Support study for the evaluation of the development of ocean energy policies

Final report

Directorate-General for Maritime Affairs and Fisheries

EUROPEAN COMMISSION

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Directorate A — Maritime Policy and Blue Economy
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Bright ideas. Sustainable change.

RAMBØLL

ABSTRACT

This study report supports DG MARE's evaluation of the European Commission's policy to promote the development of ocean energy. It focuses preliminarily on the Blue Energy Communication (the "Communication") and the Ocean Energy Strategic Roadmap (the "Roadmap"), but also takes into account the evolution of the EU's wider policy towards renewable energy development and energy technology policy, as well as looks at and the interactions with national/regional interventions in the sector. The study provides the Commission with overarching conclusions and lessons learned for the possible future review of the European policy for ocean energy.

Evidence from qualitative and quantitative data collection shows that only partial progress has been made in the implementation of the actions inscribed in the Communication and the Roadmap. Due to this and also given the fact that both the Communication and the Roadmap are "soft" policy tools, its direct effects on the development on the ocean energy sector can only be derived to a certain extent. However, the study nevertheless found evidence for positive impacts from those policy instruments. This includes in particular that they provided an agenda that guided the work of stakeholders and helped maintain the momentum around ocean energy, both internally and externally.

In general, the uptake of ocean energy technologies has been substantially pushed by the wider support provided by the EU, in particular for what concerns the consolidation of R&D activities (as backed by financial instruments such as Horizon 2020) or the improvement of stakeholder coordination in the sector.

Despite this, substantial challenges to the further development of the sector still persist, in terms of cost reductions and de-risking of the technologies, which require the continued support by the European Union, its Member States, and the private sector.

EXECUTIVE SUMMARY

About this study

This study report supports DG MARE's evaluation of the European Commission's policy to promote the development of ocean energy. It focuses preliminarily on the Blue Energy Communication (the "Communication")[1] and the Ocean Energy Strategic Roadmap (the "Roadmap"), but also takes into account the evolution of the EU's wider policy towards renewable energy development and energy technology policy, as well as looks at and the interactions with national/regional interventions in the sector. The study provides the Commission with overarching conclusions and lessons learned for the possible future review of the European policy for ocean energy.

The evaluation support study assesses the effectiveness, efficiency, relevance, coherence and EU added value of the main EU policies and instruments affecting and supporting ocean energy.

The EU intervention supporting ocean energy

The EU aims to become the first climate-neutral continent by 2050 and increasing the share of renewable energy use in Europe will be key to achieve this target. In this context, it is crucial to further develop and exploit the full breadth of renewable energy sources available in the EU, including ocean energy.

The term ocean energy subsumes five groups of technologies that convert different forms of energy present in the ocean to electric energy: wave energy converters, tidal energy converters (including technologies using tidal stream energy and tidal range and lagoons), ocean thermal energy converters and salinity gradient converters. Ocean energy is considered to have a tremendous potential to provide clean and reliable energy in the future, contributing to meet European climate and renewable energy targets, whilst supporting job creation and economic growth.

Building on the well-developed policy framework supporting renewable energy, the European Commission decided to adopt the Communication to strengthen its support for the sector and to set an agenda of action to help move the sector forward. The general objective of the Communication is to increase the uptake of ocean energy by addressing the main bottlenecks that hampered the development of the sector at the time. In 2014, these challenges mainly related to costs, financial and profitability issues; infrastructure issues; administrative and regulatory issues. To address these, the Communication seeks to:

- Bring together stakeholders to foster the competitiveness of the sector through coordinate actions to enhance technological innovation;
- Facilitate the industry's access to finance;
- Improve administrative practices and environmental monitoring.

To achieve this, the Communication outlines four specific actions, separated in two phases.

The first phase (2014 – 2016) included as first action setting up an Ocean Energy Forum (OEF)[2] in order to bring together stakeholders and develop a shared understanding of challenges and devise

[1] COM(2014)08 final COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Blue Energy Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond

[2] See: https://webgate.ec.europa.eu/maritimeforum/en/frontpage/1036

workable solutions. In 2016, the OEF delivered the Ocean strategic roadmap Building Ocean Energy for Europe (the "Roadmap")[3] which is the second action of the Communication.

The second phase of action (2017-2020) included the potential development of a European Industrial Initiative (third action of the Communication), based on the outcomes of the Ocean Energy Forum. Finally, action four of the Communication included the development of sector-specific guidelines for the implementation of relevant legislation.

The Ocean strategic roadmap Building Ocean Energy for Europe, developed by the OEF, defined four key action plans to support ocean energy development:

- Action Plan 1: Establish a European phase-gate scheme to validate sub-systems and early prototypes in less mature ocean energy technologies;
- Action Plan 2: Set-up a EUR250m Investment Support Fund;
- Action Plan: Set-up a EUR50m - EUR70m Insurance and Guarantee Fund for ocean energy demonstrations and pre-commercial projects; and
- Action Plan 4: De-risk environmental consenting through an integrated programme of measures that will develop guidance on planning, consenting, research socioeconomics and demonstration.

Main conclusions and recommendations

Relevance

The objectives of the Blue Energy Communication and Ocean Energy Strategic Roadmap were appropriate to address the needs and challenges faced by the sector in 2014 overall.

In general, the objectives identified in the Communication and Roadmap were considered appropriate to address the needs and challenges faced by the sector at the time of their adoption. These documents created momentum and provided a common direction and priorities for the further development of the sector in a moment when this was much needed. This notwithstanding, it appears that the documents were overoptimistic on the stage of development of the technology and in the expectations of additional support to be provided by Member States and the private sector. A posteriori, certain elements could have been better considered or been expanded on at the time, for instance the link with Member States strategies and approaches to ensure their future interventions, the different business cases for ocean energy, the needs of certain technologies and the connection to specific funding instruments for the implementation of the actions described.

Most of the objectives of the Communication and Roadmap remain relevant today, although these would benefit from an expansion as recent developments in the sector have caused additional needs and challenges to emerge for the ocean energy sector.

Due to the insufficient progress registered in the achievement of certain objectives of the Communication and Roadmap (e.g. in terms of access to finance, de-risking of the technologies, improvement of administrative processes and environmental monitoring), most of the objectives and actions inscribed thereof remain relevant to address the bottlenecks of the sector today. In addition to this, developments took place since 2014 that would require an adaptation or expansion of the actions and approaches identified in these policy tools. For instance, additional efforts to ensure that dedicated support is provided to ocean energy to avoid that this needs compete for support with other more advanced technologies, to engage Member States and private companies

[3] See: https://webgate.ec.europa.eu/maritimeforum/en/node/3962

in the investment for ocean energy, to adapt the financing to the new developments of the technologies (e.g. more focus on market pull mechanisms to stimulate commercialization), to exploit emerging synergies with other industries, and to avoid that the Brexit and the outbreak of COVID-19 have a negative impact on the development of the sector.

Effectiveness

Partial progress has been made in the implementation of the actions inscribed in the Communication and Roadmap, but relevant work is ongoing for two of the four action plans set out in the Roadmap, for what concerns wave energy.

The EU successfully implemented the actions included under Phase 1 of the Communication, by setting up the OEF and supporting the adoption of the Roadmap. For what concerns the actions under Phase 2, some progress has been made in the development of sector-specific guidelines for the implementation of relevant legislation, in relations to the EU Nature legislation and partially also Maritime Spatial Planning processes. No progress was registered in the establishment of and European Industrial Initiatives for ocean energy, since the intention to not move forward with this had already been communicated in 2014.

With regards to the four action plans inscribed in the Roadmap, work is ongoing thanks to European Commission funding on the development of a European phase-gate technology development process (Action Plan 1) and on the monitoring of environmental impacts of ocean energy (Action Plan 2), but only for what concerns wave energy. Both the Investment Support Fund for ocean energy farms (Action Plan 2), and the Insurance and Guarantee Fund for ocean energy (Action Plan 3) were not created to date, and financing and de-risking of the technologies still represent major bottlenecks for the sector. This notwithstanding, some upcoming initiatives might represent opportunities for the ocean energy sector in these fields, such as the Blue Invest Fund[4] and the InvestEU programme[5].

Progress on the achievement of the objectives of the Communication and Roadmap has been very limited, and it is challenging to establish a causal relationship between the achievements and these policy tools.

In terms of the achievement of the objectives of the Communication and Roadmap, limited progress has been registered so far, as many of the bottlenecks faced by the sector in 2014 still challenge the further development of ocean energy to date, as outlined in the sections below.

Overall, there has been an increase in the uptake of ocean energy in the EU, and the sector has made significant steps forward in terms of technological development over the past 5 years, in particular for tidal energy. However, this progress has been slower than expected, and current levels of installed capacity are far away from the expectations outlined in the Communication. In 2018, total installed capacity of ocean energy devices was 24.7 MW, while the Communication forecasted this would amount to 2.2 GW in 2020 (and 4.3 GW in 2035). While it is not possible to directly attribute these developments to the Communication and the Roadmap, the wider EU support has played a key role, as the majority of the current installed capacity and the most advanced technologies developed have benefited from EU financial support.

It is unclear to what extent the objective on enhanced stakeholder coordination has been achieved, as very little documentary evidence is available on this. While some sources indicate that stakeholder coordination is still insufficient, most of the stakeholders interviewed in the course of

[4] See: https://webgate.ec.europa.eu/maritimeforum/en/frontpage/1451

[5] See: https://ec.europa.eu/info/strategy/recovery-plan-europe_en

this study maintain that the sector is much more structured, organized and synergetic than it was in 2014. This is also because of the multiple stakeholder coordination initiatives undertaken or supported by the EU, which however are not linked to the publication of the Communication or Roadmap and rather predate their adoption.

Access to finance is still one of the major bottlenecks for the ocean energy sector. Despite the substantial support provided by the EU and other actors, developers still find it difficult to access available funding because of high competition, restrictive requirements and burdensome application procedures. The availability of private funding for the sector is still limited by the high risks still associated with the development of the technology, particularly in the absence of an Insurance and Guarantee fund, and by the lack of revenue support schemes within Member States. Funding is particularly lacking for the demonstration of ocean energy technologies.

Administrative practices related to consenting and licensing of ocean energy are still long and characterized by uncertainties, and the monitoring of environmental impacts is still very limited. Despite relevant individual efforts being undertaken to collect data, best practices and lessons learnt in these fields, the progress registered is considered insufficient, and it still represents a deterrent for technology developers' willingness to test and operate devices.

The effectiveness of the EU intervention in support of the development of ocean energy has been affected by several external factors.

Different factors have influenced the effectiveness of the overall EU intervention in support for ocean energy, both positively and negatively, since 2014. For instance, the increased societal awareness on climate change and increased interest in renewable energy, including by different industries, as well as the lessons learnt from the development of other offshore renewable energy technologies have had a positive impact for the development of the sector. On the other hand, factors such as high profile failures in the ocean energy industry, the increased competitiveness of other forms of renewable energy technologies, as well as the somewhat poor argumentation in favour of ocean energy have had a negative impact on Member States and private investors' willingness to support ocean energy. The limited support received by these actors compared to the expectations have had a negative influence on the overall effectiveness of the EU intervention.

Efficiency

It is not possible to identify quantitative information on the costs or administrative and regulatory burdens related to the implementation of the Communication and Roadmap, as these are "soft regulation" policy tools.

The costs related the implementation of the Communication and Roadmap relate to the costs incurred by the European Commission, Member States and private sector to implement the actions inscribed in these policy tools.

The European Commission provided financial support for the set-up of the Ocean Energy Forum and for the related development of the Roadmap. It moreover provided funding support to launch calls under Horizon 2020 and the EMFF to realize the objectives of two out of four action plans outlined in the Roadmap, and namely Action Plan 1 on "A European phase-gate technology development process for sub-systems and devices" and Action Plan 4 on "De-risking environmental consenting through an integrated programme of measures". Quantitative information is only available on the amounts provided for the calls, but as work on those projects is still ongoing, it is not possible to assess the benefits gained by investing in these initiatives.

Overall, it was not possible to identify comprehensive quantitative information with regards to the costs or administrative and regulatory burdens of implementing the actions of the Communication and Roadmap, especially from the Member States and the private sector. However, given that the two instruments are "soft regulation" policy tools, which do not prescribe specific behaviours or actions of organisations and individuals, it is assumed that they are insignificant.

Coherence

The Communication and the Roadmap are internally coherent and in line with the wider EU policy framework.

The Communication and the Roadmap are internally coherent and build logically on each other. The policy tools are also consistent with the wider renewable energy and climate policy framework.

A degree of inconsistency persists between the EU intervention on ocean energy and Member States' strategies and activities in the sector.

The Communication and Roadmap, as well as the broader EU intervention in favour of ocean energy development establish a common direction and ambition for the development of the sector. This ambition is not always reflected in national strategies, such as National Energy Climate Plans, that instead indicated a limited commitment of Member States to further develop ocean energy as a means to achieve their renewable energy targets. Where the ambition is reflected in national strategies, this is often not matched by the establishment of appropriate support mechanisms, such as revenue support, and this represents a considerable challenge for the advancement of the sector in practice.

EU added value

The Communication and the Roadmap provide EU added value in particular in terms of defining a common strategic agenda for the sector, although it remains unclear whether the sector would be substantially different now had they not been adopted. The EU added value of the broader EU intervention for ocean energy is perceived more clearly.

The Communication and the Roadmap achieved results that could not have been achieved at different levels of intervention, in particular in terms of bringing the sector's stakeholders together around a specific strategic agenda. It remains unclear to what extent the implementation of these instruments is directly responsible for the limited progress witnessed in the sector up to now, and whether this would be much different had they not been adopted. In general, is difficult to establish a clear causal link between the adoption of the Communication and Roadmap and the specific developments in the ocean energy sector, due to the fact that these are embedded in the well-developed wider policy framework of EU renewable energy and energy technology policy. This notwithstanding, it is important to note that the Communication and Roadmap were only ever intended to be "soft regulation" policy tools, representing only a part of the picture, to be complemented by additional interventions by the EU, Member States and the private sector. When the broader EU intervention, in particular the financial support provided, is taken into consideration, it is clear that this was crucial for the development of the sector.

The EU holds global leadership on ocean energy technologies thanks to the support provided by the EU and its Member States so far and a potential withdrawal of its intervention would have negative consequences for the sector internally, and also potentially abroad.

Driven by the substantial support provided by EU institutions and its Member States, the EU-27 have gained undisputed global technological leadership in the ocean energy sector. Around 70% of global ocean energy installed capacity is located in EU waters, and EU companies hold around half of the patents for tidal and wave energy globally. As most of current projects still benefit or have benefitted from EU's support, the continuation of EU's financial (e.g. Horizon 2020 and Interreg) and strategic (including the Communication and Roadmap, but also general strategic support) intervention in favour of ocean energy is crucial for the sector. The withdrawing of such support would have very negative consequences for the sector in Europe, and given the high level of "EU content" in ocean energy technologies developed abroad, this might also have consequences in the rest of the world. What is more, this withdrawal would represent a missed chance for the EU to capitalize on its first mover advance and on the substantial investments made so far, for the benefit of global late comers.

Recommendations

The European Commission, as well as its Member States and the private sector should continue to undertake activities, and explore innovative approaches, to achieve progress on the objectives set out in the Communication and Roadmap. This is particularly important for what concerns the facilitation of access to finance for both demonstration and pre-commercial projects, including through revenue support. Further work on making adequate guarantee and insurance products available to ocean energy developers should be pursued, and activities to improve administrative practices and environmental monitoring should be reinforced. Moreover, additional efforts should be undertaken to improve alignment of Member States' strategies with the EU ambition on ocean energy and to enhance their engagement in support for the sector, including by exploiting existing dialogue platforms such as ETIP Ocean and OceanSET.

GLOSSARY

Acronym	Definition
CAPEX	Capital expenditure
Communication	Blue Energy Communication
COSME	EU programme for the Competitiveness of Enterprises and SMEs
DG MARE	DG for Maritime Affairs and Fisheries
EII	European Industrial Initiatives
EMFF	European Maritime and Fisheries Fund
ERDF	European Regional Development Fund
H2020	Horizon 2020
LCOE	Levelized Cost of Energy
MSFD	Marine Strategy Framework Directive
MSP	Maritime Spatial Planning
NECPs	National Climate and Energy Action Plans
OEF	Ocean Energy Forum
OPEX	Operational expenditure
OTEC	Ocean Thermal Energy Conversion
PC	Public consultation
R&D	Research and Development
R&I	Research and Innovation
Roadmap	Ocean Energy Strategic Roadmap
SET Plan	Strategic Energy Technology Plan
TRL	Technology Readiness Level
WECs	Wave Energy Conversion system

1. INTRODUCTION

The present document is the final report of the support study for the evaluation of the development of ocean energy policies"[6] for DG Maritime Affairs and Fisheries (DG MARE).

