OceanSET Annual Report | 2023

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EXECUTIVE SUMMARY

The report updates the SET Plan implementation working group for ocean energy (OE-IWG) on progress in the sector in the calendar year 2023.

Member countries continue to support the ocean energy sector through the development of national and regional policies for offshore renewable energy, revenue support mechanisms, national and regional test and demonstration facilities, and funding programmes. However, the ocean energy sector must compete with the mature offshore energy sectors, particularly offshore wind. Ocean energy specific policy targets, dedicated revenue support mechanisms and focussed funding programmes are needed to accelerate the roll-out of ocean energy technology.

Forty-eight (48) new ocean energy projects have been identified in 2023, receiving a total commitment of €181.2 million in grant aid through European, national and regional programmes.

- The European Commission committed some €65.5 million to eight (8) projects through the Horizon R&I programme and a further €65.5 million to two (2) projects through the Innovation Fund programme.
- OE-IWG countries committed some €50.2 million to thirty-eight (38) projects.

In addition, France committed €75 million from its "France 2030" programme to the FloWatt tidal stream project that will see 17.5MW (seven (7) tidal stream turbines) installed the Raz Blanchard, Normandy.

An assessment of progress in delivering the expected investment in the Technical theme actions of the Implementation Plan (IP) identified 151 projects receiving public grant aid of some €496 million:

- 144 projects, receiving €508 million, addressed a Technical theme action ('in-scope' projects).
- 66 projects, receiving €237 million, did not address a Technical theme action ('out-of-scope' projects).

The grant aid to 'in-scope' projects represents approximately three-quarters of the recommended commitment. On this basis, progress is on track to meet the recommended investment by the end this IP's term. However, a greater number of smaller projects are being supported. This is particularly true in the wave sub-sector where the number of projects outnumber those in the tidal stream sub-sector by three-to-one and yet the grant aid committed in the two sub-sectors is broadly equivalent.

Grant aid committed to 'out-of-scope' projects remains significant, at a little under one third of the total committed grant aid.

Under the Environmental, Policy and Socioeconomics theme, eleven (11) of the twelve (12) EU Member States represented on the OE-IWG had approved a Maritime Spatial Plan by the end of 2023 [Action 2.2]. While the MSPs designate zones for offshore renewable energy production, this tends to mean offshore wind almost exclusively although Belgium, Germany, Portugal and Sweden mention ocean energy in relation to offshore renewable energy zones. The Netherlands has explicitly not pursued a policy on ocean energy. Several MS are in the process of revising their MSPs to extend offshore renewable energy zones to accommodate increased targets.

Under the Market Uptake and Financial theme, technology agnostic revenue support schemes continue to prevail. Yet, the effectiveness of dedicated single technology schemes continues to be demonstrated in the UK's Contracts for Difference (CfD) scheme where ring-fenced support for tidal stream technology has resulted in fifteen contracts to deliver a little under 94MW of tidal stream capacity in the period 2025 to 2028. The in-process AR6 is expected to deliver further capacity [Action 3.1]. A revision to the French Energy Code in December 2023 extends a purchase obligation provision to offshore renewable energy production installations (particularly osmotic and tidal stream energy installations) in receipt of National or European grant aid following a call for projects.

Despite a preferred form for establishing an insurance and warranty fund to underwrite technology-related financial risks associated with pre-commercial ocean energy projects being identified, no evidence of progressing to implementation is noted [Action 3.3]. Equally, no evidence of progress in the creation of a Common Investment Support Fund [Action 3.2] is noted.

The use of innovation procurement mechanisms continues through the cross-border (Scotland-Basque Country) EuropeWave project and the Basque Energy Agency's TurboWave project.

A review of the Offshore Renewable Energy Strategy, published in October 2023, adjusted the timeline for installed capacity targets for ocean energy to 100MW by 2027 and 1GW by the end of the decade, or early 2030's. A pathway to achieving a levelised cost of energy (LCOE) of 15cEUR/kWh by 2030 [tidal stream] and by 2035 [wave] is unchanged.

Identified deployment projects suggest the Offshore Renewable Energy Strategy's capacity target is realisable by 2027, or shortly thereafter. Installed ocean energy capacity is estimated as 16.1 MW at the end of 2023 and is projected to increase to approximately 92.1 MW by 2027 and approximately 170.1 MW by 2028.

RECOMMENDATIONS

- Continue to argue for explicit national/regional strategies, policies and targets that support the deployment of ocean energy.
- Tailor national and regional funding programmes to address the Implementation Plan's Technical theme actions.
- Evolve existing revenue support schemes to allow ocean energy deployment projects to secure support.
- Identify mechanisms to progress the implementation of a Common Investment Support Fund [Action 3.2].
- Identify mechanisms to progress the implementation of an Insurance and Warranty Fund [Action 3.3].
- Revise the Implementation Plan to reflect the new Strategic Research and Innovation Agenda (SRIA).

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1. Introduction

1.1 The SET Plan and ocean energy

The European Strategic Energy Technology Plan (SET Plan) [1] aims to accelerate the transformation of the European energy system. The SET Plan is the EU's main research and innovation policy.

Two of the SET Plan's ten actions are intended to position Europe as "*Number 1 in renewable energy*" through the development and deployment of low-carbon technologies, improving new technologies and bringing down their costs.

The SET Plan has put forward a specific vision for several technology areas (including ocean energy). Through setting ambitious targets and developing implementation plans the SET Plan will place Europe at the forefront of the next generation of low-carbon energy technologies.

The current SET Plan Implementation Plan for Ocean Energy [2] identifies the key challenges for the ocean energy sector (and particularly the wave and tidal-stream energy sub-sectors) for the period 2021 to 2025, expressed as a collection of priority actions grouped under three themes (Table 1).

Number 1 in renewable energy

1. Sustain technological leadership by developing highly performant renewable technologies and their integration in the EU's energy system.

2. Reduce the cost of key technologies.

- Technical (fifteen actions)
- Environmental Policy & Socioeconomic (three actions)
- Market Uptake and Financial (five actions).

The fifteen actions in the Technical theme are aligned with the Challenge Areas and Priority Topics identified in the sector's Strategic Research and Innovation Agenda (SRIA) [3]. The mapping is summarised in Table 1.

The targets for each technical action are focussed on general ambition of achieving:

- A deployed capacity of 100MW by 2025 [4]; and,
- A pathway to a levelised cost of energy (LCOE) of 15cEUR/kWh by 2030 [tidal] and 2035 [wave].

[1] Communication from the Commission C(2015) 6317. Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation.

[2] The Implementation Plan was first published in March 2018 and revised in October 2021 to reflect the European Commission's 'Strategy on Offshore Renewable Energy' (published in November 2020) and the 'Strategic Research and Innovation Agenda for Ocean Energy' (SRIA).

[3] The 'Strategic Research and Innovation Agenda for Ocean Energy' was published by the European Technology and Innovation Platform for Ocean Energy (ETIP Ocean) in June 2020 [https://www.etipocean.eu/knowledge_hub/strategic-research-innovation-agenda-for-ocean-energy/]

[4] The delivery date was aligned with the Offshore Renewable Energy Strategy published in November 2020 [Communication from the Commission C(2020) 741: An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future]. A review of the strategy, published in October 2023, has since revised the delivery date to 2027 [Communication from the Commission C(2023) 668: Delivering on the EU offshore renewable energy ambitions].

TABLE 1: THE ACTIONS OF THE IMPLEMENTATION PLAN

Theme	ID	SRIA Challenge Area & ID [a]		Action Description
Technical	1.1	Design and Validation of Ocean Energy Devices	1.1	Demonstration of ocean energy devices to increase experience in real sea conditions
	1.2		1.2	Demonstration of ocean energy pilot farms
	1.3		1.3	Improvement and demonstration of PTO and control systems
	1.4		1.4	Application of innovative materials from other sectors
	1.5		1.5	Development of novel wave energy devices
	1.6		1.6	Improvement of tidal blades and rotor
	1.7	Foundations, Connections and Mooring	2.1	Advanced mooring and connection systems for floating ocean energy devices
	1.8		2.2	Improvement and demonstration of foundations and connection systems for bottom-fixed ocean energy devices
	1.9	Logistics and Marine Operations	3.1	Optimisation of maritime logistics and operations
	1.10		3.2	Instrumentation for condition monitoring and predictive maintenance
	1.11	Integration in the Energy System	4.1	Developing and demonstrating near-commercial application of ocean energy in niche markets and hybrid systems.
	1.12		4.2	Quantifying and demonstrating grid-scale benefits of ocean energy
	1.13	Data Collection & Analysis and Modelling Tools	5.1	Marine observation and modelling to optimise design and operation of ocean energy device
	1.14		5.2	Open-data repository for ocean energy operation and performance
	1.15	Cross-Cutting Challenges	6.2	Standardisation and certification
Environmental, Policy and Socioeconomics	2.1	De-risking of environmental consenting through an integrated programme of measures • Promoting open data sharing on environment, consenting procedures and policy among MS • Promoting the development of environmental standards and certification • Encouraging a circular economy approach in the design of ocean energy technologies • Promoting simplified consenting procedures (including cross-border deployments)		
	2.2	Promoting ocean energy in Maritime Spatial Planning		
	2.3	Promoting political support and public backing for ocean energy		
Market Uptake and Financial	3.1	Dedicated revenue support for the first wave & tidal demonstration farms.		
	3.2	Creation of an Investment Support Fund for ocean energy farms.		
	3.3	Creation of an EU Insurance and Warranty Fund to underwrite various project risks.		
	3.4	Funding from EU, national, regional and private sector to support demonstration and innovation projects under the Technical and Environmental, Policy and Socioeconomic actions		
	3.5	Support the development of novel mechanisms to close funding gaps (such as a Public Procurement of Innovative solutions)		
	[a] "Challenge Area" is the phrase used in the SRIA to mean "an R&I field identified as most worthy of investment" during the period of the SRIA.			

1.2 The Implementation Working Group for ocean energy

The Implementation Working Group for ocean energy consists of representatives from relevant government and public sector agencies of fourteen (14) countries (12 EU Member States, Norway and the UK) (Table 2). In 2022, representation was expanded to include regional agencies as well as national agencies.

Stakeholder bodies representing the industrial and research community participate also participate as do representatives of the European Commission.

The IWG is chaired currently the National Agency for New Technologies, Energy and Sustainable Economic Development (Italy) and Wave Energy Scotland (Scotland, UK).

1.3 Report scope

The purpose of the annual reporting is to present a **clear and easy to communicate picture of the advancement of the ocean energy sector** during the year in question.

- Monitoring relevant aspects of the national/regional political support for ocean energy,
- Monitoring the technical activity,
- Assessing the progress against the actions of the implementation plan for ocean energy.

The principal audience of the annual report is

- the membership of the OE IWG (i.e., the country and region representatives and other stakeholders)
- other national and regional public authorities
- the membership of the wider OE community
- SETIS, i.e., the Commission
- the wider public.

TABLE 2: COMPOSITION OF THE IMPLEMENTATION WORKING GROUP FOR OCEAN ENERGY

Country	Organisation
Belgium	FPS Economy (DG Energy)
Cyprus	To be confirmed
Denmark	Ministry of Climate, Energy and Utilities (Danish Energy Agency)
Finland	Ministry of Economic Affairs and Employment
France	Agency for Ecological Transition
Germany	Ministry for Economic Affairs and Climate Action (Project Management Juelich)
Ireland	Sustainable Energy Authority of Ireland
Italy	Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile
Netherlands	Ministry of Economic Affairs and Climate Policy
Norway	Ministry of Petroleum and Energy
Portugal	Direção Geral de Energia e Geologia
Spain	Centre for the Development of Industrial Technology
Sweden	Swedish Energy Agency
UK	Dept for Business, Energy and Industrial Strategy
Stakeholders	**Organisation**
Industry	Ocean Energy Europe
Research	European Energy Research Alliance Joint Programme on Ocean Energy
European Commission	DG-RTD, DG-MARE, DG-JRC, DG-ENER

2. Member State Support for Ocean Energy

2.1 National/regional policies supporting ocean energy

Analysis of statements in the Ocean Energy Systems' (OES) Annual Report for 2023 [5] under the subsection "National Strategy" reveals that while all OE-IWG countries have renewable energy strategies and policies to support the delivery of carbon neutrality targets, only a few MS have explicit national strategies or policies to support ocean energy and fewer still have set explicit short-term (2030) targets for ocean energy, with the exception of Portugal (see section 2.1.1).

However, ocean energy is widely recognised as an emerging sector that will be highly relevant in the medium-to long-term; ocean energy regularly appears in the scenarios for medium-to long-term carbon-neutral energy mix planning.

- France is revising its long-term energy plan and expects to incorporate targets for tidal stream capacity on a medium-term horizon (2040).
- Italy's National Sea Plan, approved in July 2023, recognises that offshore renewable energy (including ocean energy) can make a decisive contribution in Italy's new energy development strategy.

While the immediate focus of many national offshore renewable energy strategies and policies is the offshore wind sector, the need to use the space occupied by offshore wind farms effectively is widely recognised.

- In Belgium, the Flemish Agency for Innovation and Entrepreneurship's Blue Cluster Renewable Energy Roadmap identifies initiatives that promote multiple use of space including the development and deployment of wave and tidal stream technologies.
- The Netherlands offshore wind policy recognises the potential role for other generation technologies.

The maritime spatial planning process is supporting the development of ocean energy:

- Portugal approved a Technological Free Zone (ZLT), a dedicated space for testing and demonstrating new technologies, for ocean energy technologies off the coast of Viana do Castelo in 2023.
- Spain reserved several sea areas for priority use of R&D projects while existing test areas (BiMEP and PLOCAN) are proposed for prototype testing or pilot project development.

Ireland, France, Portugal and Spain are collaborating in the Atlantic Action Plan 2.0 of the Atlantic Maritime Strategy the overarching objective of which is to unlock the potential of blue economy in the Atlantic area. Pillar III (Marine Renewable Energy) has the objective of promoting "… carbon neutrality through marine renewable energy" and actions that include the setting of deployment objectives and implementing incentives in the Atlantic regions.

