of the high level overview are presented below.

- Priority Topics with achievement rate of over 100% in project budget
 - 1.5 Development of novel wave energy devices (188%)
 - 6.1 Improvement of the environmental and socioeconomic impacts of ocean energy (151%)
 - These two projects above also record achievement rate of over 100% in number of projects
- Priority Topics with achievement rate between 75% to 100% in project budget
 - 1.4 Application of innovative materials from other sectors (90%)
- Priority Topics with achievement rate between 50% to 75% in project budget
 - 1.2 Demonstration of ocean energy technology at array scale (51%)
 - 1.6 Improvement of tidal blades and rotor (61%)
- Priority Topics with achievement rate of less than 50% in project budget
 - Around 30% achievement rate in project budget
 - Around 61% achievement rate in number of projects
- Priority Topics with 0% achievement rate in project budget (i.e. no activity recorded)
 - 5.1 Open data repository for ocean energy
 - 6.1 Standardisation and certification

It is found that most of the R&I activities in the UK and EU happen in *Challenge Area 1 - Design and Validation of Ocean Energy Devices*, which is highlighted in the SRIA as the most urgent and crucial area to focus on. It is also worth noting that 100% project achievement rate does not necessarily mean objective of the specific Priority Topic is achieved. A separate analysis is necessary to assess the achievement of the objectives of each Priority Topic which is not within the scope of this study.

Step 3: Conduct gap analysis

UK and EU as a whole

This section presents a detailed analysis of Challenge Areas 1 to 6 (16 Priority Topics) in the current SRIA, and projects under 'Other Areas' (7 Priority Topics) not currently listed in the SRIA.

The following sub-sections show the SRIA recommendations in terms of project size and number of projects, compared against projects delivered or committed. A detailed breakdown of projects into wave and tidal stream sectors with information of project name, funding amount and funding entities can be found in Appendix III.

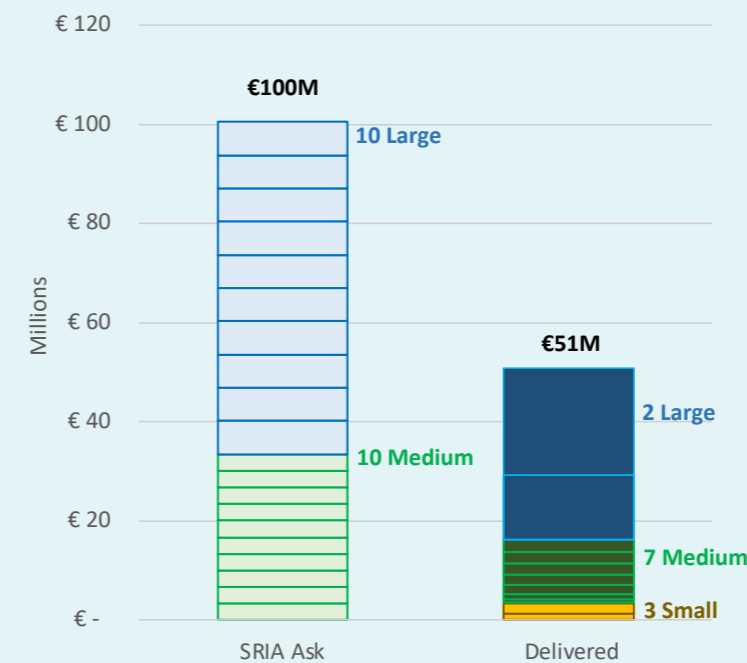
SRIA Challenge Area 1 – Design and Validation of Ocean Energy Devices

The ocean energy industry and research professionals agree that this is the most urgent and crucial area to focus on. This is reflected in the number of Priority Topics and the highest proportion of recommended budget and number of projects.

Within this Challenge Area:

- SRIA Recommended Public Funding: €459 million (Delivered €281 million, 61% achievement rate)
- SRIA Recommended Number of Projects: 73 projects (Delivered 71 projects)
- Proportion against total spending of €496 million: 57%

1.1 Demonstration of ocean energy devices to increase experience in real sea conditions



Total Spend

€51 million

Number of Projects

12

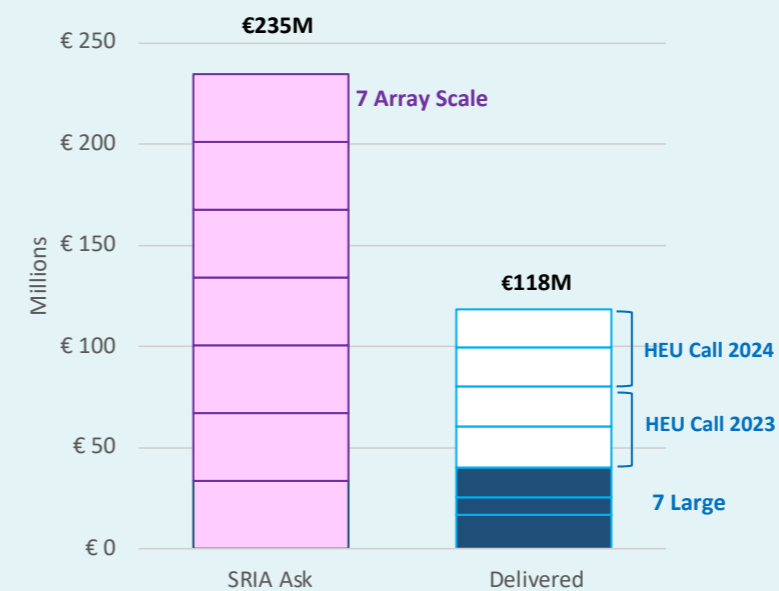
Sectoral Breakdown

- Wave: €18 million, 6 projects
- Tidal Stream: €29 million, 6 projects

Main Projects

- Wave:
 - WEDUSEA, €14.9 million²², European Commission(EC)-Horizon Europe (HEU) & UK-HEU Guarantee
- Tidal Stream:
 - FORWARD2030, €22 million, EC-HEU

1.2 Demonstration of ocean energy technology at array scale



Total Spend

€118 million

Number of Projects

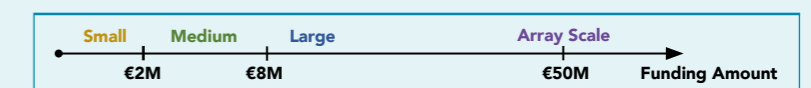
7 (incl. 4 in pipeline)

Sectoral Breakdown

- Wave: €63 million, 4 projects (incl. 2 in pipeline)
- Tidal Stream: €55 million, 3 projects (incl. 2 in pipeline)

Main Projects

- Wave:
 - Hi-Wave5, €8.5 million, EC & PT²³
 - EU-SCORES, €17 million²⁴, EC-Horizon 2020 (H2020)
- Tidal Stream:
 - EnFAIT, €14.9 million, EC-H2020

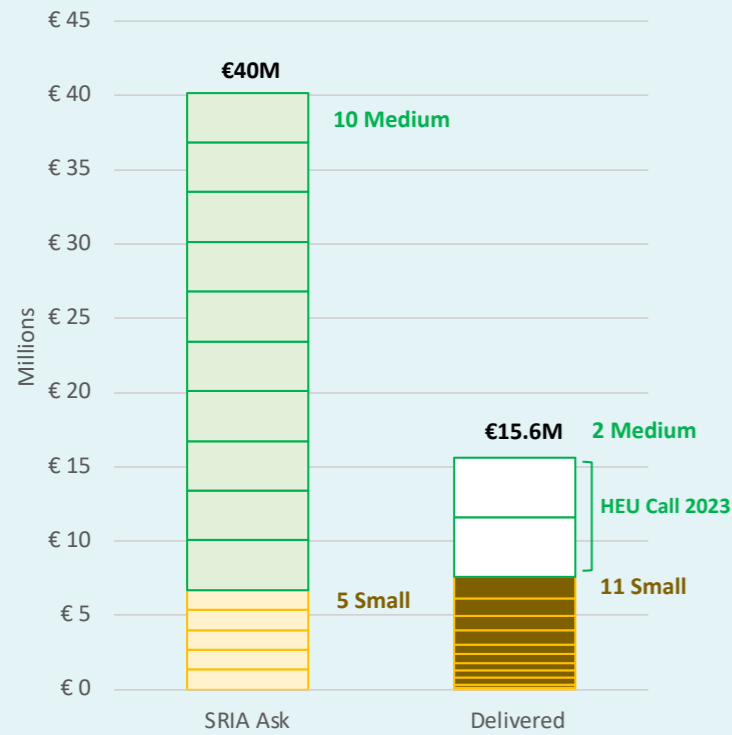


²² Total of €9.6 million (Horizon Europe, European Commission) and €5.3 million (Horizon Europe Guarantee, UK Government).

²³ This is a joint programme between ERDF and NORTE 2020 (2014–2020 North Portugal Regional Operational Programme), a financial instrument intended to support regional development in North Portugal. It is categorised into European Commission and European countries jointly funded project in the main analysis.

²⁴ This is the portion of project that supports the deployment and related works of the wave energy array.

1.3 Improvement and demonstration of PTO and control systems (Wave)



Total Spend

€15.6 million

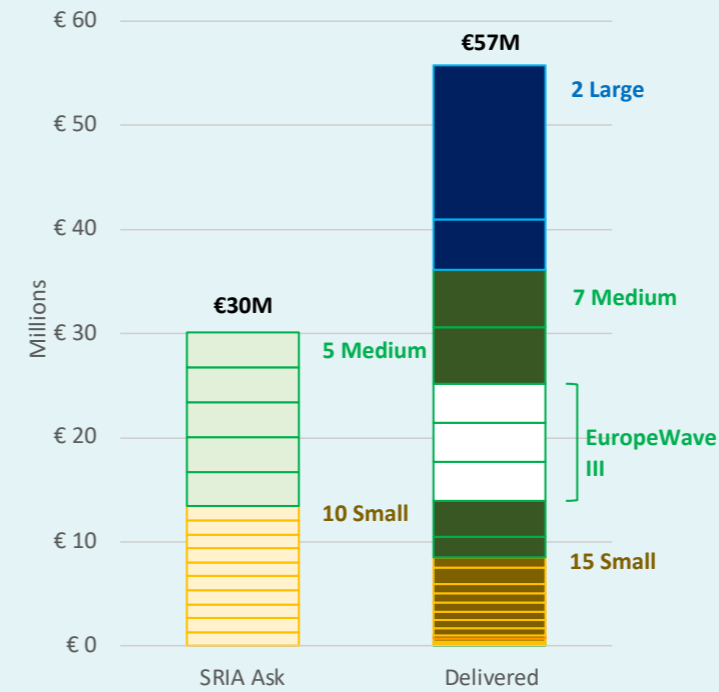
Number of Projects

13 (incl. 2 in pipeline)

Main Projects

- **Wave**
 - PTO Project by Floating Power Plant, €1.5 million, DK-EUDP²⁵
 - WEC-PTO Project by Crestwing, €1 million, DK-EUDP
 - HAPIWEC, €1.2 million, UK-EP SRC

1.5 Development of novel wave energy devices (Wave)



Total Spend

€57 million

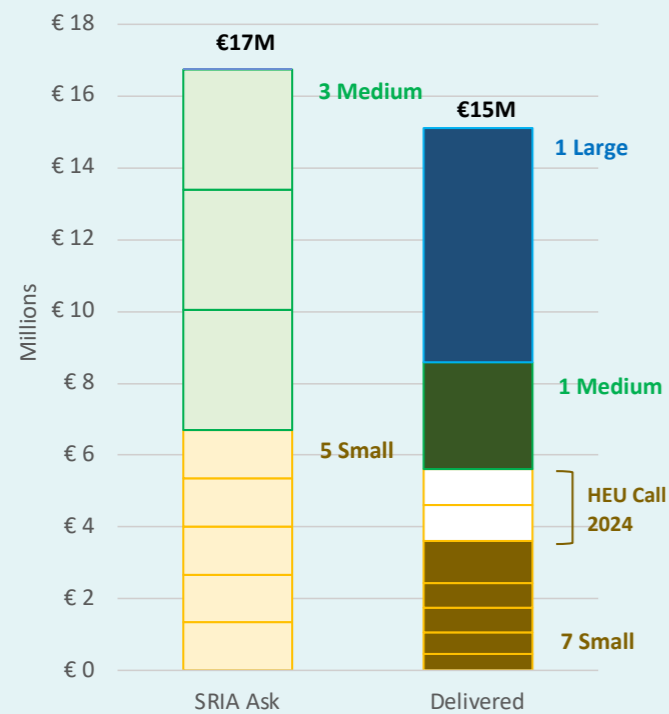
Number of Projects

24 (incl. 3 in pipeline)

Main Projects

- **Wave**
 - WaveSub2, €14.8 million, EC-ERDF
 - AWS-NW31, €5.5 million, UK-Wave Energy Scotland (WES)
 - MOE-NW31, €5.5 million, UK-WES

1.4 Application of innovative materials from other sectors



Total Spend

€15 million

Number of Projects

9 (incl. 2 in pipeline)

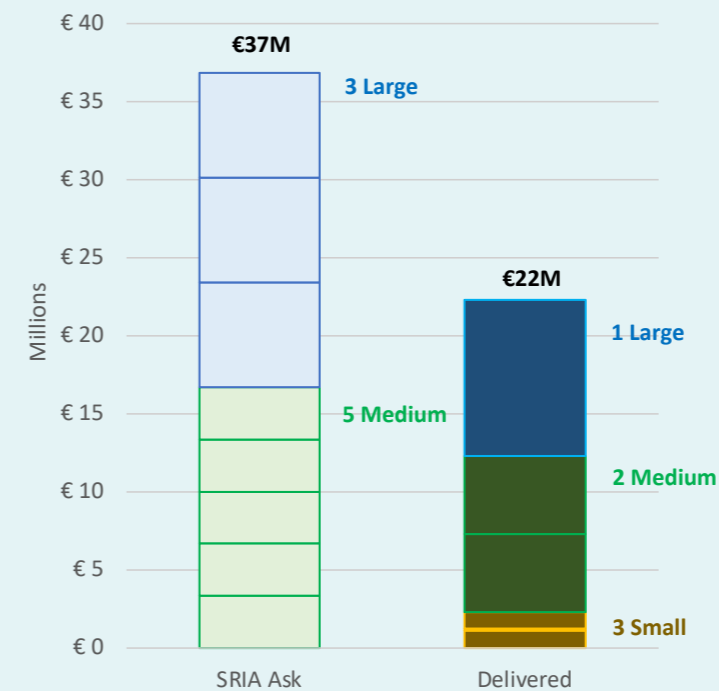
Sectoral Breakdown

- **Wave**
€4 million, 5 projects
- **Tidal Stream:**
€9 million, 2 projects
- **Wave & Tidal Stream**
€2 million, 2 projects in pipeline

Main Projects

- **Wave**
 - BASM-WEC, €1.2 million, UK-EP SRC
- **Tidal Stream**
 - FIBREGY, €6.5 million, EC-H2020
 - CRIMSON, €3.0 million, EC-H2020

1.6 Improvement of tidal blades and rotor (Tidal stream)



Total Spend

€22 million

Number of Projects

6

Main Projects

- **Tidal Stream**
 - MAXBLADE, €10 million²⁷, EC-HEU & UK-HEU Guarantee
 - ELEMENT, €5 million, EC-H2020
 - NEMMO, €5 million, EC-H2020



²⁵ The Energy Technology Development and Demonstration Programme EUDP under the Danish Energy Agency funds work by enterprises and universities on demonstration of new green energy technologies.

²⁶ S3 is categorised as Large (in Appendix) as the total project cost is €14.2 million (SRIA categorises project size according to total project budget, i.e. public plus private funding).

²⁷ Total of €8.7 million (Horizon Europe Guarantee, UK Government) and €1.3 million (Horizon Europe, European Commission).

SRIA Challenge Area 2 – Foundations, Connections and Moorings

The technologies that make up the focus of this Challenge Area share many similarities with those of existing marine structures for coastal defence, offshore wind and offshore oil and gas. However, the novel functional requirement needed for ocean energy devices must be thoroughly developed and tested at sea.

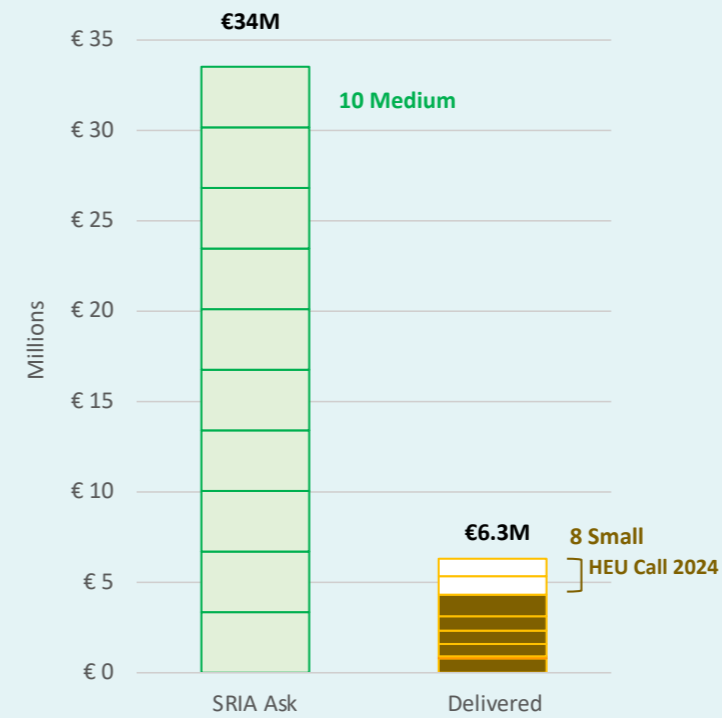
Within this Challenge Area:

- SRIA Recommended Public Funding: €57 million (Delivered €6.3 million, 11% achievement rate)
- SRIA Recommended Number of Projects: 20 projects (Delivered 8 projects)
- Proportion against total spending of €496 million: 1.3%



Quick Connection System (Source: Quoceant)

2.1 Advanced mooring and connection systems for floating ocean energy devices



Total Spend
€6.3 million

Number of Projects:
8 (incl. 2 in pipeline)

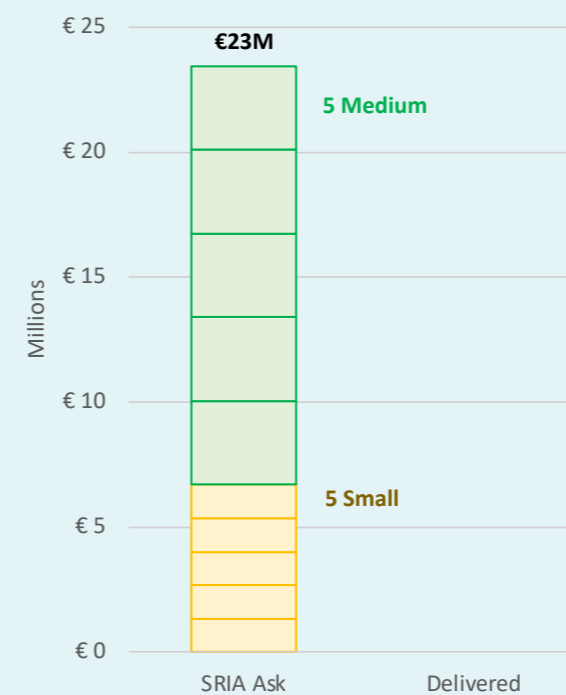
Sectoral Breakdown

- **Wave:** €3.5 million, 5 projects
- **Wave & Tidal Stream:** €2.7 million, 3 projects (incl. 2 in pipeline)

Main Projects

- **Wave**
 - BASM-WEC, €1.2 million, UK-EPSC
- **Wave & Tidal Stream**
 - MoorWEC, €1.2 million, UK-EPSC
 - SEASNAKE, €0.8 million, OCEANERA-NET

2.2 Improvement and demonstration of foundations and connection systems for bottom-fixed ocean energy devices



No activities recorded.