The objective of this study is to assist DG MARE's evaluation of the European Commission's policy to promote the development of ocean energy. The study primarily examines the state of implementation of the different actions lined out in the Blue Energy Communication (the "Communication")[7] and the Ocean Energy Strategic Roadmap (the "Roadmap")[8], but also takes into account the evolution and further development of the EU's wider policy towards renewable energy development[9] and energy technology policy[10]; and also looks at interactions with national/regional interventions . On this basis, the study provides overarching conclusions and lessons learned for the possible future review of the European policy for ocean energy.

In line with the Better Regulation Guidelines[11], the study assesses the effectiveness, efficiency, relevance, coherence and EU added value of the main EU policies and instruments affecting and supporting ocean energy.

The temporal scope of the assignment (i.e. period of analysis) is 2014 – the year of adoption of the Communication – until the end of 2019.

The technological scope includes the five principal technology groups that convert ocean energy into electricity, namely:

- Wave energy;
- Tidal stream energy;
- Tidal range and lagoon;
- Ocean Thermal Energy Conversion (OTEC); and
- Salinity gradient.

This report presents the work carried out as well as the results of the work, in the form of answers to the evaluation questions and conclusions and lessons learned/recommendations.

6 In line with the discussions in the kick-off meeting we have changed the working title of the project from "Evaluation of the development of ocean energy and support policies" to "Evaluation of the development of ocean energy policies" to avoid confusion about the scope of the study.

7 COM(2014)08 final COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Blue Energy Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014DC0008

8 Ocean Energy Forum (2016) Ocean Energy Strategic Roadmap 2016, building ocean energy for Europe. Available at: https://webgate.ec.europa.eu/maritimeforum/en/node/3962

9 For more information on the EU's renewable energy policies, see here: https://ec.europa.eu/energy/topics/renewable-energy_en

10 For more information on the EU's research and innovation policies related to renewable energy see here: https://ec.europa.eu/info/research-and-innovation/research-area/energy-research-and-innovation_en

11 European Commission, 2017, Better Regulation Guidelines (SWD (2017) 350). Available at: https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox_en . The Better Regulation Guidelines set out the principles that the European Commission follows when preparing new initiatives and proposals and when managing and evaluating existing legislation. This includes certain minimum criteria for evaluations, which we are referring to here.

The evaluation relies on a mixed methods approach, making use of both qualitative and quantitative data collected through desk review, a Public Consultation[12], and interviews with the public sector (including at EU, national and regional level), private sector actors, and research institutions.

[12] See: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12061-Evaluation-of-ocean-energy-development-and-support-policies/public-consultation

2. METHODOLOGY

This chapter provides a brief overview of the methodology, notably the data collection and analysis tools used, and limitations to the reliability or representativeness of the information used to develop findings.

2.1 Approach

The study encompasses both a summative and a formative perspective. It focuses on the assessment of the achievements of the Communication and the Roadmap during the years they have been implemented (summative dimension) and, where relevant, gives clear and implementable recommendations for improvements (formative dimension), based on the evidence collected.

It should be noted that the evaluation took place at a time when the Roadmap had been published for less than four years which gives rise to challenges in assessing impacts and results that take a longer time to materialise, especially in an area as diverse and fragmented as renewable energy development.

The approach to this evaluation consisted in assessing the relevance, effectiveness, efficiency, coherence and EU added value of the Communication and Roadmap, also taking into account the evolution and further development of the EU's wider policy towards renewable energy development and energy technology policy. To ensure the robustness of the assessment, a structured evaluation approach was used, relying on an elaborated intervention logic, operationalised evaluation matrix, and a mix of data collection and analytical methods.

2.2 Evaluation questions

In line with the requirements of the Commission's Better Regulation Guidelines, the evaluation criteria of relevance, effectiveness, efficiency, coherence and EU added value were covered as part of this evaluation. To do so, thirteen evaluation questions were answered which are presented in the Table below.

Table 2.1 Overview of evaluation questions

Criterion	Evaluation questions
Relevance	EQ 1. To what extent have the objectives of the intervention proven to be appropriate for responding to the needs identified in the impact assessment?
	EQ 2. To what extent do the objectives of the intervention remain appropriate in the light of the evolution of the EU energy, climate, maritime and R&I policies?
Effectiveness	EQ 3. What progress has been made in implementing the activities of the intervention?
	EQ 4. To what extent have the objectives of the intervention been met so far?
	EQ 5. What have been the quantitative and qualitative effects of the intervention?
	EQ 6. What factors have influenced effectiveness (positively or negatively), how and to what extent?
Efficiency	EQ 7. To what extent are the costs of implementing the intervention justified, given the benefits it has achieved?

Criterion	Evaluation questions
	EQ 8. What factors have influenced efficiency (positively or negatively), how and to what extent?
Coherence	EQ 9. To what extent are the components of the intervention coherent internally; are there any overlaps, inconsistencies, or incoherencies?
	EQ 10. To what extent is the intervention coherent with wider EU policy and initiatives?
	EQ 11. To what extent is the intervention coherent with other relevant EU support schemes (e.g. funding, sectorial policies), in particular linked to renewables and innovation?
EU Added Value	EQ 12. What is the additional value resulting from the intervention, compared to what could have been expected from private initiatives and investments, and Member States acting at national/regional levels?
	EQ 13. What would be the most likely consequences of stopping or withdrawing the existing intervention?

These questions were subdivided into sub-questions, as outlined in Appendix 1 - Evaluation question matrix. These were further operationalised, and associated indicators and judgement criteria were developed, to provide a framework within which the appropriate data could be collected, and evaluative judgements could be made.

2.3 Methods used

The methodology included a database and literature review, in-depth interviews with the public sector (including at EU, national and regional level), private sector actors, and research institutions, and a Public Consultation.

2.3.1 Database and literature review

Method

A review of existing databases and relevant literature was carried out. The aim of this review was to collect, organise and analyse relevant information from secondary sources.

The review of existing databases aimed at collecting relevant quantitative data e.g. on installed capacities, deployment and power generation, ongoing and planned projects for the evaluation study. Available databases were assessed in detail, and the most relevant evidence was fed into the answers to the evaluation questions.

The review of the literature covered legislative documents, strategy and policy papers, technology and market reports, scientific papers and industry reports. The information was coded using NVivo following a coding framework based on the indicators outlined in the evaluation matrix, which made it possible to track key gaps in evidence, which guided the revision of data collection tools to ensure adequate coverage of those aspects for which limited documentary evidence was available. The results of this review formed the basis for the development of the baseline and for the answers to evaluation questions.

Data reliability and limitations linked to the method

The databases used to feed into this project are all published by reliable institutions and are considered robust.

The literature that was assessed included legislative documents, strategy and policy papers, technology and market reports, scientific papers and industry reports. They can also be considered reliable and are cited throughout the document.

2.3.2 Targeted consultations

Method

Interviews were carried out with public sector actors (including at EU, national and regional level), private sector actors, and research institutions, to gather their insights into several aspects of this study.

Tailored interview questionnaires were developed for the different stakeholder groups. The table below summarises the main consultation themes that were focused on for the different stakeholder groups.

Table 2.2 Consultation themes per stakeholder category

Category of stakeholder	Proposed consultation themes
Public sector	Information about the relevance, effectiveness, efficiency, coherence and EU added value of the Communication and Roadmap, information about relevant policy and funding support provided to the ocean energy sector, recommendations
Private sector	Information about the relevance, effectiveness, efficiency, coherence and EU added value of the Communication, information about relevant policy and funding support received or needed, information about technology deployment, identified challenges (e.g. related to the specific scope of action of the interviewee), recommendations
Research	Information about the relevance, effectiveness, efficiency, coherence and EU added value of the Communication, information about relevant policy and funding support received or needed, information about technology deployment, research needs and recommendations

A total of **25** interviews were conducted. The table below presents an overview of the interviewees.

Table 2.3 Conducted interviews per stakeholder group

Category of stakeholder	Type of stakeholder	Conducted
Public sector	EU institutions and bodies	2
	International organisations	1
	Member State Institutions and bodies – National and regional	7
Private sector	Industry representatives	1
	Finance/Insurance/Investment sector	2
	Technology developers – Tidal	2
	Technology developers – Wave	3

Category of stakeholder	Type of stakeholder	Conducted
	Technology developers – OTEC	1
	Technology developers – Salinity gradient	1
	Utility	1
	Cluster organisation	1
Research	Research organisations	3
Total		**25**

The interviews were semi-structured, following interview guides designed for each of the different stakeholder categories. Detailed interview notes were taken for each interview, which were subsequently analysed using the qualitative analysis software NVivo.

An analysis of the results of these interviews is presented in Appendix 3 to this report. The results fed into the answers to the evaluation questions.

Data reliability and limitations linked to the method

No difficulties were encountered in identifying relevant stakeholders for all envisaged categories. The data collected through interviews was useful and relevant to respond to all evaluation questions that were foreseen to make use of these interviews.

The stakeholders interviewed in the course of the study can be considered "expert" stakeholders, since they are all directly involved in the development of the ocean energy sector, and as such they provided "expert" opinion and insights on the sector. The interviewees constituted a representative sample of stakeholders from within the ocean energy sector, as they belonged to the most relevant and influential categories involved in the sector, such as policymakers (EU, Member States and International), private sector (industry representatives, technology developers from each of the four technologies object of the study, utilities and cluster organisations), as well as research organisations involved in the ocean-energy related research projects. At the same time, these stakeholders most likely have a vested interest in seeing the sector progress, and this factor was considered when assessing the input.

2.3.3 Public consultation

Method

On 27th August 2020, the European Commission launched a public consultation to gather the opinions of the broader stakeholder community on the Ocean Energy Communication, and to take stock of ocean energy development in Europe. Once launched, the public consultation remained open for responses from all EU citizens for 15 weeks, until 10th of December 2020.

A total of 71 respondents participated to the public consultation. Of these, one response was not taken into account as it came from a member of the project team, therefore the total number of responses analysed is **70**. Two stakeholders that were consulted in the course of the targeted interviews also replied to the public consultation (namely, one technology developer and one representative of the European Commission), and their responses are taken into account in the analysis. All the responses received were complete.

Following the profiling questions, respondents were split into groups based on those that wanted to provide their 'View on the sector of ocean energy' and those who wanted to provide a 'Detailed view

on the Blue Energy Communication and the Roadmap'. 41 respondents belong to the first group, and 29 to the latter.

During data cleaning it was found that **18** out of these 29 responses correspond to "coordinated answers" according to the Better Regulations Toolbox[13] and the decision was made to segregate the data and conduct a separate analysis so to not skew the results. These answers were segregated from the main dataset and the main differences are highlighted during the analysis.

The results from the survey were analysed in Excel. The detailed analysis is presented in Appendix 3 to this report.

Data reliability and limitations linked to the method

Difficulties were encountered in generating a high response rate to the Public Consultation. As the majority of respondents only provided their general views on the sector of ocean energy, and a campaign of coordinated answers was identified in the course of data cleaning among the stakeholders that provided their detailed view on the Blue Energy Communication and the Roadmap, there are limitations to the robustness of the contribution of the public consultation as evidence for the study and this has been flagged out in the report, where relevant.

In addition to this, as for the targeted consultations, the stakeholders that replied to the Public Consultation are for the most part "expert" stakeholders, and as such they provided "expert" opinion and insights on the sector. The fact that there a campaign of coordinated answers was identified can also signal that a number of expert stakeholders wanted to pass a clear message for consideration of the study and its readers. At the same time, these stakeholders most likely have a vested interest in seeing the sector progress, and this factor should be considered when assessing the conclusions based on their input.

2.4 Limitations to the robustness of the evidence

In the process of data collection and analysis, a few general challenges and limitations were encountered. There are listed in the Table below, along with the way the challenges and limitations were addressed or mitigated.

Table 2.4 Challenges encountered in the evaluation

Challenge	Solution / mitigation
The Blue Energy Communication and the Ocean Energy Roadmap are "soft regulation"[14] policy tools which do not specify behaviour of organisations or individuals. They are embedded in well-defined policy frameworks, most notably of research and innovation policy, as well as renewable energy policy. The effects of the policy interventions are thus difficult to separate from the effects of the wider policy framework.	The challenge was already identified during the inception and interim stage. To mitigate this challenge, this evaluation study presents, where possible, two layers of evidence for evaluation questions. In a first layer, evidence is presented for effects that can be clearly linked to the Roadmap and the Communication.

[13] Better Regulation Tool #54, page 49. Available at: https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-54_en_0.pdf

[14] Better Regulation Toolbox. Tool #18 The choice of policy instruments. https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-18_en_0.pdf

Challenge	Solution / mitigation
	In a second layer, evidence is presented that links to the wider framework of research, innovation, and renewable energy policy.
The publication of the Public Consultation was delayed, and results were only available towards the end of the study.	The project team undertook several efforts to communicate about the Public Consultation through the implementation of a detailed stakeholder engagement plan. This included e.g. advertisement though social media accounts and reaching out to relevant umbrella organisations and other multipliers to ensure that they inform their members about the Public Consultation and send reminders.
The Public Consultation partly ran in parallel to another initiative in the same policy field, the EU strategy for offshore renewables[15]. There was a risk that stakeholders confuse the two parallel initiatives.	In the communication on the Public Consultation the parallel initiative was clearly mentioned and the differences between the two explained, to avoid confusion. When reaching out to umbrella organisations and other stakeholders they were specifically asked to make their members aware of the differences between the two.

[15] See https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12517-Offshore-renewable-energy-strategy/public-consultation

3. POLICY CONTEXT

The potential of ocean energy

Renewable energy can be produced from a wide variety of sources. By using more renewables to meet its energy needs, the EU lowers its dependence on imported fossil fuels and makes its energy production more sustainable. The renewable energy industry also drives technological innovation and employment across Europe.

Within this context, ocean energy is considered to have a tremendous potential to provide clean and reliable energy in the future[16] contributing to meet European renewable energy targets, whilst supporting job creation and economic growth[17].

The term ocean energy subsumes five groups of technologies that convert different forms of energy present in the ocean to electric energy: wave energy converters, tidal energy converters (including technologies using tidal stream energy and tidal range and lagoons), ocean thermal energy converters and salinity gradient converters.

Europe has a 70,000 km coastline along four seas, the Baltic, the North Sea, the Mediterranean, and the Black Sea, and two oceans, the Atlantic and Arctic Oceans. Along those coastlines, there is enormous theoretical potential of energy that could be harvested – given that the right energy policy framework is in place to foster the development of the technologies.

The EU policy framework supporting renewable energy

The development of a common energy policy in Europe took pace in 2006, when the Commission's green paper *A European for Sustainable, Competitive and Secure Energy*[18] was published, identifying a number of common challenges, such as the growing demand for energy and fossil fuels, reliance on energy imports, increasing energy prices and climate change projections. The green paper called for action in six priority areas, including the diversification of the energy mix to improve energy security and efficiency, whilst ensuring sustainable and competitive energy generation. It led to the initial definition of Europe's Energy Policy[19] to reduce greenhouse gas emissions by 20%, increase the proportion of energy consumption from renewable sources by 20% and achieve a 20% improvement in energy efficiency (in relation to 1990 levels)[20].

In line with this, the Renewable Energy Directive (2009/28/EC) established a common framework for the promotion of energy from renewable sources. Acknowledging the importance of renewable energy, the EU also set binding targets for the share of final energy consumption from renewable sources to be obtained by 2020 (20% by the EU as a whole).

[16] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions. Blue Energy, Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond. COM(2014) 8 final. Available at: https://eur-lex.europa.eu [Last accessed 02/12/19]

[17] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions. Innovation in the Blue Economy: realising the potential of our seas and oceans for jobs and growth. Available at: https://eur-lex.europa.eu [Last accessed 02/12/19]

[18] Commission of the European Communities (2006) Green Paper. A European Strategy for Sustainable, Competitive and Secure Energy. Available at: https://europa.eu [Last accessed 02/12/2019]

[19] Commission of the European Communities (2007) Communication from the Commission to the European Council and the Parliament. An Energy Policy for Europe. See: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52007DC0001&from=EN

[20] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources. See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32009L0028

With the target year of 2020 approaching, longer-term decarbonisation efforts came into focus and a discussion on EU objectives for 2030 arose. The European Council decided on climate and energy targets for 2030 in October 2014[21]. The heads of state and government agreed on a legally binding new renewable energy target of at least 27% of final energy consumption for the whole EU by 2030. The target for renewables was revised upwards in 2018 to at least 32%. The Renewable Energy Directive was revised in 2018 and incorporates now the same 32% goal[22]. This was part of the "Clean Energy Package"[23] which in turn facilitates the implementation of the "Energy Union Strategy[24]".

In 2020, the EU adopted the 2030 climate target plan, which establishes that greenhouse gas emissions should be reduced by at least 55% by 2030 compared to 1990. To deliver on this increased ambition, the Commission planned to revise existing legislation, including the Renewable Energy Directive, in 2021. The revision will consider the upward review of the 2030 target of at least 32% of renewables.

The EU policy response to foster the deployment of Ocean Energy: A communication and a roadmap

To better exploit the enormous potential of ocean energy within this wider renewable energy framework and push the Technology Readiness Level (TRL) of the technologies towards industrial roll-out (TRL 7-9)[25], the European Commission launched a number of targeted support instruments.