Denmark's Partnership for Wave Power continues to promote the wave energy sector and lobby for national and regional wave energy deployment targets in the North Sea region.

[5] Ocean Energy Systems, the intergovernmental Technology Collaboration Programme on Ocean Energy Systems established by the International Energy Agency. The annual report may be found here: https://www.ocean-energy-systems.org/publications/oes-annual-reports/document/oes-annual-report-2023/

2.1.1 National energy and climate plans

Integrated national energy and climate plans (NECPs) outline how MS intend to meet the EU energy and climate targets. The NECPs exist alongside national long-term low greenhouse gas emission development strategies for MS to meet their Paris Agreement commitments for 2050. The preparation of an NECP involves setting national objectives, targets and contributions for all the five dimensions of the Energy Union and planning relevant policies and measures to achieve those. In this respect, the NECPs are a key policy instrument.

The first NECPs cover the 10-year period from 2021 to 2030.

MS are obliged to report on progress towards the implementation of their NECPs every two years. This reporting took place for the first time in 2023.

Also in 2023, MS were engaged in the process of updating their NECPs to reflect the EU's increased energy and climate ambition and much-changed geopolitical situation since the preparation of the original NECPs. Draft updates were submitted in June 2023 with the Commission publishing its assessment and recommendations in October 2023. Final versions of updated NECPs are due for submission in June 2024.

While the draft updates regularly reference offshore renewable energy, few mention ocean energy explicitly. The Commission's assessment (COM(2023) 796) notes that only Portugal provided an indicative target for ocean energy (200MW installed wave energy capacity by 2030) contributing to the Offshore Renewable Energy Strategy's objective of 1GW of ocean energy by 2030. A consistent observation in the Commission's assessment of individual NECPs is the absence of information on the deployment of innovative renewable energy technology [6], which represents an opportunity for ocean energy.

Several MS indicate support mechanisms for ocean energy:

- Portugal includes actions to promote ocean renewable energy recognising the potential of wave energy (Action 3.1.5) and to promote pilot renewable energy projects including wave energy (Action 3.1.7).
- Ireland's draft update expresses support for ocean energy research through a development and demonstration pathway for emerging technologies and associated test infrastructure as part of its long-term term strategy for 2050. A new Technology Development and Demonstration Pilot is to be launched in 2024 to invest in key innovative technology development and demonstration projects, including offshore renewable energy technology.
- Italy's draft update notes the potential for ocean energy and indicates an investment of 680M€ [7] to support the deployment of innovative technologies in offshore renewable energy generation systems, combining high-potential technologies with experimental technologies (such as wave energy). The ambition is 200MW of installed capacity.
- In Spain's draft update, ocean energy R&I activities are targeted at demonstration projects that generate knowledge and experience in a real marine environment, increasing TRL to 7, 8 and 9. Measure 1.4 (Development of innovative renewable energy installations) foresees calls for low-capacity demonstration projects or flagship projects targeting renewable energy technologies that are not yet competitive but have great potential.

[6] The revised Renewable Energy Directive (EU/2023/2413) requires MS to set indicative targets for the installation of innovative renewable energy technologies, at least 5 % of newly installed renewable energy capacity by 2030.

[7] An investment of Measure M2C2 1.3 of the National Recovery and Resilience Plan.

The Netherlands has chosen not to set objectives in the field of ocean energy as the resource potential is noted as being too low to make a substantial contribution to the national energy transition, however it expresses support for indigenous ocean energy technology developers.

Those MS that participate in the North Seas Energy Cooperation (NSEC) [8] have incorporated a common statement regarding a non-binding agreement on offshore renewable energy production, however these targets relate to offshore wind capacity [9].

2.2 Market incentives (revenue support)

TABLE 3: REVENUE SUPPORT SCHEMES

Type		Country	Observation
Competitive [a]	Dedicated	UK	Contracts for Difference (CfD) scheme. The fourth CfD allocation round (launched in Dec 2021) included a separate auction process for 'less established' technologies (including ocean energy) and a ring-fenced minimum support for tidal stream (£20 million). Four tidal stream projects received contracts to deliver 40.82MW at a strike price of £178.54/MWh.
	Restricted	France	Energy and Climate Act, 2019, Article 33 …"The experimentation contract". Feed-in-tariff for innovative renewable energy technology projects. Terms are decided on a case-by-case basis in response to a call for projects.
		Spain	General incentive scheme for renewable energy technology providing support through annual competitive public tender processes. Projects propose a value they are willing to accept and the most competitive are selected. Separate auction for at least 20MW capacity of 'other technologies' (including ocean energy) every second year (Order TED/1161/2020).
	Open	Netherlands	SDE++ is a general technology agnostic subsidy scheme. Annual rounds with phased allocation, subsidy increases in later phases. Subsidy is benchmarked against offshore wind costs. Subsidy is expected to decrease year on year. Maximum subsidy in 2022 was 300 €/ton avoided CO2.
		Ireland	The Renewable Electricity Support Scheme is a general technology agnostic auction-based subsidy scheme. A variant dedicated to offshore wind, the Offshore Renewable Electricity Support Scheme (ORESS), was launched in 2022. It is conceivable the ORESS could evolve to support ocean energy technology.
		Italy	Ministerial Decree 23 June 2016 defines the scheme. Guaranteed incentive for 'small' plant up to 60kW (direct access). Larger capacity projects must apply for entry in the registries, or, where capacity exceeds 5MW, compete in a reverse auction competition. Base tariffs and capacity quotas are defined by technology type, including 'offshore energy' although it is not clear whether ocean energy is considered.
Other		Belgium	Federal and regional tradable green certificate schemes. Network operators obliged to secure a quota of green certificates from generators at a minimum price.
None		Denmark	-
		Norway	Renewable electricity certificate scheme (run jointly by Norway and Sweden) closed to new generation plant on 31 Dec 2021. Policy is technology agnostic, so no specific instruments to incentivise ocean energy technology.
		Sweden	

[a] Competitive schemes are categorised as:
- Open: all technologies compete on equal terms (i.e., the scheme is technology agnostic).
- Restricted: technologies are grouped in some way and compete only with technologies in their group.
- Dedicated: a single technology competition.

[8] The North Seas Energy Cooperation supports and facilitates the development of the offshore grid and the large renewable energy potential of the North Sea basin. Members include Belgium, Denmark, France, Germany, Ireland, the Netherlands, Norway, and Sweden.

[9] At least 260GW of offshore wind energy by 2050 with intermediate targets of at least 76GW (2030) and 193GW (2040).

A stable revenue support mechanism is consistently reported as being significant factor for unlocking ocean energy projects [10]. This is recognised by the inclusion of Action 3.1 in the Implementation Plan. Revenue support mechanisms are defined typically at a national level but occasionally at a regional level.

Most OE-IWG countries implement revenue support schemes for renewable energy generation in a competitive form based on periodic public tender or reverse-auction processes. The Scandinavian countries are the exception currently. Neither Denmark, Norway and nor Sweden operate a revenue support scheme currently; the joint Norwegian-Swedish scheme closed to new plant at the end of 2021.

Technology agnostic schemes prevail, in which all technologies compete on equal terms (Netherlands, Ireland, Italy). As this approach is solely based on cost, it favours the mature technologies; less mature technologies such as ocean energy are unable to compete on a purely cost basis.

Restricted schemes, in which grouped technologies compete together, can provide an opportunity for less mature technologies to secure support (France, Spain, UK). However, the likelihood of success for ocean energy will depend on the technologies it is grouped with.

Dedicated single technology schemes naturally provide the best opportunity. Examples of such schemes in the countries represented in the OE-IWG remain rare.

The UK's recent CfD allocation rounds (AR4, AR5 & the in-process AR6) have included ring-fenced support for tidal stream within the emerging technologies grouping (providing dedicated support in an otherwise restricted scheme). To date, this approach has resulted in fifteen contracts for a little under 94MW of tidal stream capacity to be delivered in the period 2025 to 2028.

The French Energy Code was revised in December 2023 to extend a purchase obligation provision to offshore renewable energy production installations that are in receipt of National or European grant aid following a call for projects, but particularly osmotic and tidal stream energy installations [11].

In the absence of dedicated schemes, mechanisms incorporated into open competition schemes can be used to support ocean energy. For example, in the Italian scheme 'small' capacity plant are guaranteed support irrespective of technology type ('small' is defined as less than 60kW in this instance). With appropriate definition, this mechanism could provide targeted support for ocean energy.

2.3 Funding programmes

All OE-IWG countries continue to operate general technology research and innovation national funding programmes, i.e., technology agnostic programmes open to applications from any technology sector. Good examples of such programmes are:

- Denmark's Energy Technology Development and Demonstration Program (EUDP) focuses on clean energy technologies and demonstration projects at a TRL of between 4 and 8 with the possibility for commercialisation after project end. The two calls of 2023 programme committed grant aid of some 5.0M€ (37.4M DKK) to four ocean energy related projects.
- Ireland's National Energy Research Development and Demonstration (RD&D) Funding Programme committed a little

[10] Stakeholder & policy needs. ETIP Ocean (2019) [https://www.etipocean.eu/knowledge_hub/revenue-support-will-unlock-ocean-energy-projects-confirms-new-etip-ocean-report/].

[11] The previous provision was limited to wave and tidal stream energy installations that were in receipt of grant aid from France's Investment for the Futures programme.

over 3.1M€ in grant aid to five projects relevant to the ocean energy sector in its 2023 round.

- Sweden's Future Electricity Systems programme (Framtidens elsystem) committed 3.1M€ (35.3M SEK) to four ocean energy projects through the Clean Energy Technology Partnership programme.

Individual MS Recovery and Resilience Plans (RRP) [12] continue to be used to support ocean energy.

- In Italy,
  - The Green Islands Program, financed from Investment 3.1 of Mission 2 Component 1 of the national RRP, is supporting two islands to pursue wave energy projects. The programme aims to improve the environmental and energy resilience of the municipalities of smaller non-interconnected islands.
  - Investment 1.3 of Mission 2 Component 2 of the national RRP, with a budget of 680M€, is promoting offshore renewable energy generation systems that combine mature and innovative technologies (particularly wave energy) in innovative structures.
- Spain's Renmarinas Demos Program is investing in pilot projects and testing infrastructures in marine renewable energies. In 2023, the first call committed a little over 40.7M€ to eleven (11) ocean energy related projects.

Programmes with a narrower focus more relevant to the ocean energy sector are also evident, notably programmes targeting support for the offshore renewable energy sector generally and occasionally the ocean energy sector directly (Table 4).

TABLE 4: EXAMPLES OF OCEAN ENERGY FUNDING PROGRAMMES

Country	Programme name	Funding	Focus
Belgium (Flanders)	Blue Cluster	€ 8,000,000	Co-funding industry driven offshore renewable energy R&D projects.
Spain (Basque Country)	Demonstration and validation of emerging marine renewable energy technologies	€ 2,500,000	Support for demonstration and validation of emerging technologies in the field of marine renewable energy. Deployments must occur at the region's open sea test site, the Biscay Marine Energy Platform (BiMEP).
Sweden	National ocean energy programme (Phase 2)	€ 10,200,000	The €10.2 million programme operates from Mar 2018 to Mar 2024. Three national calls (in 2018, 2019 & 2020) have funded 21 projects. No further calls planned.
United Kingdom (Scotland)	Wave Energy Scotland	€ 10,000,000	Support for development of technology relevant to the wave energy sector.

2.4 Test and demonstration facilities

2.4.1 Open-sea facilities

Most facilities summarised in Table 5. provide an operational environment for either wave or tidal stream technology at mid to late technology readiness levels. Many are represented in the International WaTERS (Wave and Tidal Energy Research Sites) network, a global network of more than thirty (30) open-sea test and research centres from over twenty (20) countries established to encourage collaboration and knowledge transfer.

[12] Recovery and resilience plans, https://reform-support.ec.europa.eu/what-we-do/recovery-and-resilience-plans_en.

TABLE 5: TEST AND DEMONSTRATION FACILITIES [* IN DEVELOPMENT]

Country (Region)	Facility	Sector
Belgium (West Flanders)	Blue Accelerator Platform	General
Denmark	DanWEC	Wave
	DanWEC NB	Wave
France	SEM-REV	Wave, Floating Offshore Wind
	Sainte-Anne du Portzic	Wave
	SEENEOH - Paimpol-Bréhat	Tidal stream
	SEENEOH - Bordeaux	Tidal stream
Ireland	SmartBay	Wave
	Atlantic Marine Energy Test Site (AMETS) *	Wave
Netherlands	Grevelingendam *	Tidal range
Portugal	Aguçadoura	Wave
	Viana do Castelo Pilot Zone	Wave, Floating Offshore Wind
Spain (Basque Country)	Biscay Marine Energy Platform (BiMEP)	Wave, Floating Offshore Wind
	Mutriku	Wave
	HarshLab	General
Spain (Canaries)	Plataforma Oceánica de Canarias (PLOCAN)	Wave
Spain (Galacia)	Punta Langosteira Experimental Marine Energy Zone	Wave, Floating Offshore Wind
Sweden	Lysekil Research Site	Wave
	Testbed for Marine Materials	General
UK (Scotland)	European Marine Energy Centre - Billia Croo	Wave
	European Marine Energy Centre - Scapa Flow	Wave
	European Marine Energy Centre - Falls of Warness	Tidal stream
	European Marine Energy Centre - Shapinsay Sound	Tidal stream
UK (Wales)	West Anglesey Tidal Demonstration Zone (Morlais) *	Tidal stream
	Marine Energy Test Area Phase 1	General
	Marine Energy Test Area - Dale Roads	Wave
	Marine Energy Test Area – East Pickard Bay	Wave
	Marine Energy Test Area – Warrior Way	Tidal stream
UK (England)	Falmouth Bay Test Site (FaBTest)	Wave, Tidal stream
	Perpetuus Tidal Energy Centre (PTEC) *	Tidal stream

In 2023, the International WaTERS network launched a database presenting the capabilities of these open-sea test facilities [13].