SRIA Challenge Area 3 – Logistics and Marine Operations

Challenge Area 3 includes technology development and demonstration of marine operations related to installation, operation, maintenance and decommissioning of ocean energy devices or arrays. Limited number of devices and arrays deployed to date and high design variability of wave energy devices makes it particularly challenging for the sector to develop a specialised and dedicated supply chain in this area.

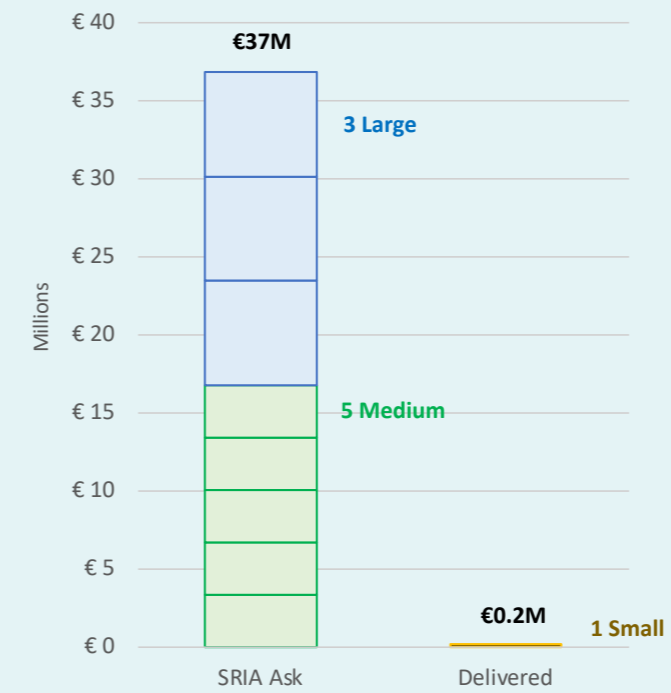
Within this Challenge Area:

- SRIA Recommended Public Funding: €54 million (Delivered €5 million, 9% achievement rate)
- SRIA Recommended Number of Projects: 16 projects (Delivered 6 projects)
- Proportion against total spending of €496 million: 1%



Orkney supply chain vessels (Source: EMEC)

3.1 Optimisation of maritime logistics and operations



Total Spend

€ 0.2 million

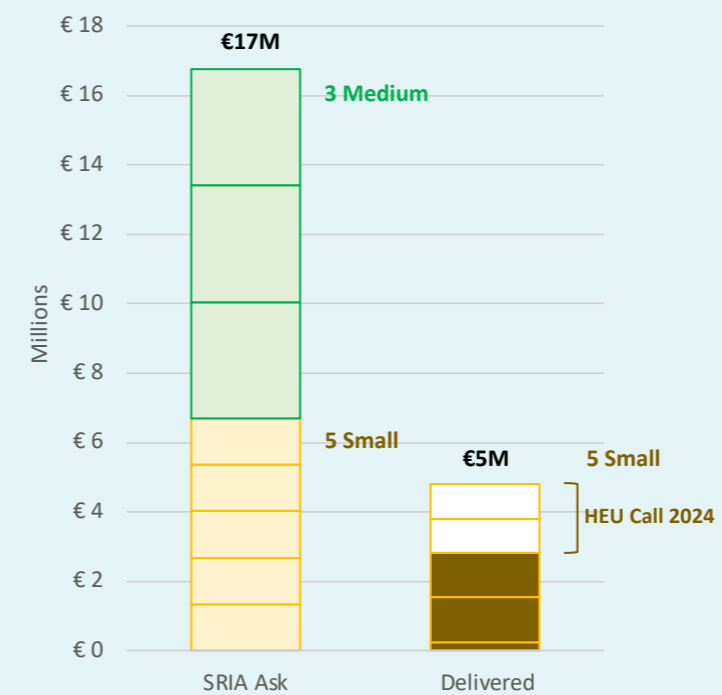
Number of Projects

1

Main Project

- **Wave & Tidal Stream**
 - Installation and maintenance methods of marine energy converters, €0.2 million, SE

3.2 Instrumentation of condition monitoring and predictive maintenance



Total Spend

€5 million

Number of Projects

5 (incl. 2 in pipeline)

Sectoral Breakdown

- **Tidal Stream**
€1.3 million, 1 project
- **Wave & Tidal Stream**
€3.5 million, 4 projects (incl. 2 in pipeline)

Main Projects

- **Tidal Stream**
 - ReCORD, €1.3 million, DE
- **Wave & Tidal Stream**
 - DYNAMO, €1.3 million, FR



SRIA Challenge Area 4 – Integration in the Energy System

Challenge Area 4 includes actions that will assist and speed-up the integration of ocean energy arrays into the European energy system, in both national grid and small grids, such as island deployment. The actions in this challenge area will evaluate electricity system balancing benefits of ocean energy deployment in both grid types.

Within this Challenge Area:

- SRIA Recommended Public Funding: €58 million (Delivered €27 million, 47% achievement rate)
- SRIA Recommended Number of Projects: 16 projects (Delivered 13 projects)
- Proportion against total spending of €496 million: 5.4%



4.1 Developing and demonstrating near-commercial application of ocean energy in niche markets



Total Spend

€25 million

Number of Projects

11

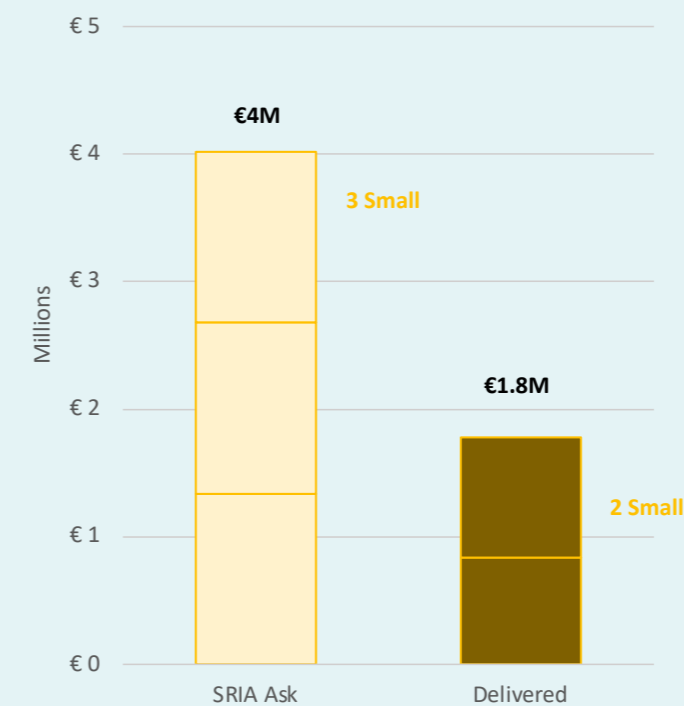
Sectoral Breakdown

- **Wave**
€18 million, 9 projects
- **Tidal Stream**
€6 million, 1 project
- **Wave & Tidal Stream**
€1.3 million, 1 project

Main Projects

- **Wave**
 - MUSICA, €9 million, EC-H2020
 - W2EW, €3.0 million, EC-H2020
 - CWEI, €2.5 million, EC-H2020
- **Tidal Stream**
 - PHARES²⁸, €6 million, FR
- **Wave & Tidal Stream**
 - PORTOS, €1.3 million, EC-ERDF

4.2 Quantifying and demonstrating grid-scale benefits of ocean energy



Total Spend

€1.8 million

Number of Projects

2

Sectoral Breakdown

- **Wave & Tidal Stream**
€1.8 million, 2 projects

Main Projects

- **Wave & Tidal Stream**
 - EVOLVE, €0.9 million, OCEANERA-NET
 - SEEC, €0.9 million, EC-ERDF



²⁸ PHARES is categorised as Large (in Appendix) as the total project cost is €19.9 million.

²⁹ Assumes equal distribution of total project cost (€3.8 million) between four project aims: 1. Improved resource characterization (SRIA 5.1); 2. Improved understanding of multiple resource interaction (SRIA 5.1); 3. Exploring future grid integration of marine renewable energy (SRIA 4.2); 4. Improved methods of quantifying environmental impacts (SRIA 6.1).

SRIA Challenge Area 5 – Data Collection & Analysis and Modelling Tools

This challenge area addresses the generation of information and tools that are critical for other challenge areas.

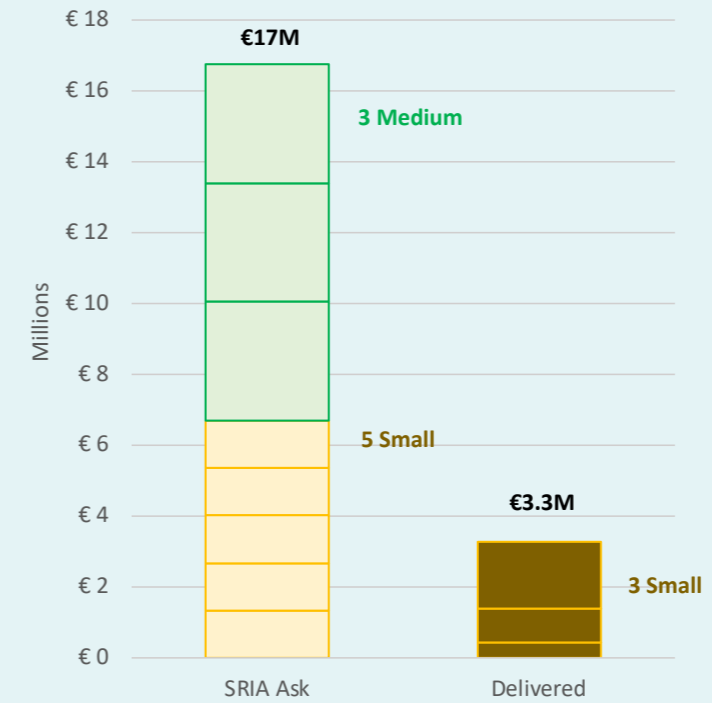
Within this Challenge Area:

- SRIA Recommended Public Funding: €24 million (Delivered €3 million, 13% achievement rate)
- SRIA Recommended Number of Projects: 13 projects (Delivered 3 projects)
- Proportion against total spending of €496 million: 0.6%



RealTide Advanced Turbulence Sensor (Source: University of Edinburgh & EMEC)

5.1 Marine observation, modelling and forecasting to optimise design and operation of ocean energy devices



Total Spend

€3.3 million

Number of Projects

3

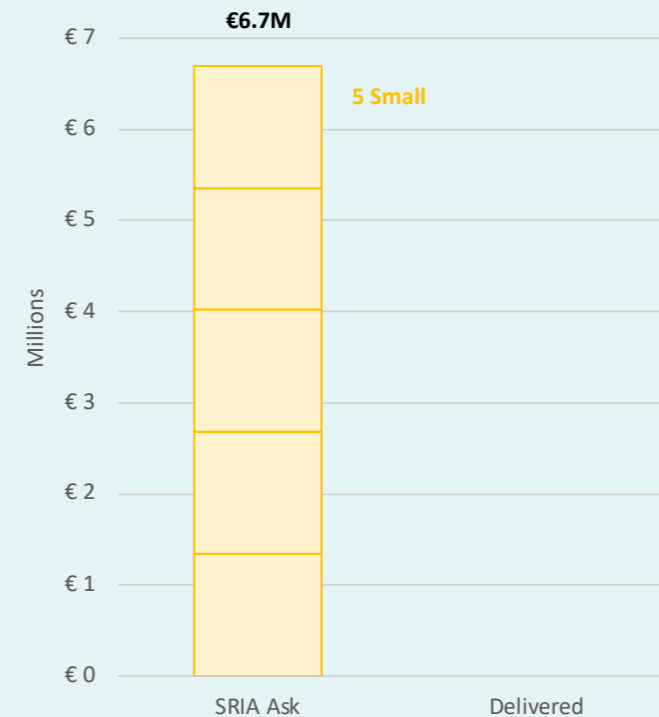
Sectoral Breakdown

- **Wave:** €1.4 million, 2 projects
- **Wave & Tidal Stream:** €1.9 million, 1 project

Main Projects

- **Wave:**
 - NHP-WEC, €0.9 million, UK-EPSC
- **Wave & Tidal Stream:**
 - SEEC³⁰, €1.9 million, EC-ERDF

5.2 Open-data repository for ocean energy



No activities recorded.



³⁰ Please refer Footnote 20.

SRIA Challenge Area 6 – Cross-cutting Challenges

This challenge area aims to demonstrate and quantify the environmental and socio-economic benefits of the ocean energy sector for more informed policy and financial decisions regarding their contribution to the future energy mix. In addition, in order to reduce the cost of private capital, establishment of widely accepted standards and certification is also crucial.

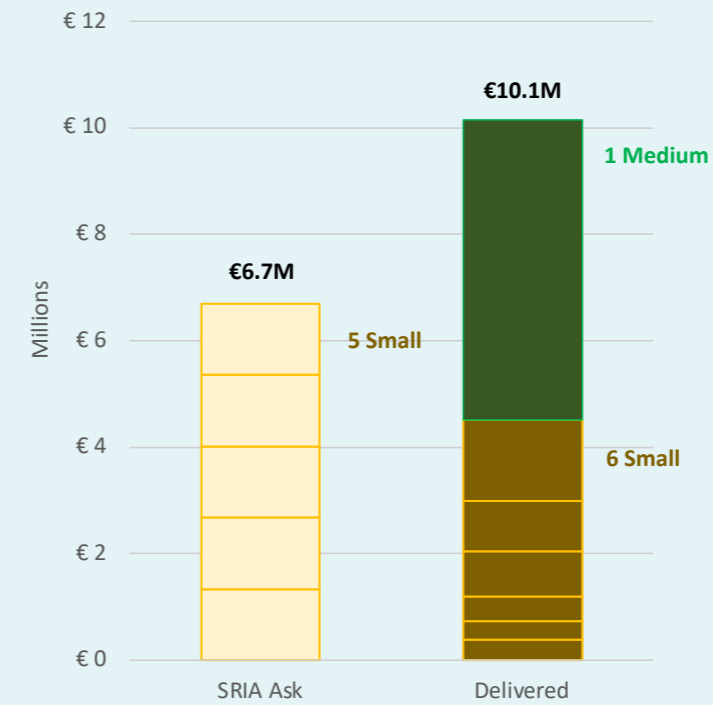
Within this Challenge Area:

- SRIA Recommended Public Funding: €14 million (Delivered €10 million, 71% achievement rate)
- SRIA Recommended Number of Projects: 10 projects (Delivered 7 projects)
- Proportion against total spending of €496 million: 2.0%



Orkney vessel trials project (Source: Aquatera)

6.1 Improved knowledge of the environmental and socioeconomic impacts of ocean energy



Total Spend

€10.1 million

Number of Projects

7

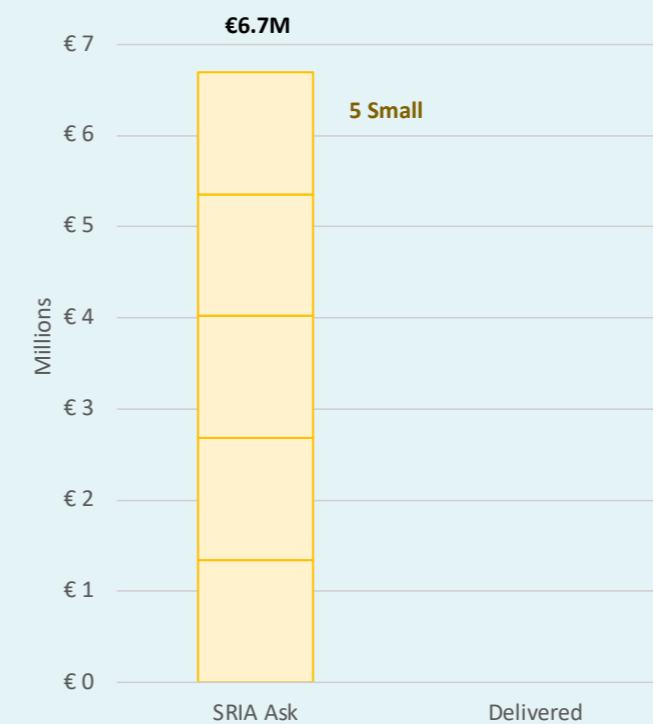
Sectoral Breakdown

- **Wave**
€2 million, 2 projects
- **Tidal Stream**
€6.3 million, 3 projects
- **Wave & Tidal Stream**
€1.8 million, 2 projects

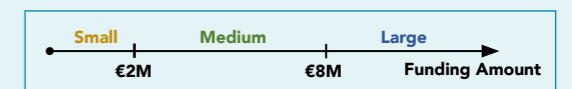
Main Projects

- **Wave**
 - SafeWAVE, €1.5 million, EC-EMFF
- **Tidal Stream**
 - MCRP, €6 million, EC-ERDF
- **Wave & Tidal Stream**
 - SEEC³¹, €0.9 million, EC-ERDF
 - CETUS, €0.9 million, IE-SEAI

6.2 Standardisation and certification



No activities recorded.



³¹ Assumes equal distribution of total project cost (€3.8 million) between four project aims: 1. Improved resource characterization (SRIA 5.1); 2. Improved understanding of multiple resource interaction (SRIA 5.1); 3. Exploring future grid integration of marine renewable energy (SRIA 4.2); 4. Improved methods of quantifying environmental impacts (SRIA 6.1).

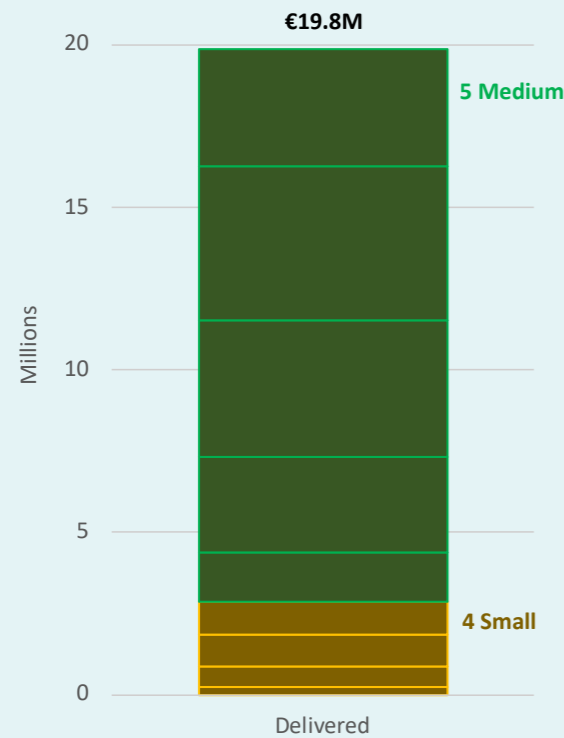
Other Topics (Area 7)

Within the project database, there are R&I activities that do not fit into the current SRIA categories. This section presents these R&I areas. These areas could be reviewed during the upcoming SRIA update exercise.