This includes notably the 2014 Communication on Blue Energy[16] (the "Communication") which is subject to this project. It was published recognising, that ocean energy was at the time still at an early development stage but had the potential to develop over time.

The Communication recommends four specific actions, separated in two phases of action. The approach of rolling out the actions in two phases was according to the Communication chosen to "allow for the accumulation of a critical mass of actors and development of a shared response to the issues at stake in a bottom-up manner, thus creating a sense of ownership among involved stakeholders" for the second phase.

The first phase (2014 – 2016) included as first action setting up the Ocean Energy Forum (OEF)[26] in order to bring together stakeholders and develop a shared understanding of challenges and devise workable solutions. In 2016, the OEF delivered the Ocean strategic road map *Building Ocean Energy for Europe*[27] (the "Roadmap") which is the second action of the Communication.

The second phase of action (2017-2020) included the potential development of a European Industrial Initiative (third action of the Communication), based on the outcomes of the Ocean

[21] A policy framework for climate and energy in the period from 2020 to 2030. See : https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014DC0015

[22] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources. See: https://eur-lex.europa.eu/eli/dir/2018/2001/oj

[23] Clean Energy for all Europeans. See: https://eur-lex.europa.eu/resource.html?uri=cellar:fa6ea15b-b7b0-11e6-9e3c-01aa75ed71a1.0001.02/DOC_1&format=PDF

[24] A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy. See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2015:80:FIN

[25] The classification of the "industrial roll-out phase" has been defined in the Ocean Energy Strategic Roadmap "Building Ocean Energy for Europe". The definition of TRL employed is the one provided by the European Commission Horizon 2020 framework.

[26] See more information at: https://webgate.ec.europa.eu [Last accessed 02/12/19]

[27] Available at: https://www.oceanenergy-europe.eu [Last accessed 02/12/19]

Energy Forum. Finally, action four of the Communication included the development of sector-specific guidelines for the implementation of relevant legislation.

The **Ocean strategic roadmap *Building Ocean Energy for Europe***, developed by the OEF, defined four key action plans to support ocean energy development:

- Establish a European phase-gate scheme to validate sub-systems and early prototypes in less mature ocean energy technologies;
- Set-up a EUR250m Investment Support Fund;
- Set-up a EUR50m - EUR70m Insurance and Guarantee Fund for ocean energy demonstrations and pre-commercial projects; and
- De-risk environmental consenting through an integrated programme of measures that will develop guidance on planning, consenting, research socioeconomics and demonstration.

The assessment of the implementation and recent development of each of these phases and actions is the object of this study and is presented in chapter 5.

A set of relevant policy tools to support Ocean Energy

Other policies, instruments and programmes that supported the ocean energy sector[28], include the following:

- The **Integrated Maritime Policy** 2007[29], which calls for an increased coordination between different policy areas, and identifies Maritime Spatial Planning (MSP)[30] as an important tool for the sustainable development of marine areas and coastal regions, including in relation to the deployment of ocean energy technologies;
- The Commission's Communication on ***Accelerating Clean Energy Innovation 2016***[31], which lays out a comprehensive strategy for the three main policy levers the EU can deploy to boost private investment in clean energy innovation;
- The **Strategic Energy Technologies Plan** (SET Plan)[32], which sets the agenda for an EU energy technology policy and establishes European Industrial Initiatives (EII), already implemented in the offshore wind sector and available to support the ocean energy sector;
- **Horizon 2020 funding** for research and innovation, which, among others, currently provides funding to the Ocean Energy ERA-Net cofound initiative[33] to coordinate support for research and development in ocean energy, to encourage collaborative projects that tackle some of the key challenges identified for the sector as it progresses towards commercialisation.
- **NER300 programme**[34] for renewable energy technologies and carbon capture and storage;
- **Interreg Europe**[35] (financed by the European Regional Development Fund), aimed at helping regional and local governments across Europe to develop and deliver better policy by supporting actions developed in research and innovation, SME competitiveness, low-carbon economy, environment and resource efficiency;

[28] During the temporal scope covered by this evaluation.

[29] Including the so-called "Blue Paper" (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52007DC0575) and the corresponding action plan (https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52007SC1278)

[30] The requirement for Member States to prepare maritime spatial plans is captured in the Maritime Spatial Planning Directive 2014/89/EU (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0089)

[31] See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52016DC0763

[32] See: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=uriserv%3AOJ.C_.2016.133.01.0025.01.ENG

[33] See: https://www.oceancofund.eu/

[34] See: https://ec.europa.eu/clima/policies/innovation-fund/ner300_en

[35] See: https://www.interregeurope.eu/about-us/what-is-interreg-europe/

- **Regional initiatives**, including, among others:
  - The original Atlantic Action Plan[36], which aims to boost the Atlantic Ocean Area's sustainable blue economy by 2020, and the version 2.0, updated in 2020[37].
  - EU Strategy for the Baltic Sea Region 2013[38], which aims to strengthen cooperation between countries bordering the Baltic and provides for regional energy policy.

Recent policy developments

Ocean energy and renewable energy operate in a highly dynamic policy field.

While not covered by the temporal scope of this evaluation, there are a number of recent developments in the policy framework which have the potential to further influence the uptake of ocean energy in the future. The most relevant are listed in the Box below.

Box 3.1 Recent policy developments outside the temporal scope of the evaluation

Recent developments – Policy

The European Green Deal[39]

The European Green Deal was adopted in 2019 by the von der Leyen Commission and it presents the Commission's integrated strategy to transform the EU into a modern, resource efficient and competitive, economy, while leaving no one behind. The Green Deal sits on three pillars:

- Climate neutrality of the EU by 2050;
- Economic growth decoupled from resource use;
- Just transition for all Europeans.

The European Green fully recognises the key role of the offshore renewable energy sector in contributing to the clean energy transition and that this sector will have to substantially scale up to reach the climate neutrality target by 2050.

EU offshore renewable energy strategy[40]

In November 2020, the European Commission adopted the **EU strategy on Offshore renewable energy[41]** that assesses the potential contribution of the sector to the ambitious EU energy and climate targets, as well as proposes way forward to support the long-term sustainable development of offshore renewable energy. The strategy:

- Sets ambitious targets for the growth of the sector;
- Provides a clear and stable legal framework within which this can develop;
- Encourages public and private investments;
- Stimulates regional cooperation within the EU.

With regards to ocean energy, the strategy sets ambitious targets: by 2030, overall installed capacity should reach at least 1 GW, and by 2050 this should be 40 GW.

[36] See: https://atlanticstrategy.eu/en/content/atlantic-strategy

[37] See: https://atlanticstrategy.eu/sites/default/files/sites/default/files/aap_v2.0_en.pdf

[38] See: https://www.balticsea-region-strategy.eu/

[39] See : https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf

[40] See : https://ec.europa.eu/energy/sites/ener/files/offshore_renewable_energy_strategy.pdf

[41] COM(2020)741 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0741)

Recent developments – Funding

Innovation Fund[42]

The Innovation Fund is one of the world's largest funding programme for demonstration of innovative low-carbon technologies. The revenues for the Innovation Fund come from the auctioning of 450 million EU Emission Trading System allowances from 2020 to 2030, as well as any unspent funds coming from the NER300 programme. The Fund may amount to about 10 billion EUR, depending on the carbon price.

The Fund aims to create the right financial incentives for projects to invest now in the next generation of technologies needed for the EU's low-carbon transition, including innovative renewable energy generation, and as such it can play an important role in supporting the development of ocean energy. This is particularly true as one of the aims of the Fund is to share the risk with project promoters to help with the demonstration of first-of-a-kind highly innovative projects.

The first calls for proposals will open in 2020-2021.

InvestEU[43]

The InvestEU Programme will bring together under one roof the multitude of EU financial instruments currently available and expand the successful model of the Investment Plan for Europe, the Juncker Plan. With InvestEU, the Commission will further boost investment, innovation and job creation, triggering at least 650 billion EUR in additional investment. The InvestEU Programme will finance projects in different policy areas, including sustainable energy, for the period 2021-2027. As such, the programme can provide support and guarantees for emerging technologies such as ocean energy.

Blue Invest Initiative[44]

The Blue Invest Initiative will channel funding towards enterprises active in the field of Blue Economy. This will be done thanks to:

- The allocation of grants to SMEs targeting the blue economy via the "Blue Invest Grants", with a budget of 22.5 million EUR earmarked from the European Maritime and Fisheries Fund
- The provision of finance to financial intermediaries targeting the blue economy via "Blue Invest Fund", with 75 million EUR earmarked from the European Investment Fund

Calls for applications for the "Blue Invest Grants" have been closed in February 2020, the one for the "Blue Invest Fund" in September 2020.

NextGenerationEU and Recovery and Resilience Facility[45]

NextGenerationEU recovery plan is a temporary initiative designed to boost the recovery post-COVID-19 in Europe. It is coupled with the Recovery and Resilience Facility, an instrument that will make 672.5 billion EUR available in loans and grants to support reforms and investments undertaken by Member States to mitigate the economic and social impact of the coronavirus pandemic and make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions. 37% of the Facility's budget will be channelled to the green transition, and it will be important to support reforms and investments in offshore renewable energy under the 'Power up' flagship initiative.

The current state of ocean energy in Europe

The ocean energy sector has experienced growth in Europe over the last few years, both due to continuous progress in technology and successful demonstration projects. The EU is considered to host 78% of global wave and tidal energy capacity, which has itself doubled between 2017 and

[42] See : https://ec.europa.eu/clima/policies/innovation-fund_en

[43] See : https://ec.europa.eu/info/strategy/recovery-plan-europe_en

[44] See : https://webgate.ec.europa.eu/maritimeforum/en/frontpage/1451

[45] See : https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en

2018. However, the operational capacity of ocean energy within the EU lacks behind expectations[46] and it is clear that there are still a number of challenges that need to be addressed, including in relation to supporting policy and access to financial instruments aimed at supporting the commercialisation of prototypes and demonstration projects[47].

The current state of ocean energy in Europe according to the resource (wave, tidal, OTEC and salinity gradient) and the different technologies under development is summarized in two JRC's reports published in 2019[48].

Wave energy

Wave Energy Converters demonstration projects have been deployed by different technology developers. Main focus has been on point absorbers (small devices compared to the wave length) OceanEnergy, Oceantec Marmok, Wedge W1, Demowave, Corpower C3, Seabased, Nemos, Wello Pengui, Laminaria and integrated in breakwaters such as SinnPower, Ecowavepower, Mitrico OWC plant, floating or submerged Surging flaps WavePiston, WaveRoller, and larger floating and submerged structures like the Hace in and Bomboa integrating power from several absorbers to a common larger turbines are being tested. The demonstration of these technologies typically takes place at European test sites such as at EMEC, Mitriku, Plocan, Sem-Rev, FabTest and DanWEC.

Tidal energy

Tidal technologies which are tested and demonstrated range from the 240 MW tidal barrages La-Range that was built in the 1960th to modern fixed and floating tidal stream turbines similar to underwater windmills (Nova Innovation, Atlantis, Andritz Hydro-Hammerfest, Openhydro, Orbital, Schottel, and Tocardo) and tidal kites like Minesto being deployed at the Faroe islands. These are still considered demonstration projects, being tested for prolonged times, and operational strategies are being implemented and improved before commercial roll-out can take place.

OTEC

The OTEC resource in European continental waters is limited; nevertheless, some projects exist. In Europe e.g. the OTEC specialist Bluerise (spinoff from TU Delft) which has been bought by the offshore company Allseas. OTEC is also used for heating and cooling of buildings on a smaller scale i.e. in the Principality of Monaco.

Salinity Gradient

Salinity Gradient power can also contribute to base load electricity production with a significant potential worldwide. Two principles can be used, Pressure Retarded Osmosis or Reversed Electro Dialysis. A Pressure Retarded Osmosis prototype was built by Statkraft in Norway in 2010, but development was put on halt in 2013. The Reversed Electro Dialysis technology is being developed by REDstack in the Netherlands with a prototype demonstration plant at the Blue Energy pilot installation on the Afsluitdijk. It is not clear how fast salinity gradient technologies will develop both in terms of technology and market.

[46] Magagna, D., Ocean Energy Technology Development Report 2018, EUR 29907 EN, European Commission, Luxemburg, 2019, ISBN 978-92-76-12428-3, doi:10.2760/158132, JRC118296.9

[47] European Commission (2018) Market Study on Ocean Energy. Available at: https://www.etipocean.eu [Accessed 02/12/19]

[48] JRC (2019) Technology Development and Technology Market Report.

4. BASELINE

4.1 Introduction

To evaluate the effects of the Communication and the Roadmap, the study developed a counterfactual scenario which assumes the Communication the Roadmap had not existed. The baseline provides a point of comparison to determine the actual impact of the intervention.

The baseline covers:

- The expected evolution of the policy context considering relevant external factors; and
- The expected evolution of key variables.

The main point of reference for the definition of the baseline is the Impact Assessment accompanying the proposal for the adoption of the Communication[49].

The Impact Assessment defined the problems associated with the EU legal framework on support for ocean energy and its expected evolution in the absence of any further intervention (business as usual scenario). It has provided the starting point for the definition of the baseline.

As already pointed out in section 2.4, it should be noted that the Blue Energy Communication and the Ocean Energy Roadmap are "soft regulation"[50] policy tools which do not specify behaviour of organisations or individuals. However, there are still a number of effects to be expected compared to the counterfactual scenario, as outlined below.

4.2 EU context

In the absence of the Communication, it is assumed that the existing policy instruments would continue to impact the ocean energy sector. Thus, business as usual assumes a baseline involving Community action in the form of the wider policy framework, since the Communication was the first EU policy tool specifically targeting the ocean energy sector.

Other EU initiatives supporting the ocean energy sector

However, even though it was the first EU policy tool specifically targeting the ocean energy sector, the Communication was the follow-up to (or embedded in) a few policy initiatives at the time of its adoption (i.e. in 2014), including most notably the Blue Growth Communication and the Limassol declaration.

The 2011 Blue Growth Communication[51] identified five areas of the blue economy where targeted EU action could stimulate economic growth and jobs in Europe, one of them the ocean energy sector, which stated that "increased effort should now be devoted to technologies such as wave and currents that will reach full maturity in the coming decades". Blue Growth itself is one of the five pillars of the Commission's Integrated Maritime Policy.

[49] Commission Staff Working Document, Impact Assessment (Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions), Ocean Energy: Action needed to deliver on the potential of ocean energy by 2020 and beyond, SWD (2014) 13 final. https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/docs/body/swd_2014_13_en.pdf

[50] Better Regulation Toolbox. Tool #18 The choice of policy instruments. https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-18_en_0.pdf

[51] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Blue Growth opportunities for marine and maritime sustainable growth. /* COM/2012/0494 final */. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52012DC0494

Likewise, in 2012, the Limassol Declaration[52] was adopted by the European Ministers responsible for the Integrated Maritime Policy and the European Commission. It provided further impetus to the sector by stating that signatories will work towards goals of "carbon emissions and renewable energy and create new employment opportunities by increasing marine renewable energy production and exploration, so as to strengthen the EU's global leadership position".

In the absence of the Blue Energy Communication, it can be expected that those two policy initiatives would have delivered some of the benefits of the Blue Energy Communication with regard to demonstrated support by the EU institutions for the ocean energy sector, albeit not to the same extent as a dedicated Communication.

Europe 2020 strategy

Both, the Blue Growth Communication and the Limassol Declaration stress the importance of maritime activities for growth and jobs and place the blue economy (including the ocean energy sector) as the maritime pillar of the Europe 2020 strategy[53], working towards the key targets of the strategy (including employment, spending in R&D, and fighting climate change including through targets for renewable energy).

As such, the objectives of the Blue Energy Communication are in sync with some of the flagship initiatives of the Europe 2020 Strategy, including the Innovation Union (see below "research policy") and Resource-Efficient Europe (see below "renewable energy policy).

It can be expected that in the absence of the Blue Energy Communication and the Ocean Energy Roadmap this wider policy framework of the Europe 2020 strategy and its follow-up initiatives would have often had almost the same effects.

Research and innovation policy

EU research and innovation policy aims to consolidate the scientific and technological foundations, promote competitiveness and support research activity in Europe. Given that the ocean energy sector is still mostly an emerging sector, this policy framework is crucial for it.

Through the European Framework Programmes, research and innovation activities are funded to promote the scientific and technological development of European industry and its competitiveness as well as other EU policy areas. Before the adoption of the Blue Energy Communication in 2014, the sector was already supported through research and development projects, pre-commercial demonstration projects, and market uptake projects notably through its 6th and 7th Framework Research Programmes, the Intelligent Energy Europe programme and the NER-300 programme.

The financial support carried on after 2014 as part of Horizon 2020. Compared to the previous Framework Research Programmes, under H2020 there were no more dedicated calls for ocean energy projects, and instead the ocean energy sector was put in competition with other renewables. This was not part of the Blue Energy Communication and thus in its absence the same development could be expected.