Materials and component testing facilities targeting the offshore renewable energy sector are becoming more prevalent (e.g., in Spain: Harshlab [Basque Country], Harshlab 0.5 [Gran Canarias], El Bocal [Cantabria]; In Sweden: Testbed for Marine Materials [Fiskebäckskil]).

A recent trend for open-sea facilities established initially to support ocean energy technology, and particularly wave energy technology, is a diversification to support other offshore renewable energy generation technology (e.g., floating offshore wind, floating solar) and alternative energy vectors (e.g., hydrogen). This diversification could threaten the ability to support ocean energy technology deployments where the new activity takes place within the current site boundaries.

[13] https://www.internationalwaters.info/test-sites

2.4.2 Notable activity in 2023

The capabilities of established open-sea facilities continue to be enhanced.

- Denmark's DanWEC test-site is in the process of establishing of a new operational framework to reinvigorate the facility.
- In France, the creation of the Open-C Foundation has brought five offshore renewable energy test-sites (four ocean energy and one floating offshore wind site) under a single management structure.
- Ireland continues to develop its Atlantic Marine Energy Test Site (AMETS). A recent focus has been to establish the onshore infrastructure and to extend the site's consent to include floating offshore wind.
- In The Netherlands, North Sea Famers is diversifying the use of its Offshore Test Site (OTS), a 6km2 sea area located 12km off the coast of Scheveningen, to accommodate offshore energy technologies (wave and floating solar) while also working towards establishing a grid connection. The OTS is situated within the larger Proeftuin op de Noordzee (Testing Gound in the North Sea) zone that is designated for short-term tests of innovative products and technologies.
- Portugal confirmed the extent of a Technological Free Zone (ZLT) proposed within the boundary of the Viana do Castelo Pilot Zone will be a 7.63km2 area located adjacent to the Windfloat Atlantic project site. A ZLT is a "safe space" for testing innovative products without incurring all normal regulatory consequences.
- In Scotland, UK, the European Marine Energy Centre (EMEC) secured a site-wide 'Section 36' consent for an installed capacity of up to 20MW at its Billia Croo site (wave) while also extending the footprint of the site by some 2.6km2 into deeper water. The consent, which replicates the situation at EMEC's Falls of Warness tidal stream site, will streamline the permitting process as it allows up to twenty (20) individual wave energy devices to be installed at the site without the need for further public consultation, subject to individual technologies satisfying a broad design envelope. Technologies not satisfying the design envelope will require public consultation while individual devices with capacities over 1MW will require a separate 'Section 36' consent.
- In Wales, UK, the Morlais tidal stream site completed its onshore substation infrastructure.

2.4.3 MARINERG-i Distributed Research Infrastructure

The MARINERG-i initiative is pursuing the formation of a pan-European Research Infrastructure [14] that will coordinate and consolidate expertise, investment and access to European offshore renewable energy testing infrastructures to support the growth of the sector, a Distributed Research Infrastructure (DRI). The initiative, which is an evolution of coordinated approach established through the MaRINET and MaRINET 2 projects, involves members from Ireland, Belgium, The Netherlands, Portugal, Spain, and the United Kingdom as well as prospective members from France, Germany, Italy, and Norway.

Having been included as one of eleven (11) new Research Infrastructures in the European Strategy Forum on Research Infrastructures' 2021 roadmap [15], the MARINERG-i initiative has secured funding from the Horizon Europe INFRADEV programme [16] for a preparatory phase, to establish the legal, governance, scientific and business components required to implement the MARINERG-i DRI.

[14] https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/european-research-infrastructures_en

[15] https://roadmap2021.esfri.eu/

[16] The MARINERG-i_PP project began in December 2023 [https://cordis.europa.eu/project/id/101128668]

3. EU support for ocean energy

3.1 Policy

The European Commission's Offshore Renewable Energy Strategy, published in November 2020, set installed capacity targets and a timeline for delivery for ocean energy. A review of the strategy [17], published in October 2023, adjusted the timeline for installed capacity targets to 100MW by 2027 and 1GW by the end of the decade, or early 2030's.

Amendments to the Renewable Energy Directive (EU/2018/2001) offers opportunities for ocean energy. The amending Directive (EU/2023/2413), which entered into force in November 2023, requires Member States to set an indicative target for innovative renewable energy technology [18] of at least 5% of newly installed renewable energy capacity by 2030 (Article 3), and, to promote the testing of innovative renewable energy technology through pilot projects in a real-world environment (Article 15).

The amending Directive also introduces upper time-limits for the permit-granting process for renewable energy projects, and, the concept of renewable acceleration areas [19] in which the permit-granting process is subject to shorter time-limits (Article 16a):

- not exceeding two years, for offshore renewable energy projects,
- not exceeding six months, for new projects with a capacity of less than 150kW and for repowering of existing plant.

Member States are required to adopt plans designating renewable acceleration areas for one or more types of renewable energy sources by February 2026.

3.2 Funding

The European Commission continues to support ocean energy through its Horizon Europe research and innovation programme and notably in 2023 through its Innovation Fund.

3.2.1 Horizon Europe

The Horizon Europe 2021-2022 work programme contained four topics associated with ocean energy all which closed for submissions in the first half of 2022 (Table 6). The funded projects had started by the first quarter of 2023.

The Horizon Europe 2023-2024 work programme, adopted in December 2022, includes four topics in Cluster 5 (Climate, Energy and Mobility) dedicated to ocean energy. The topics are based on the priority topics of the SRIA for ocean energy.

Calls for two topics concluded by the end of 2023. A third topic's call closed in January 2024:

- Pilot tidal stream farms [D3-01-08]: The topic is supporting two projects (SEASTAR & EURO-TIDES) each deploying an array of tidal stream devices. In total, 20 devices will be installed with a cumulative rated capacity of 13.6MW. Projects began in the final quarter of 2023 and installation is expected in 2027.
- Innovative power take-off systems for wave energy devices [D3-02-10]: Two projects (MEGA PTO Wave & SHY) were announced in December 2023 and are scheduled to get underway in the second quarter of 2024.

[17] Communication from the Commission C(2023) 668: Delivering on the EU offshore renewable energy ambitions.

[18] Directive EU/2023/2413 defines "innovative renewable energy technology" as renewable energy generation technology that improves, in at least one way, comparable state-of-the-art renewable energy technology or that renders renewable energy technology that is not fully commercialised or that involves a clear degree of risk exploitable.

[19] Directive EU/2023/2413 defines a "renewable acceleration area" as an area designated as particularly suitable for the installation of renewable energy plants.

TABLE 6: HORIZON EUROPE WORK PROGRAMME CALLS

WP	Call title	Open	Close	Projects	Project acronym
2021-22	Demonstration of wave energy devices to increase experience in real sea condition [HORIZON-CL5-2021-D3-02-01]	24-Jun-21	05-Jan-22	1	WEDUSEA
	Support to the activities of the ETIPs and technology areas of the SET Plan [HORIZON-CL5-2021-D3-02-15]	24-Jun-21	05-Jan-22	10	SEETIP Ocean
	Innovative foundations, floating substructures and connection systems for floating PV and ocean energy devices [HORIZON-CL5-2021-D3-03-10]	02-Sep-21	23-Feb-22	3	PLOTEC [b]
	Demonstration of innovative rotor, blades and control systems for tidal energy devices [HORIZON-CL5-2022-D3-01-07]	14-Oct-21	26-Apr-22	1	MAXBlade
2023-24	Preparatory phase of new ESFRI research infrastructure projects [HORIZON-INFRA-2023-DEV-01-08]	06-Dec-22	09 Mar-23	1	MARINERG-i_PP
	Demonstration of sustainable tidal energy farms [HORIZON-CL5-2023-D3-01-08]	13-Dec-22	30-Mar-23	2	SEASTAR EURO-TIDES
	Development of innovative power take-off and control systems for wave energy devices [HORIZON-CL5-2023-D3-02-10]	04-May-23	05-Sep-23	2	MEGA PTO Wave SHY
	Demonstration of sustainable wave energy farms [HORIZON-CL5-2024-D3-01-08]	12-Sep-23	16-Jan-24	2	-
	Critical technologies for the future ocean energy farms [HORIZON-CL5-2024-D3-02-04]	17-Sep-24	21-Jan-25	2	-

[a] Of the ten projects, the SEETIP Ocean project is supporting ocean energy.

[b] Of the three projects, two related of offshore floating PV technology. Only the PLOTEC project related to ocean energy technology.

- Pilot wave farms [D3-01-08]: The topic is expected to support two projects, each demonstrating the installation and operation of multiple wave energy devices. Awards are expected in the second quarter of 2024.

The call for the fourth topic is scheduled to open in the third quarter of 2024.

3.2.2 Innovation Fund

The Innovation Fund's Large-Scale programme [20] announced awards amounting to a little under 65.5 million EUR to two ocean energy projects in the final quarter of 2023 with both projects getting underway in the first quarter of 2024:

The Saoirse Wave Energy Project (SAO): A pre-commercial 5 MW wave energy array located off County Clare, Ireland, developed by the Simply Blue Group in conjunction with ESB Wind Development utilising CorPower Ocean's technology, specifically CorPower Ocean's CorPack modular array concept, clustering 14 wave energy converters with an associated centralised electrical collection system. Financial close is anticipated by October 2027 with entry into operation date by January 2030.

Sustainable dispatchable energy enabled by wave-wind offshore platforms with onboard hydrogen (SEAWORTHY): A first-of-a-kind commercial-scale demonstration of Floating Power Plant's technology [P-Demo] to be deployed at PLOCAN, integrating a 4.3 MW wind turbine generator, a 0.8 MW wave energy converter system and a hydrogen production system consisting of a 1 MW electrolyser, 48 MWh of energy storage and a 1.2 MW fuel cell on a common platform. Financial close is anticipated by November 2025 with entry into operation by June 2028.

[20] Through the InnovFund-2022-LSC call.

4. Progress of the Implementation Plan Actions

The Implementation Plan sets out a collection of actions grouped by "Theme" and "Challenge Area" (Table 1) that represent the activities considered most worthy of investment over the plan's period. For each action, the plan identifies the anticipated number of projects and the corresponding anticipated investment considered necessary to deliver the desired outcome of each action. The Implementation Plan anticipates a total of 143 R&I projects (a mix of small, medium and large projects) and an overall investment of 981 million euros with public sector funding amounting to 654 million euros (Table 9).

Progress towards satisfying this expectation is monitored with the OceanSET Register of Projects (the 'Register') which maintains a record of funded projects in the ocean energy sector. The Register includes projects supported by

- Commission funding programmes (e.g., Horizon, InnovFund, ERDF, EMFAF [21])
- National and Regional funding programmes
- Joint funding programmes (e.g., OCEANERA-NET, Clean Energy Transition Partnership)

Process: Projects supported by the European Commission directly are identified through interrogation of the CORDIS database and collaboration with the JRC.

National and Regional funding programmes supporting the ocean energy sector, and projects funded by them, are identified by a request for information issued to the country and regional representatives of the IWG membership.

A project is categorised according to its most relevant IP action. A category 'Other' is used where no relevant IP action can be determined. Comparing this categorisation of projects against the expectation of the IP actions provides an assessment of the progress towards achieving the ambition of the IP, an assessment that can guide future public R&I funding to ensure delivery of that ambition. The analysis presents an assessment of the current R&I landscape in the ocean energy sector and of how well it addresses the challenges facing the sector.

[21] Horizon – the R&I programme Horizon Europe and Horizon 2020; InnovFund – Innovation Fund, ERDF – European Regional Development Fund; EMFAF – European Maritime, Fisheries and Aquaculture Fund (previously the European Maritime and Fisheries Fund, EMFF).

4.1 Projects in 2023

The Register has been updated to include R&I projects that were active in 2023.

4.1.1 European Commission funded projects

The Commission committed some 131.0 million EUR of grant aid to ten (10) ocean energy related projects in 2023 (Figure 1), awarding some 65.5 million EUR through the Horizon R&I programme to eight projects in a mix of Innovation Actions (IA), Research & Innovation Actions (RIA), Coordination & Support Actions (CSA), and Marie Curie Fellowships as well as a similar total of some 65.5 million EUR to two projects through the Innovation Fund.

FIGURE 1: EUROPEAN COMMISSION COMMITTED GRANT AID BY YEAR OF AWARD. VALUES FOR 2024 ONWARDS REPRESENT INTENDED COMMITMENTS (CALLS IN THE HORIZON EUROPE WORK PROGRAMME FOR 2023-24).

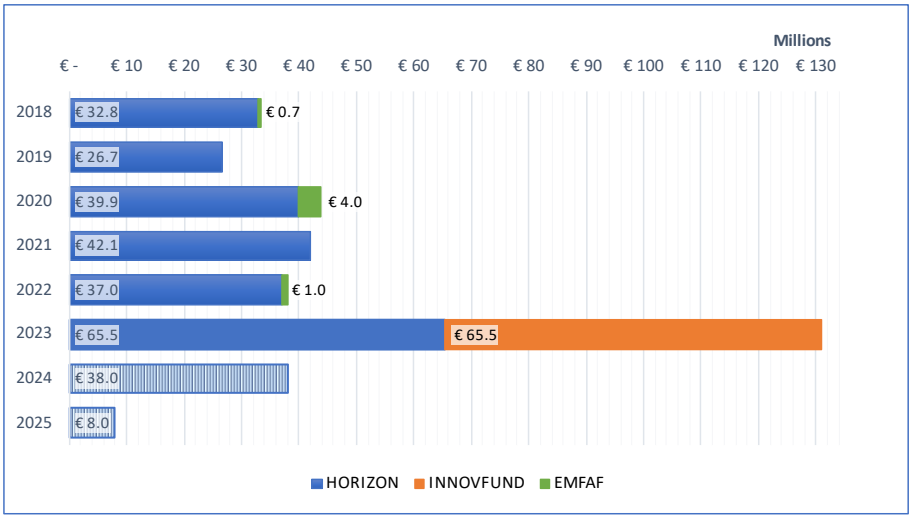


TABLE 7: OCEAN ENERGY RELATED PROJECTS AWARDED GRANT AGREEMENTS IN 2023.