Within this Area:

- Total Public Funding Spend: €164 million
- Total Number of Projects: 43
- Proportion against total spending of €496 million: 33%

7.1 Coordination and support actions including knowledge sharing



Total Spend
€19.6 million

Number of Projects
9

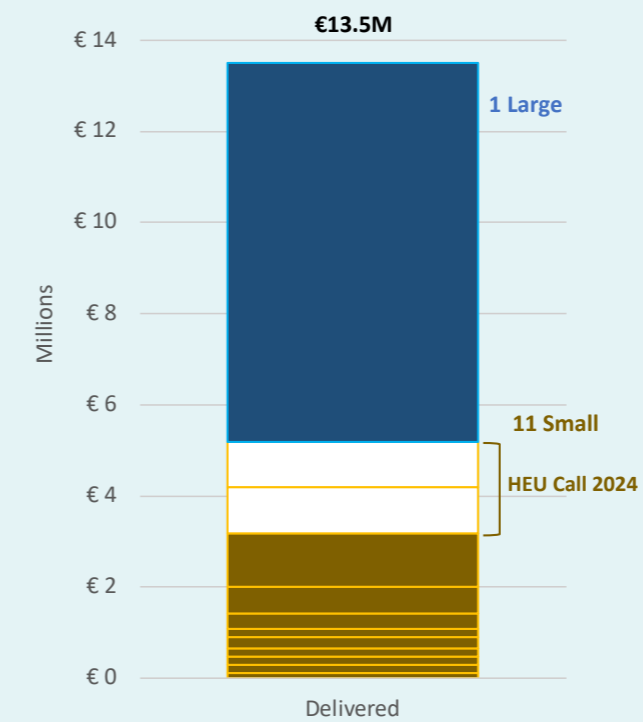
Sectoral Breakdown

- **Wave:** €0.6 million, 1 project
- **Wave & Tidal Stream:** €19 million, 8 projects

Main Projects

- **Wave**
 - WECANet-COST Action, €0.6 million, EC-COST
- **Wave & Tidal Stream**
 - Supergen ORE Hub, €5 million, UK-EPSC
 - MEA, €3.6 million, EC-ERDF
 - SELKIE, €4.2 million, EC-ERDF
 - MEECE, €2.9 million, EC-ERDF
 - OPIN, €1.5 million, EC-ERDF

7.2 Analysis and modelling tools



Total Spend
€13.5 million

Number of Projects
12 (incl. 2 in pipeline)

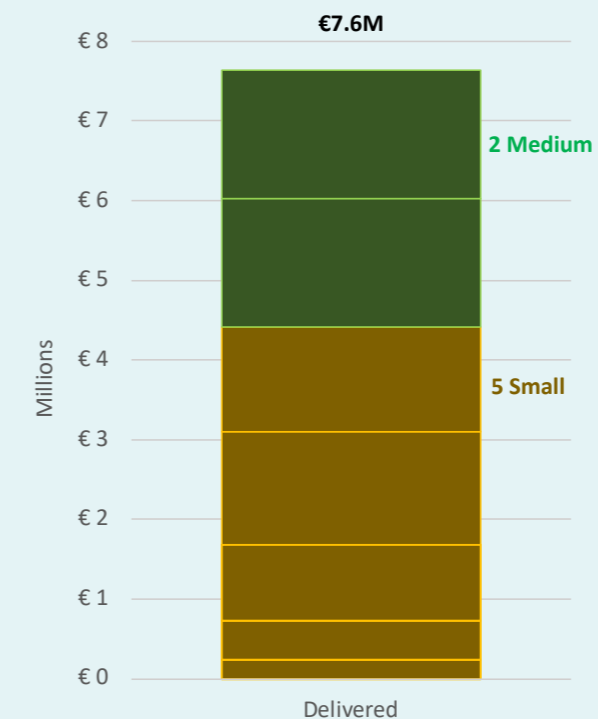
Sectoral Breakdown

- **Wave** €3.1 million, 8 projects
- **Tidal Stream** €8.3 million, 1 project
- **Wave & Tidal Stream** €2.1 million, 3 projects (incl. 2 in pipeline)

Main Projects

- **Wave**
 - WavE-Suite, €1.2 million, UK-EPSC
- **Tidal Stream**
 - Co-Tide, €8.3 million, UK-EPSC
- **Wave & Tidal Stream**
 - FASTWATER, €0.1 million, UK-Supergen FlexFund

7.3 Development and testing of tidal devices (Tidal Stream)

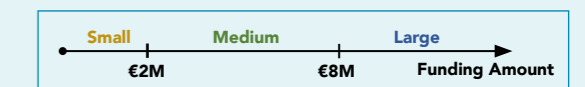


Total Spend
€7.6 million

Number of Projects
7

Main Projects

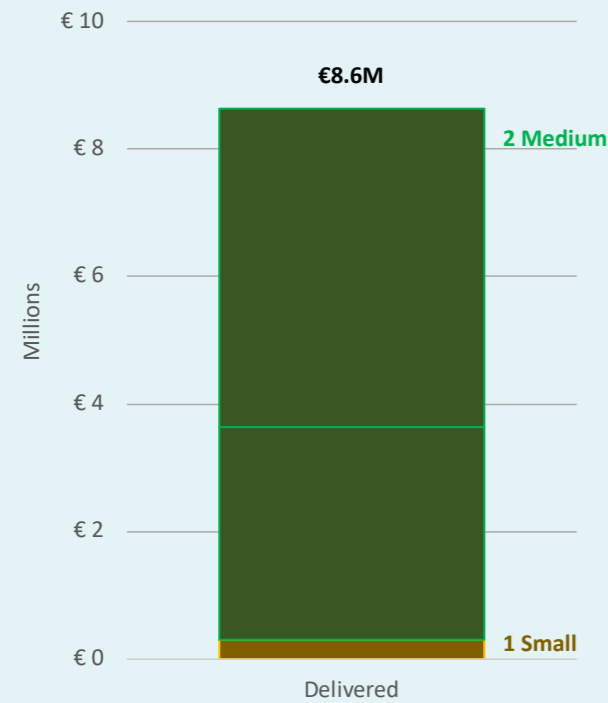
- **Tidal Stream**
 - ENCORE³² – Water2Energy, €1.6 million, EC-ERDF
 - ENCORE³³ – EEL Energy, €1.6 million, EC-ERDF
 - FITS, €1.3 million, UK-Innovate UK
 - ATIR, €1.4 million, UK-Energy Entrepreneurs Fund (EEF)
 - CREATE, €0.9 million, UK-EEF



³² Assumes equal distribution of total project cost (€9.8 million) between four Offshore Renewable Energy solutions: Water2Energy (Other 7.3), Eel Energy (Other 7.3), Teamwork Technology (SRIA 1.5), Oceans of Energy (Offshore floating PV).

³³ Same as Footnote 32.

7.4 Testing facilities & infrastructures (Includes building of and access to)



Total Spend
€8.8 million

Number of Projects
3

Sectoral Breakdown

- Wave
€8.8 million, 3 projects

Main Projects

- Wave
 - VALID, €5 million, EC-H2020
 - IMPACT, €3.3 million, EC-H2020

7.6 Support for demonstration or consenting of devices and arrays



Total Spend
€65.5 million

Number of Projects
7

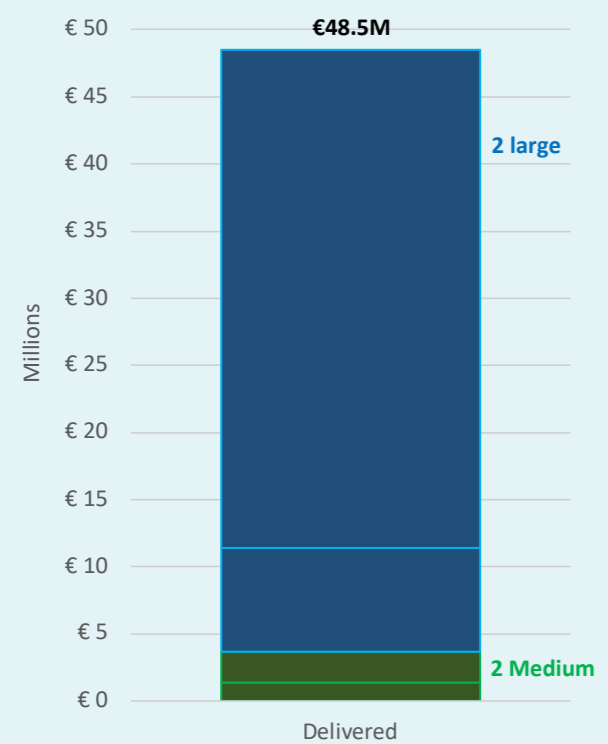
Sectoral Breakdown

- Wave
€3.2 million, 2 projects
- Tidal Stream
€53.1 million, 4 projects
- Wave & Tidal Stream
€9.2 million, 1 project

Main Projects

- Wave
 - WaveFarm, €2.5 million, EC-EMFF
- Tidal Stream
 - TIGER, €33 million, EC-ERDF
 - Deep Green Phase-2, €17 million, EC-ERDF
 - SCELPHY, €1.8 million, FR
- Wave & Tidal Stream
 - Pembroke Dock, €9.2 million, EC-ERDF

7.5 Open sea test sites (includes consenting, building of and supporting access to)



Total Spend
€48.5 million

Number of Projects
4

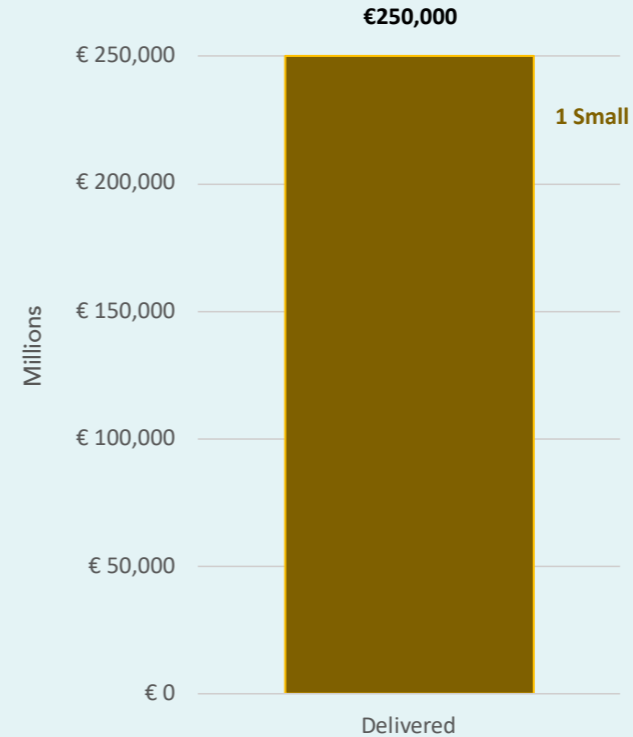
Sectoral Breakdown

- Tidal Stream
€37.1 million, 1 project
- Wave & Tidal Stream
€11.4 million, 3 projects

Main Projects

- Tidal Stream
 - Morlais Infrastructure, €37 million, EC-ERDF
- Wave & Tidal Stream
 - OceanDEMO, €7.7 million, EC-ERDF
 - HarshLab, €2.3 million, ES
 - META, €1.4 million, EC-ERDF

7.7 Co-location of multiple devices (similar or different technologies)



Total Spend
€0.25 million

Number of Projects
1

Sectoral Breakdown

- Wave & Wind

Main Projects

- Wave & Wind
 - WEC4MUP, €0.25 million, PT



Caption

Section Summary

Analysis on SRIA Challenge Area shows that:

- Over 50% of total R&I spending happens in Challenge Area 1
- Over 30% of total R&I spending happens in 'Other' Area out with SRIA categories
- R&I spending in Challenge Areas 2-6 are in the range of 1-6%

The breakdown and percentage of spending in each Challenge Area are presented in Table 2 and Figure 9.

Table 2 Percentage of R&I spending in each Challenge Area

Challenge Area	Total Budget €	Percentage
1 Design and Validation of Ocean Energy Devices	280,904,399	56.6%
2 Foundations, Connections & Mooring	6,314,404	1.3%
3 Logistics and Marine Operations	5,001,565	1.0%
4 Integration in the Energy System	26,900,099	5.4%
5 Data Collection, Analysis & Modelling Tools	3,056,125	0.6%
6 Cross-Cutting Challenges	10,148,985	2.0%
7 Others	163,805,030	33.0%
Total	496,130,606	100%

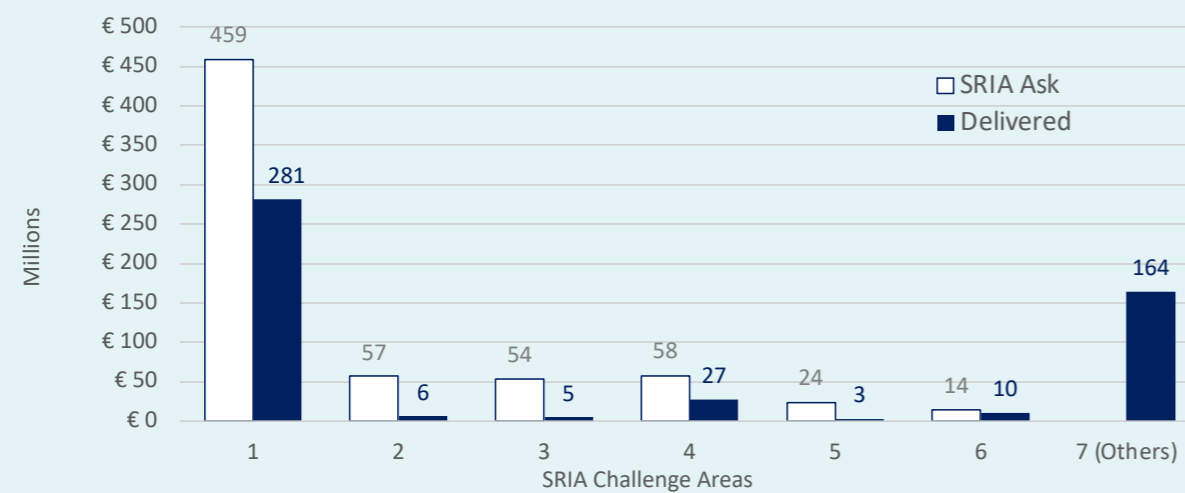


Figure 9 R&I spending breakdown according to SRIA Challenge Areas

Caption

4 UK DEEP DIVE



The Morlais Tidal Energy Zone (Source: Welsh Government)

UK Deep Dive

In order to provide the fullest possible information that could inform future R&I funding initiatives in the UK, a detailed investigation has been performed on the current R&I funding situation. This analysis is presented in the following sections.

Main Funders

Within 2022 to 2025, according to data collated as of June 2023, the UK provides the highest support in terms of technology push funding among all European countries, with a total funding amount of €63 million. These fundings were allocated through the following organisations and their initiatives.

- National research programmes
 - EPSRC
 - Innovate UK
 - Energy Entrepreneurs Fund
 - Supergen ORE Hub – Flexible Funding
 - Wave Energy Scotland
- International collaborative programmes
 - EuropeWave
 - OCEANERA-NET
 - Horizon Europe Guarantee

Figure 10 shows the main funders and their initiatives for R&I in the UK.

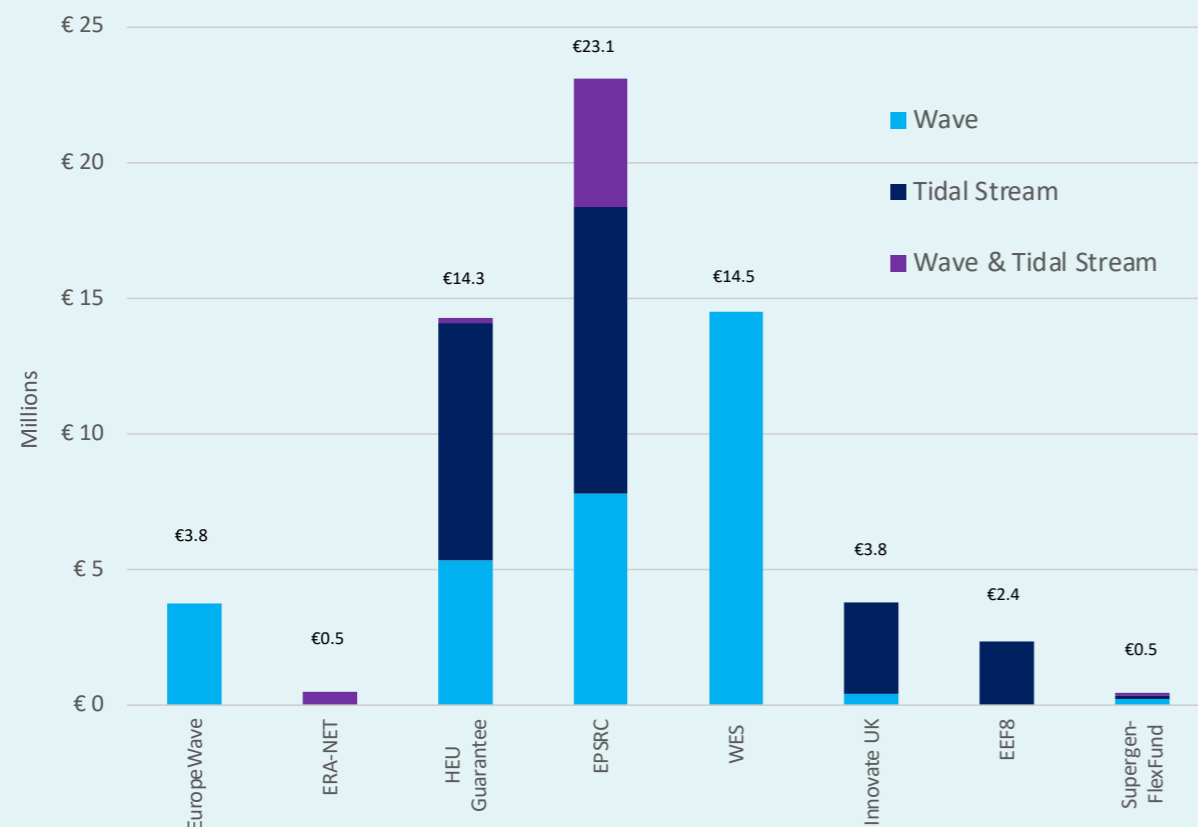


Figure 10 Main R&I funders and their initiatives in the UK

Main observations are outlined below.

- EPSRC is the biggest funder with a total funding of €23 million, with a rather equal distribution within the wave and tidal stream sectors.
- The Scottish Government is the second biggest funder with a total funding of €18.8 million where the majority goes to the wave sector:
 - €18.3 million via Wave Energy Scotland through its own programmes and EuropeWave.
 - €0.5 million via Scottish Enterprise through OCEANERA-NET.

Sectoral Breakdown

An analysis of sectoral breakdown of funding in the UK is shown in Figure 11.