The first Action Plan of the Ocean Energy Roadmap "A European phase-gate technology development process for sub-systems and devices" and the fourth Action Plan "De-risking

[52] Cyprus Presidency of the Council of the European Union (2012). Declaration of the European Ministers responsible for the Integrated Maritime Policy and the European Commission, on a Marine and Maritime Agenda for growth and jobs the "Limassol Declaration". https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/docs/body/limassol_en.pdf

[53] Europe 2020: A strategy for smart, sustainable and inclusive growth. https://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf

environmental consenting through an integrated programme of measures" provided guidance for relevant research in the sector. This has been further refined and operationalised by the European Commission as part of the SET implementation plan[54]. However, the other two Action Plans, which are concerned with funding and financing (Action plan 2 "An Investment Support Fund for ocean energy farms" and Action plan 3 "An EU Insurance and Guarantee Fund to underwrite project risks") have not yet been implemented and thus don't influence the baseline.

It can thus be assumed that, in the absence of the Blue Energy Communication and the Ocean Energy Roadmap, the overall quantity of funding for research and innovation would not have been different; however, it would be expected that there was less coordination among research activities.

Renewable energy policy

The impact assessment of the Blue Energy Communication acknowledges the importance of the EU's renewable policy framework for the ocean energy sector. This includes the Renewable Energy Directive[55], the "Energy Roadmap 2050"[56], the SET Plan[57], and the 2012 Communication on Renewable Energy[58].

The Renewable Energy Directive establishes since 2009 a common framework for the production and promotion of energy from different renewable sources and set the aim for the EU to get 20% of its energy from renewable sources by 2020. EU Member States have also taken on binding national targets for raising the share of renewables in their energy consumption by 2020, under the Renewable Energy Directive. To this end, Member States drafted "National Renewable Energy Action Plans" in which they provided roadmaps for the development of renewable energy. In some of those plans, (e.g. Portugal and UK) ocean energy was included as being part of the energy mix. In 2014, the 2030 climate and energy framework was adopted which also set a renewable energy target of 27% for 2030, which was again revised in 2018 to 32%.

With the adoption of the Communication "Energy Roadmap 2050", the EU committed to reducing greenhouse gas emissions to 80-95% below 1990 levels by 2050 and highlighted the challenges posed by delivering the EU's decarbonisation objective, while at the same time ensuring security of energy supply and competitiveness.

To reach its 2020 and 2050 targets for cutting CO2 emissions, the high-performance low-carbon technologies are required. The EU energy technology policy has been set by the SET plan in 2010, to accelerate the development and deployment of cost-effective low carbon technologies, comprising measures relating to planning, implementation, resources and international cooperation in the field of energy technology, including ocean energy technology.

In 2012, the Commission published a Communication setting out a strategy to enable the EU to have a world-class technology and innovation sector fit for coping with the challenges up to 2020 and beyond. The document stressed the need for accelerating innovation in cutting edge low-carbon technologies and innovative solutions, for reducing costs rapidly and speeding up the introduction

[54] Temporary Working Group on Ocean Energy (2018) SET-Plan Ocean Energy – Implementation plan. https://setis.ec.europa.eu/system/files/set_plan_ocean_implementation_plan.pdf

[55] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 established a common framework for the production and promotion of energy from renewable sources. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

[56] Energy roadmap 2050. https://ec.europa.eu/energy/sites/ener/files/documents/2012_energy_roadmap_2050_en_0.pdf

[57] https://ec.europa.eu/energy/topics/technology-and-innovation/strategic-energy-technology-plan_en

[58] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Renewable Energy: a major player in the European energy market/* COM/2012/0271 final */. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52012DC0271

of new technologies to the market. The Communication called, among other, for further efforts to reinforce research and development in the field of ocean energy.

Almost all of the above initiatives (expect the revision of the 2030 targets and the SET Plan Ocean) were adopted either before or at the same time as the Blue Energy Communication and thus the Communication and consequently the Ocean Energy Roadmap did not influence them. The Roadmap however strongly influenced the SET Plan Ocean Implementation Plan, as can be seen by the fact that the Plan reiterates some of the objectives identified in the Roadmap. The Communication and Roadmap also had an influence in the programming of Horizon 2020 calls, as was indicated by Commission staff in the course of this study.

4.3 Member state and regional context

This relates to Q4.3 "How much have Member States supported the uptake of ocean energy since 2014 (including revenue support schemes)?"

In addition to action by the EU, the ocean energy sector also receives support at national and regional level in a few locations across Europe. In fact, in the period between 2004 and 2010, support for the development of tidal energy technology was provided predominantly through national grants. From 2012 funds, including EU mechanisms have focussed more on supporting single demonstration of devices and pre-commercial farms[59].

The impact assessment for the Blue Energy Communication reported that at that time, over a dozen countries had dedicated support for ocean energy, with nine EU countries having some kind of a revenue support in place, mostly feed-in-tariffs. Only four countries, however, had a differentiated revenue support scheme specifically for ocean energy in place.

The effects of the Blue Energy Communication on the Ocean Energy Roadmap on member state support is difficult to assess. Evidence from the stakeholder consultations show, however, that in some cases (e.g. Ireland) there was a cross-fertilisation between the EU support (in form of the ocean energy forum) and national processes. In other cases, e.g. France, certain types of member state support were stopped after 2014, while others continued[60].

In general, a number of specific actions of the Blue Energy Communication and the Ocean Energy Roadmap could potentially have influenced member state action; this includes the ocean energy forum (which brought together stakeholders to develop a shared understanding of the problems faced by the Ocean Energy sector and to collectively devise workable solutions), the process of developing the Ocean Energy Roadmap (which was a collaborative process of different stakeholders, including public stakeholders) and the Ocean Energy Roadmap itself.

4.4 Private sector context

The private sector is both, receiver of funds as well as actively supporting and funding, in order to develop technologies.

The impact assessment of the Blue Energy Communication reports on two main type of private stakeholders; the technology developers (mostly SMEs) as well as large industrial players in the power generation market (such as Alstom Power, Siemens, ABB, Andritz Hydro, Voith Hydro, Bosch Rexroth and Rolls Royce).

[59] JRC (2019) Ocean Energy Technology Market Report

[60] E.g. ADEME's Investment for the Future continued to support ocean energy.

Since 2014, this situation has changed, and most industrial players have turned away from the ocean energy market. The main reason stated for this by stakeholders was the slow development of the ocean energy market which led to industrial players turning towards other technologies.

It is expected that, in the absence of the Blue Energy Communication and the Ocean energy Roadmap, this development would have somewhat comparable with, however, a tendency towards lower private investments, given the confidence effect that the Blue Energy Communication and the Ocean Energy Roadmap have by showing political will for the sector at EU level.

4.5 Development of key parameters

Besides the qualitative description of the baseline presented above the study has also considered how some key variables should be expected to evolve.

More specifically, variables relating to the core indicators to assess ocean energy development in the impact assessment have been used to describe the expected evolution under the baseline scenario.

Table 4.1 Key monitoring indicators proposed in the impact assessment

Indicator	Relevance
Installed capacity	Technology commercialisation
Number of projects planned	Investor confidence and political saliency
Magnitude of investment into the sector	Perceived reliability, efficiency and cost- effectiveness of the technologies
Capital cost reduction	R&D efficiency
Capital cost reduction/R&D spending over a given period of time	R&D consolidation and efficiency
Number of collaborative undertakings	Industry cooperation and collaboration, synergies
Amount of Member State financial support for ocean energy, including differentiated revenue support schemes	Political saliency
Lead time length (i.e. the total time taken to get building consent and grid connection permits)	Efficiency of planning and licensing procedures
Proportion of the administrative cost compared to the total project costs	Efficiency of planning and licensing procedures
Availability of relevant baseline environmental data	Monitoring of environmental impacts
Time and resources spent satisfying the requirements of the EIAs	Optimising the application of environmental protection legislation

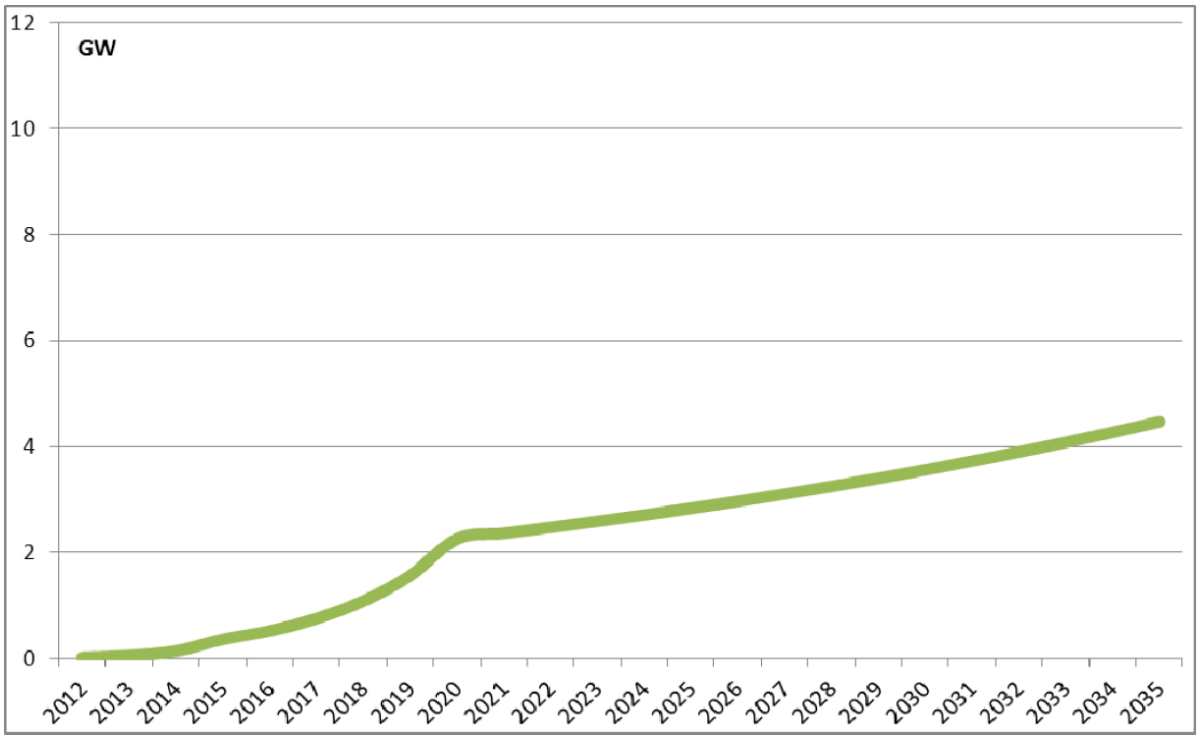
4.5.1 Installed capacity and number of projects planned

This relates to Q4.1 "How many new ocean energy projects have been installed and deployed in Europe since 2014?"

In the impact assessment, for the development up to 2035 the 'business as usual' scenario predominantly followed the reference scenario in the Commission's Energy Roadmap 2050. For the short term, up to 2020, the scenario was refined by using the commitments made by Member States in the "National Renewable Energy Action Plans" referred to above.

The baseline resulted in the assumption that ocean energy installed capacity will grow to 2.2 GW in 2020 (and 4.3 GW in 2035), on top of the 10 MW installed in 2014. The development of that baseline is presented in the Figure below.

Figure 4.1 Baseline for installed capacity



Source: Impact assessment

In 2018[61], even though the installed capacity more than doubled at 24.7 MW compared to the 10 MW installed in 2010, it is much lower than the expected approx. 1.6 GW.

Thus, the installed capacity is still relatively low and comes only from a few selected projects. Also, given the early stages of technology development that the sector is in in general, a lot of the installed capacity is from demonstration and prototype projects which are at one point decommissioned[62].

Compared to the baseline, the policy options presented in the impact assessment were expected to only add value after 2020, i.e. it was assumed that the policy intervention (what eventually would become the Blue Energy Forum and the Ocean Energy Roadmap) would only affect the installed capacity after 2020. However, it is important to note that the majority of the current installed capacity and the most advanced technologies have benefited from EU financial support[63].

With respect to planned projects, no detailed assumptions were made in the impact assessment. However, it can be expected that the same methodology would have been applied up to 2020 as for the installed capacity.

[61] Latest available numbers, based on JRC (2019) Ocean Energy Technology Market Report

[62] JRC (2019) Ocean Energy Technology Market Report

[63] JRC (2019) Technology Market Study

4.5.2 Magnitude of investment into the sector

This relates to:

- Q4.2 "How much has been invested in the ocean energy sector since 2014 (both public and private investments)?";
- Q4.5 "What is the extent of the investments in R&D for ocean energy since 2014 (public and private)?"; and
- Q5.3 "To what extent has ocean energy's access to finance been facilitated?"

In the impact assessment, for the baseline scenario, it was expected that EU funding will continue as planned[64]. No assumptions were made for member state, regional, or private sector investments.

Compared to the baseline, it was expected that additional policy interventions will lead to an increase in "political, investor and public awareness of the opportunities available […] as will confidence in the sector"; also other effects such as enhanced project bankability and investment commitments from the industry were expected. However, it was also acknowledged that the precise impacts of the actions on the above cannot be quantified.

At EU level, funding was provided through a number of different funds as described in Table 5.2 in chapter 5. In line with the baseline of the impact assessment, it is assumed that this funding would have also continued without the Communication and the Roadmap.

4.5.3 Capital cost reduction

This relates to Q4.4 "How much have the capital costs for the deployment of ocean energy been reduced since 2014?"

Capital cost reduction is an important objective of the Blue Energy Communication. Given, that in ocean energy there is a lack of commercial scale applications, this results in a lack of reliable data to analyse the cost trends[65]. This was also acknowledged in the impact assessment which stated that "data are not available on actual costs of electricity per generating technology".

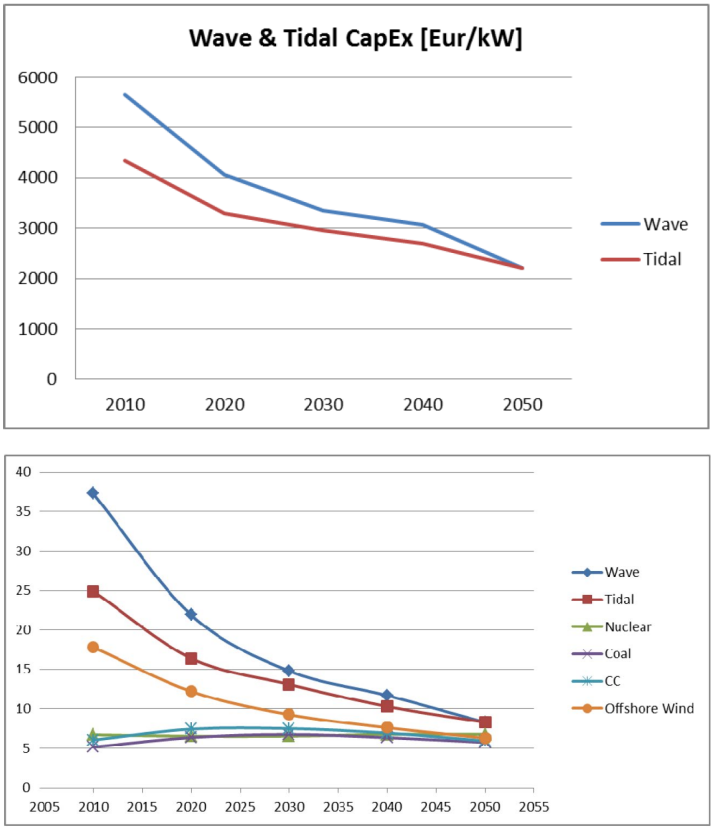
However, the impact assessment nevertheless made assumptions (for tidal and wave, based on calculations by the JRC[66]) about the development of capital cost of ocean energy as well as about the competitiveness of marine energy technologies based on the levelised cost of electricity (LCOE).

[64] "EU funding for R&D projects under the existing FP7 programme as well as the second call under the NER300 programme will continue. An ERA-Net on ocean energy is expected to be established in 2013 which will strengthen research coordination and encourage joint calls for funding amongst Member States thus capitalizing on national and regional research efforts to accelerate ocean energy development. The Commission, Member States and stakeholders will continue discussions on the future priority areas for renewable energy under the new Horizon 2020 programme."

[65] European Commission (2019). Study on impacts of EU actions supporting the development of Renewable Energy technologies.

[66] By JRC-SETIS, the Information System for the European Strategic Energy Technology (SET)-Plan

Figure 4.2 Capital cost reductions in wave and tidal energy technologies; and LCOE projections for the main power generation technologies



Source: Impact assessment

As shown in section 4.5.1, market uptake has, compared to the expectations at the time, rather stagnated. Thus, learning effects and economies of scale likely do not play as big a role as expected in the impact assessment in the reduction of capital costs and LCOE.[67] That being said, there are some learning effects "as the industry now better understands how to build their foundations so they can resist harsh conditions, how and when to install them, how to build machines that produce more while decreasing the amount of materials used (after a phase when over-sizing was common as part of testing, the ocean energy industry is moving into an efficiency phase)."[68]

It is thus suggested that those effects should be taken into consideration; however, to a smaller extent than predicted in the impact assessment.