	Project title	Call topic	Grant aid
July	Performance Optimization of a Hybrid Offshore Wind-Wave Energy Platform [POHOWEP]	MSCA Postdoctoral Fellowships 2022 [HORIZON-MSCA-2022-PF-01-01]	€252,724
	Producing Green Hydrogen Using Power of Ocean Waves [GreenH2Wave]	Women TechEU [HORIZON-EIE-2022-SCALEUP-02-02]	€75,000
Oct	Marine Renewable Energy Distributed Research Infrastructure - Preparatory Phase [MARTINERG-i_PP]	Preparatory phase of new ESFRI research infrastructure projects [HORIZON-INFRA-2023-DEV-01-08]	€2,678,599
	EUROpean Tidal energy pilot farm focused on Industrial Design, Environmental mitigation and Sustainability [EURO-TIDES]	Demonstration of sustainable tidal energy farms [HORIZON-CL5-2023-D3-01-08]	*€20,000,000*
Nov	Sustainable European Advanced Subsea Tidal Array [Seastar]		*€20,000,000*
	Research Infrastructure advice for promoting renewable energy (RISEnergy]	Research infrastructure services to enable R&I addressing main challenges and EU priorities [HORIZON-INFRA-2023-SERV-01-01]	€14,499,997
Dec	Modular electrical generator PTO system for wave [MEGA PTO Wave]	Development of innovative power take-off and control systems for wave energy devices [HORIZON-CL5-2023-D3-02-10]	*€4,000,000*
	Seawater hydraulic PTO using dynamic passive controller for wave energy converters [SHY]		*€4,000,000*
	The Saoirse Wave Energy Project [SAO]	Innovation Fund Large Scale Projects [InnovFund-2022-LSC-04-PILOTS]	€39,475,000
	Sustainable dispatchable Energy enabled by wAve-Wind OffshoRe plaTforms with onboard Hydrogen [SEAWORTHY]		€26,000,000
Grant aid values shown in italics includes the grant aid contribution from the UK Government's Horizon Europe Guarantee Fund provided to UK participants.			

4.1.2 National & Regional funded projects

The countries and regions of the OE IWG identified commitments of more than 50.2 million EUR in grant aid from national and regional programmes to thirty-eight (38) ocean energy related projects in 2023 (Figure 2).

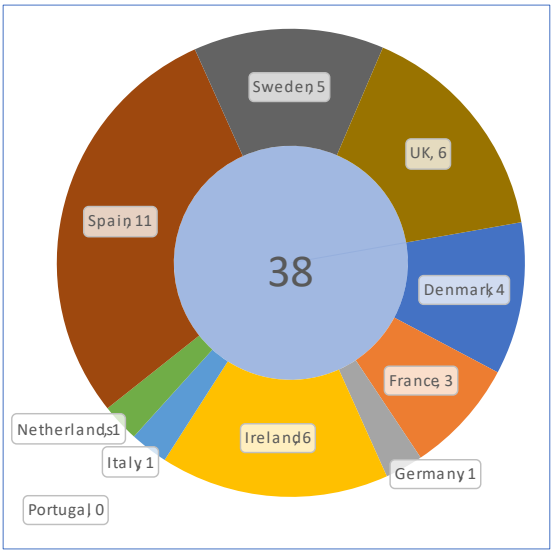
In addition to this investment, France announced a significant commitment of 75 million EUR from its "France 2030" programme [22] to the FloWatt tidal stream project being developed by HydroQuest and Qair that will see seven (7) 2.5MW tidal stream turbines deployed in Normandy's Raz Blanchard.

Spain's Renmarinas Demos Program [23], part of Spain's Recovery and Resilience Plan, is also worthy of note. The programme is directing European funding to support pilot projects and test platforms and infrastructures in the marine renewables sector. Its first call, launched in 2023, committed a little over 40.7 million EUR to eleven (11) projects relevant to the ocean energy sector:

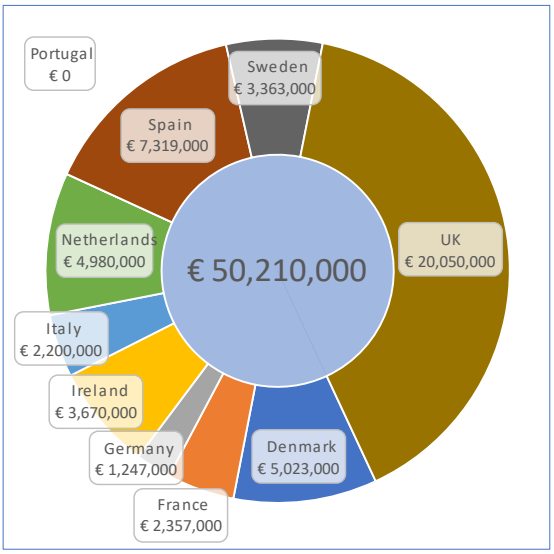
- Some 28.8 million EUR committed to six (6) projects to create or extend the functionality of test platforms and infrastructures (sub-programmes 1 and 2);
- Some 12.0 million EUR committed to five (5) wave energy technology deployment projects (sub-programme 3).

FIGURE 2: NATIONAL & REGIONAL COMMITMENTS TO OCEAN ENERGY PROJECTS IN 2023: (A) NUMBER OF PROJECTS (B) GRANT AID.

(A)



(B)



[22] https://anr.fr/en/france-2030/france-2030/

[23] https://www.idae.es/ayudas-y-financiacion/programa-renmarinas-demos.

Of the thirty-eight nationally and regionally funded projects, the majority were associated with the wave technology sub-sector (21). Only four (4) were associated with the tidal stream (4) sub-sector, while the tidal range and the ocean thermal energy conversion (OTEC) sub-sectors had one project each. The remaining eleven (11) projects were technology agnostic, i.e., applying to the ocean energy sector generally (Figure 3).

Twenty-nine (29) of the thirty-eight (38) projects have an association with an IP Action (Figure 4).

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

- Danish support for Wavepiston AS [Wave] and Floating Power Plant AS [Wave-Hybrid]
- French support for Seaturns SAS [Wave]
- German support for SINN Power GmbH [Wave]
- Spanish support for Renewable Ocean Energy SL [Wave]
- UK support for Flex Marine Power Ltd [Tidal Stream]

1.3 Improvement and demonstration of PTO and control systems

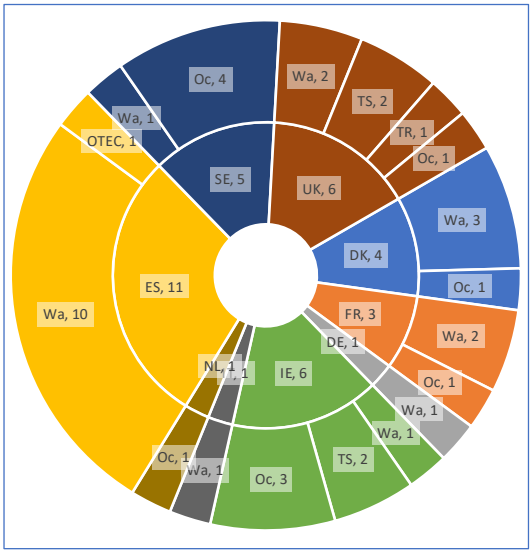
- Danish support for Crestwing ApS [Wave]
- Irish support for Maynooth University [Wave
- Spanish support for Carnegie Technologies Spain [Wave] and for five companies participating in the first phase of the TurboWave precommercial procurement programme.

1.4 Application of innovative materials from other sectors

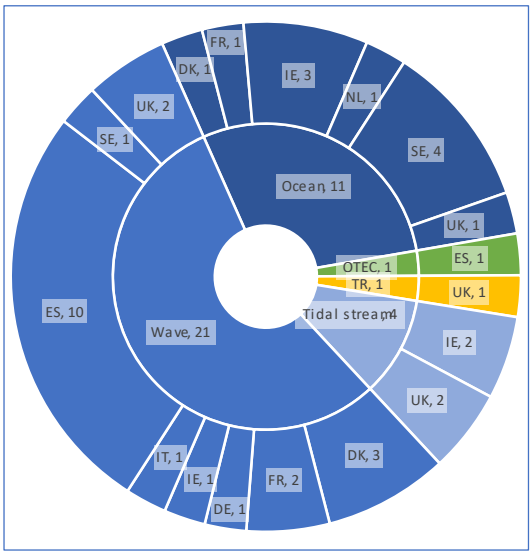
- Swedish support for all Swedish participants in two Clean Energy Transition Partnership projects led by Research Institutes of Sweden AB [Ocean]

FIGURE 3: NATIONAL & REGIONAL COMMITMENTS TO OCEAN ENERGY PROJECTS IN 2023: NUMBER OF PROJECTS (A) BY COUNTRY AND BY SUB-SECTOR; (B) BY SUB-SECTOR AND BY COUNTRY.

(A)



(B)



1.5 Development of novel wave energy devices

- French support for IDEE Services AS [Wave]
- Italian support for ENEA/Politecnico di Torino [Wave]
- Swedish support for OE Systems AB [Wave]

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

- Irish support for CTL Tástáil Teo [Tidal Stream]

1.7 Advanced mooring and connection systems for floating ocean energy devices
- Irish support for four projects led by ORPC Ireland [Tidal Stream], University College Dublin [Ocean], Atlantic Technological University [Ocean] and Trinity College Dublin [Ocean]
- Swedish support for all Swedish participants in a Clean Energy Transition Partnership project led by Research Institutes of Sweden AB [Ocean]

1.10 Instrumentation for condition monitoring and predictive maintenance
- Spanish support for Ocean Oasis AS [Wave]
- Swedish support for all Swedish participants in a Clean Energy Transition Partnership project led by Research Institutes of Sweden AB [Ocean]

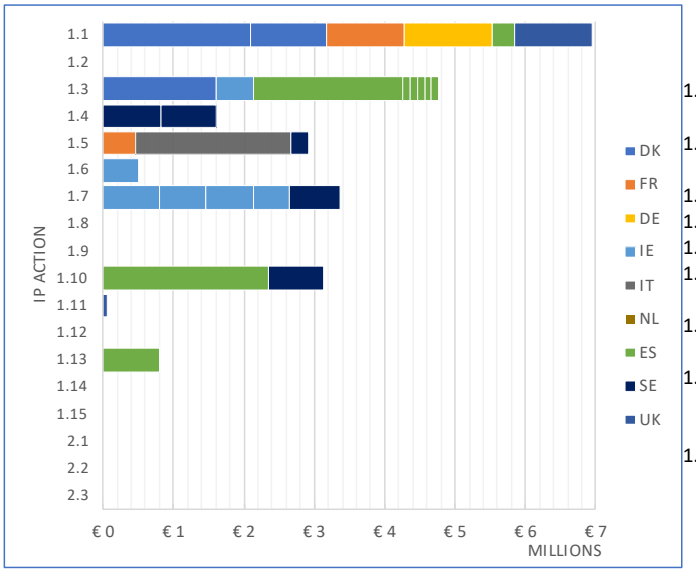
1.11 Developing and demonstrating near-commercial application of ocean energy in niche markets and hybrid systems.
- UK support for Wave Venture Ltd. [Wave]

1.13 Marine observation and modelling to optimise design and operation of ocean energy device
- Spanish support for Fundacion Tecnalia Research & Innovation [Wave]

However, nine (9) of the thirty-eight projects, with a combined commitment of some €26.1 million (a little over half of the total commitment identified for 2023) could not be associated directly with any IP Action. French support for DEEPRUN [OTEC] to develop new materials for deep water extraction

- Danish support for Aalborg University's participation in IEA-OES Task 10 (WEC modelling) activities
- French support for France Energies Marines to develop methodologies for optimal integration of marine renewable energy in islanded-grids & off-grid applications.
- Dutch support for the Offshore For Sure project assisting five offshore renewable energy technology developers (including wave and tidal stream) with specialist advice.
- Spanish support for BiMEP and IH Cantabria for business development activities, and for Enerbasque SL to develop a proof of concept for a hybrid OTEC system.
- UK support for Jacobs UK Limited [Tidal range, low head turbine development], Ingine Wave Energy Systems Ltd [Wave, feasibility study], Oxford University [Tidal stream], and the Supergen ORE Impact Hub 2023 led by the University of Plymouth [Ocean].

FIGURE 4: NATIONAL AND REGIONAL COMMITMENTS TO OCEAN ENERGY PROJECTS IN 2023: PROJECTS GROUPED BY ASSOCIATED IMPLEMENTATION PLAN ACTION



1.1 Demonstration of ocean energy devices to increase experience in real sea conditions
1.3 Improvement and demonstration of PTO and control systems
1.4 Application of innovative materials from other sectors
1.5 Development of novel wave energy devices
1.6 Improvement of tidal blades and rotor
1.7 Advanced mooring and connection systems for floating ocean energy devices
1.10 Instrumentation for condition monitoring and predictive maintenance
1.11 Developing and demonstrating near-commercial application of ocean energy in niche markets and hybrid systems.
1.13 Marine observation and modelling to optimise design and operation of ocean energy device

4.2 Progress against the Technical actions (including gap analysis)

The assessment of progress in delivering the investment in each Technical theme action has been updated [24]. The assessment focusses on the seventeen (17) priority topics of the 2021 SRIA, topics that are replicated in the fifteen (15) actions of the IP's Technical theme [25].

4.2.1 Overview

The SRIA recommends that to address the issues represented by the priority topics associated with wave and tidal stream energy technology would require some €664 million of public finance across 148 projects of varying size over the period 2021 to 2025 [26].