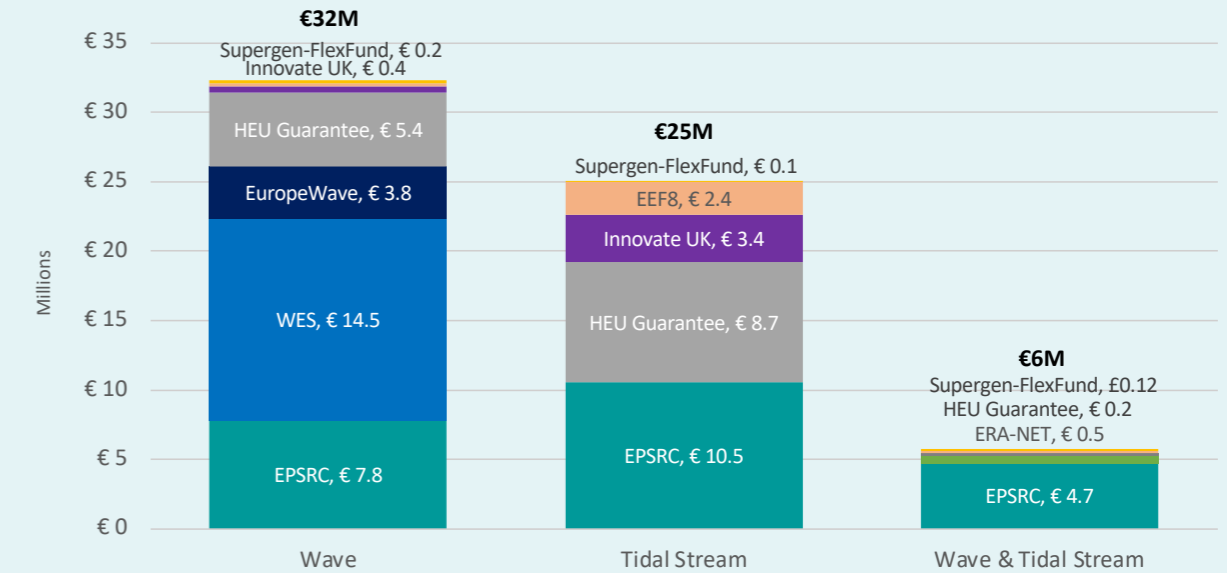


Figure 11 Sectoral breakdown of funding

Wave

The wave sector receives €32 million (around 50% of total R&I funding in the UK) with main funders being:

- Scottish Government (WES and EuropeWave): €18.3 million, 16 projects
- EPSRC: €7.8 million, 8 projects

Tidal Stream

The tidal stream sector receives €25 million in total, with main funder being:

- EPSRC: €10.5 million, 3 projects (Co-Tide is the biggest contributor with €8.3 million funding)

Wave and Tidal Stream

For projects that contribute to both the wave and tidal stream sectors, a total funding of €6 million is observed, with the main funder being:

- EPSRC: €4.7 million via Supergen ORE Hub 2018³⁴ activities

³⁴ This is the total funding amount of Supergen ORE Hub 2018 minus funding for Flex-Fund programme, taking 2/3 of the remaining funding (assuming the remaining funding is distributed evenly between offshore wind, wave and tidal stream).

SRIA Mapping

In this section, R&I activities in UK is mapped against SRIA Challenge Areas. Figure 12 shows breakdown of R&I activities in the UK according to the SRIA Priority Topics .

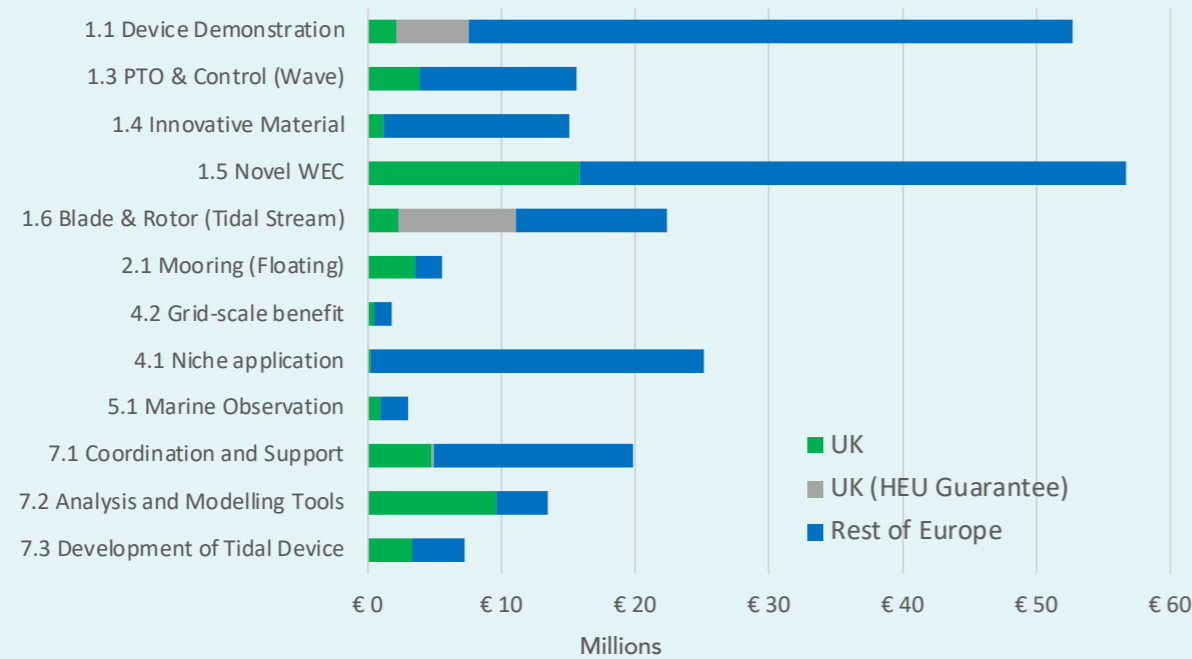


Figure 12 Breakdown of R&I activities in UK according to SRIA Priority Topics³⁵

Main observations of the analysis is outlined below.

Challenge Area 1

- Receives around 63% of the total R&I funding in UK.
- 1.5 Development of Novel WEC: UK contributes €15.8 million (around 30%) to total funding in Europe.

Challenge Area 2

- 2.1 Advanced mooring and connection systems for floating ocean energy devices: UK contributes €3.5 million (Over 60%) of total funding in Europe mainly through WES project for Quick Connectors.

Others (Area 7)

- 7.1 Coordination and Support: UK contributes €5 million (around 25%) of total funding in Europe mainly through Supergen ORE Hub 2018 activities.
- 7.2 Analysis and Modelling Tools: UK contributes €9.6 million (Over 70%) of total funding in Europe mainly through EPSRC's Co-Tide project.
- 7.3 Development and Testing of Tidal Devices: UK contributes €3.3 million (46%) of total funding in Europe through 3 projects supported by Energy Entrepreneurs Fund and Innovate UK.

³⁵ Only Priority Topics where there have been projects and activities in the UK within the analysis boundaries are shown.

Section Summary

The analysis above shows that although the UK is active in R&I funding in the wave and tidal stream sector, the below trend is observed.

- Over half of the R&I funding (€32 million of total €63 million) is provided for the wave sector.
- Over half of the wave funding (€18.3 million of total €32 million) is provided by the Scottish Government through Wave Energy Scotland, and EuropeWave.
- Majority of the funding for both sectors is in low TRL stage supporting underpinning science, provided by the UK government (EPSRC, total funding €23 million).
- There is a significant lack of funding in high TRL stage projects that is crucial to encouraging commercialisation of devices, provided by the UK government (Innovate UK, total funding €3.8 million).

In terms of SRIA mapping, the UK depicts a similar distribution with that of Europe where over 60% is spent in Challenge Area 1, with the second largest portion in Area 7, as shown in Table 3 and Figure 13.

Table 3 Breakdown of R&I Funding in the UK

Challenge Area	UK €	UK (HEU - Guarantee) €	Percentage
1 Design and Validation of Ocean Energy Devices	25,294,833	14,074,012	63%
2 Foundations, Connections & Mooring	3,542,408	-	6%
3 Logistics and Marine Operations	-	-	0%
4 Integration in the Energy System	814,191	-	1%
5 Data Collection, Analysis & Modelling Tools	943,474	-	2%
6 Cross-Cutting Challenges	-	-	0%
7 Others	17,677,908	210,594	29%
Total	48,272,814	14,284,606	100%

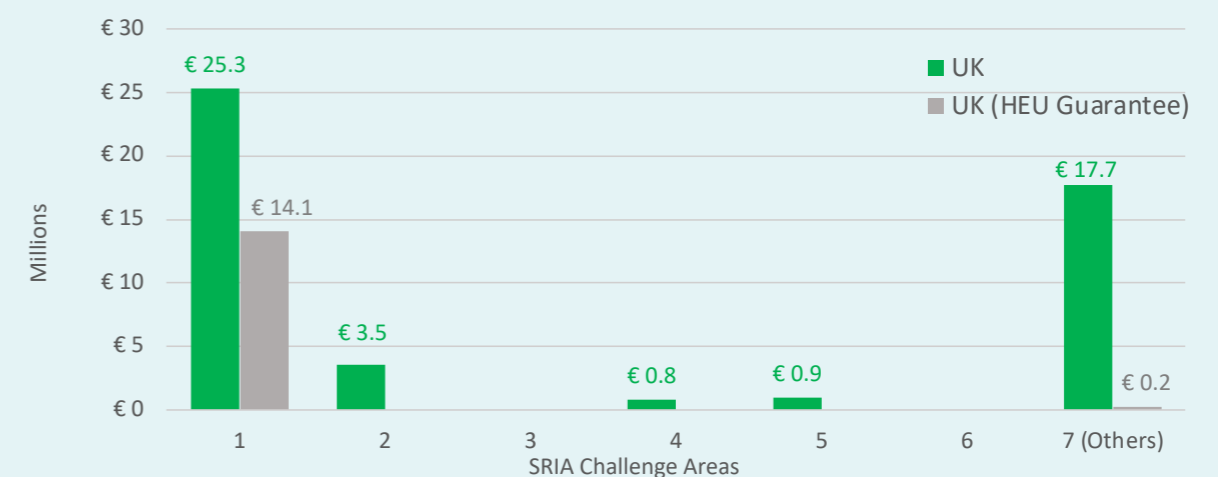


Figure 13 Breakdown of R&I Funding in the UK

UK's continued role within the European ocean energy sector

As well as an active country in the development and deployment of the wave and tidal stream technologies, the UK is also an active member in the international ocean energy community. Besides funding R&I activities, the UK plays vital roles in a number of strategic European ocean energy organisations and activities promoting the development of wave and tidal technologies, including:

European Technology & Innovation Platform for Ocean Energy, ETIPOcean³⁶

Helps define research and innovation priorities for the ocean energy sector in Europe



SET Plan Working Group

Secretariat to the SET Plan Implementation Working Group for Ocean Energy (OE-IWG)



European Energy Research Alliance, EERA³⁷

Encourages collaboration of R&I activities through knowledge sharing initiatives

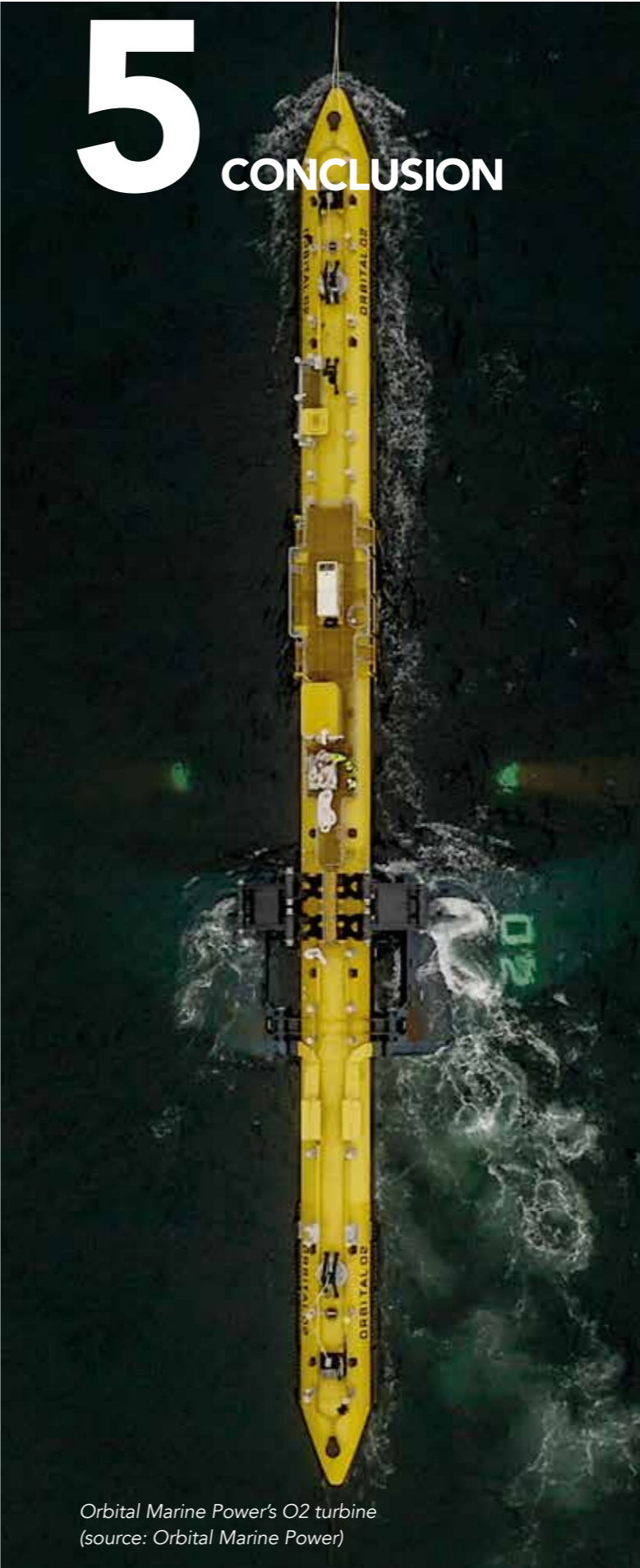


As the biggest individual country funder for R&I in wave and tidal stream sector in Europe, it is important that the UK maintains close collaboration with countries active in the ocean energy sector in Europe and also globally.

³⁶ ETIP Ocean & Ocean SET Partner organisations: The University of Edinburgh & Wave Energy Scotland, UK; TECNALIA, ES; Oceanic Platform of the Canary Islands PLOCAN, ES; France Energies Marines, FR; Sustainable Energy Authority of Ireland SEAI, IE; Directorate General of Energy and Geology DGEG, PT; National Agency for New Technologies, Energy and Sustainable Economic Development ENEA, IT.

³⁷ EERA Joint Programme Coordinator for Ocean Energy: University of Edinburgh

5 CONCLUSION



Orbital Marine Power's O2 turbine
(source: Orbital Marine Power)

As of June 2023, around mid-term of the SRIA period (2021-2025), R&I initiatives in the UK and EU that includes all projects funded by the European Commission, the UK and European countries is found to be on track against the SRIA recommendations with around €496 million of public funding allocated to over 151 wave and tidal stream projects with the following breakdown:

- Within SRIA recommended Priority Topics:
 - €332 million (50% of SRIA recommended budget of €664 million)
 - 108 projects (73% of SRIA recommended 148 number of projects)
- Outwith SRIA recommended Priority Topics³⁸:
 - €164 million
 - 43 projects

The UK is currently the biggest single country funder among all European countries, providing a total public funding of €63 million into the wave and tidal stream sectors, contributing to around 12% of total R&I public funding in Europe. The breakdown of UK funding is as follows:

- Engineering and Physical Sciences Research Council (EPSRC): €23 million
- Scottish Government: €18.8 million
- UK Government Innovation Funding:
 - Innovate UK: €3.8 million
 - Horizon Europe Guarantee: €14 million
 - Energy Entrepreneurs Fund: €2.4 million

This analysis demonstrates that a relatively large portion of UK funding is focused on early-stage research with limited funding in higher TRL stages specifically in the tidal stream sector that is essential for the commercial deployment of wave and tidal stream devices.

³⁸ Although these projects do not fit into SRIA Priority Topics, they still contribute to the development of the wave and tidal stream.

APPENDIX



Mooring in tidal flow at EMEC (Source Colin Keldie)

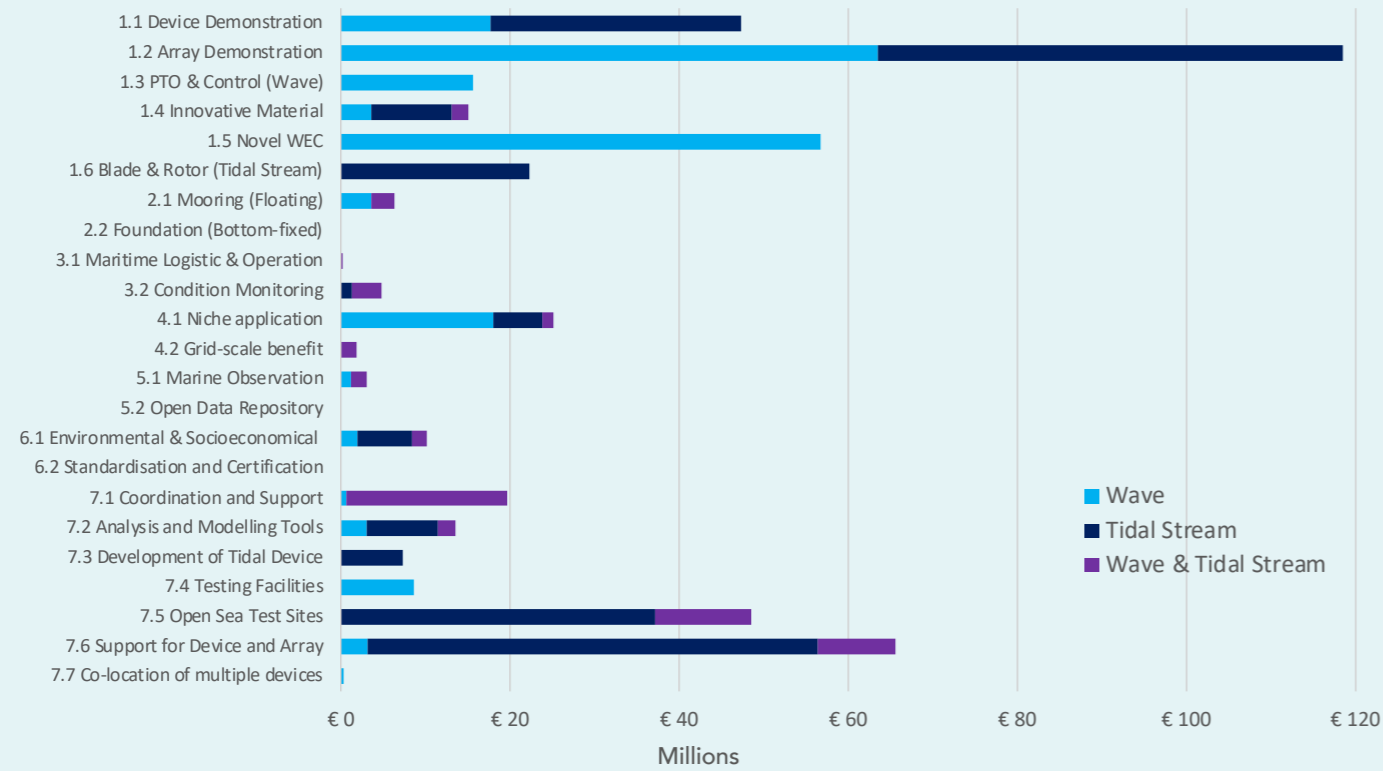
APPENDIX I – SRIA Challenge Areas and Priority Topics