The baseline for LCOE in the impact assessment does only predict effects from policy options to take part after 2020. This should also be seen in interplay with the SET-Plan declaration of intent for ocean energy which has set ambitious LCOE targets for wave and tidal energy in 2016[69].

[67] In the impact assessment it was assumed that additional supportive action (i.e. the Blue Energy Communication and the Ocean Energy Roadmap) would stimulate market uptake, which would lead to accelerated cost reduction through learning effects and economies of scale, i.e. lowering the capital cost and LCOE over time.

[68] European Commission (2019). Study on impacts of EU actions supporting the development of Renewable Energy technologies

[69] European Commission (2016) SET Plan – Declaration of Intent on Strategic Targets in the context of an Initiative for Global Leadership in Ocean Energy. https://setis.ec.europa.eu/system/files/integrated_set-plan/declaration_of_intent_ocean_0.pdf

4.5.4 Number of collaborative undertakings

This relates to Q5.2 "To what extent have the stakeholders been brought together and coordinated their action to enhance technological innovation and competitiveness?"

No baseline for the number of collaborative undertakings could be developed; however, an overview of current collaborative undertakings is presented in the evaluation question.

4.5.5 Amount of Member States' financial support for ocean energy, including differentiated revenue support schemes

This relates to Q4.3 "How much have Member States supported the uptake of ocean energy since 2014 (including revenue support schemes)?"

An important indicator is also the number of countries with differentiated revenue support schemes in place. An overview of instruments in place is provided in the impact assessment but no estimation is provided on how the Roadmap and the Communication would impact the number of support schemes.

An overview of current Member State support is provided in Appendix 5 of this report.

4.5.6 Environmental and administrative burdens

This includes the indicators:

- Lead time length (i.e. the total time taken to get building consent and grid connection permits);
- Proportion of the administrative cost compared to the total project costs;
- Availability of relevant baseline environmental data; and
- Time and resources spent satisfying the requirements of the EIAs.

No quantitative estimations were made for either of those indicators in the impact assessment.

5. KEY FINDINGS

This chapter presents the study's findings on the basis of the data collected and analysed. The results are presented at the level of the evaluation criteria and questions.

For the findings it is important to reiterate that both the Blue Energy Communication and the Ocean Energy Roadmap are "soft regulation" policy tools which do not specifically prescribe behaviours of organisations or individuals, which influences the magnitude of the impacts that such initiatives can produce. Moreover, these instruments are embedded in well-defined policy frameworks, most notably of research and innovation policy, as well as renewable energy policy. The presence of this wider context makes it difficult to establish a clear causal link between the adoption of the Communication and Roadmap and the specific developments in the ocean energy sector. These considerations are taken into account when assessing the relevance, effectiveness, efficiency, coherence and EU added value of these tools.

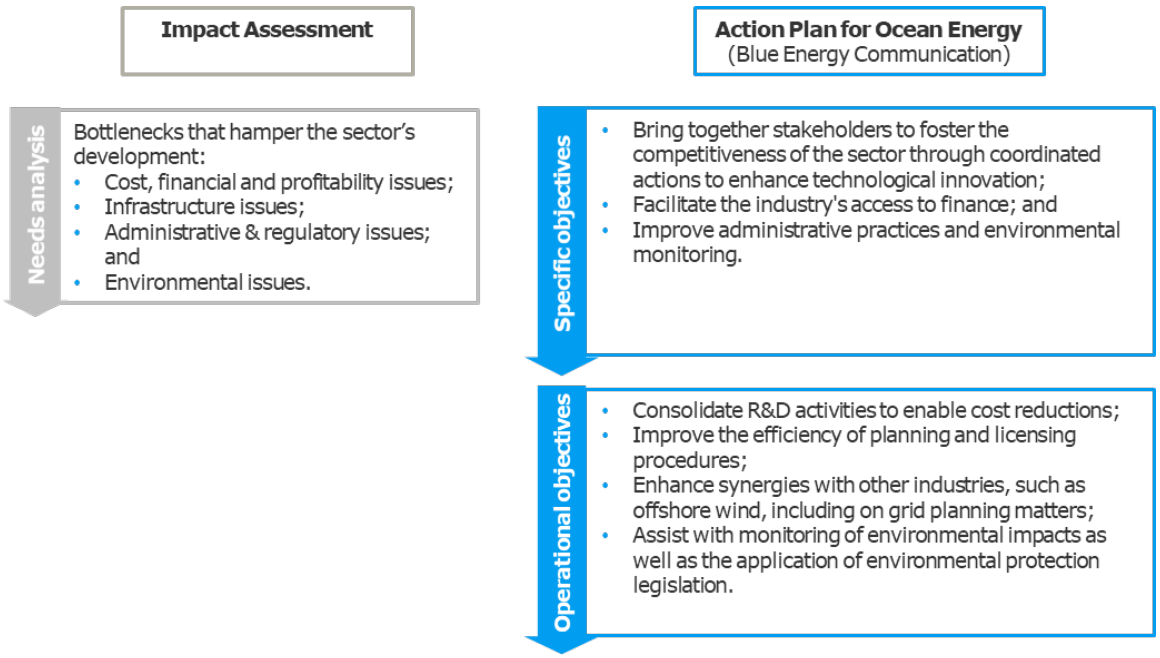
5.1 Relevance

This section presents the *key findings* concerning the continued relevance of the Communication by assessing (a) the degree to which the objectives were appropriate considering the needs and problems facing the ocean energy sector at the time of its adoption; (b) whether there have been any changes or developments in the sector and in the wider EU policy framework since then; (c) the extent to which the objectives may need to be adapted in light of these developments.

5.1.1 EQ 1: To what extent have the objectives of the intervention proven to be appropriate for responding to the needs identified in the impact assessment?

The Blue Energy Communication established three specific objectives and four operational objectives to address the needs and challenges faced by the ocean energy sector in 2014.

Figure 5.1 Needs identified in the Impact Assessment and specific and operational objectives of the Blue Energy Communication



The collected evidence suggests that the objectives identified in the Blue Energy Communication and Ocean Energy Strategic Roadmap were appropriate to respond to the needs of the sector as identified in the impact assessment.

While only a limited number of the stakeholders interviewed during the study were able to refer to the specific objectives of the Communication or Roadmap, the majority of them agree that the publication of a cohesive document indicating a common direction and priorities for the further development of ocean energy served to create momentum and to give some level of confidence to investors, which was needed at the time. At the same time, some stakeholders indicate that these instruments were not meant to be self-sufficient to address all the needs and challenges of the sector, but were intended to function as a piece of the puzzle, to be complemented by additional support coming from Member States and the private sector. This is also reflected in the Communication itself, which indicated that the sector already counted on a well-developed policy framework, constituted by a number of provisions that facilitate the development of renewables and the development of ocean energy technologies.

The Communication and Roadmap contained adequate elements to guide the sector in identifying the workstreams where its resources should focus on, and this was particularly useful for national and regional authorities or private actors aiming to develop their own strategies or to make the business case for ocean energy, according to the stakeholders belonging to these category interviewed in the course of the study. In this context, the objective of consolidating R&D activities to enable cost reductions was considered particularly appropriate given the stage of development of the sector at the time, according to the stakeholders consulted[70]. By contrast, some stakeholders raised concerns that coordination and knowledge sharing might be regarded as inappropriate by technology developers trying to preserve their intellectual property for competitiveness reasons, and this is also reflected in documentary evidence[71].

Notably, stakeholders involved in the development of OTEC and salinity gradient technologies stated that documents were not appropriately tailored to address the needs of these technologies specifically but were rather geared towards being useful for wave and tidal technologies instead. It was also pointed out by one stakeholder representing a national research institute in the Mediterranean that the Communication and Roadmap could have paid more attention to the future development of ocean energy technologies in the Mediterranean. It is important to highlight however, that no evidence of substantial developments with regards to ocean energy technologies in the Mediterranean at the time of publication of these documents was identified in the context of this study, and that the interest of Mediterranean countries for the development of this sector is described as being quite recent[72].

Via the stakeholder consultation, it was found that additional aspects could have been more appropriately considered in the Communication or Roadmap at the time of their adoption, namely:

- Although the importance of Member States intervention is highlighted throughout the documents, the link to Member States' complementary intervention could have been made clearer, as well as a clear strategy to ensure the engagement of Member States and to increase collaboration among the regions active in the field of ocean energy could have been included;
- The documents could have further expanded on the 'business case' for ocean energy, by treating more prominently aspects such as the predictability of the technology and the advantages of localised energy production for Member States, although it is noted that knowledge of these

[70] We refer here to the stakeholders consulted via the Public Consultation.

[71] European Commission (2017): "Study on lessons for Ocean energy"

[72] G. Pisacane et al (2018) Marine Energy Exploitation in the Mediterranean Region: Steps Forward and Challenges. Available at: https://www.frontiersin.org/articles/10.3389/fenrg.2018.00109/full

aspects might be of more recent origin, as indicated by the date of publication of available studies on such issues[73];

- The link to a dedicated budget line or specific funding instrument for the implementation of the actions set in the Communication and Roadmap could have further been considered.

5.1.2 EQ 2: To what extent do the objectives of the intervention remain appropriate in the light of the evolution of the EU energy, climate, maritime and R&I policies?

There is a widespread agreement among the consulted stakeholders that most of the objectives of the Communication and Roadmap remain relevant to date, notwithstanding the evolution of the broader framework on EU energy, climate, maritime and R&I climate policies. This is to a large extent because insufficient progress has been registered in their achievement so far, and therefore a large part of the needs and challenges identified in 2014 remains valid today. This is also confirmed by relevant documentary evidence[74]. In particular, the first annual review of Ocean SET, as well as other sources[75] highlight that progress relating to objectives related to finance and administrative or environmental actions is still limited. Stakeholders also specifically confirmed that the objective of enhancing synergies with other industries remains relevant[76]. Notably, it was indicated by a small part of the stakeholders consulted that the Communication and Roadmap were perhaps too optimistic with regards to the maturity of the sector at the time of their adoption, and this might be a reason why some of their objectives are still relevant to date.

In addition to this, important developments also took place in the sector and in the context in which this operates, which resulted in the emergence of additional needs and challenges for the sector according to the stakeholders interviewed in the course of the study. The developments most stakeholders refer to can be summarised as follows:

- Rapid development of other renewable energy sources e.g. offshore wind and offshore floating wind, "outcompeting" ocean energy and therefore requiring additional efforts to ensure that ocean energy receives the necessary support to further develop;
- Progress in the technological development of ocean energy technology (especially tidal energy), resulting in the evolution of the financing needs of the sector for some of the technologies e.g. need for market pull mechanisms;
- Limited support provided by Member States and private investors compared to the initial expectations, requiring additional strategies to ensure their involvement. Notably, the uncertainty about the continuity of Member States' support policies for ocean energy can further discourage private investors and reduce the spectrum of funding available to technology developers[77];
- Emergence of additional opportunities for synergies e.g. with the oil and gas sector or offshore floating wind, which would need to be further explored;

[73] To cite a few, Sasaki (2017) Predictability of global offshore wind and wave power , Available at: https://www.sciencedirect.com/science/article/abs/pii/S2214166917300036 ; Segura et al (2017) Techno-economic challenges of tidal energy conversion systems: Current status and trends, Available at: https://www.sciencedirect.com/science/article/abs/pii/S1364032117305567; Bezerra Leite Neto (2020) The effect of complementarity between solar, wind and tidal energy in isolated hybrid microgrids, Available at: https://www.sciencedirect.com/science/article/abs/pii/S0960148119313217

[74] European Commission (2017): "Study on lessons for Ocean energy"; Temporary Working Group on Ocean energy (2018): "SET-Plan Ocean energy – Implementation Plan"; JRC (2019): "Ocean energy Technology Market Report"; OceanSET (2020) OceanSET First Annual Report

[75] Thethys website (2020) "Regulatory Frameworks for Marine Renewable Energy" ; Mendoza et. Al. (2019) "Renewable and Sustainable Energy Reviews"

[76] This is also reflected in Interreg report on PELAGOS (2019): "Strategic research Agenda towards innovation in Blue energy"

[77] JRC (2019): Ocean energy Technology Market Report

- Brexit, likely causing a reduction in the amount of available funding for ocean energy, as well as having an impact on the capitalisation of the investments made in the British ocean energy sector so far;
- COVID-19 outbreak potentially causing a reduction of available funding of ocean energy but also representing an opportunity for ocean energy as many countries will look into recovering through low carbon strategies, as indicated in the EU post-COVID-19 recovery strategy. It is important to note that while a few sources[78] have been identified backing up the latter opinion, no evidence was found supporting the suggestion that there might be a negative relation between the pandemic and the reduction of funding for ocean energy.

According to the stakeholders interviewed in the course of the study, most of the developments listed above also had an influence, both positive and negative, in how effective the overall EU policy in support of ocean energy has been up to now. A list of relevant EU policies that have an impact on the development of the ocean energy sector is in the table below.

Table 5.1 Relevant EU policies that have an impact on the development of the ocean energy sector

Sector	Policy tool	Relevance for the ocean energy sector
All sectors	European Green Deal	The European Green Deal recognises the key role of the offshore renewable energy sector in contributing to the clean energy transition and that this sector will have to substantially scale up to reach the climate neutrality target by 2050.
Energy policy	Clean energy package (CEP)	The Clean energy package brought about a comprehensive update of the energy policy framework, and it highlighted the importance of fostering investments in future clean energy technologies such as ocean energy.
	Renewable Energy Directive and targets	The recast renewable energy directive set new binding renewable energy targets for the EU for 2030 of at least 32%. These targets include ocean energy as energy from renewable sources.
	SET Plan on Ocean Energy – Implementation Plan	The SET Plan outlines a set of high-level actions to be implemented by different stakeholders to enable wave and tidal technologies to reach commercial stage.
Climate policy	EU emission trading system and NER 300/Innovation Fund	A part of the revenues from the sale of emission trading system allowances are used to fund the NER300 (and starting from 2021, the Innovation Fund) which provide funding for the development of innovative low-carbon technologies, including ocean energy technologies.
	National Climate and Energy Action Plans (NECPs)	Member States are required to establish integrated 10-year NECPs for 2021-2030, outlining their strategy to achieve their respective targets on different dimensions of the energy union. This includes renewable energy targets. For certain countries these targets can be achieved via a further deployment of ocean energy.

[78] See: https://seabased.com/news-insights/ocean-energy-an-exciting-option-for-covid-19-recovery

Sector	Policy tool	Relevance for the ocean energy sector
Maritime policy	Blue growth strategy	The Blue growth strategy fosters the development of sectors that have a high potential for sustainable jobs and growth, including ocean energy.
	Marine Spatial Planning Directive (MSP)	The MSP Directive is important tool for the sustainable development of marine areas and coastal regions, including in relation to the deployment of ocean energy technologies.
	Marine Strategy Framework Directive (MSFD)	The Marine Strategy Framework Directive (MSFD) requires Member States to assess and monitor impacts of human activities on their marine waters in order to determine whether these achieve good environmental status. This can include activities related to the deployment of ocean energy technologies.
	Atlantic Action Plan	The Atlantic Action Plan calls for the strengthening of cooperation in the European ocean energy community, and to develop a specific ocean energy framework for EU islands in the Atlantic.
	European Maritime and Fisheries Fund (EMFF)	The EMFF enables, inter alia, investments the monitoring of ocean energy devices.
Research and Innovation policy	Research Framework Programmes (FP7, Horizon 2020 and Horizon Europe)	EU Research Framework Programmes provide funding for the development of ocean energy technologies.
Cohesion policy	European Regional Development Fund (ERDF) and Interreg	The ERDF and Interreg help regional and local governments across Europe to develop and deliver better policy by supporting actions in different fields, including developed in research and innovation, SME competitiveness, low-carbon economy, environment and resource efficiency.
SME support	EU programme for the Competitiveness of Enterprises and SMEs (COSME)	COSME supports SMEs in the following areas: facilitating access to finance, supporting internationalization and access to markets, creating an environment favourable to competitiveness, encouraging an entrepreneurial culture. This can be accessed by SMEs involved in the development of ocean energy technologies.

With regards to the continued relevance of the objectives of the intervention in light of the evolution of the wider EU policy framework, the literature points out[79] that while this general and non-targeted policy framework was instrumental for the sector, this was not always able to secure the success in the development and commercialisation of ocean energy technologies, not even when taken in combination with national and regional support.

In this context, the majority of the stakeholders consulted maintain that ocean energy requires dedicated support from the EU. It is important to note that this conclusion is mainly qualitative and that the stakeholders consulted in the course of the study are principally technology developers or

[79] JRC (2019) "Ocean energy Technology Market Report"

actors involved in the development of the sector overall, that have vested interest in the growth of the sector. This represents a limit to the robustness of this conclusion.