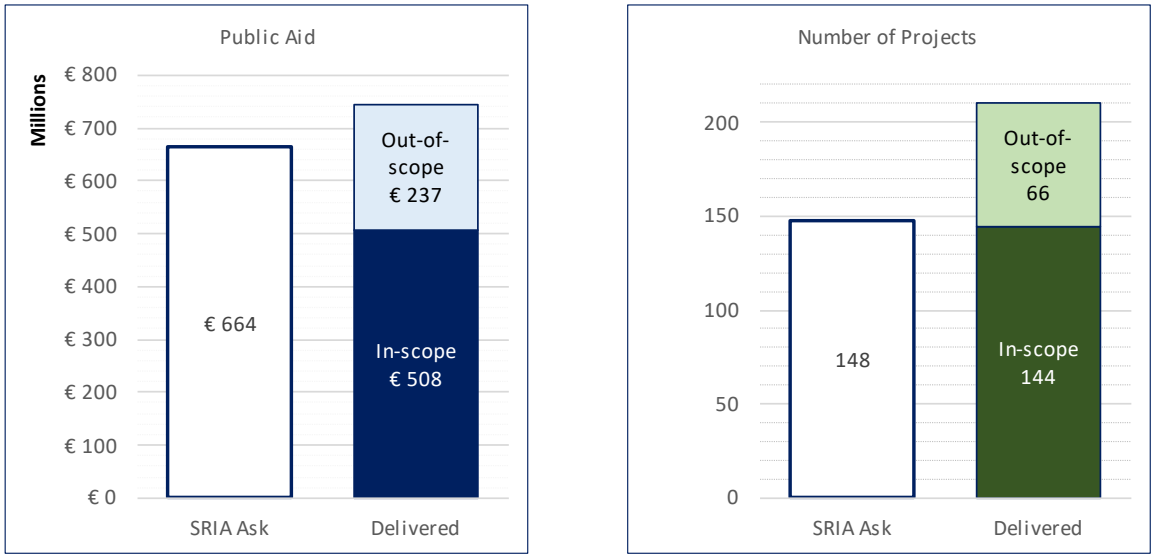
The current assessment has identified 210 projects receiving public grant aid of some €745 million [27] (Figure 5)..

- 144 projects addressed a priority topic (i.e., considered 'in-scope') receiving €508 million in public aid.
- 66 projects, receiving €237 million in public aid, did not address a priority topic directly (i.e., considered 'out-of-scope').

The in-scope projects represent approximately the SRIA's recommended number of projects and approximately three-quarters of the recommended public grant aid. On this basis, progress remains on track to meet the SRIA recommendations in terms of committed grant aid. However, the typical project grant aid is typically lower than the SRIA recommendation; a greater number of smaller projects are being supported.

The consequence of this observation in relation to achieving the objectives of the priority topics is not certain. While it is conceivable the objectives may be met through a greater number of lower valued projects, this is not

FIGURE 5: SRIA RECOMMENDATIONS AND KNOWN COMMITMENTS BY GRANT AID AND NUMBER OF PROJECTS.



[24] The previous assessment was undertaken in collaboration with the UK's Supergen Offshore Renewable Energy Hub (ORE Hub) with the study's report published in July 2023: "Research and Innovation for Wave and Tidal Stream in the UK and EU: A 2023 Summary" [https://www.policyandinnovationedinburgh.org/research-and-innovation-for-wave-and-tidal-stream-in-the-uk-and-eu-a-2023-summary.html]

[25] One SRIA priority topic, namely 1.7 [Development of other ocean energy technologies], is omitted as an IP technical action. The SRIA priority topic 6.1 [Improvement of the environmental and socioeconomic impacts of ocean energy] effectively equates to the three IP's Environmental, Policy and Socioeconomic actions.

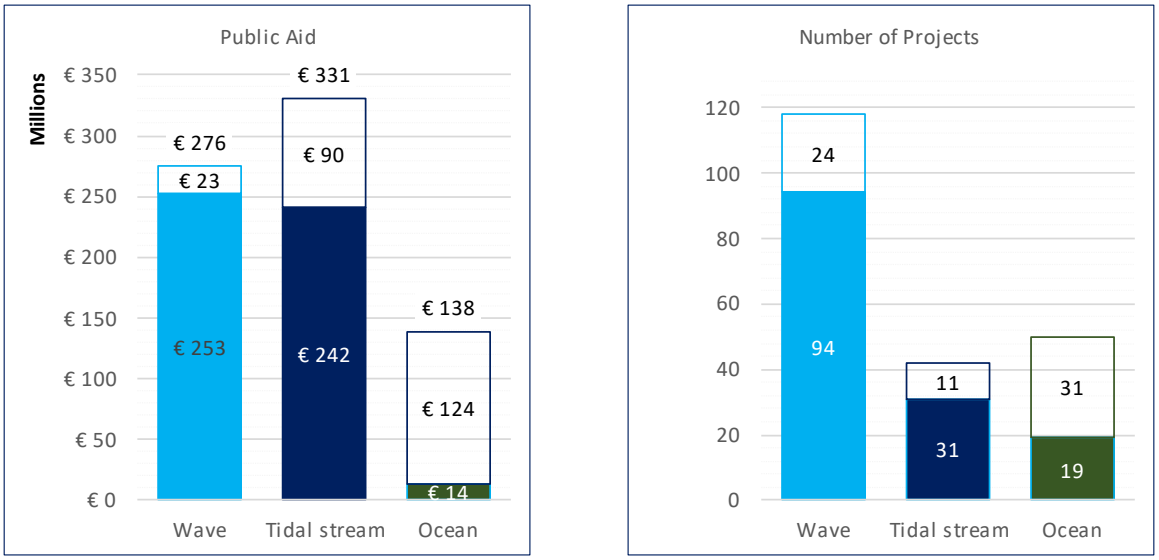
[26] The stated values represent those SRIA priority topics focussed on the wave and tidal stream energy sub-sectors, i.e., SRIA priority topic 1.7 [Development of other ocean energy technologies] was excluded in the study.

[27] Projects which concluded before or during 2021 have been excluded from the assessment on the basis that they would not have been responding to the recommendations of the SRIA.

what the sector identified in the SRIA as being required to accelerate development and realise cost-reductions. Low value projects are frequently synonymous with low technology readiness level (TRL) activities, and it is certain that the ocean energy sector will not achieve industrial scale development with a disproportionate focus on low TRL activity.

The grant aid committed to in-scope wave sub-sector projects is broadly equivalent to that committed to in-scope tidal stream sub-sector projects, however, projects in the wave sub-sector outnumber those in the tidal stream sub-sector by three-to-one (Figure 6).

FIGURE 6: KNOWN GRANT AID COMMITMENTS AND NUMBER OF PROJECTS BY SUB-SECTOR.

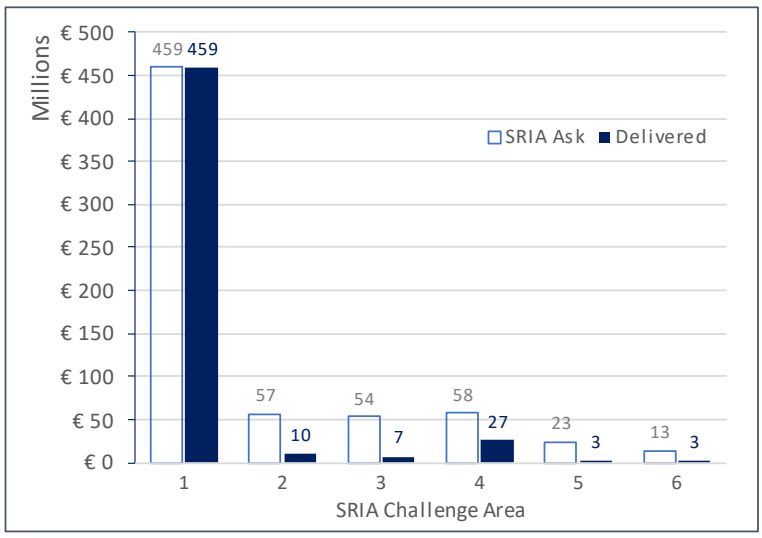


4.2.2 IP Actions

This assessment has been undertaken at the start of the fourth year of the five-year SRIA period.

The categorisation of the 144 in-scope projects with an associated priority topic reveals progress is not consistent across all Challenge Areas (Figure 7) and Priority Topics (Figure 8).

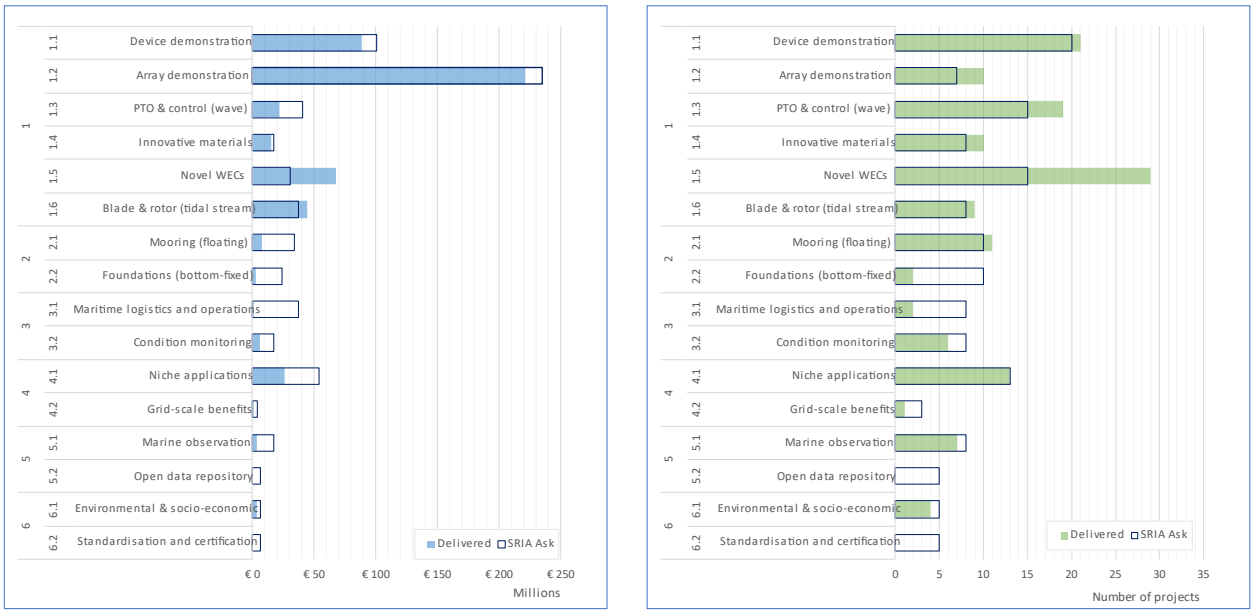
FIGURE 7: GRANT AID ACROSS THE SRIA CHALLENGE AREAS



Notable observations are:

1) The six topics of Challenge Area 1 have each received the expected or greater attention than recommended in terms of the number of projects and collectively have received the combined recommended public grant aid anticipated for this Challenge Area. However, two topics display both an over and under investment:
   - Topic 1.5 [Development of novel wave energy devices] continues to receive greater attention than anticipated, the assessment identifying twice as many projects receiving more than double the anticipated grant aid;

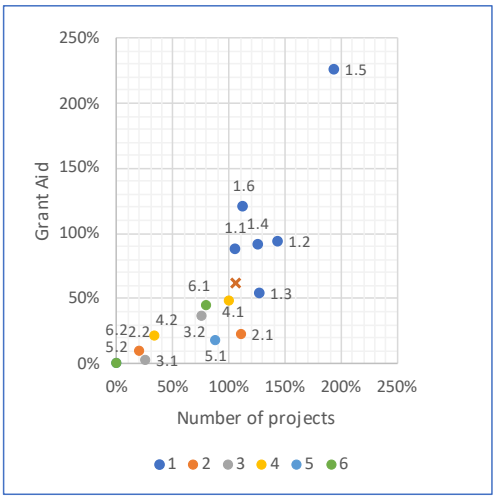
FIGURE 9: PROGRESS AGAINST RECOMMENDATIONS FOR EACH PRIORITY TOPIC BY GRANT AID AND NUMBER OF PROJECTS.



- Topic 1.3 [Improvement and demonstration of PTO and control systems (wave)] has received a little more than half the anticipated grant aid, despite more projects than anticipated being identified.

2) The remaining five Challenge Areas are characterised by a substantially lower level of grant aid than anticipated, typically between 10 and 20%, despite the anticipated number of projects being identified in many of the individual topics. An exception is Challenge Area 4 which has received roughly half the anticipated grant aid primarily due to projects identified as targeting Topic 4.1 [Developing and demonstrating near-commercial application of ocean energy in niche markets and hybrid systems].

FIGURE 8: PROGRESS AGAINST RECOMMENDATIONS BY CHALLENGE AREA.



3) Two topics have yet to receive any attention:
   - Topic 5.2 [Open-data repository for ocean energy]; and,
   - Topic 6.2 [Standardisation and certification].

4.3 Progress against the Environmental, Policy and Socioeconomics actions

Three (3) actions are presented in the Environmental, Policy and Socioeconomics theme.

4.3.1 Environmental consenting

Action 2.1 concerns the streamlining of the consenting process [28] to accelerate the deployment of ocean energy technology while protecting the marine environment.

While no update on the progress of streamlining national consenting processes is provided in this report, it is noted that accelerating the consenting process for renewable energy projects is a priority for the European Commission. Directive (EU/2023/2413), which entered into force in November 2023, amends the Renewable Energy Directive (EU/2018/2001) to introduce upper time-limits for the permit-granting process for renewable energy projects, and, the concept of renewable acceleration areas [29] in which the permit-granting process is subject to shorter time-limits (Article 16a):

- not exceeding two years, for offshore renewable energy projects,
- not exceeding six months, for new projects with a capacity of less than 150kW and for repowering of existing plant.

Member States are required to adopt plans designating renewable acceleration areas for one or more types of renewable energy sources by February 2026.

Meanwhile, OES has a permanent task maintaining an overview of the consenting processes for ocean energy in most of the countries represented on the OE-IWG [30].

This action will be the subject of closer scrutiny in the next annual report.

4.3.2 Maritime Spatial Planning

Action 2.2 concerns using the maritime spatial planning process to support the deployment of ocean energy and particularly using the process to assist in achieving the targets published in the EU Strategy on Offshore Renewable Energy.