Item	Challenge Areas	Priority Topics	W/T	Action Small ≤€2M	Action €2M <Medium <€8M	Action Large >€8M	Total Budget €M	Public Funding €M
1	Design and Validation of Ocean Energy Devices	1.1 Demonstration of ocean energy devices to increase experience in real sea conditions	W&TS	-	10	10	150	101
		1.2 Demonstration of ocean energy technology at array scale	W&TS	7 Array Scale (Around €50)			350	235
		1.3 Improvement and demonstration of PTO and control systems	W	5	10	-	60	40
		1.4 Application of innovative materials from other sectors	W&TS	5	A few (3)	-	25	17
		1.5 Development of novel wave energy devices	W	10	5	-	45	30
		1.6 Improvements of tidal blades and rotor	TS	-	5	A few (3)	55	37
		1.7 Development of other ocean energy technologies *Excluded from this analysis	N/A	-	A few (3)	-	15	10
2	Foundations, Connections and Mooring	2.1 Advanced mooring and connection systems for floating ocean energy devices	W&TS	-	10	-	50	34
		2.2 Improvement and demonstration of foundations and connection systems for bottom-fixed ocean energy devices	W&TS	5	5	-	35	23
3	Logistics and Marine Operations	3.1 Optimisation of maritime logistics and operations	W&TS	-	5	A few (3)	55	37
		3.2 Instrumentation for condition monitoring and predictive maintenance	W&TS	5	A few (3)	-	25	17
4	Integration in the Energy System	4.1 Developing and demonstrating near commercial application of ocean energy in niche markets	W&TS	-	Several (10)	A few (3)	80	54
		4.2 Quantifying and demonstrating grid scale benefits of ocean energy	W&TS	A few (3)	-	-	6	4
5	Data Collection & Analysis and Modelling Tools	5.1 Marine observation, modelling and forecasting to optimise design and operation of ocean energy devices	W&TS	5	A few (3)	-	25	17
		5.2 Open-data repository for ocean energy	W&TS	5	-	-	10	7
6	Cross-cutting Challenges	6.1 Improvement of the environmental and socioeconomic impacts of ocean energy	W&TS	5	-	-	10	7
		6.2 Standardisation and certification	W&TS	5	-	-	10	7
7	Others (Areas outwith SRIA Recommendations)	7.1 Coordination and support actions including knowledge sharing						
		7.2 Analysis and Modelling tools						
		7.3 Development and testing of tidal devices						
		7.4 Testing facilities & infrastructures (Includes building of and access to)						
		7.5 Open sea test sites (includes consenting, building of and supporting access to)						
		7.6 Support for demonstration or consenting of devices and arrays						
		7.7 Co-location of multiple Devices						
Total recommended budget							991	664

*Public funding takes suggested proportion of SRIA, 67% of total budget i.e. EU (27%) plus Member States (40%) funding.
*Total budget and public funding excludes 1.7 Development of other ocean energy technologies

APPENDIX II – Sectoral Breakdown of Delivered Projects

Sectoral Breakdown of Project Budget

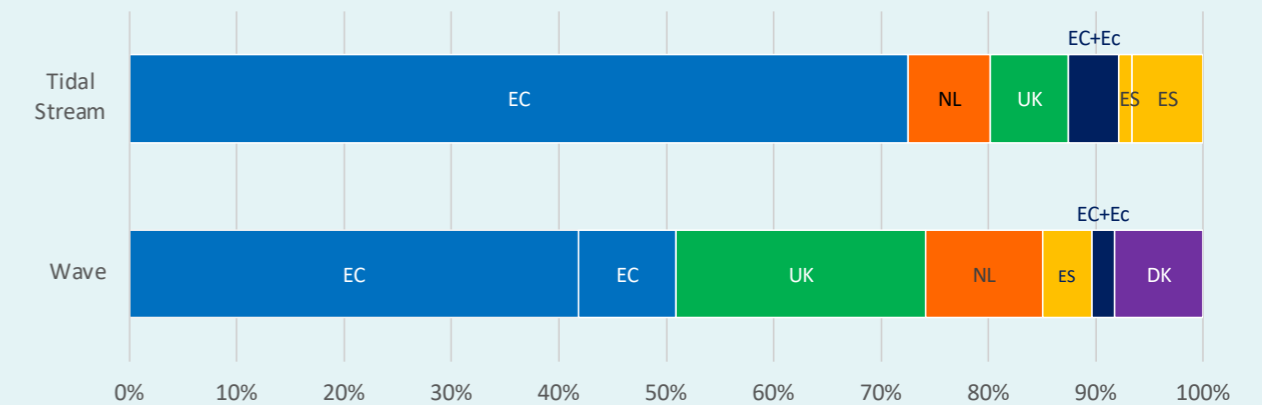
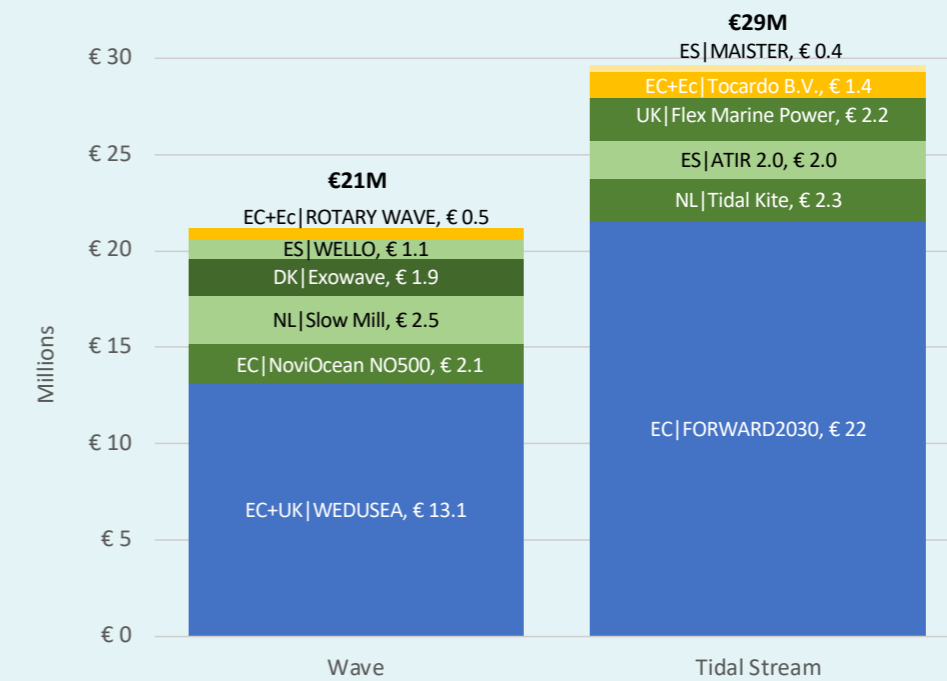


Sectoral Breakdown of Number of Projects

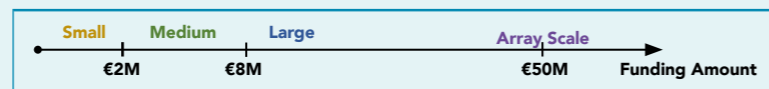
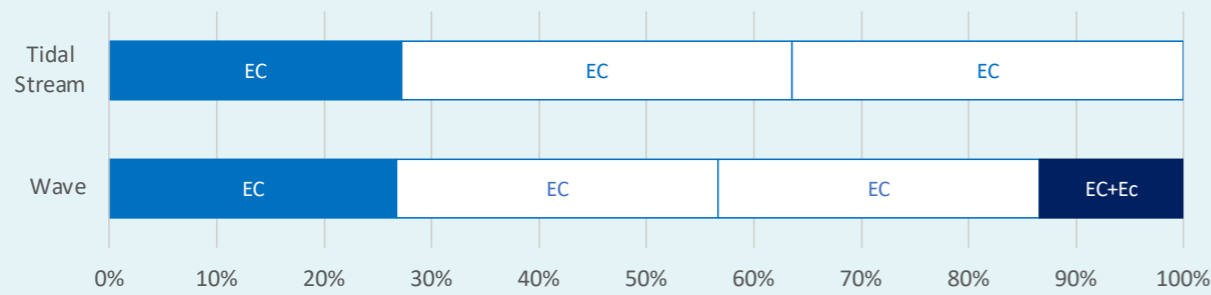
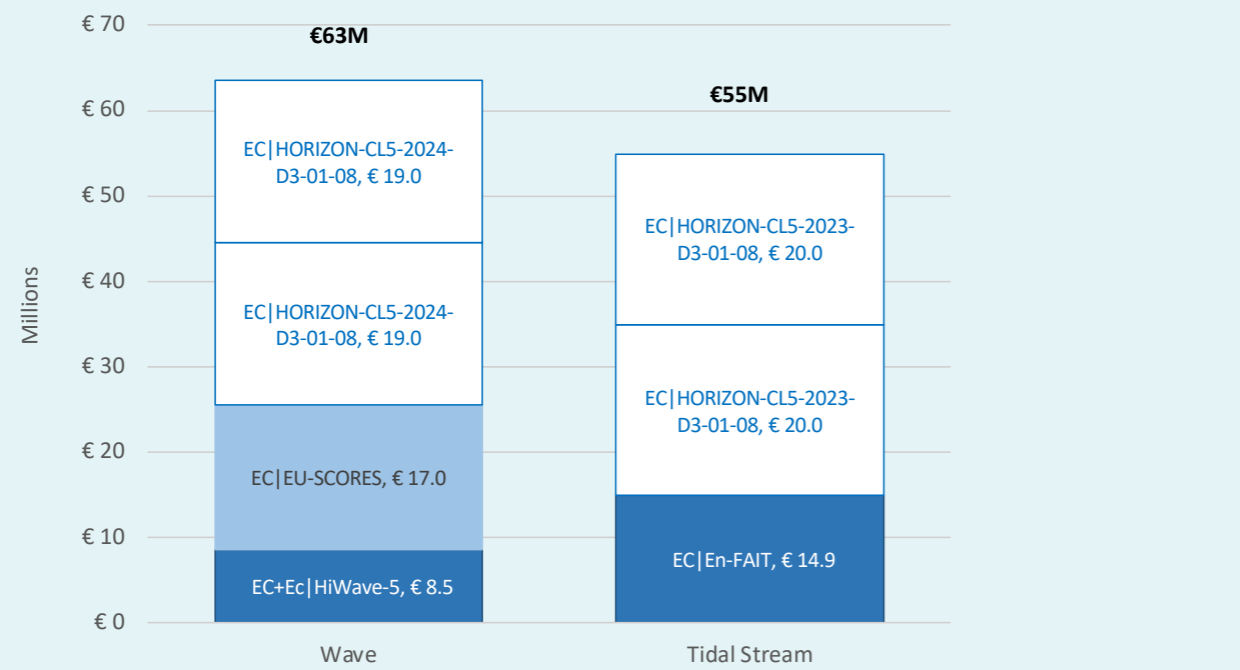


APPENDIX III – SRIA Priority Topics Delivered Projects Detail

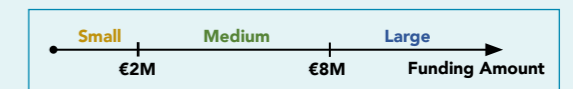
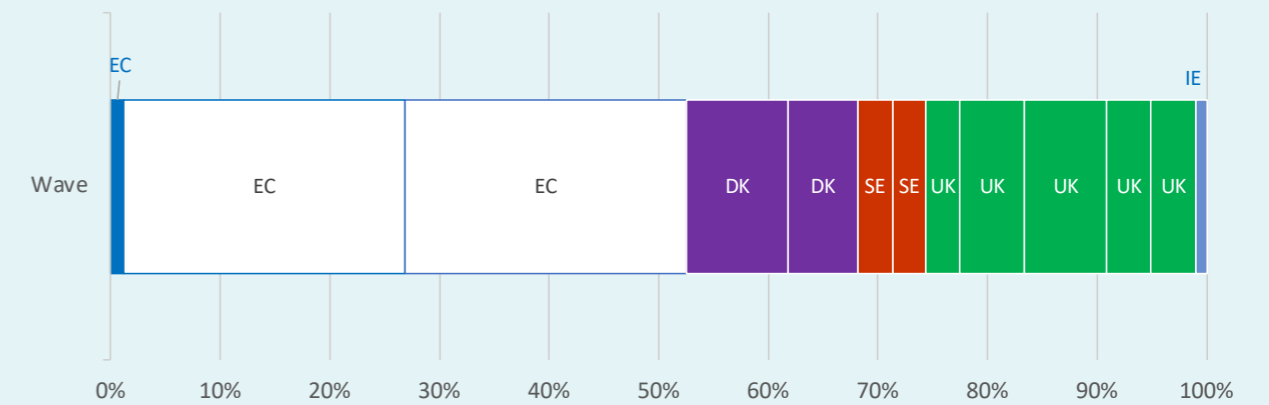
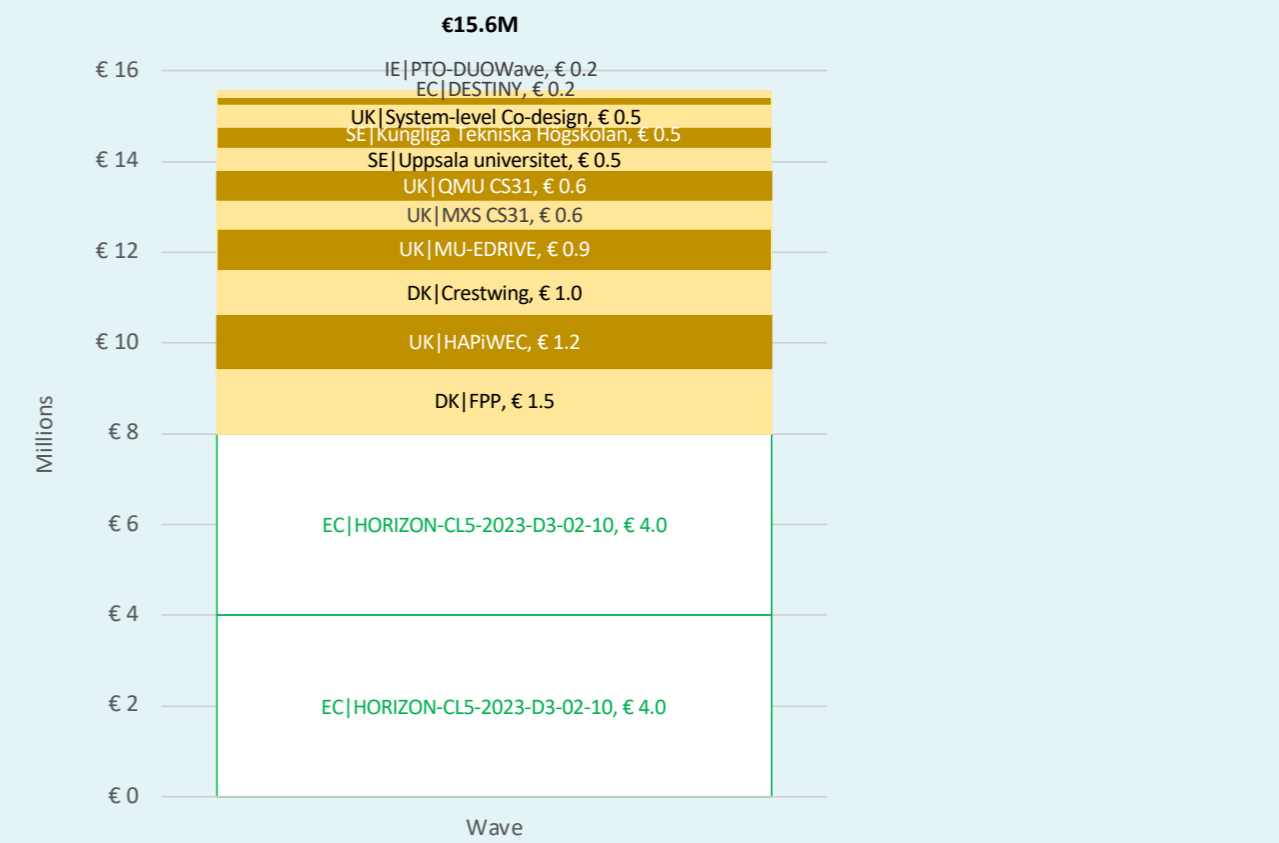
1.1 Demonstration of ocean energy devices to increase experience in real sea conditions



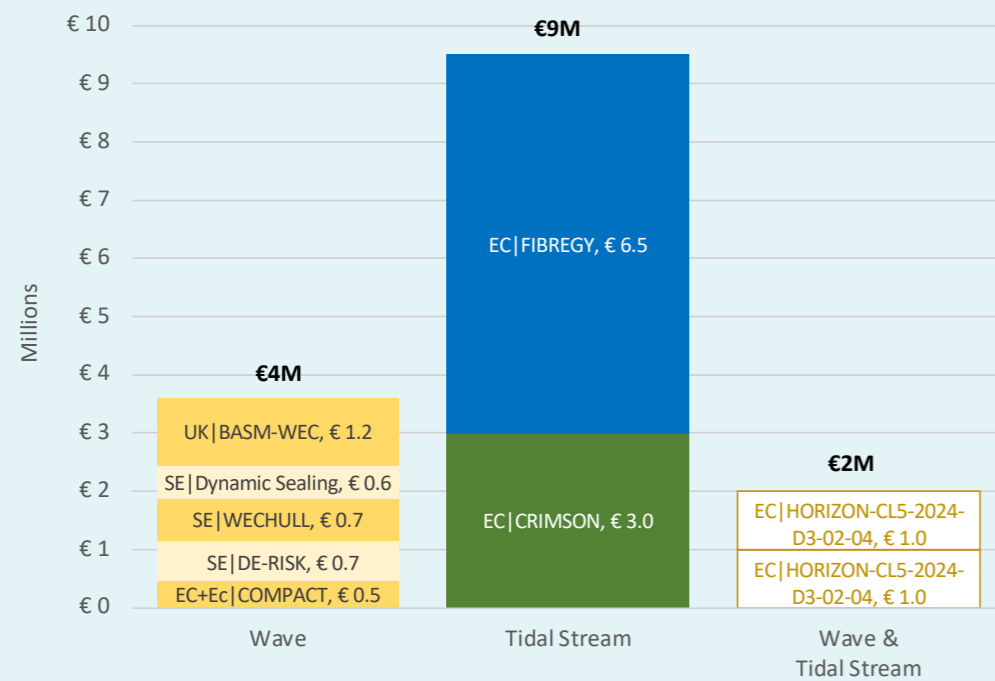
1.2 Demonstration of ocean energy technology at array scale