Despite the fact that there are wider policies at the EU level that indirectly support the uptake of ocean energy e.g. renewable energy policy, research and innovation policy as well as different financing mechanisms, this technology is still at an early stage of development, and it would likely not be able to progress further effectively without targeted support from the EU, according to these stakeholders. It has been repeatedly asserted that it would be particularly challenging for ocean energy to progress if it continues to be required to compete for EU support with other more established and less costly sources of renewable energy e.g. offshore wind.

5.2 Effectiveness

This section presents the *key findings* on the effectiveness of the Communication and the Roadmap in terms of the extent to which it has achieved its general, specific and operational objectives, what has actually been achieved by the Communication versus other external factors and key factors that facilitated or hindered the achievement of objectives.

5.2.1 EQ 3: What progress has been made in implementing the activities of the intervention?

The Communication established a two-phased action framework to increase the uptake of ocean energy. A first phase, envisaging the establishment of the Ocean Energy Forum and the development of the Roadmap, and a second phase foreseeing the development of a European Industrial Initiative and of sector-specific guidelines for the implementation of legislation relevant to ocean energy. Notably both, the Communication and Roadmap stressed that EU, Member States and the ocean energy sector should work together to achieve the objectives and implement the actions inscribed thereof.

Phase 1 (2014-2016)

Both the documentary evidence collected, and the stakeholders consulted, confirm that the first phase of the action framework was successfully implemented.

Ocean Energy Forum

The Ocean Energy Forum was created in 2014 and it brought together more than 100 stakeholders over a period of two years with the aim of discussing and designing solutions to support the development of the ocean energy sector. The Forum was organised in three workstreams for technology, finance and environment and consenting, each with a Steering Committee and a Chair guiding the open concertation process. A Secretariat was also created, with the purpose of supporting the work of the Forum and ensuring the delivery of the Ocean Energy Strategic Roadmap.

Ocean Energy Strategic Roadmap

As foreseen, the Forum adopted the Ocean Energy Strategic Roadmap in November 2016. This Roadmap has been considered as a "declaration of intent" developed by different stakeholders in the ocean energy industry and with the agreement of the European Commission[80]. The Roadmap established four key action areas for the development of ocean energy, to be implemented jointly

[80] Temporary Working Group Ocean energy (2018): "SET-Plan Ocean energy Implementation Plan" https://setis.ec.europa.eu/system/files/set_plan_ocean_implementation_plan.pdf

by the EU and National Authorities. According to the evidence collected[81], the EU, its Members States and the private sector have made some progress in the implementation of two out of four of these action plans, namely Action Plan 1 and 4, although most of the work is ongoing.

Action Plan 1 "A European phase-gate technology development process for sub-systems and devices"

The Roadmap proposed that a phase-gate process for sub-systems and devices be created that would set clear performance indicators to be met before moving to one step of testing and development to the other. Partial progress on this Action Plan took place, only with regards to wave energy.

A 20,752,112 EUR call for proposals was issued in 2018 under Horizon 2020 titled 'European Pre-Commercial Procurement Programme for Wave Energy Research & Development'[82], aimed at bringing European Wave Energy Research and Development more efficiently into the direction of commercialization by introducing a phase gate procedure for wave energy development at EU level. At the time of writing of this report, a grant agreement for the project has been signed with the consortium led by Wave Energy Scotland and including the Basque Energy Agency and Ocean Energy Europe. The project is expected to start on the 1st of January 2021 and it will aims to lead to the development and implementation of a pre-commercial procurement structure for wave energy technology, including common performance levels and associated specifications for wave energy systems.

Action Plan 2 "An Investment Support Fund for ocean energy farms"

The Roadmap suggests that an Investment Support Fund for financing single demonstration/pre-commercial projects, able to provide different types of finance and able to help developers access other financing sources could be created. This Fund could have a budget of around 200-300M EUR over a period of 5-10 years, and could be financed via Member States budgets, national revenue from the EU emission trading system, EU structural funds, EU demonstration programmes such as ERA-Net co-fund, Innovation Fund, European Fund for Strategic Investments.

No single such fund has been created to date, and therefore it cannot be concluded that progress with this action plan has been made at this stage. While there is no indication at present that a single fund, established as a Public Private Partnership between the EU and its Member States and the private sector will be created, it appears that individual actions are taking place, both from the EU itself and its Member States. The following initiatives demonstrate progress has been made to some extent in the establishment of financial institutions and programmes that can be used to invest in ocean energy projects or companies after 2014[83], although none of them are directly targeted to providing support for ocean energy:

- The European Commission is in the process of implementing an investment platform called Blue Invest that will provide support of maritime-based industries, including ocean energy[84];

[81] The evidence includes stakeholder opinion and the following publication: ETIP Ocean (2019): "Powering homes today, powering nations tomorrow"; as well as the publication OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

[82] Retrieved from: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/lc-sc3-ja-3-2019

[83] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

[84] The Blue Invest Initiative will channel funding towards enterprises active in the field of Blue Economy. This will be done thanks to:

- The allocation of grants to SMEs targeting the blue economy via the "Blue Invest Grants", with a budget of 22.5 MLN EUR earmarked from the European Maritime and Fisheries Fund

- The European Commission established the InnovFin EDP facility[85], which enables the EIB to finance innovative first-of-a-kind demonstration projects at the pre-commercial stage that contribute to the energy transition, including in the fields of renewable energy technologies, with the aim of contributing to de-risking the technologies and reassuring financial investors of their commercial viability;
- Member States' initiatives such as France's Bpifrance[86].

Reportedly[87] however, access to these instruments is still challenging for ocean energy actors, due to the eligibility requirements. This issue will be further expanded on in the sections below.

Action Plan 3 "An EU Insurance and Guarantee Fund to underwrite project risks"

The Roadmap proposed that an Insurance and Guarantee Fund be created to support deployment of the first demonstration and pre-commercial farms by insuring project revenues in the early years.

The evidence collected so far shows that no progress was made in the implementation of this Action Plan. Reportedly[88], in 2018 Ocean Energy Europe submitted a project proposal under Horizon 2020 aimed at defining how the EU Insurance and Guarantee Fund would work. While the proposal was selected for funding, the grant agreement preparations were terminated by the consortium due to the withdrawal of one key member of the project consortium. This signals that there is interest from the stakeholders and the EU to work on understanding the feasibility of setting up such an instrument, but there are no indications that this will be established in the near future.

This might also be because relevant actions are being taken, although not specifically targeted to ocean energy, to help underwrite project risks. For the next Multi-annual Financial Framework (MFF) covering the 2021-2027 period, the European Commission proposed to bring together under one roof the different EU financial instruments currently available that provide financing in the form of loans and guarantees. This will lead to the creation of InvestEU, a platform that will boost investment, innovation and job creation by triggering at least EUR650 billion in additional investments thanks to the EU budgetary guarantee. The guarantee will cover part of the risk of investment projects of EU strategic interest with the aim of mobilising additional amounts of private and public capital for these projects[89]. The InvestEU Programme will finance projects in different domains, including sustainable energy, and as such, it can provide support and guarantees for emerging technologies such as ocean energy. Although this initiative cannot be considered as realising Action Plan 3, in that it is not yet in place, nor it is dedicated to ocean energy specifically, it can represent an important opportunity for the ocean energy sector in terms of increasing the confidence of investors and reducing costs[90].

- The provision of finance to financial intermediaries targeting the blue economy via "Blue Invest Fund", with 75 MLN EUR earmarked from the European Investment Fund
- Calls for applications for the "Blue Invest Grants" have been closed in February 2020, while those for the "Blue Invest Fund" were open until September 2020. Retrieved from https://webgate.ec.europa.eu/maritimeforum/en/frontpage/1451

[85] InnovFin Energy Demonstration Projects provides loans, loan guarantees or equity-type financing typically between EUR 7.5 million and EUR 75 million. For more information see: https://www.eib.org/en/products/mandates-partnerships/innovfin/products/energy-demo-projects.htm

[86] For more information see: https://www.bpifrance.fr/Qui-sommes-nous/Notre-mission

[87] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

[88] Including stakeholder opinion and OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

[89] Jacques Delors Institute (2020) The Member State compartment of the InvestEU Fund: how does it work? Will it fly? Available at: https://institutdelors.eu/wp-content/uploads/2020/03/PP247_InvestEUFund_Rubio-EN-1.pdf

[90] DG MARE Website (2018) Ocean energy - A new source of green, blue power. Available at: https://ec.europa.eu/maritimeaffairs/press/ocean-energy-new-source-green-blue-power_en

Action Plan 4 "De-risking environmental consenting through an integrated programme of measures"

The Roadmap suggested to develop a set of 5 environment and consenting projects to address specific challenges related to environment and consenting for the ocean energy sector, and namely:

- Project 1 – Planning: provide guidance and recommendations on how to apply spatial planning and assessment to aid the ocean energy sector in selecting sites and ensuring compliance with Directives/Regulations in a proactive manner;
- Project 2 – Consenting: provide guidance promoting best practice techniques based on review of consenting and licensing processes;
- Project 3 – Research: provide guidance describing the approaches to secure delivery of site specific planning and monitoring, research and assessment;
- Project 4 – Socio-economics: provide data on potential socio-economic benefits and impacts as well as recommendations on the most effective techniques to assess and report upon cost reduction and maximising social and economic benefit of ocean energy technologies;
- Project 5 – Demonstration Strategy: develop an Environmental Demonstration Strategy which will take advantage of first arrays to monitor and assess the environmental impacts of ocean energy technologies.

Partial progress has been made on the implementation of Project 1, 2 and 5 for what concerns wave energy, as three projects are in the process of being implemented that focus on increasing the amount of environmental data available and to improve the knowledge on assessing possible impacts of ocean energy devices, including to improve the planning and consenting procedures.

In 2017[91] and 2019[92] the European Commission published two calls on "Environmental monitoring of wave and tidal devices" under the EMFF. Following the publication of the 2017 call for proposal, the Sea Wave project[93] and the WESE Project[94] were cumulatively funded with 1.5 million EUR from the EMFF and launched in October-November 2018. Both projects are under way and will run until 2021. The 2019 call gave light to the SafeWAVE project[95], started in October 2020 and running until 2023.

The **Sea Wave Project**[96] aims to "undertake one of the first targeted multi-WEC ecological sampling campaigns adopting a rigorous experimental approach to address some of the remaining uncertainties that exist for WECs in offshore environments"[97]. The project will develop, among other things, a comprehensive environmental impact data review and an impact model framework, that will serve to deliver and disseminate evidence-based guidance and best practice documents to facilitate the adoption by national regulatory bodies of risk-based consenting processes and to

[91] Call for proposals: Environmental monitoring of wave and tidal devices (2017) https://ec.europa.eu/easme/en/call-proposals-environmental-monitoring-wave-and-tidal-devices

[92] Call for proposals: Ocean monitoring (2019) https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/om;freeTextSearchKeyword=;typeCodes=1;statusCodes=31094501,31094502,31094503;programCode=EMFF;programDivisionCode=null;focusAreaCode=null;crossCuttingPriorityCode=null;callCode=Default;sortQuery=openingDate;orderBy=asc;onlyTenders=false;topicListKey=to

[93] See http://www.emec.org.uk/projects/ocean-energy-projects/environmental-monitoring/sea-wave-strategic-environmental-assessment-of-wave-energy-technologies/

[94] See http://wese-project.eu/

[95] See https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/org-details/999999999/project/101000175/program/31098847/details

[96] See https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/org-details/999999999/project/101000175/program/31098847/details

[97] See http://www.emec.org.uk/projects/ocean-energy-projects/environmental-monitoring/sea-wave-strategic-environmental-assessment-of-wave-energy-technologies/

support developers in securing future multi-device consents. The link to the objectives of the Roadmap is directly recognised on the project description available on the website[98]. The project is led by the European Marine Energy Centre, coordinating a consortium that brings together academic experts, environmental consultants, data managers and wave technology developers. It will run until October 2021, and it is composed by 6 Work Packages. The first deliverables of WP 1 on the gap analysis, WP 3 on data collection, WP 4 on modelling and validation, and WP6 on communication have been produced and are available on the project's website[99].

The **WESE project** aims at improving "the current knowledge of potential environmental effects and risks of wave energy, better inform decision-makers and managers on environmental risks and reduce environmental consenting uncertainty"[100] in Portugal and Spain. The project is implemented by the WESE consortium, led by the RD&I Basque centre AZTI and a multidisciplinary team of partners composed by technology device developers, EIA consultants, academic experts and data managers and it is articulated in 7 Work Packages (WP), including the collection, processing, analysis and sharing of environmental data around three wave energy devices currently operating at sea. The project is progressing and will run until October 2021. The first deliverables of WP 2 on Environmental monitoring, WP4 on Risk and adaptive based consenting for wave energy deployments and WP7 on communication and dissemination have been delivered and are available on the project's website[101].

The **SafeWAVE** project aims to better inform decision-makers and managers on environmental risks of wave energy devices, as well as to help reduce environmental consenting uncertainty thereof and to support the development of country-specific licensing guidance and suitability maps for wave energy developments based on MSP decision support tools for most of the EU countries in the Atlantic Arch. This will be done by collecting, processing, analysing and sharing of environmental data on devices currently operating at sea and modelling future impacts of larger scale wave energy deployments. The project started in October 2020 and is at the initial stages of its implementation. It will run until 2023[102].

Phase 2 (2017-2020)

The evidence collected demonstrates that limited progress was made in the implementation of phase 2 of the action framework established by the Communication, for what concerns wave and tidal energy only.

European Industrial Initiative

The Communication suggested that a European Industrial Initiative (EII) be created as a public-private partnership to bring together ocean energy industry, researchers, Member States and the Commission to set out and achieve clear and shared objectives for the sector. No evidence that a dedicated European Industrial Initiative for ocean energy was created was found in the course of the study, and according to a stakeholder consulted in the course of this study, the intention to not continue with the EII had already been communicated at the time of publication of the Communication.

[98] See: http://www.emec.org.uk/projects/ocean-energy-projects/environmental-monitoring/sea-wave-strategic-environmental-assessment-of-wave-energy-technologies/

[99] See: http://www.emec.org.uk/projects/ocean-energy-projects/environmental-monitoring/sea-wave-strategic-environmental-assessment-of-wave-energy-technologies/project-deliverables/

[100] See: https://tethys.pnnl.gov/stories/european-unions-efforts-understanding-environmental-impacts-wave-energy-devices

[101] See http://wese-project.eu/

[102] See: https://www.wavec.org/en/research-development/projects/safewave

Sector-specific guidelines for the implementation of relevant legislation

The Communication recommended that guidelines be developed to "streamline and facilitate the implementation" of relevant EU legislation (e.g. Birds and Habitats Directive, Renewable Energy Directive, Maritime Spatial Planning Directive) and to facilitate the licensing of relevant ocean energy projects and therefore "ease the burden faced by public authorities and project developers".

Notably, in 2019 the European Commission published the "Guidance on Energy Transmission Infrastructure and EU nature legislation"[103], with the aim to provide guidance to project developers, transmission system operators and authorities responsible for the permitting of energy transmission plans and projects on how best to approach the installation, operation and decommissioning of energy transmission infrastructure in relation to Natura 2000 sites and species protected under the EU Habitats and Birds Directive. The document provides an overview of the potential impacts that energy transmission infrastructure might have on protected habitats and species, it presents approaches on how to identify appropriate mitigation measures during different stages of the plan or project cycle, and it also touches upon permitting procedures under the Habitats Directive. Notably, the document also includes a chapter dedicated to marine renewable energy, including wave and tidal current power. The guidance however specifies that due to the current level of development of these types of technologies, there is still uncertainty with regards to the scale and complexity of their impacts on the marine environment, and it suggests a case by case assessment to identify the impacts.

Although these cannot be considered official guidelines for the purposes of assessing the level of implementation of Phase 2 of the Communication, it is possible to note that the European Commission has funded different initiatives in the context of which specific recommendations for Maritime Spatial Planning processes in support of the ocean energy sector have been produced. For instance, the MSP Platform published a document[104] in 2018 outlining some general recommendations on how to support the development of wave and tidal energy projects alongside other sectors and interests. The MUSES project[105], yet to be completed, is going to develop an action plan to address the challenges and opportunities for Multi-Uses of the oceans, including by addressing issues relating to the deployment of wave and tidal energy. Moreover, the MARINA Platform Project[106], concluded in 2014, produced a set of protocols covering the engineering and economic evaluation of multi-purpose Marine Renewable Energy platforms, including wave and tidal devices, taking into account also non-energy uses and planning & consenting issues surrounding their deployment, which are relevant in the context of the spatial planning decisions.