The Maritime Spatial Planning Directive required the twenty-two (22) coastal EU Member States to produce maritime spatial plans (MSPs) for the marine waters under their jurisdiction by March 2021, and to review them at least every ten years. This includes the twelve (12) EU Member States represented on the OE-IWG.

By the end of 2023, eleven (11) of the twelve (12) EU Member States represented on the OE-IWG had an approved MSP: the Spanish MSP was approved in February; the Cypriot MSP was approved in December [31].

The remaining OE-IWG member, Italy, is finalising its MSP following public consultation and expects to complete the process by the end of 2024.

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[28] The process of securing the permits, licenses and other forms of authorisation necessary to allow the deployment of ocean energy technology.

[29] Directive EU/2023/2413 defines a “renewable acceleration area” as an area designated as particularly suitable for the installation of renewable energy plants.

[30] https://www.ocean-energy-systems.org/oes-projects/consenting-processes-for-ocean-energy-on-oes-member-countries/

[31] The European Maritime Spatial Planning Platform, an information and communication gateway supporting EU Member States implement maritime spatial planning, summarises the status of each country’s maritime spatial plan [https://maritime-spatial-planning.ec.europa.eu/]

TABLE 8: COMMENTARY ON THE MARITIME SPATIAL PLANS OF THE OE-IWG COUNTRIES

Country	Commentary
Belgium	First issue covering the period 2014-2020. Designated one zone for offshore renewable energy. Second issue covering the period 2020-2026. Designates three additional zones for offshore renewable energy. Explicitly mentions offshore wind, wave, and tidal stream. **Consultation on third issue (2026-2034) initiated in Q2 2023.** **Study investigating additional zoning for offshore renewable energy ongoing.**
Cyprus	**Approved in December 2023.**
Denmark	Adopted in March 2021. Designated development zones for offshore renewable energy. No explicit mention of ocean energy. **In the second half of 2023, new offshore energy targets were agreed, doubling of the area designated for renewable energy and energy islands to approximately 30% of the sea area. Public consultation launched. A revised issue expected 2024.**
Finland	First issue approved in December 2020 covering the period to 2030. Designates development zones for offshore renewable energy but identifies these with offshore wind explicitly. No explicit mention of ocean energy. **A revision process initiated at the start of 2024. A revised issue is expected by 2026.**
France	Four sea basin MSPs approved between April and May 2022: East Channel-North Sea; North Atlantic-West Channel; South Atlantic; Mediterranean. The provision for ocean energy (particularly) and offshore renewable energy (generally) is not clear. **Public consultation on new offshore renewable energy zones was initiated at the end of 2023**.
Germany	First issue came into force in 2009 (two distinct plans: one for the North Sea and one for the Baltic Sea). Second issue came into force in 2021 (a single plan). Designates development zones for offshore wind. Area plans include a limited provision for 'Other energy generation' which theoretically includes ocean energy.
Ireland	National Marine Planning Framework presents a set of planning policies relating to offshore renewable energy. Spatial designations for future activity, including offshore renewable energy, to be developed through Designated Marine Area Plans (DMAPs) for specific maritime areas.
Italy	Draft MSP issued for public consultation in the autumn of 2022.
Netherlands	First issue in 2009 (known as North Sea Policy Document). Second issue in 2015 covering the period 2016-2021. Third issue in 2022 covering the period 2022-2027 (part of the North Sea Programme 2022-2027). Designates zones for offshore wind (pre- and post-2030). No explicit provision for ocean energy is foreseen in the present planning period, however, actions to assess the potential of ocean energy technologies are anticipated (actions 47-49). **A revision process initiated to increase offshore renewable energy targets (deliver 50 GW by 2040). Process to be completed in September 2025.**
Portugal	First issue came into force in 2019. The Situation Plan is the primary instrument, supplemented by Allocation Plans that allocate uses and activities not identified in the Situation Plan. Designates a 'pilot zone' for offshore renewable energy demonstration projects (Viana do Castelo) where activities are not subject to the usual title assignment requirements (TUPEM). Indicates intention to expand an area with an existing private use of the sea (TUPEM) permit for a previous wave energy demonstration project (Almagreira, Peniche).
Spain	**Adopted MSPs for each of its five marine subdivisions in February 2023** [North Atlantic; South Atlantic; Estrecho and Alboran; Levantine-Balearic; Canary Islands].
Sweden	Separate MSPs for each of three marine areas [Gulf of Bothnia; Baltic Sea; Skagerrak/Kattegat]. Designates zones for offshore renewable energy (explicitly offshore wind and wave). **MSPs under review to accommodate new electricity generation targets for offshore wind. Proposals expected by the end of 2024.**

The following observations are noted regarding the approved MSPs

- Designated zones for ocean energy production: None [Although Portugal intends to extend an existing private use of the sea (TUPEM) permit for a wave energy demonstration project].
- Designated zones for offshore renewable energy production: Belgium, Denmark, Finland, Germany, The Netherlands, and Sweden. These zones are almost exclusively associated with offshore wind development, although Belgium, Germany and Sweden mention ocean energy in relation to these zones.

Other pertinent observations

- Several MS initiated revision processes to introduce additional zoning for offshore renewable energy in response to increased capacity targets [Belgium; Denmark; Finland; France; Netherlands; Sweden].

The extent to which the aim of this action has been achieved in the current adopted maritime spatial plans is unclear.

The revision processes underway currently in several MS provide an opportunity to ensure provision for the deployment of ocean energy technologies is incorporated. OE-IWG member countries should engage with their review processes.

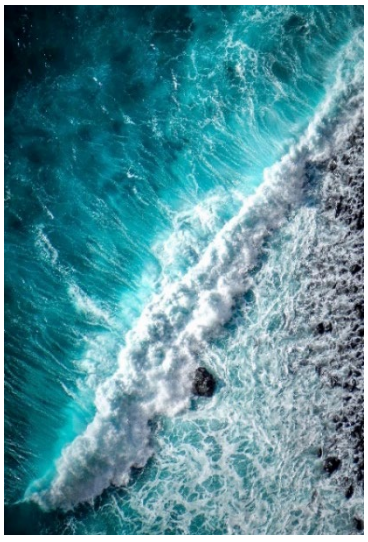
The Commission's review of the preparation of MS maritime spatial plans [32] highlighted the lack of clear targets in the various sectors active in the maritime space created difficulties in prioritising maritime space uses and allocating space at sea to enable various economic activities and achieve various policy objectives, while at the same time protecting the environment or leaving space for future uses.

The targets pertaining to ocean energy published in the EU Strategy on Offshore Renewable Energy should be used as the basis for targets in MSPs.

4.3.3 Promoting political support & public backing for ocean energy

Action 2.3 concerns the identification and assessment of the socio-economic impact of ocean energy deployments by reviewing the supply and value chain structure, industry plans, social acceptance, and education needs to establish the best routes to favour developers, communities and the EU, with a particular focus on European islands with significant endogenous resource.

A mechanism for monitoring progress in this action has not been established.



[32] Commission Communication COM(2022) 185 final, published May 2022. [https://oceans-and-fisheries.ec.europa.eu/news/european-commission-report-implementation-maritime-spatial-planning-directive-good-progress-more-2022-05-03_en]

4.4 Progress against the Market Uptake and Financial theme actions

Five (5) actions are presented in the Market Uptake and Financial theme.

4.4.1 Revenue support

The current situation concerning revenue support for the first wave and tidal stream demonstration projects [Action 3.1] is presented in section 2.2.

Although general technology agnostic revenue support schemes continue to prevail, examples exist of restricted schemes in which a sub-set of technologies are grouped and compete amongst themselves (France, Spain) and of derogations within general schemes that guarantee support irrespective of technology type (France, Italy).

The effectiveness of dedicated single technology schemes continues to be demonstrated in the UK's Contract-for-Difference scheme. Recent allocation rounds (AR4, AR5 & the in-process AR6) have included ring-fenced support for tidal stream within the emerging technologies grouping (providing dedicated support in an otherwise restricted scheme). To date, this approach has resulted in fifteen contracts for a little under 94MW of tidal stream capacity to be delivered in the period 2025 to 2028.

The implementation of restricted and dedicated schemes should be continued and expanded to other jurisdictions.

4.4.2 Investment Support Fund

Action 3.2 concerns the creation of a Common Investment Support Fund that would provide flexible capital for ocean energy projects.

The action anticipated a feasibility study to consider the viability of such a fund. There is no evidence to suggest that this study has been undertaken.

4.4.3 Insurance and Warranty Fund

Action 3.3 concerns the creation of a European insurance and warranty fund to underwrite certain technology-related financial risks associated with pre-commercial ocean energy projects. Commercial insurance for such risks does not exist currently and the fund would lower the cost of capital and overall cost of these pre-commercial ocean energy projects.

Progress to date has been two studies:

- A feasibility study considered how such a fund might be established and operated [33].
- A follow-on study providing greater detail of the preferred form (a protected cell company (PCC)), governance structure, and types of risk coverage that could be provided [34].

The cooperation of relevant national and regional industry bodies must now be enlisted to support approaches to European, national and regional governments to secure the finance to establish an ocean energy insurance entity based in the proposed PCC structure. This remains an open activity.

4.4.4 Funding of demonstration and innovation projects

Action 3.4 concerns the funding of projects to address the actions of the IP, particularly those of the Technical theme. The current situation is presented in section 4.2.

[33] 'Design Options for an Insurance and Warranty Fund', July 2021, OceanSET project. https://www.etipocean.eu/wp-content/uploads/2022/04/OceanSET_Design-Options-for-an-Insurance-and-Gurantee-Fund.pdf.

[34] 'The Ocean Energy Accelerator', October 2022, Tidal Stream Industry Energiser (TIGER) project. https://interregtiger.com/download/tiger-report-the-ocean-energy-accelerator/

4.4.5 Novel public funding mechanisms

Action 3.5 concerns the use of innovation procurement mechanisms to overcome the difficulties of securing private finance to match conventional grant aid support for R&D. The action is particularly focussed on supporting (a) the development and demonstration of utility-scale wave energy converters and (b) the operation of small demonstration wave or tidal stream arrays.

Pre-commercial procurement is proving to be an effective mechanism for public agencies to support R&D in the ocean energy sector through the purchase of targeted R&D services.

Wave Energy Scotland's Programmes: The PCP mechanism was the basis for the five (5) development programmes undertaken by Wave Energy Scotland to date [35].

EuropeWave: A cross-border collaborative R&D programme for wave energy systems [36]. The PCP process awarded seven (7) &D services contracts for Phase 1 (Jan 2022), five (5) contracts for Phase 2 (September 2022), and three (3) contracts for the final phase (September 2023). Phase 3 will culminate with the deployment and operation of three large-scale prototypes in 2025 at the test sites of BiMEP in the Basque Country and EMEC in Scotland.

TurboWave: The Basque Energy Agency's TurboWave PCP programme is developing air turbine technologies tailored to a wave power application generally and specifically to the technical requirements of the Mutriku wave power plant. Five (5) R&D service contracts for Phase 1 were awarded in July 2023 following an open procurement exercise. Four (4) contracts were awarded in April 2024 for Phase 2 which is expected to conclude in February 2025.

[35] Wave Energy Scotland ran five (5) programmes between 2015 and 2022: Power take-offs; Novel wave energy converter; Structural materials; Control Systems; Quick Connection Systems. https://www.waveenergyscotland.co.uk/programmes/

[36] The 20 million EUR procurement exercise is being undertaken by a buyers group consisting of Wave Energy Scotland (Scotland, UK) and the Basque Energy Agency (Basque Country, Spain). The procurement is funded in part by the Horizon 2020 programme. https://www.europewave.eu/

5. Technical Progress

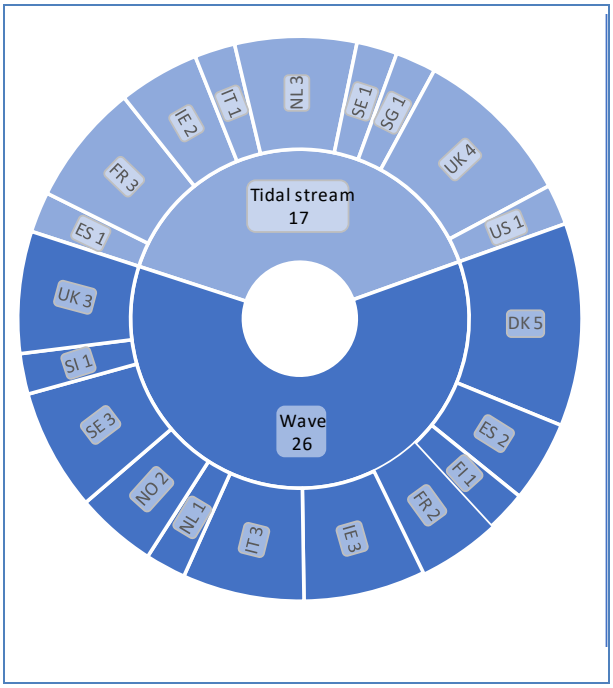
The deployment of 100 MW of ocean energy capacity by 2027 represents the principal target of the technical actions of the implementation plan for ocean energy, together with a pathway to achieving a levelised cost of energy (LCOE) of 15cEUR/kWh by 2030 [tidal stream] and by 2035 [wave] [37].

An assessment of the timeline of known current and planned deployments of both wave energy and tidal stream energy systems in European waters has been prepared through direct engagement with the technology and project developers.

A request for information (RfI) was issued to forty-four (43) technology and project developers [38] identified as actively pursuing the deployment of whole-system wave and tidal stream technologies in European waters [39] (Figure 10). Developers were invited to provide administrative information of current and planned deployments.

Responses from twenty-seven (27) developers were received. This information was augmented with publicly available information.

FIGURE 10: DEVELOPER REQUEST FOR INFORMATION. INNER: BY SUB-SECTOR; OUTER: BY COUNTRY.