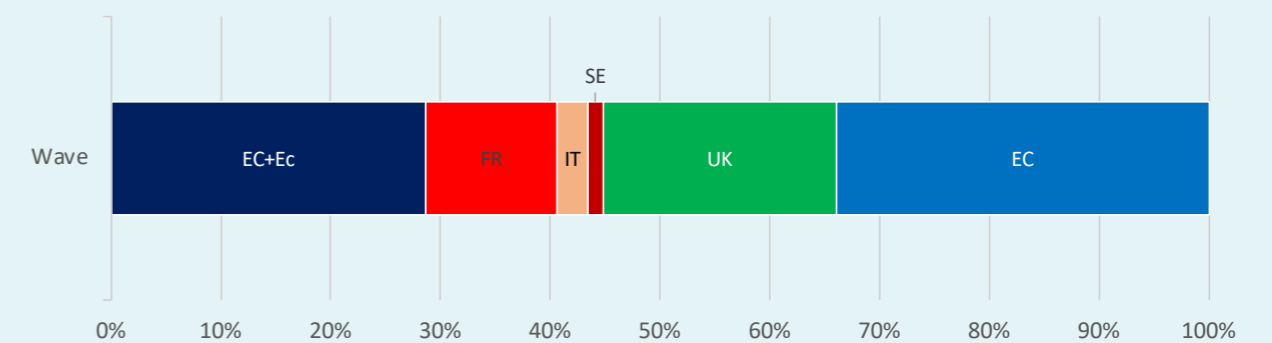
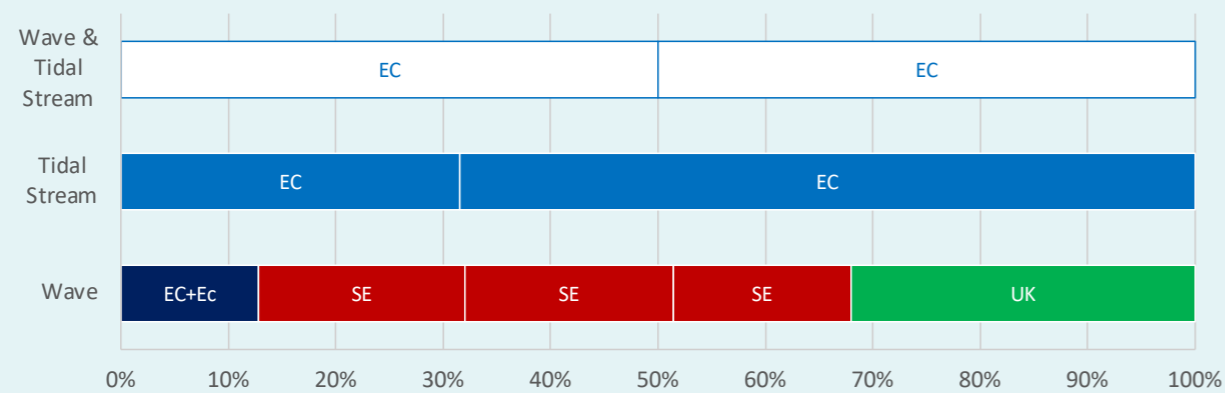
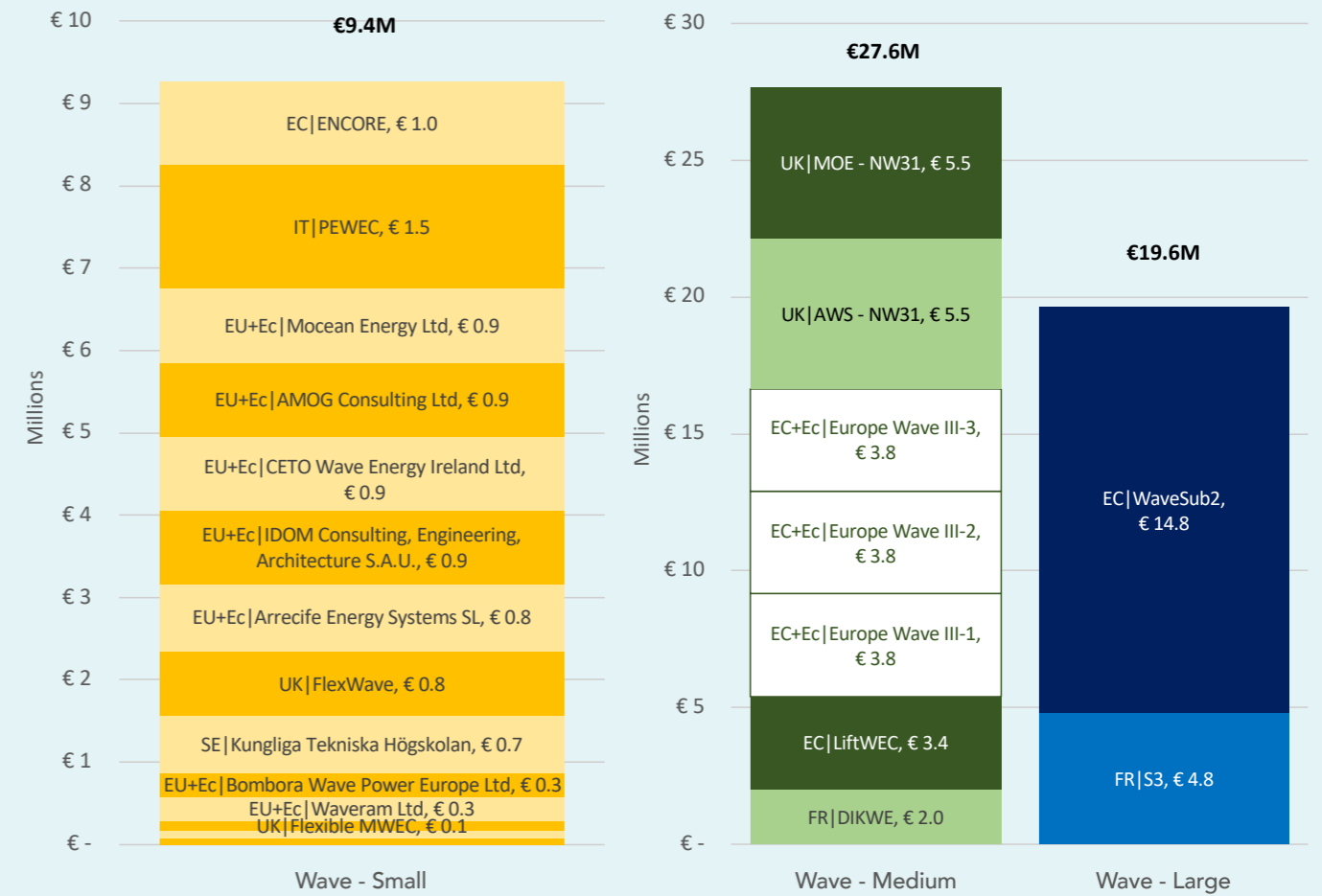
1.3 Improvement and demonstration of PTO and control systems (Wave)



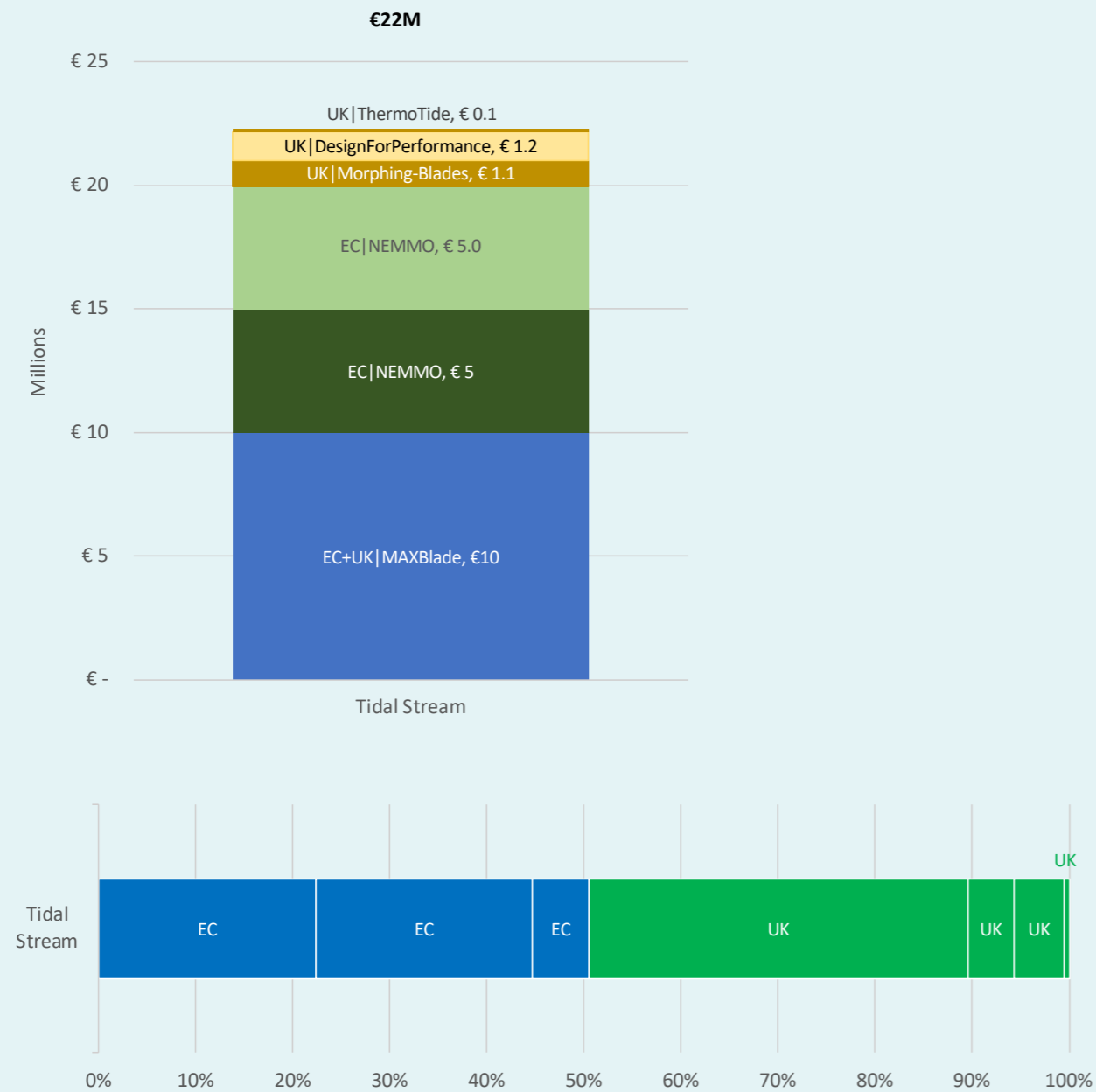
1.4 Application of innovative materials from other sectors



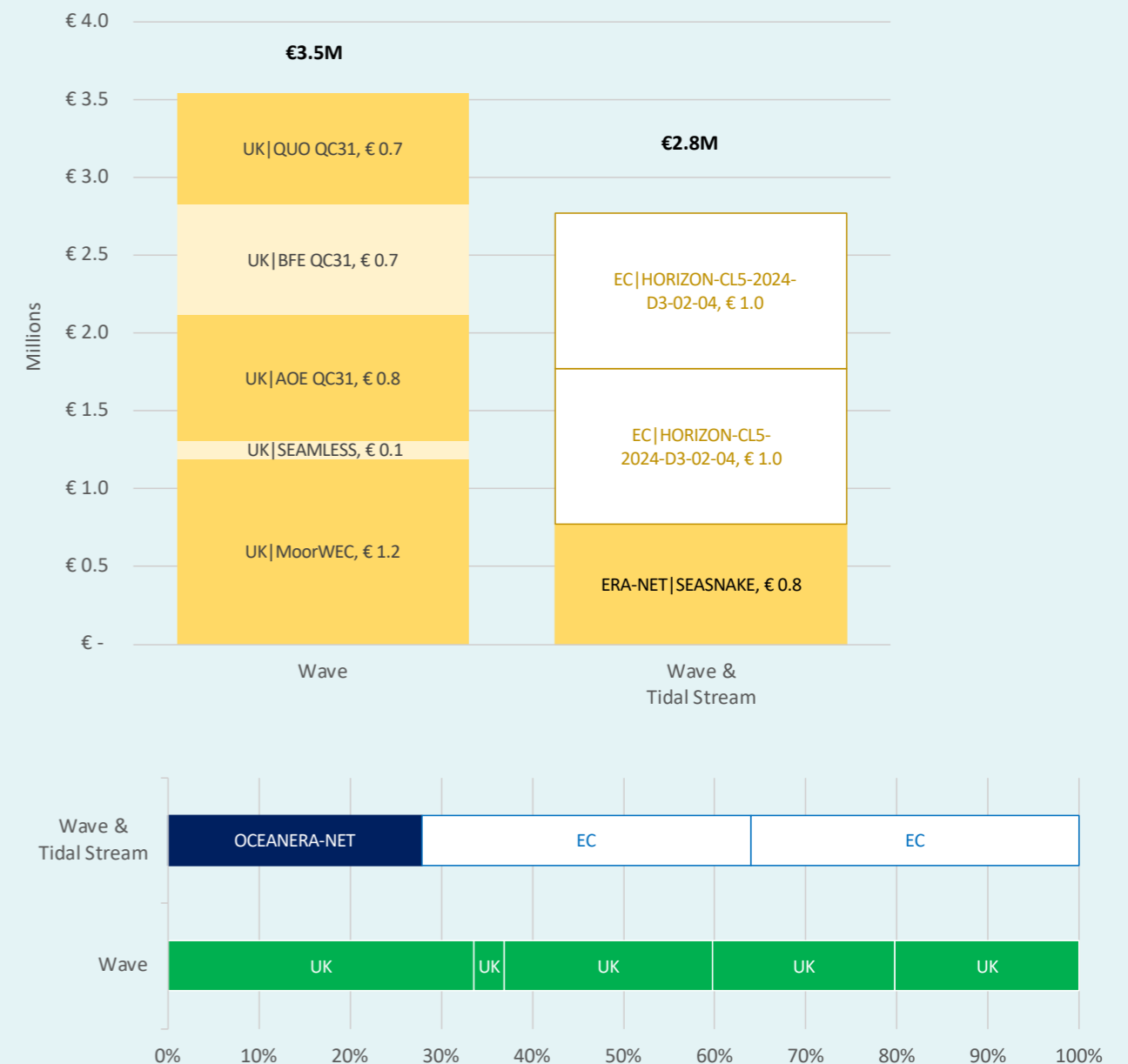
1.5 Development of novel wave energy devices (Wave)



1.6 Improvement of tidal blades and rotor (Tidal stream)



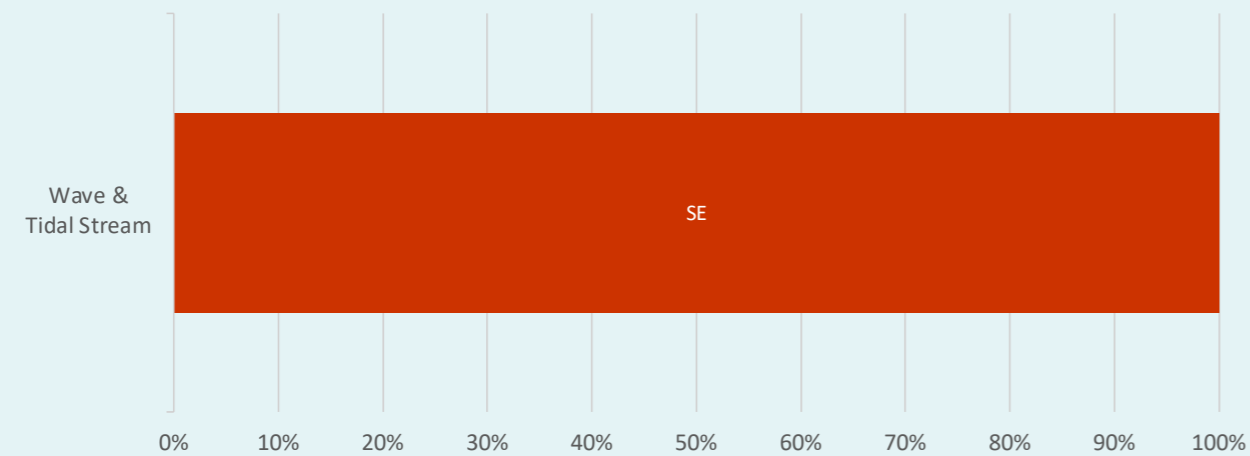
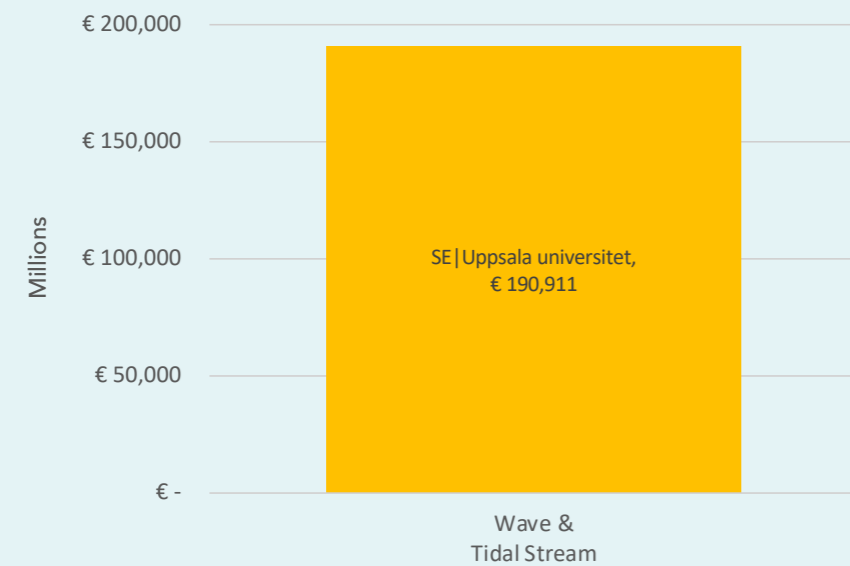
2.1 Advanced mooring and connection systems for floating ocean energy devices



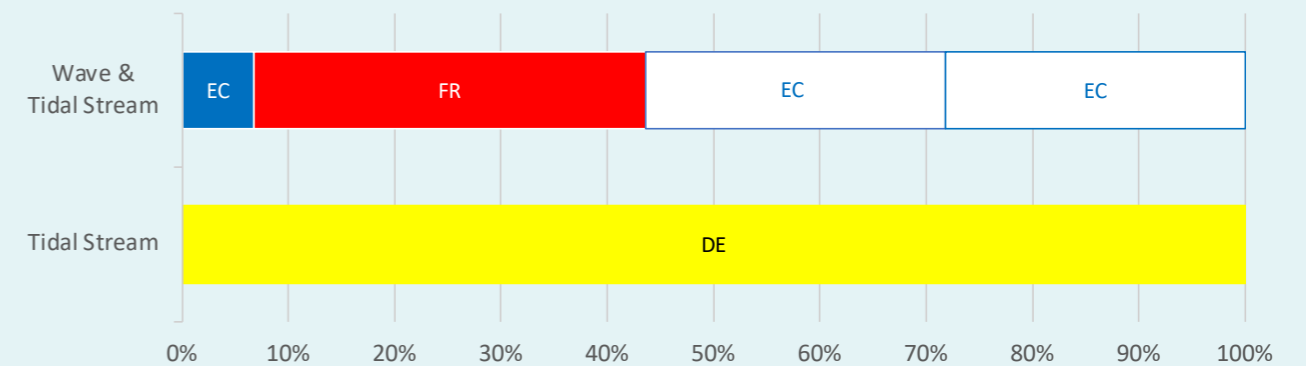
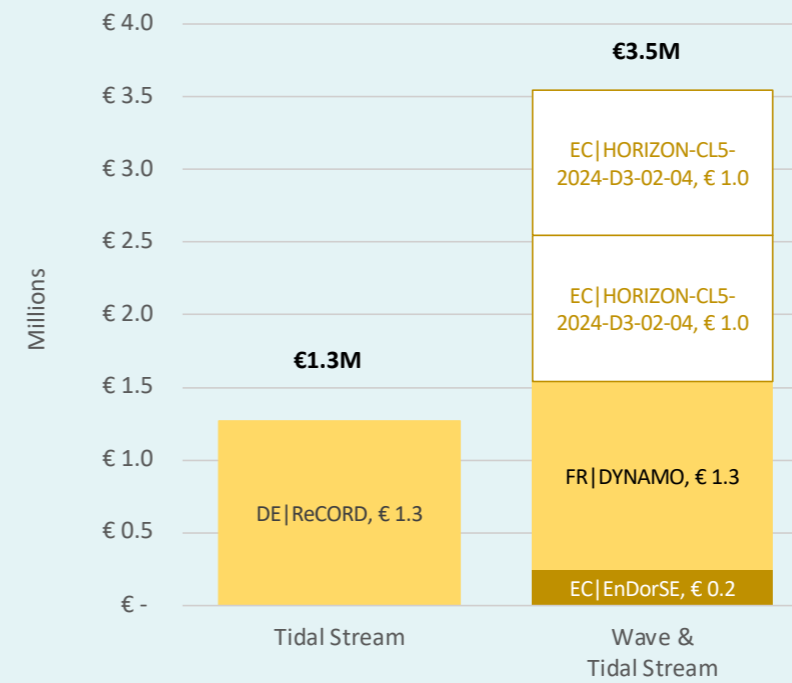
2.2 Improvement and demonstration of foundations and connection systems for bottom-fixed ocean energy devices

No activities recorded.