5.2.2 EQ 4: What have been the quantitative and qualitative effects of the intervention?

Ocean energy projects installed and deployed since 2014

The combined installed capacity of ocean energy devices in 2014 in Europe was 10 MW[107]. At the end of 2018, this amounted to 24.7 MW[108]. Evidence collected provides data mostly regards to wave and tidal technology devices. The collected information shows that while the installed capacity of wave technology devices doubled compared to 2015 (from 4.8 MW to 10 MW), the installed capacity

[103] European Commission (2019) Guidance on energy transmission infrastructure and EU nature legislation. Available at: https://op.europa.eu/en/publication-detail/-/publication/82e2011b-be3e-11e9-9d01-01aa75ed71a1

[104] See: https://www.msp-platform.eu/sites/default/files/sector/pdf/mspforbluegrowth_sectorfiche_tidalwave.pdf

[105] See: https://muses-project.com/?page_id=45

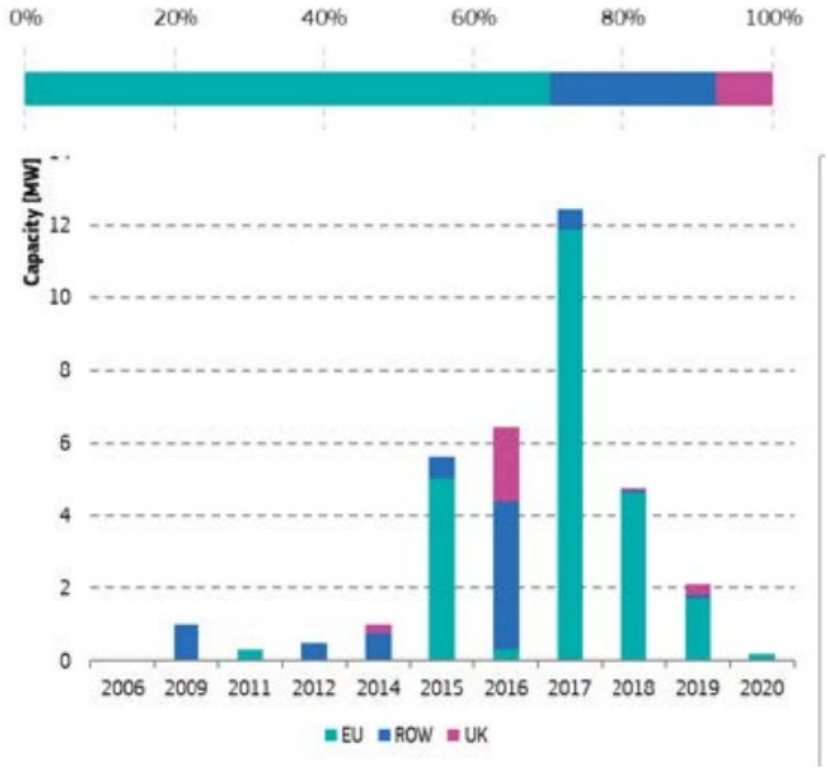
[106] See: https://cordis.europa.eu/project/id/241402/reporting

[107] European Commission (2014) Impact Assessment accompanying the Communication on Ocean energy

[108] JRC (2019) Technology Market Report

of tidal energy quadrupled (from 4.6 MW to 20 MW)[109]. 11.8 MW of the tidal energy installed capacity are located in the United Kingdom[110]. Reportedly, 27.7 MW of tidal stream and 11.8 MW of wave energy were installed in Europe since 2010[111]. It is important to know however, that a portion of this installed capacity was removed or decommissioned at the end of their testing and demonstration phase. In particular, according to recently collected data[112], 10.4 MW of tidal stream is currently operating, while 17.3 MW have been decommissioned following the successful completion of testing programmes. Of the 11.8 MW of wave energy deployed since 2010, only 1.5 MW is currently in the water, while 10.3 MW have been decommissioned as well.

Figure 5.2 Installed capacity by origin of technology



Source: JRC 2020 – 9 JRC (2020) – Facts and figures on Offshore Renewable Energy Sources in Europe, JRC121366 (upcoming)[113]

According to the Ocean SET report[114], compiling information from a survey directed to EU Member States, the average annual electricity production per installed capacity was 1,762 MWh/MW for tidal

[109] JRC (2019) Market Study Report; Ocean Energy Europe (2020) Key trends and statistics 2019 reports that in 2019, the installed capacity in EU waters amounted to 10.4 MW for tidal energy and 1.5 MW for wave energy.

[110] JRC (2019) Market Study Report

[111] Ocean Energy Europe (2020) Key trends and statistics 2019

[112] ETIPOcean (2020) Strategic Research And Innovation Agenda For Ocean Energy

[113] European Commission (2020) Report on progress of clean energy competitiveness. Retrieved from: https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

[114] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

energy. No information on electricity production was found for wave energy or other ocean energy technologies.

OTEC is being developed at the Principality of Monaco (2019) for heating and cooling of buildings (approximately 1MW of installed capacity). Salinity gradient is being developed in the Netherlands, with the installed capacity at the REDSTACK site being around 50 kW. This is planned to be upscaled. In general, the information regarding developments with OTEC and salinity gradient technologies is rather scarce in the main technology reports published to date in the EU. This can be attributed to the fact that these technologies are at earlier stages of development compared to wave and tidal, and that their applicability to the EU continent appears to be limited.

In this context, it is important to highlight that ocean energy manufactures (e.g. manufacturers of different components of ocean energy devices) seem to be regaining interest in the sector, and the creation of new manufacturing facilities was announced in France (Normandy) and Shetland (United Kingdom)[115].

While it is possible to conclude that there has been progress in the installation and deployment of wave and tidal energy since 2014, there is no direct evidence, that this slight increase of installed capacity is due to the policy intervention object of this study. On the other hand, it is important to note that most of the installed capacity within EU waters received EU funding[116], and this can be an indication that the wider EU support for ocean energy played an important role for the further installation of ocean energy devices in the water.

European Union's investments in ocean energy since 2014, including R&D funding

The EU provides funding to ocean energy since the early 2000s but presenting an accurate picture of the exact amount of funding provided, especially by type of fund, remains challenging.

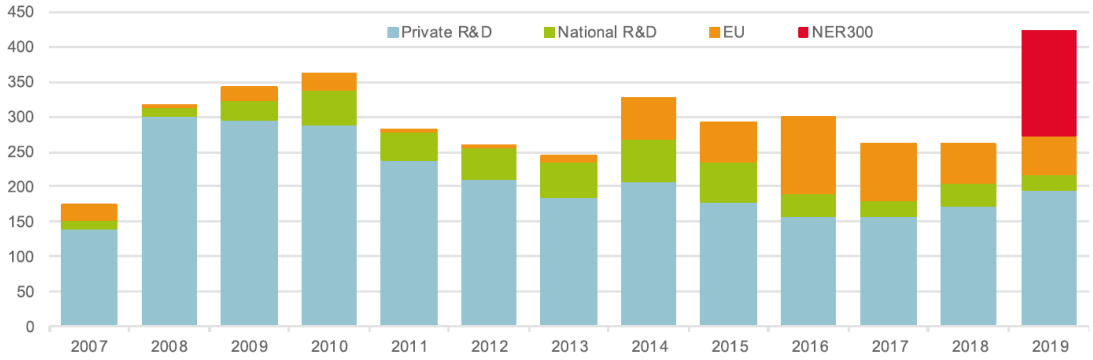
According to the energy competitiveness report[117], the total R&I expenditure on wave and tidal in the EU was 3.84 billion EUR from 2007 to 2019, with 2.74 billion EUR coming from private sources and 436 million EUR coming from national R&I programmes. In this context, the EU contribution from R&I funds was around 650 million EUR (this includes R&I programmes as well as contributions from NER300 and Interreg projects).

[115] JRC (2019): "Ocean energy supply chain"

[116] JRC (2019) Technology Market Report

[117] European Commission (2020) Report on progress of clean energy competitiveness. Retrieved from: https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

Figure 5.3 EU R&D expenditure on Wave and tidal energy, EUR million[118]



Notes: Data for 2017, 2018 and 2019 are estimates.
Source: International Energy Agency, European Patent Office and Commission Services.

In terms of trends, while private investments in the sector decreased between 2010 and 2016, national and EU R&D funds increased. By contrast, between 2017 and 2019, private R&D investments started increasing again, while EU and national support slightly decreased.

According to a stakeholder from the European Commission consulted in the context of the study, the Communication and Roadmap helped steer internal policy dynamics within the European Commission and channel considerable funding from EU mechanisms such as Horizon 2020, ERDF (Interreg) and NER300 in the direction of ocean energy. It was not possible however, to find additional documentary evidence to confirm this.

The table below provides an overview of the financial support provided to ocean energy by each different EU fund, based on the 2019 JRC Technology Development Report (unless stated otherwise). This overview also includes minor sources of funding and support that can be accessed by ocean energy developers, although no indications on the resources allocated to the sector so far are available.

Table 5.2 Overview of the main EU funding mechanisms supporting ocean energy

Funding mechanisms	Responsible entity	Amount (in million EUR)	Period
Horizon 2020	European Commission, DG Research and Innovation	140[119]	2014-2019
Of which Ocean ERA-NET		7.6[120]	2013-2019
Of which EIT InnoEnergy[121]		N/A	N/A
Of which Enhanced European Innovation Council (EIC) pilot[122]		N/A	N/A

[118] Retrieved from: European Commission (2020) Blue Economy Report 2020

[119] JRC (2019) Technology development report.

[120] JRC (2019) Technology development report.

[121] InnoEnergy supports start-ups and scale-ups that work on innovative sustainable energy technologies. For more information see: https://www.innoenergy.com/

[122] The Enhanced European Innovation Council (EIC) pilot supports researchers and innovators developing high-risk, breakthrough innovations with the potential to create new markets and boost jobs, growth and prosperity in Europe. The pilot provides grants and blended finance. For more information see: https://ec.europa.eu/programmes/horizon2020/en/h2020-section/european-innovation-council-eic-pilot

Funding mechanisms	Responsible entity	Amount (in million EUR)	Period
NER 300	European Commission, DG Climate Action	148[123]	2010-2019
European Regional Development Fund, including Interreg Europe	European Commission, DG Regional Policy	209.5[124]	2007-2019
Of which Interreg		72,5[125]	2016-2022
European Maritime Fisheries Fund	European Commission, DG Maritime Policy	1.8[126]	2017-2020
COSME[127]	European Commission, DG for Internal Market, Industry, Entrepreneurship and SMEs	N/A[128]	N/A

Member States' support for ocean energy since 2014

Little comprehensive data is available on the total amount of Member States' investments in ocean energy since 2014. The JRC reported that Member States spent around 100 million EUR in ocean energy between 2014 and 2015[129], while other sources inform that contribution from national R&I programmes amounted to 463 million EUR in the period 2007-2019[130]. According to a recent report from OceanSET, the contribution from Member States amounted to 26.3 million EUR in 2018[131]. It is however unclear whether these numbers refer to wave and tidal only, or also include OTEC and salinity gradient. In addition to this, it is important to note that, as stated in this report, difficulties persist in accessing accurate information regarding national funding of ocean energy projects.

[123] European Commission (2020) Blue Economy Report.

[124] JRC (2019) Technology development report.

[125] This figure was identified based on an assessment done by the DG MARE.

[126] Based on an assessment of project names 2 projects directly linked to ocean energy were identified, and the amounts added. Cross-cutting projects, that also might benefit the OCEN sector, were not added. See: https://ec.europa.eu/easme/en/european-maritime-and-fisheries-fund-0

[127] COSME is the EU programme for the Competitiveness of Enterprises and SMEs, running from 2014 to 2020, with a budget of 2.3 billion EUR. COSME supports SMEs in the following areas: facilitating access to finance, supporting internationalization and access to markets, creating an environment favorable to competitiveness, encouraging an entrepreneurial culture. For more information see: https://ec.europa.eu/growth/smes/cosme_en

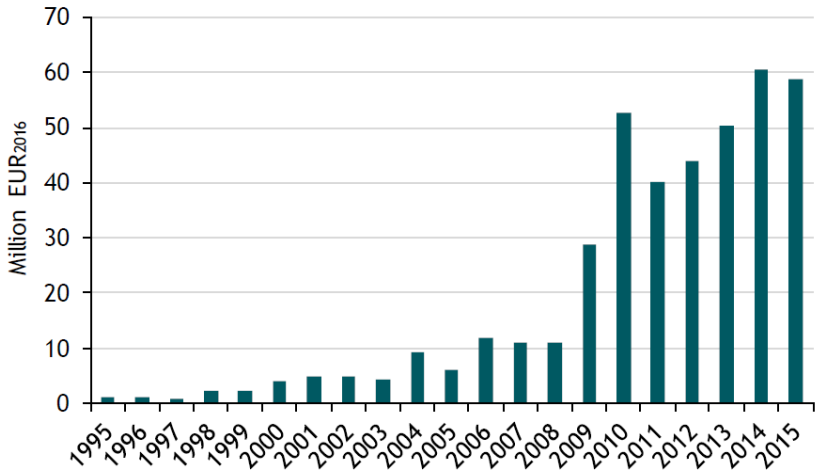
[128] It was not possible to estimate the amount of the support provided by the COSME instrument, but this is included in the overview for completeness of information, as this instrument can be relevant for ocean energy developers which are SMEs in most cases.

[129] JRC (2019): "Technology Development Report"

[130] European Commission (2020) Report on progress of clean energy competitiveness. Retrieved from: https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

[131] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

Figure 5.4 Annual Member State R&D funding in the EU for ocean technologies



Source: European Commission (2019): "Study on impacts of EU actions supporting the development of Renewable Energy technologies

It is important to note that support for ocean energy development often comes from specific coastal regions within the different Member States. In this respect, regions such as Brittany, Pays de la Loire (France), Basque country (Spain) and Flanders (Belgium) currently play an important role in helping the sector, also by providing dedicated support to it in some cases. An overview of the main support policies, including regional ones, is presented in Appendix 6. Aside for the direct provision of funding to the ocean energy sector, Member States and regions also support the sector by ensuring the availability of, suitable test centres for these technologies. Access to these sites is crucial to enable technology developers to have a practical experience of the different phases of installation, operation, maintenance and decommissioning of their devices, including the related administrative procedures. Open Sea Test Sites, two to three per country, are available in the Netherlands, Ireland, Portugal, Spain, Denmark, Belgium, Sweden and France[132].

[132] OES (2019) Annual Report. Available at : https://www.etipocean.eu/assets/Uploads/oes-annual-report-2019.pdf

Capital costs reduction in ocean energy since 2014

"Significant cost reduction is needed for tidal and wave energy technologies to exploit their potential in the energy mix, for which intensified and continued demonstration activities are necessary"[133]. The capital expenditure (CAPEX) costs of ocean energy are on a decreasing trend, but the costs of ocean energy are still above the cost of other renewable energy sources[134].

Cost reduction has been achieved at a faster pace than expected for tidal stream technologies[135]. Recent estimates on the current levelized cost of energy (LCOE) of ocean energy report a LCOE of 400 EUR/MWh for tidal energy, and of 560 EUR/MWh for wave energy[136]. Although there has been a reduction in the LCOE of ocean energy since 2014, by 40% for tidal stream in three years alone according to official sources[137] and by 30-50% for single wave energy devices[138], the development of ocean energy is still associated with both high capital expenditure (CAPEX) and high operational expenditure (OPEX)[139], and the sector struggles with creating a viable market for itself[140].

It is important to highlight that data con cost trends are still limited, due to the lack of commercial scale applications and estimates are currently mostly drawn by analysing baseline case[141]. In addition to this, the LCOE of ocean energy is both site and technology specific, and without transparent and shared performance data from demonstration projects it is difficult to draw firm conclusions on the LCOE development.

It was not possible to identify evidence proving the existence of a direct and causal link between the adoption of the Communication and Roadmap and the achieved cost reductions. However, documentary evidence indicates that EU funding, and in particular Horizon 2020, helped increase know-how in the sector and decrease CAPEX[142][143].