5.1 Whole system deployments

The following analysis is based on deployment projects where an installation date has been identified (actual or anticipated) [40].

Known deployments of wave energy and tidal stream systems in the period from 2020 to 2031 are presented in Figure 11 and Figure 14 respectively. The data presented considers deployments that are complete (i.e., the devices have been recovered and the deployment decommissioned), are currently operational, are under-construction, or are in-development. In the latter two categories, the installation date is provisional and subject to change. In all categories other than 'complete', the deployment duration is as intended and subject to change.

[37] The target date for achieving 100MW installed capacity has been revised to 2027 (from 2025) to align with the recommendation of the Commission's review of its Offshore Renewable Energy Strategy published in October 2023 [Communication C(2023) 668: Delivering on the EU offshore renewable energy ambitions].

[38] A technology developer being an entity whose primary activity is the development of a technology. A project developer being an entity whose primary activity is the development of a project that will use a technology developed by a technology developer. A technology developer frequently adopts the role of project developer in the latter stages of the technology development process when demonstrating the technology at full-scale.

[39] The entity (the technology or project developer) leading the deployment can be registered in a non-European country.

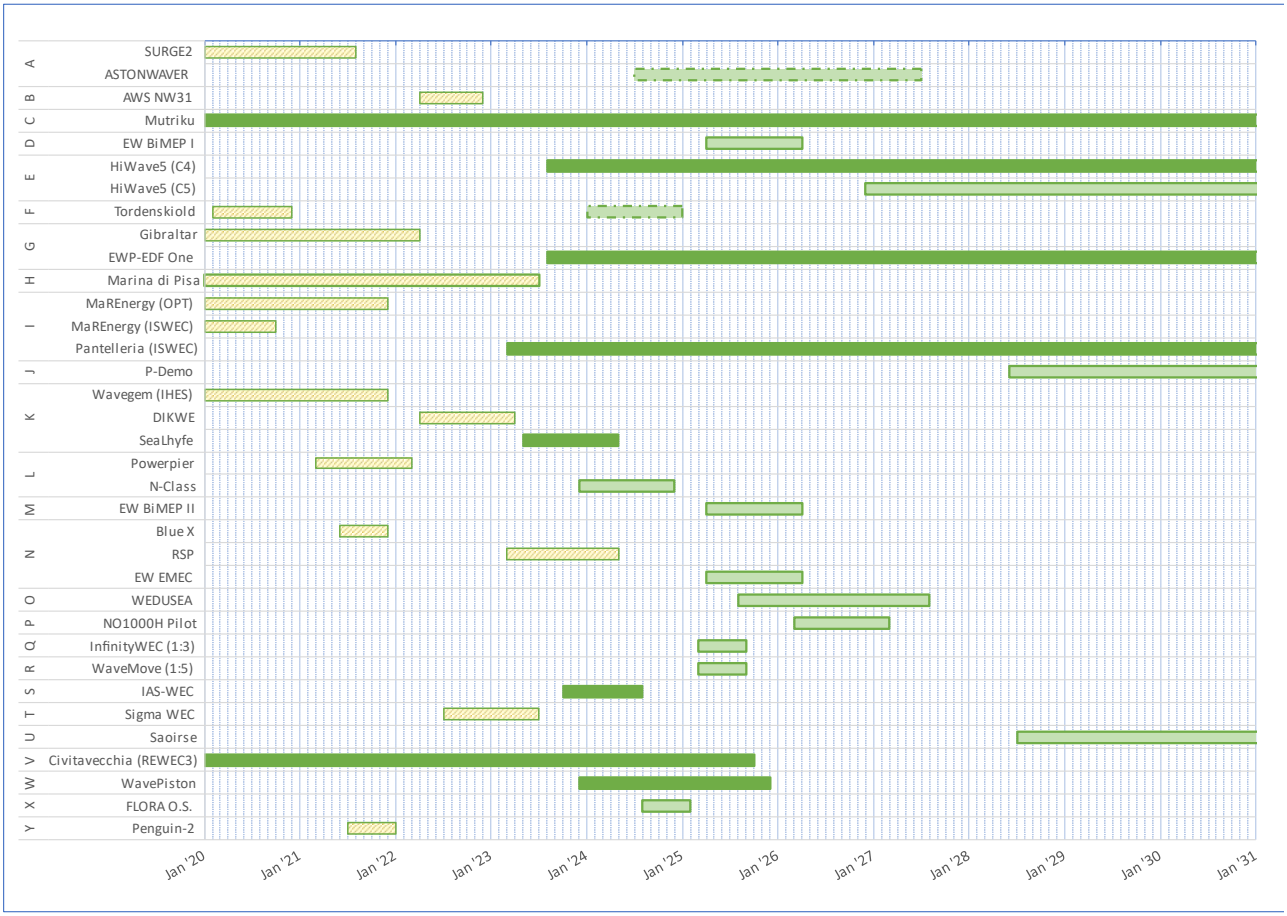
[40] The analysis omits certain known deployment projects where an installation date was not provided or not be identified.

5.1.1 Wave energy systems

Twenty-five (25) companies (twenty-one categorised as technology developers, four categorised as project developers) have been identified as progressing a total of thirty-five (35) deployment projects in the period 2020 to 2031. At the end of 2023, eight (8) deployments were considered operational, twelve (12) had been decommissioned and the remaining fifteen (15) were categorised as being 'in-development', 'approved' or 'construction'.

A further two (2) projects were reported as 'suspended', meaning project development has been paused temporarily with an intention to review circumstances periodically and restart development should circumstances be favourable. 'Suspended' projects are not included in the analysis.

FIGURE 11: TIMELINE OF WAVE ENERGY SYSTEM DEPLOYMENTS 2020-2031 (AS OF DECEMBER 2023).



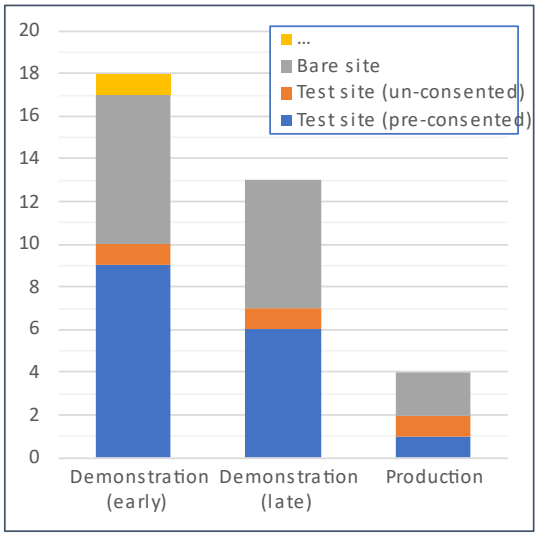
Decommissioned	A	AW-Energy	J	Floating Power Plant	R	OE Systems
Operational	B	AWS Ocean Energy	K	GEPS Techno	S	Seaturns
In development (Confirmed)	C	Biscay Marine Energy Platform	L	Havkraft	T	Sigma Energy
In development (Unconfirmed)	D	CETO Wave Energy Ireland	M	IDOM	U	Simply Blue Group
	E	CorPower Ocean	N	Mocean Energy	V	Wavenergy.IT
	F	CrestWING	O	New Wave Technologies	W	WavePiston
	G	Eco Wave Power Global	P	NoviOcean	X	Wedge Global
	H	Enel Green Power	Q	Ocean Harvesting Technologies	Y	Wello
	I	Eni				

While the distribution of project type [41] again identifies that most deployment projects are categorised as 'Demonstration (early)', the number of projects categorised as 'Demonstration (late)' is increasing which arguably indicates the growing maturity of the sub-sector's technology (Figure 12). The reduction in the number of projects categorised as 'Production' (from six to four) reflects the decision to 'suspend' development of two projects.

Deployments in both 'Demonstration' categories are distributed broadly equally between pre-consented test sites and bare sites.

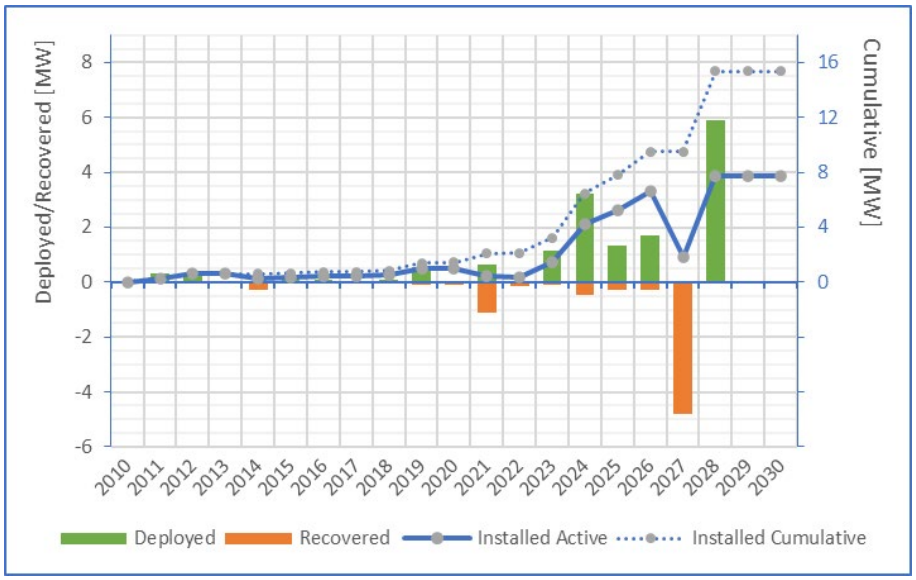
A total capacity of 1.14MW was installed during 2023. A few (3) small deployments were recovered resulting in the active installed capacity at the end of 2023 estimated at approximately 1.46MW (Figure 13).

FIGURE 12: WAVE ENERGY DEPLOYMENT PROJECTS BY PROJECT AND LOCATION TYPE.



The expectation for the three-year period 2024-26 is the deployment of a further 6.2MW. Although much of this capacity is expected to be recovered during 2027 as it is associated with the short-duration deployments characteristic of the 'Demonstration (late)' category, a similar capacity is currently scheduled for deployment in 2028 by two projects.

FIGURE 13: INSTALLED CAPACITY OF WAVE ENERGY TECHNOLOGY: ACTUAL AND ANNOUNCED.

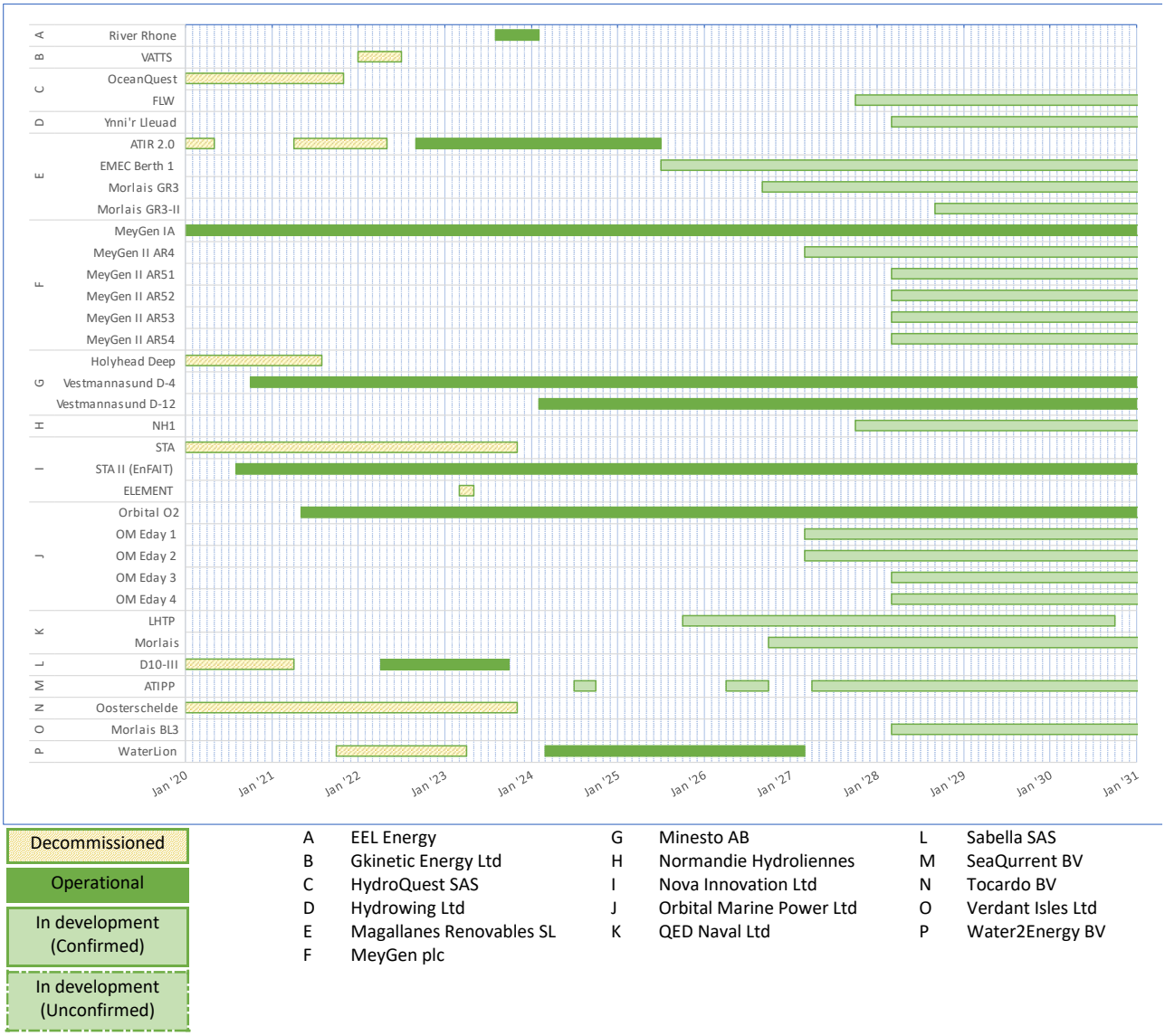


[41] 'Demonstration (early)' – typically deployments of a single partial-scale device for periods of up to 12 months, corresponding to OES Stage 3 (TRL5-6).
'Demonstration (late)' – typically deployments of a single full-scale first-of-a-kind device for periods of between 12 and 24 months, corresponding to OES Stage 4 (TRL7-8).
'Production' – typically deployments of multiple devices for periods in excess of 2 years, corresponding to OES Stage 5 (TRL8-9).