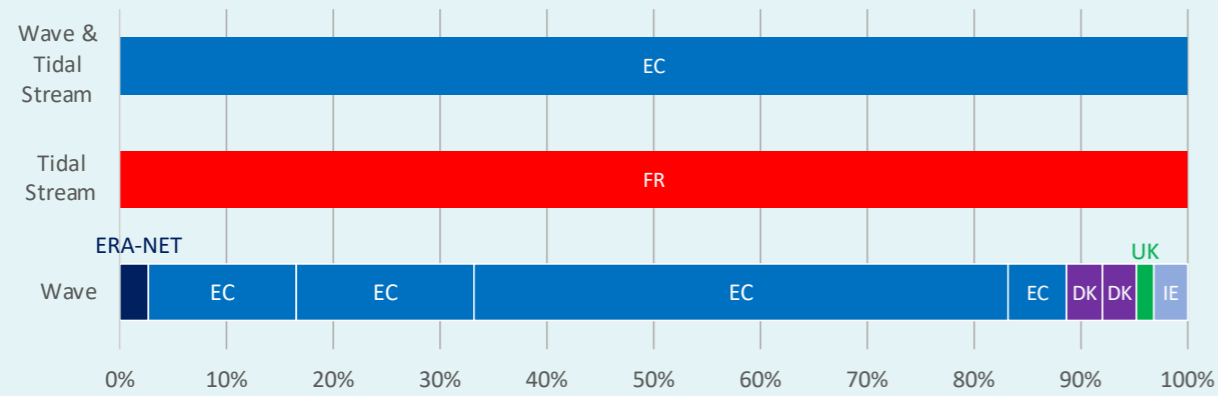
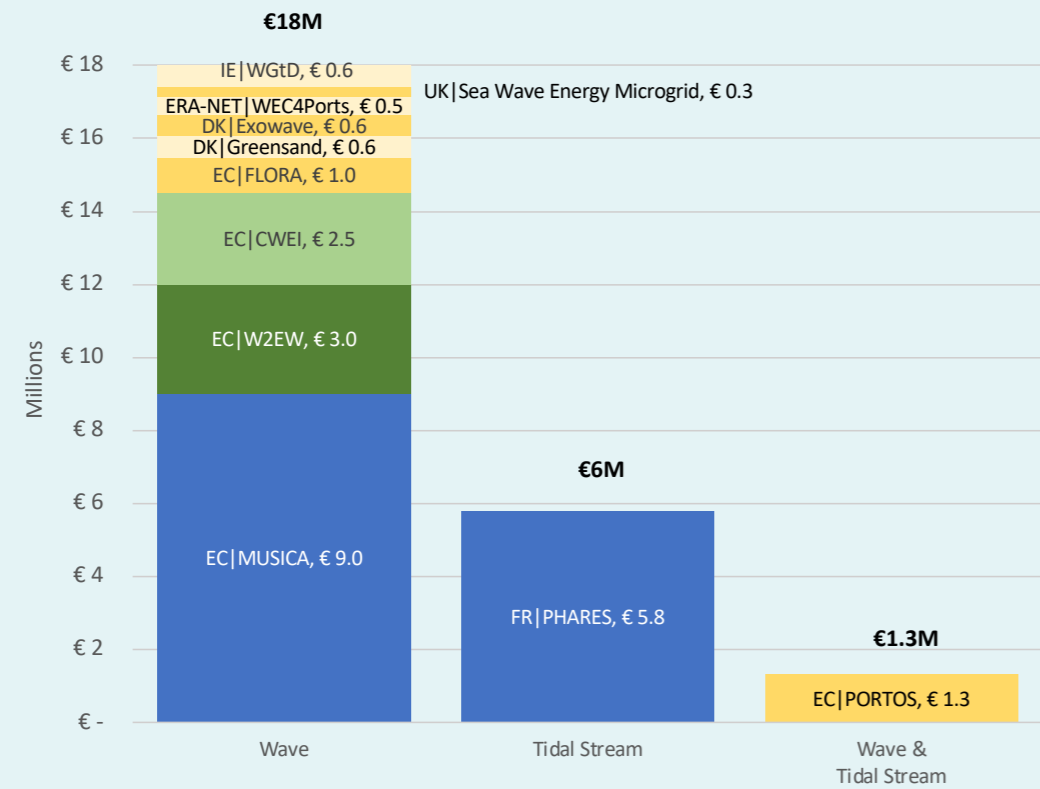
3.1 Optimisation of maritime logistics and operations



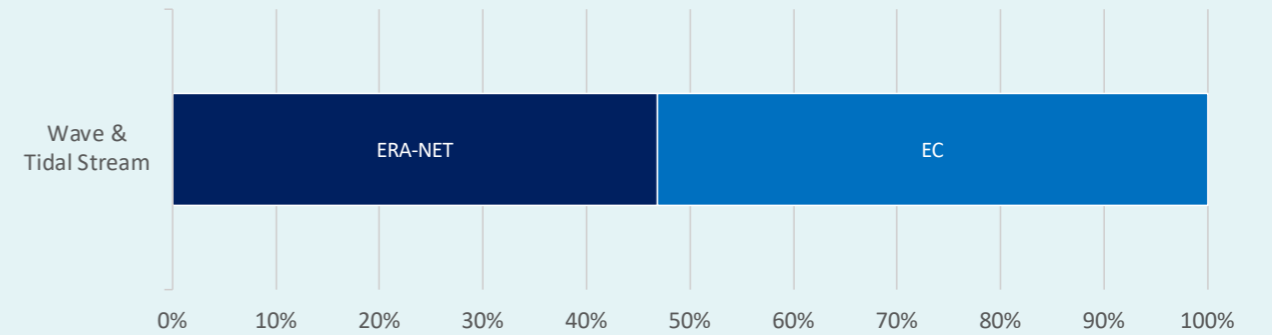
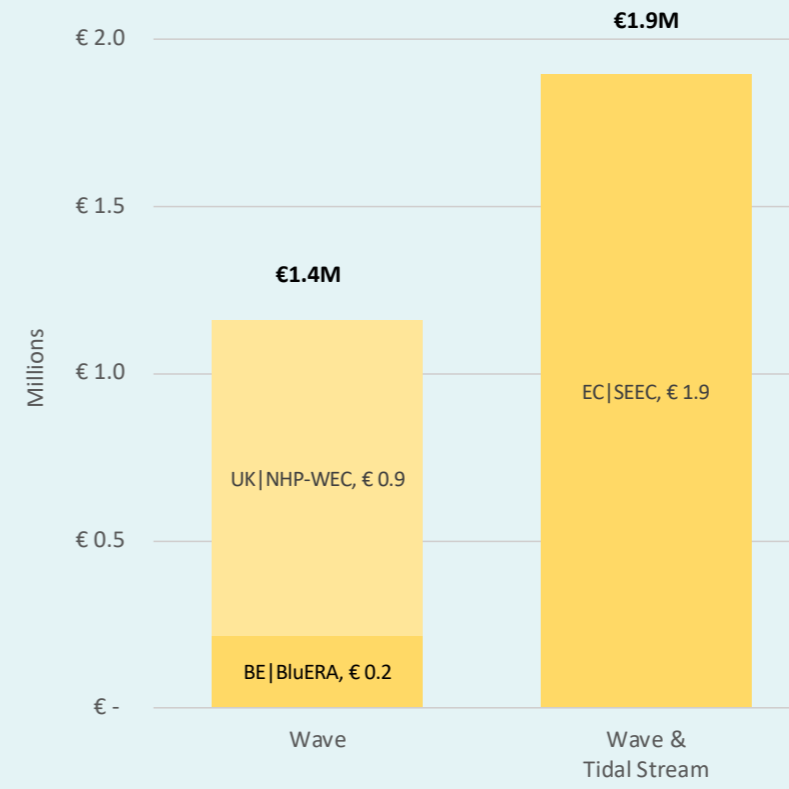
3.2 Instrumentation of condition monitoring and predictive maintenance



4.1 Developing and demonstrating near-commercial application of ocean energy in niche markets



4.2 Quantifying and demonstrating grid-scale benefits of ocean energy



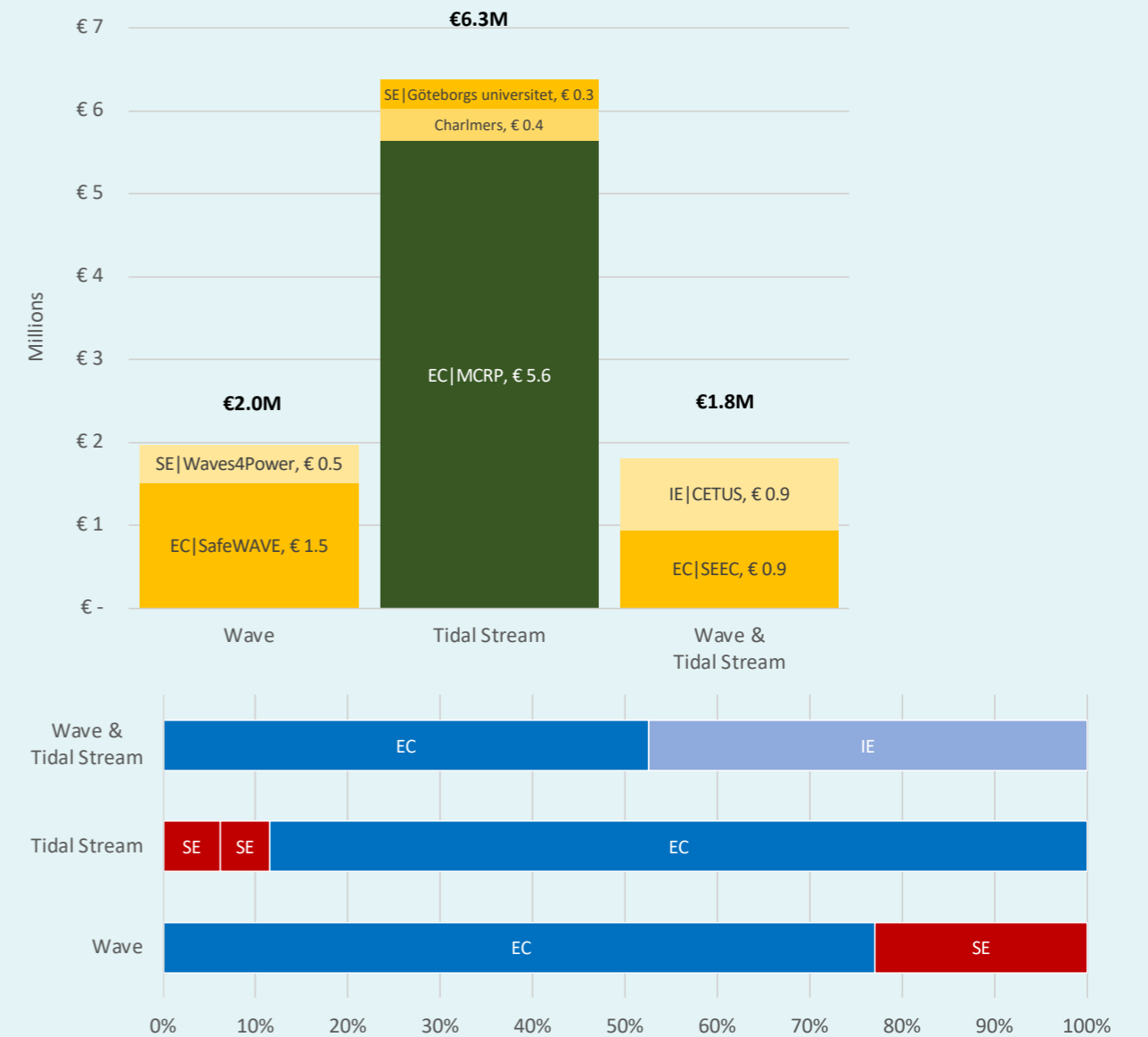
5.1 Marine observation, modelling and forecasting to optimise design and operation of ocean energy devices



5.2 Open-data repository for ocean energy

No activities recorded.

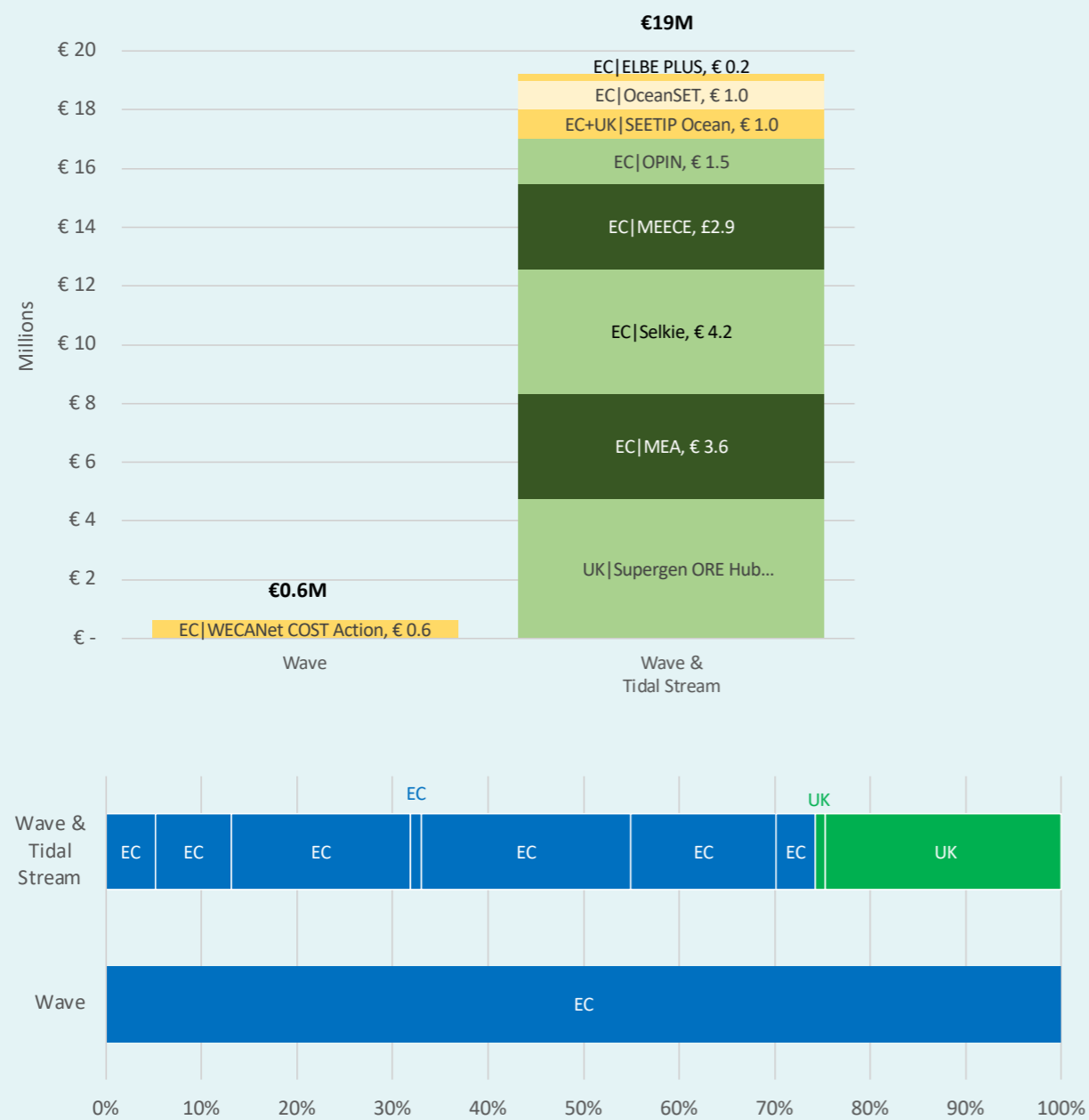
6.1 Improved knowledge of the environmental and socioeconomic impacts of ocean energy



6.2 Standardisation and certification

No activities recorded.

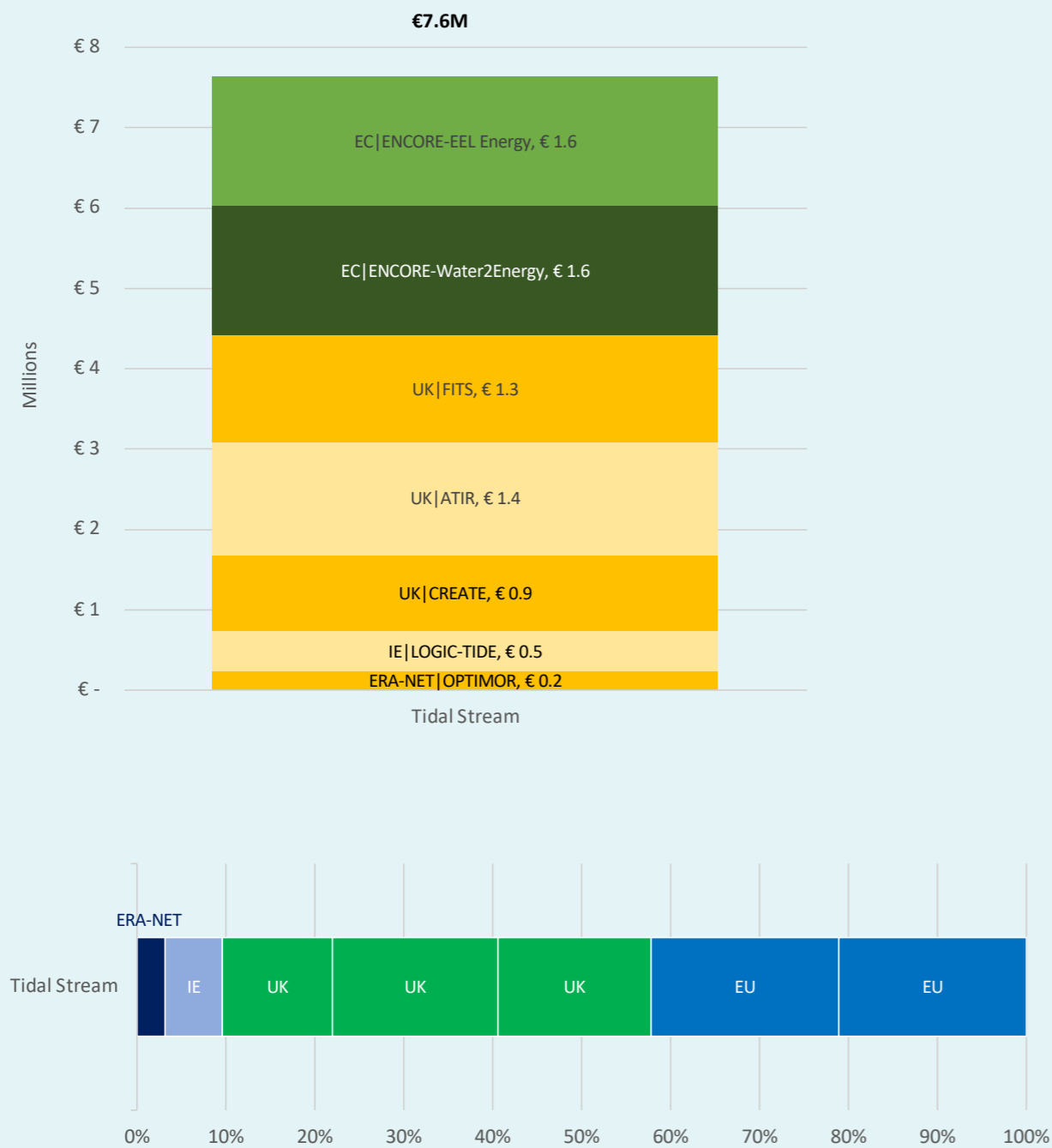
7.1 Coordination and support actions including knowledge sharing



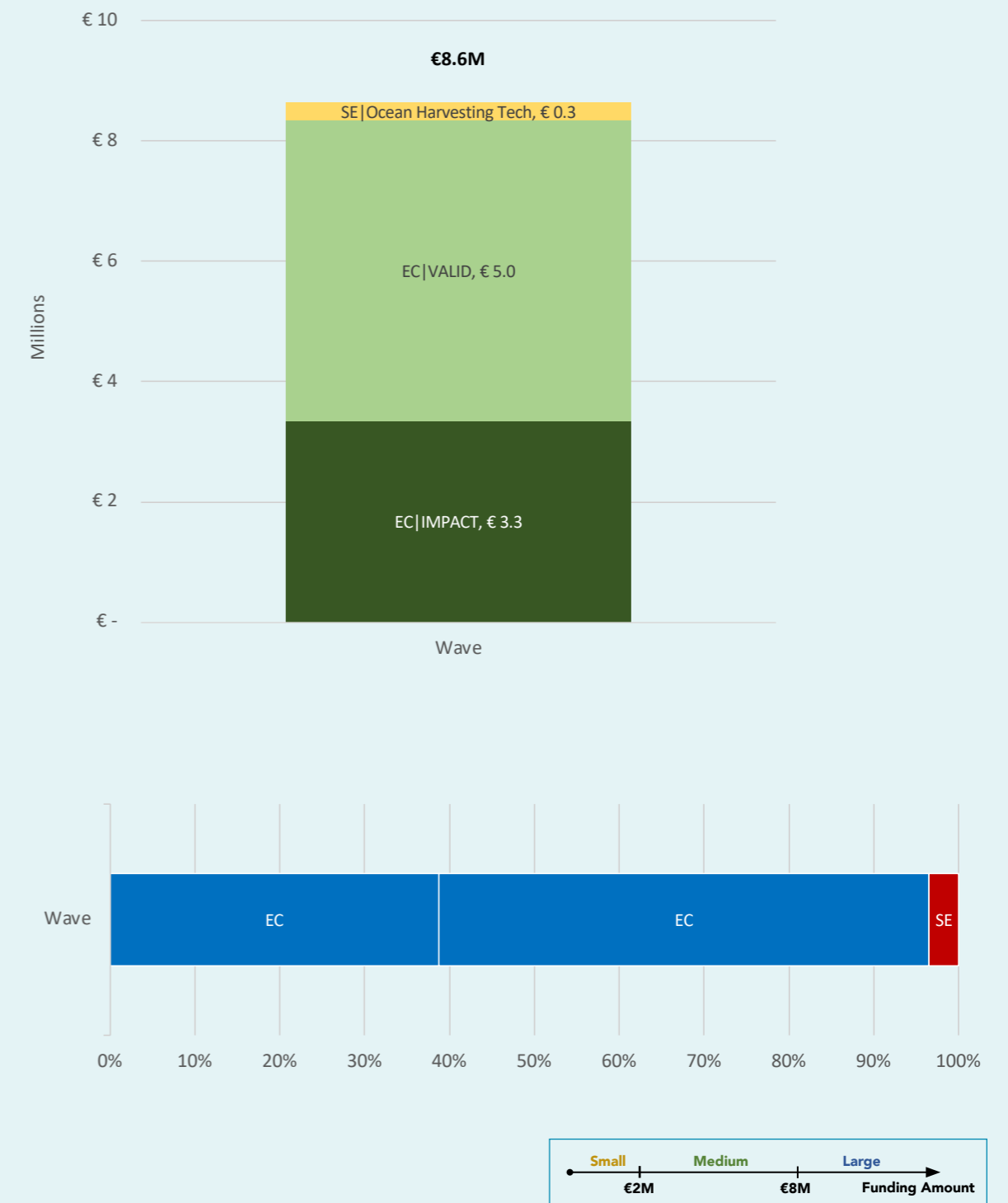
7.2 Analysis and modelling tools



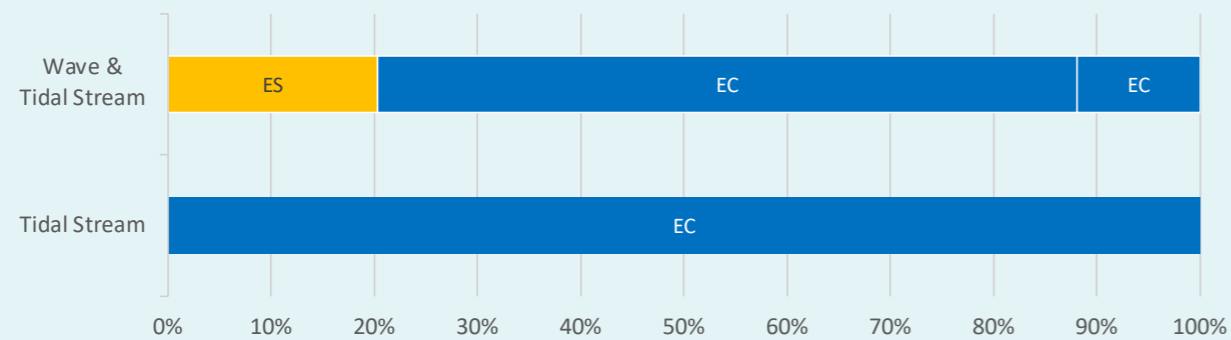
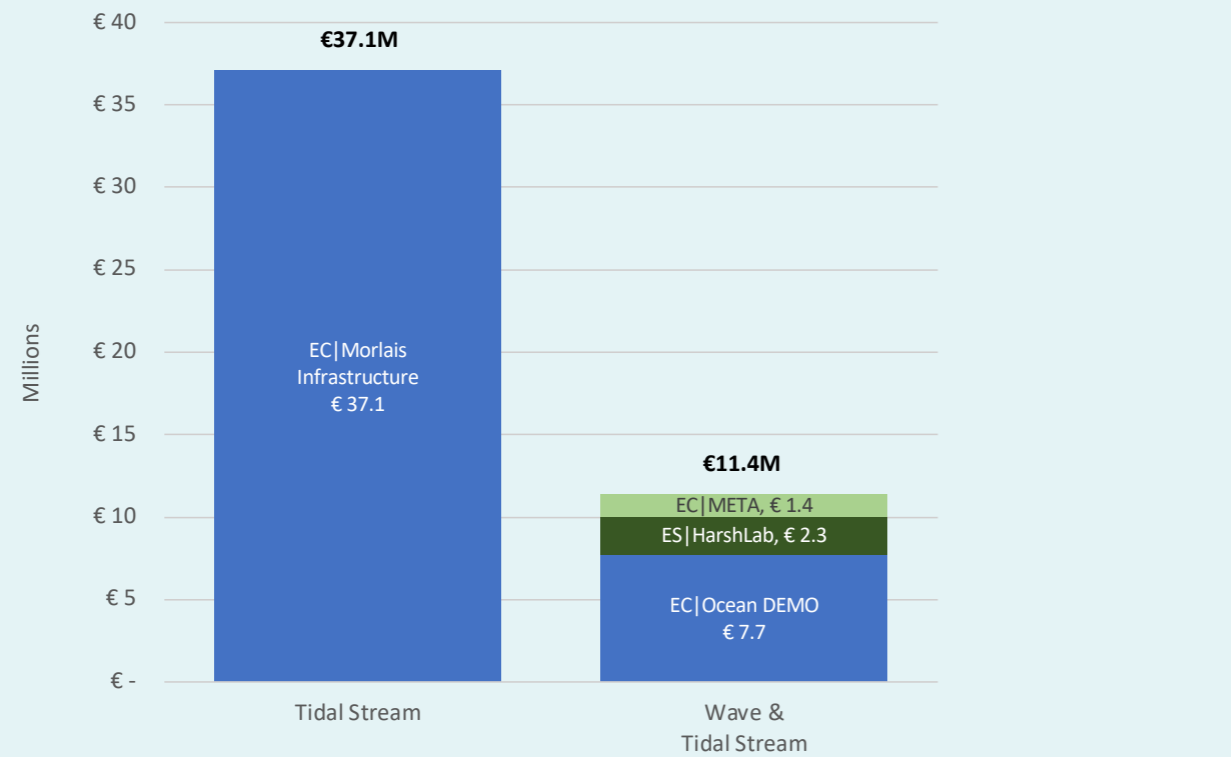
7.3 Development and testing of tidal devices (Tidal Stream)



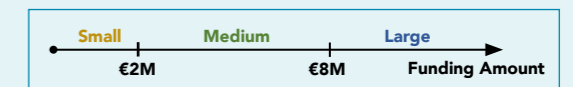
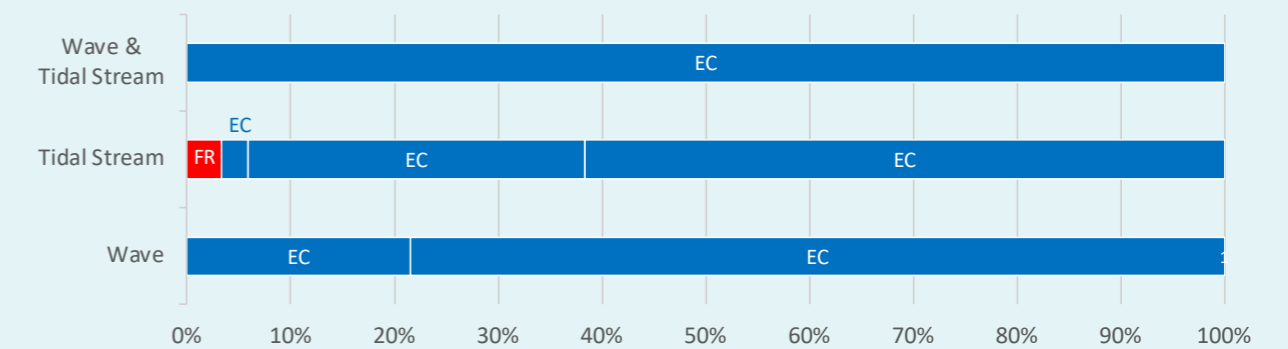
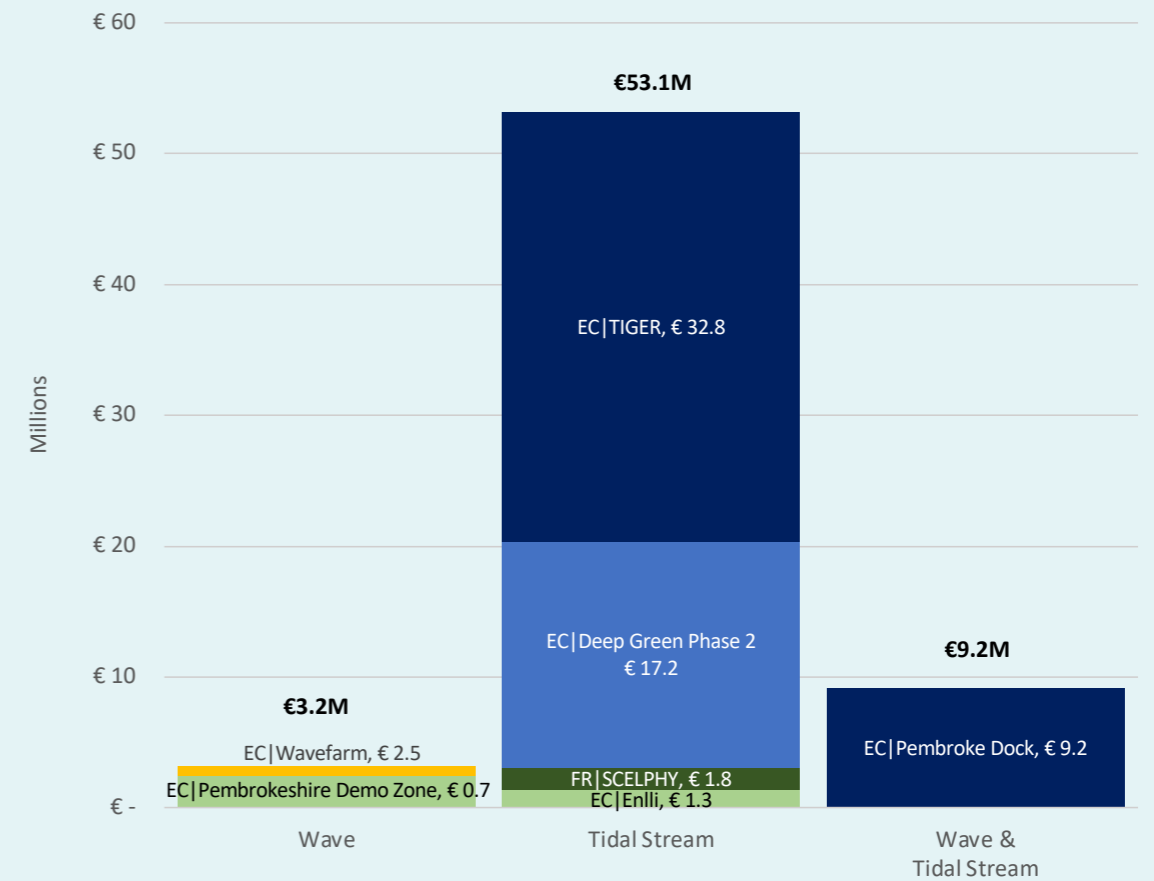
7.4 Testing facilities & infrastructures (Includes building of and access to)



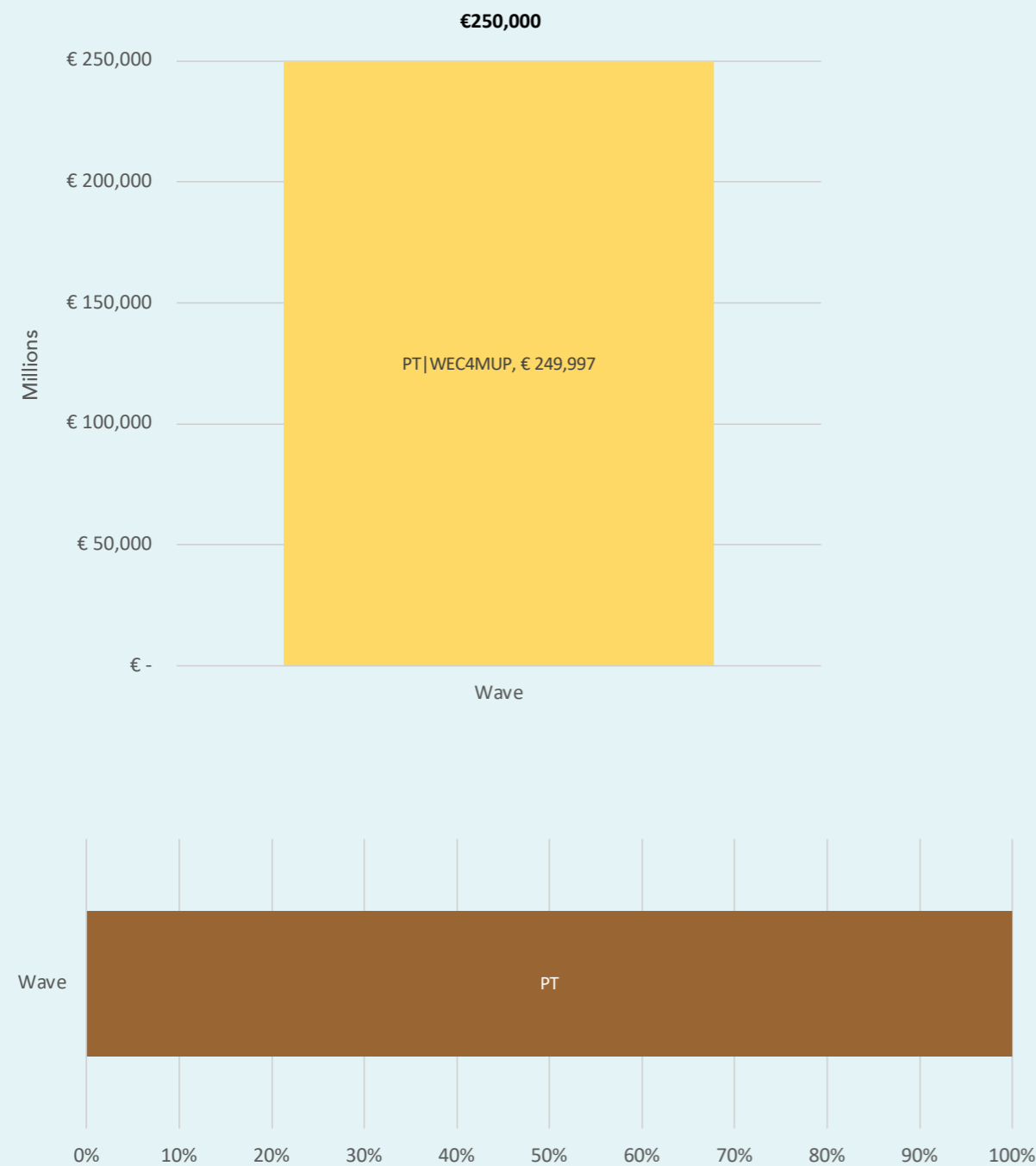
7.5 Open sea test sites (includes consenting, building of and supporting access to)



7.6 Support for demonstration or consenting of devices and arrays



7.7 Co-location of multiple devices



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