5.1.2 Tidal stream systems

By the end of 2023, sixteen (16) companies (of which three are categorised as project developers) were identified as actively progressing a total of thirty-four (34) deployment projects in the period 2020 to 2030, an increase that is largely due to the eleven (11) projects awarded contracts in AR5 of the UK's CfD scheme and due to be commissioned in 2027/28.

FIGURE 14: TIMELINE OF TIDAL STREAM ENERGY SYSTEM DEPLOYMENTS 2020-2031 (AS OF DECEMBER 2023).



Only two (2) short-term deployments are noted during 2023 with recovery occurring after a few months of operation.

Four (4) significant projects continued to operate

- Magallanes Renovables' ATIR 2.0 device at EMEC's Fall of Warness test-site
- Phase 1A of Simec Atlantis Energy's Meygen project
- Minesto's deployment of two Dragon-4 devices at Vestmannasund in the Faroes
- Orbital Marine Power's O2 device at EMEC's Fall of Warness test-site

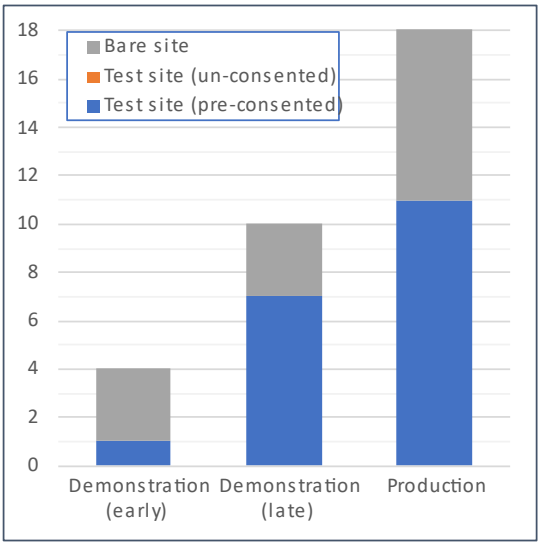
Two (2) long-running deployments were decommissioned during 2023:

- Tocardo's Oosterschelde Tidal Power Plant
- The three initial turbines (Ailsa, Betty and Charlotte) of Nova Innovation's Shetland Tidal Array.

The development of several deployments has been reported as being suspended or cancelled:

- The PHARES project, led by AKUO Energy in partnership with Sabella to provide a multi-source solution for Ushant Island, was terminated in February 2023. A failure to secure authorisation for the onshore wind element undermined the economic model.
- The collapse of Sabella at the end of 2023 resulted in the cancellation of the proposed Gulf of Morbihan, Brittany, deployment in collaboration with 56 Energies.
- Aquantis Inc. has paused development of its proposed deployment at EMEC's Shapinsay Sound scale test site and longer-term interest in deployment at the Morlais site.
- Seapower scrl has paused development of a demonstration of the GEMSTAR device at Messina in the Thyrrenian Sea.

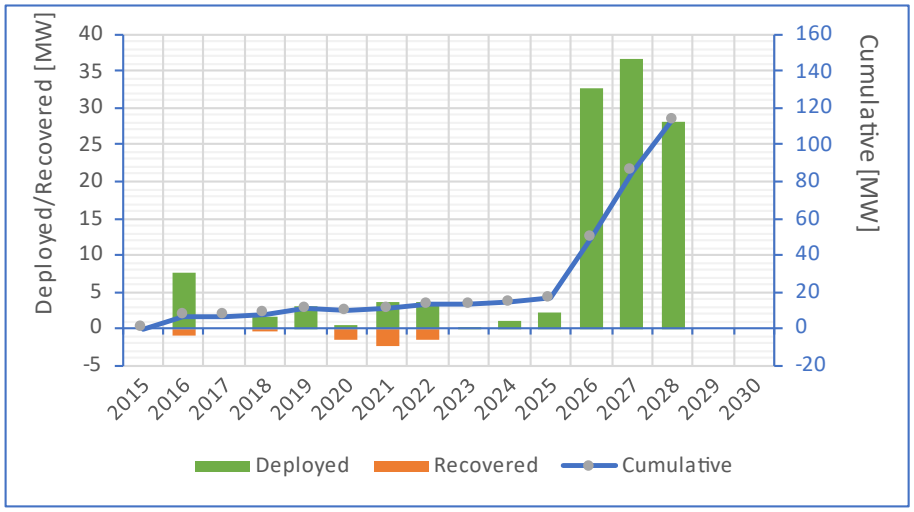
FIGURE 15: TIDAL STREAM ENERGY DEPLOYMENT PROJECTS BY PROJECT AND LOCATION TYPE.



The outcome of the UK's fifth CfD allocation round has shifted the emphasis to 'Production' type deployments, not surprisingly. The benefit of pre-consented test-sites in facilitating these projects is apparent (Figure 15).

Active installed capacity of tidal stream energy deployments at the end of 2023 is estimated at 11.1 MW (Figure 16). This represents a small decrease from that reported at the end of 2022.

FIGURE 16: INSTALLED CAPACITY OF TIDAL STREAM TECHNOLOGY: ACTUAL AND ANNOUNCED.



Little further capacity is expected to be deployed in the period up to the end of 2025. However, a substantial increase in capacity is expected in the following years as projects in the UK and France are commissioned.

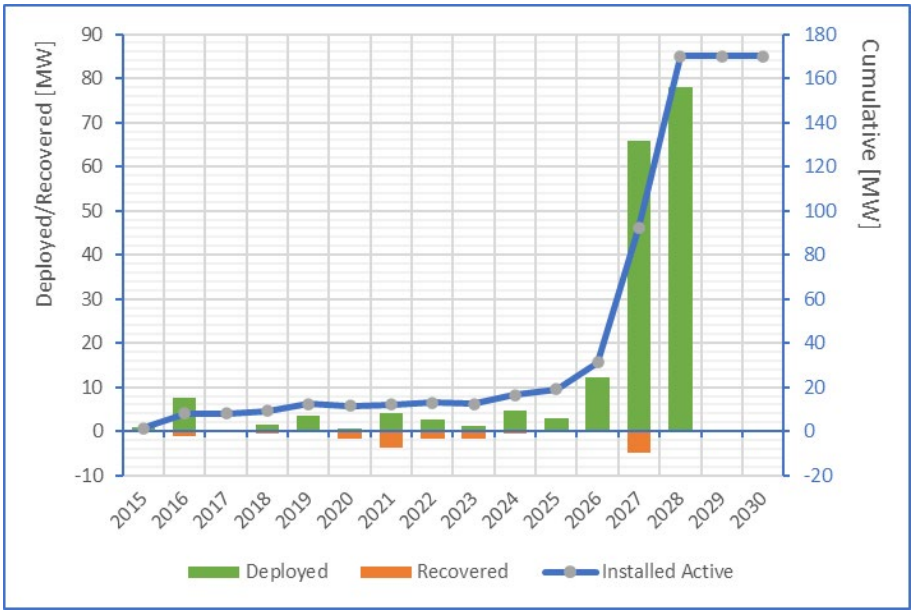
If current installation dates can be achieved the tidal stream sector can expect to see an active installed capacity of approximately 90.3 MW by the end of 2027 and approximately 162.4 MW by the end of 2028.

5.1.3 Ocean energy installed capacity

Combining the information in Figure 13 and Figure 16 provides an indication of the trajectory for the installed capacity of ocean energy technology over time (Figure 17).

The annual increase is expected to be modest through to 2025 with capacity rising from the 12.5 MW at the end of 2023 to 19.2 MW at the end of 2025. This capacity is due to deployments in the wave energy sub-sector.

FIGURE 17: INSTALLED CAPACITY OF OCEAN ENERGY TECHNOLOGY: ACTUAL AND ANNOUNCED.



However, over the period 2026 to 2028, a substantial increase is expected primarily due to deployments in the tidal-stream sub-sector, assuming projects currently 'under-construction' or 'in-development' remain on schedule.

Achieving the Offshore Renewable Energy Strategy's target of 100 MW of ocean energy capacity by 2027, appears to be realisable as desired, or shortly thereafter.

5.2 Techno-economic metrics

Previous OceanSET RfIs have invited developers to provide techno-economic metrics regarding their deployment projects, namely: CAPEX (M€/MW); OPEX (€/kW per annum); Availability (%); Capacity factor (%); Average annual energy production (MWh); and Levelised cost of energy (€/MWh).

The present RfI did not seek this information.

The primary justification for this decision is the limited or partial responses to previous RfIs which made any interpretation potentially unrepresentative of the sub-sectors.

Secondary justifications relate to

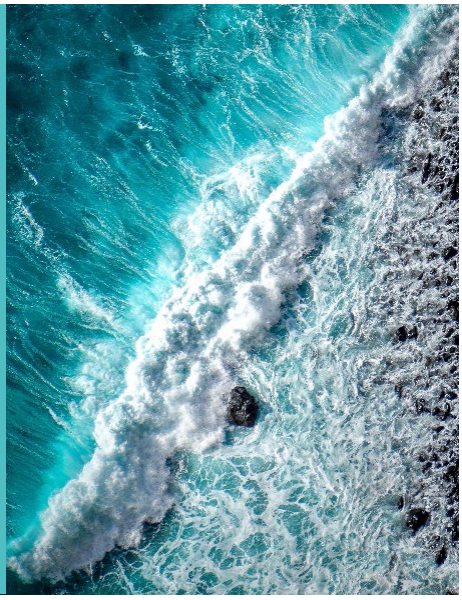
- Project status: Many projects are at an 'in-development' stage making any reported metrics largely aspirational.
- Levelised cost of energy: Developers are generally reluctant to provide this metric regardless of project type or status.

6. Recommendations

Recommendations made in the 2022 Annual Report remain relevant.

A: Continue to argue for explicit national/regional strategies, policies and targets that support the deployment of ocean energy.

Support for offshore renewable energy is clear, however there is a tendency for offshore renewable energy to be interpreted as offshore wind implicitly and to the exclusion of other forms of offshore renewable energy, particularly in the short-term period to 2030. While the zoning of the sea in maritime spatial planning process is making provision for offshore renewable energy production it reveals significant competition for space with other uses. This, combined with a focus on the development of offshore wind in the short-term, risks limiting space for the development of ocean energy in medium-term. The targets for ocean energy expressed in the EU Strategy on Offshore Renewable Energy should form the basis for corresponding targets in national maritime spatial plans.



B: Tailor national and regional funding programmes to address the Implementation Plan's Technical theme actions.

While the funding of research and innovation in the ocean energy sector by European, national and regional programmes does appear to target the actions of Implementation Plan, it appears to be supporting activities at a smaller scale (lower value and arguably lower TRL) than recommended in the Implementation Plan. Furthermore, a significant proportion of the funding appears to support activities not identified in the Implementation Plan or Strategic Research and Innovation Agenda.

C: Evolve existing revenue support schemes to allow ocean energy deployment projects to secure support.

Technology agnostic revenue support schemes continue to prevail, i.e., competitive schemes where all technologies compete on equal terms. However, variants to such schemes restricting competition to groupings of technologies or to a single technology have been successful in securing ocean energy capacity. Derogations from the competitive process for limited (small) capacity deployments can provide guaranteed support for early projects.

D: Identify mechanisms to progress the implementation of a Common Investment Support Fund [Action 3.2].

There is no evidence to suggest that the feasibility study anticipated in this action has been undertaken. The OE-IWG should consider how to determine the feasibility of establishing this fund.

E: Identify mechanisms to progress the implementation of an Insurance and Warranty Fund [Action 3.3].

A preferred form, governance structure, and types of coverage that could reasonably be provided has been developed. The OE-IWG should consider how to support approaches to European, national and regional governments to secure the finance to establish such a fund.

F: Revise the Implementation Plan to reflect the new Strategic Research and Innovation Agenda (SRIA).

A new SRIA for ocean energy, covering the period 2026 to 2030, will be published in the second half of 2024. The OE-IWG should consider revising the Implementation Plan to reflect the new priority research and innovation topics.

Appendix A – Implementation plan technical theme actions

TABLE 9: EXPECTED ACTIVITY IN EACH TECHNICAL THEME ACTION

IP 2021	SRIA [3] 2021	Number of Projects [4]				Budget [1] (€M)	Public Funding [2] (€M)
		Small < €2M	Medium [€2M, €8M]	Large > €8M	Total		
1.1	1.1	-	10	10	20	150	101
1.2	1.2	7 array scale			7	350	235
1.3	1.3	5	10	-	15	60	40
1.4	1.4	5	3	-	8	25	17
1.5	1.5	10	5	-	15	45	30
1.6	1.6	-	5	3	8	55	37
1.7	2.1	-	10	-	10	50	34
1.8	2.2	5	5	-	10	35	23
1.9	3.1	-	5	3	8	55	37
1.10	3.2	5	3	-	8	25	17
1.11	4.1	-	10	3	13	80	54
1.12	4.2	3	-	-	3	6	4
1.13	5.1	5	3	-	8	25	17
1.14	5.2	5	-	-	5	10	7
1.15	6.2	5	-	-	5	10	7
					143	981	657

[1] Budget assumes project values of 2M€ (small), 5M€ (medium), 10M€ (large) and 50M€ (array scale).

[2] Public funding assumed to be 67% of total budget.

[3] One SRIA priority topic, namely 1.7 [Development of other ocean energy technologies], is omitted as an IP technical action. SRIA priority topic 6.1 [Improvement of the environmental and socioeconomic impacts of ocean energy] effectively equates to the IP Environmental, Policy and Socioeconomic actions.

[4] Number of projects are interpreted from the phrases in the IP as: 'few' (3), 'several' (10).

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