To what extent has the development of ocean energy sector contributed to job creation, economic growth or EU's sustainability objectives since 2014

Evidence collected so far points at the lack of data and studies on ocean energy-related job creation[144]. Despite this, estimates have been found reporting that the ocean energy sector has

[133] European Commission (2020) Report on progress of clean energy competitiveness. Retrieved from: https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

[134] JRC (2019) "Technology Market Report"

[135] Davide Magagna - JRC (2020) Ocean Energy in Europe Analysis of the state of play of the Ocean Energy sector in Europe and implications moving forward. Retrieved from: https://www.oceanenergy-europe.eu/wp-content/uploads/2020/10/2030-Vision-Launch-Davide-Magagna.pdf

[136] JRC (2019) "Technology Development Report"

[137] European Commission (2020) EU strategy on offshore renewable energy

[138] ETIPocean (2020) Strategic Research And Innovation Agenda For Ocean Energy

[139] JRC (2019) "Technology Development Report"

[140] European Commission (2020) Report on progress of clean energy competitiveness. Retrieved from: https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

[141] Trinomics (2019) "Study on impacts of EU actions supporting the development of Renewable Energy technologies"

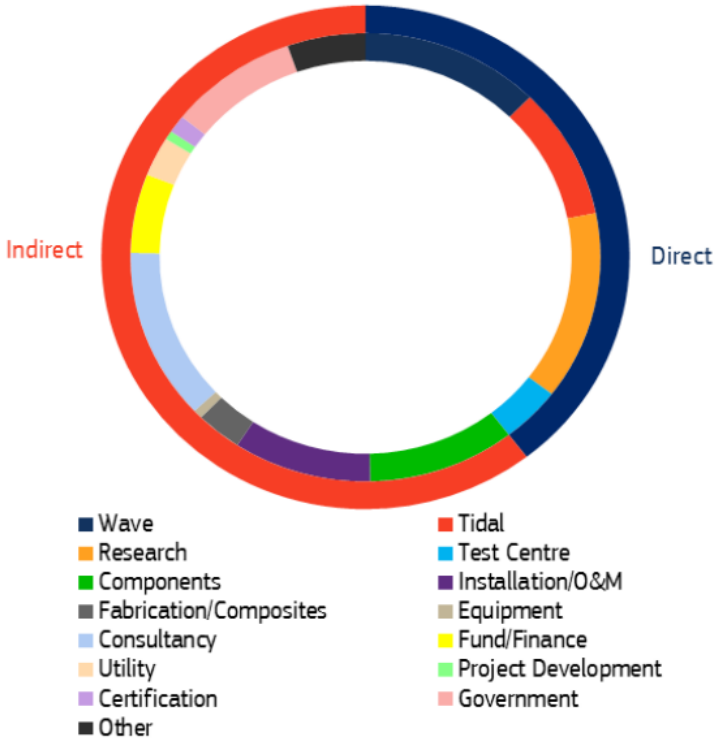
[142] Trinomics (2019) "Study on impacts of EU actions supporting the development of Renewable Energy technologies"

[143] SETIS magazine (2019): "Ocean energy"

[144] Dalton (2018) "Ocean energy Wave and Tide"

generated around 2,000 jobs, both through direct and indirect[145] job creation, in 2018[146][147]. Other sources[148] inform that TRL7+ projects in wave energy have created 121 jobs in 2018, and those in tidal energy have created 78. According to the Blue Economy Report[149], 2250 jobs were generated by the ocean energy sector in 2019, with over 430 companies being involved in different stages of the supply chain in the EU. The figure below provides and overview of the different types of jobs created by the ocean energy sector.

Figure 5.5 Breakdown of key actors in EU ocean energy sector (2017)[150]



Source: JRC, updated Dec 2017

Most of the information retrieved on the contribution of ocean energy to the EU economic growth and sustainability objectives is represented by forecasts and future outlooks. For this reason, it is not included in the analysis. However, it is important to note that there is widespread confidence in the fact that a developed ocean energy sector will contribute to providing economic benefits, in particular to EU peripheral areas, as well as to the reduction of EU GHG emissions and the

[145] This relates to indirect employment in companies along the supply chain providing intermediate services and components to the ocean energy sector.

[146] European Commission (2020) The 2018 annual economic report on the EU blue economy. Available at : https://op.europa.eu/en/publication-detail/-/publication/79299d10-8a35-11e8-ac6a-01aa75ed71a1

[147] Trinomics (2019): "Study on impacts of EU actions supporting the development of renewable energy technology"

[148] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

[149] European Commission (2020) Blue Economy Report 2020

[150] European Commission (2020) The 2018 annual economic report on the EU blue economy. Available at : https://op.europa.eu/en/publication-detail/-/publication/79299d10-8a35-11e8-ac6a-01aa75ed71a1

achievement of the climate neutrality target by 2050, including by supporting the decarbonisation of EU islands. This is also backed by relevant recent policy documents[151][152].

5.2.3 EQ 5: To what extent have the objectives of the intervention been met so far?

It is important to note that none of the stakeholders interviewed in the course of the study have been able to make a direct reference to the objectives of the Blue Energy Communication. Notably, one third of them have provided a positive feedback on the effectiveness of the instrument "in general", with the majority of the others remaining rather neutral in their judgment.

Increase in the uptake of ocean energy

Documentary evidence allows to conclude that the installed capacity of ocean energy worldwide has increased by 50% between 2016 and 2017. In 2018, the installed capacity of wave and tide combined amounted to 31.4 MW worldwide, this went up to 34 MW in 2019 (12MW wave, 22 MW tidal)[153]. 70%[154] of this global ocean energy installed capacity is located within the EU-27 waters and therefore it is possible to conclude that there has been an increase in the uptake of ocean energy both globally and in the EU. Overall, the sector has made significant steps forward in terms of technological development over the past 5 years[155], although this progress has been described as "limited" or "slow" compared to original expectations[156]. In fact, the Blue Energy Communication included a projection that foresaw total installed capacity of ocean energy to reach 2.2 GW in 2020 (and 4.3 GW in 2035) (as backed by the Impact Assessment that accompanied it), which is far from the current levels. Other estimates foresaw an installed capacity of around 2GW[157],[158] or 3.6 GW[159] by 2020. Different stakeholders mentioned that the Communication was "overoptimistic" in terms of the stage of development and potential of ocean energy at the time of its publication.

In this context, it is important to note that documentary sources indicate that while the uptake of tidal energy has been notable, in particular since 2017[160], the wave energy sector's progress has been slower. According to the EU, tidal technologies 'can be considered as being at pre-commercial stage', with a number of projects and prototypes being deployed across Europe[161] (with TRL of most devices being around 6-8)[162]. The progress made by tidal energy has been judged superior to the

[151] European Commission (2020) Blue Economy Report 2020

[152] European Commission (2020) EU strategy on offshore renewable energy

[153] Davide Magagna - JRC (2020) Ocean Energy in Europe Analysis of the state of play of the Ocean Energy sector in Europe and implications moving forward. Retrieved from: https://www.oceanenergy-europe.eu/wp-content/uploads/2020/10/2030-Vision-Launch-Davide-Magagna.pdf

[154] European Commission (2020) Blue Economy Report 2020

[155] European Commission (2020) Report on progress of clean energy competitiveness. Retrieved from: https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

[156] JRC (2019): "Technology Market Report"

[157] European Renewable Energy Council (2010) Mapping Renewable Energy Pathways towards 2020. Available at : http://www.eufores.org/fileadmin/eufores/Projects/REPAP_2020/EREC-roadmap-V4.pdf

[158] Davide Magagna, Andreas Uihlein (2015) Ocean energy development in Europe: Current status and future perspectives. Available at : https://reader.elsevier.com/reader/sd/pii/S2214166915000181?token=261027A4D4DADF08B4683A81CCC0675B46BD37E6F39B7954D12615CC34EFE6CF08EC4012DB8276E2568A3265B50574BA

[159] Position Paper - Towards European industrial leadership in Ocean Energy in 2020

[160] JRC (2019): "Ocean energy supply chain"

[161] European Commission (2020) Report on progress of clean energy competitiveness. Retrieved from: https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

[162] ETIPOcean (2020) Strategic Research And Innovation Agenda For Ocean Energy

expectations, in particular in terms of the reliability of the devices, as well as their ability to provide stable input to the grid[163]. By contrast, wave energy technologies appear to still be at the R&I stage (with most of the approaches being at TRL 6-7)[164], and substantially lagging behind in terms of performance, in particular when electricity generation is taken into account[165]. In both cases, technological maturity varies amongst developers.

The number of patents filed for a certain technology can provide indications on the level of its uptake. The number of EU patents filed for ocean energy technologies has been reducing. Since 2006, above 170 ocean energy patents have been filed every year. The number of EU patents increased until 2009, when 313 patents were filed, after which it decreased again to pre-2007 levels. However, the reason for this decrease appears to be a shift away for developing new devices to improving existing ones, which can be an indication of technological convergence. In addition to this, incentives and (test) project sites outside of the EU have increased over the past years, which can be related to the increase in patents being filed by non-EU countries[166][167].

It was not possible to identify evidence proving the existence of a direct link between the EU intervention analysed in this study and the increase in the uptake of ocean energy verified. However, it is important to note that the majority of the current installed capacity and the most advanced technologies have benefited from EU financial support[168].

Enhanced stakeholder coordination

According to the evidence collected in the course of the study, the EU support enabled the creation of platforms aiming to facilitate the development of a European-wide coordinated, unified and streamlined ocean energy sector[169]. Several initiatives favouring the encounter of stakeholders in the sector have been undertaken since before 2014. Most of these initiatives include stakeholders from both the industry, research and public sector, and aim to define common research priorities, identify solutions to enable and in general facilitate the further development of ocean energy. A non-exhaustive list of relevant initiatives in which the EU participates is provided in the table below.

Table 5.3 Overview of the main stakeholder coordination initiatives relating to ocean energy and their timeline

Initiative type	Initiative name	Purpose/Output	Period of activity	The initiative receives EU funding
Organisation	European Technology and Innovation Platform for Ocean Energy (ETIP Ocean)	• define research and innovation priorities for the ocean energy sector • promote solutions to the industry, European and national policy makers.	Since 2013	Yes

[163] European Commission (2020) Blue Economy Report 2020

[164] European Commission (2020) Report on progress of clean energy competitiveness. Retrieved from: https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

[165] European Commission (2020) Blue Economy Report 2020

[166] Trinomics (2019): "Study on impacts of EU actions supporting the development of renewable energy technology"

[167] Dalton (2018): "Ocean energy Wave and Tide"

[168] JRC (2019) Technology Market Study

[169] Trinomics (2019) "Study on impacts of EU actions supporting the development of Renewable Energy technologies"

Initiative type	Initiative name	Purpose/Output	Period of activity	The initiative receives EU funding
Organisation	EERA Joint Programme on Ocean Energy	• define research and innovation priorities for the ocean energy sector from the point of view of research organisations	since 2010	Yes
Cofund action	FP7 Oceaneranet H2020 OceanERANET COFUND	• facilitate cooperation and alignment of national and regional research programmes • support the demonstration and development of ocean energy technologies	2013 - 2018 2017 – 2021	Yes
Cluster organisation	ELBE project	• Deliver support to internationalisation activities of SMEs in the blue economy sectors • Position European companies in the global blue economy market	Since 2018	Yes
Collaborative programme	The Technology Collaboration Programme on Ocean energy Systems	• Accelerate the viability, uptake, acceptance of ocean energy systems I an environmentally acceptable manner	2001	No/ The European Commission is a member since 2016.
Collaborative project	OceanSET	• Support action for the implementation working group of the ocean energy SET Plan IP	Since 2019	Yes
Professional network	Ocean Energy Europe (OEE)	• Promote the development of ocean energy industry in Europe	Since 2005	Yes [170]

Several events bringing ocean energy stakeholders together are also regularly organised, such as European Wave and Tidal Energy Conference [171], Offshore Energy Exhibition & Conference [172], WaveEC Annual Seminar [173], Marine Energy Week [174], Ocean Energy Europe Annual Event [175].

In 2017 some stakeholders [176] still expressed concerns with regards to the current "do it alone" approach in ocean energy and lamented that insufficient sharing of knowledge was slowing down the development of the sector. Little documentary evidence assessing the current level of stakeholder collaboration in the sector is available. This notwithstanding, the majority of the expert

[170] Ocean Energy Europe participates to EU-funded projects relating to ocean energy e.g. FORESEA, MARINET2.

[171] See: https://ewtec.org/

[172] See: https://www.offshore-energy.biz/

[173] See: http://www.wavec.org/en/events/seminar-2020

[174] See: https://wmw.bilbaoexhibitioncentre.com/en/meeting/marine-energy-week/

[175] See: https://www.oceanenergy-europe.eu/annual-event/oee2020/

[176] JRC (2019) "Ocean energy supply chain"

stakeholders consulted in the course of this study affirm that the ocean energy sector is sensibly more structured, coordinated and organised than it was in 2014, in particular because of the EU support of several of the initiatives indicated above.

Facilitated access to finance

Access to finance is still an issue in the context of ocean energy and this affects the development of the sector[177][178][179]. While funding for research and development is usually regarded as "reasonably good", the stakeholders express concerns with regards to the amounts of the funding, as well as the lack of funding in support of the commercialisation of the technology and the lack of engagement of private sector and Member States. These shortcomings are also highlighted in the documentary evidence analysed[180][181][182]. In addition to this, a part of the stakeholders consulted indicate that a limited understanding of the available instruments still persists in some cases. Moreover, access to funding is deemed particularly difficult for OTEC and salinity gradient technology developers, which even mentioned, during the interviews conducted in the course of the study, that 'there was no access to finance'. It is important to highlight that this feedback was provided by stakeholders that are directly involved in the ocean energy sector (e.g. technology developers, research institutes and public authorities) and that have a vested interest in seeing the sector develop further.

The evidence collected in the course of the study points at different persisting obstacles to access to finance for ocean energy development to date, as outlined in the section below.

The high competition for available funding and restrictive requirements and burdensome application procedures of available funding mechanisms (e.g. the requirement for projects to be 'bankable'[183]);

While different EU funding mechanisms are available for ocean energy development (as indicated in EQ4), difficulties in accessing these funds persist, according to the stakeholders consulted. First, there is high competition for the available funds, not only from within the ocean energy sector, which practically lowers the chances of success for single applicants. Second, the eligibility and other technical requirements for the disbursement of the funds can be too restrictive or difficult to comply with for emerging technologies such as wave and tidal energy. The need for "specifically designed calls" has been highlighted by the JRC, as it is important to ensure that these include realistic time scales for manufacturing, deployment and optimisation of devices[184]. For instance, some facilities require projects to be bankable i.e. to demonstrate that they will deliver direct return on the investment over the lifetime of the project. In absence of dedicated revenue support by Member States, bankability is particularly difficult to attain[185]. Third, the application procedures appear to be overly complicated and time consuming for a part of the stakeholders consulted,

[177] JRC (2019) Technology development report

[178] European Commission (2017): "Study on lessons for ocean energy development

[179] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

[180] JRC (2019) "Technology Market Report"

[181] ETIP Ocean (2019) "Powering homes today, powering nations tomorrow"

[182] ETIP Ocean (2020) Strategic Research and Innovation Agenda for Ocean Energy

[183] i.e. the project must demonstrate that they will deliver a return on the investment. Retrieved from: OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

[184] JRC (2019) Technology Development Report

[185] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

requiring technology developers to engage a substantial amount of resources in proposal writing and therefore de-facto excluding certain actors from accessing the funds. This is mainly because technology developers are in large part SMEs, that often find it challenging to gather the resources necessary to navigate the funding landscape and its related complex requirements.

According to the stakeholders consulted in the course of the study, some of these shortcomings in the characteristics of available funding mechanisms have resulted in funding being allocated to technologies that ended up being unsuccessful. At the same time, it was clarified that it is quite difficult for the authorities to assess the potential of these technologies, and that in some cases technology developers themselves 'overpromised' in terms of the maturity of their technologies. Notably, some stakeholders also indicated that excessive pressure on the technological development has been put by project financers, supposedly forcing the technologies to demonstrate substantial advancements ahead of time. In their views, this has led to the failure of some of the devices as well.

The absence of commercial insurance products for ocean energy devices

As indicated in EQ3 above, no insurance and guarantee fund for ocean energy exists to date, and this represents an important obstacle for technology developers and investors that have to take charge of substantial project risks. According to the majority of the stakeholders consulted, limited progress has been made in the reduction of risks for investors, and this still constitutes one of the main bottlenecks when it comes to attracting private capital to the sector. The new InvestEU programme could constitute a positive advancement on this as it will provide EU budgetary guarantee to leverage investments on different projects, including ocean energy ones, as highlighted in section 5.2.1. The impact of this programme for the sector however still remains to be seen.

The limited availability of targeted revenue support schemes in Member States as well as private sector investments

According to the OceanSET report, 5 EU Member States provide revenue support for ocean energy (wave and tidal), namely the Netherlands, Spain, Belgium, Sweden, France. Notably, France is the only country that ring-fences funding for ocean energy. In all other countries, "attempt to compete against other, more established, renewables, which have already been able to lower costs through deploying substantial capacity. As a result, where revenue support is not ring-fenced, the payment to ocean energy projects is typically EUR 0."[186]. More details on the revenue support provided by EU Member States (and other) is provided in the table below. The table was drafted by OceanSET based on a survey completed by the representatives of different Member States participating in the OceanSET Plan.

The absence of dedicated revenue support for ocean energy has been mentioned as one of the factors discouraging private investments in the sector by the stakeholders consulted in the course of the study, together with the scarcity of clear national strategies and targets for ocean energy deployment, that would give confidence on the existence of future potential markets for the technology[187].

[186] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

[187] This is also supported by documentary evidence such as the: OceanSET (2020) OceanSET First Annual Report and the JRC (2019) Technology development report

Table 5.4 Member States revenue support for ocean energy [188]

Country	Revenue support for wave?	Revenue support for tidal?	Is revenue support ring-fenced?	Revenue support tariff for wave? (in EUR)	Revenue support tariff for tidal? (in EUR)	Revenue support paid to ocean energy in 2018? (in EUR)
Finland	No	No	Skipped	0	0	0
The Netherlands	Yes	Yes	No*	100	100	Not publidy available.
Italy	No	No	N/A	0	0	N/A
Spain	Yes	No	No*		N/A	Subsidy to investment costs: EUR151,197; Subsidy to operation cost: EUR35,581
Ireland	No	No	N/A	0	0	0
Belgium (Flanders)	Yes	-	No*	0	0	0
Belgium (Ghent Univeristy)	Yes	Yes	N/A	50	50	0
Sweden	Yes	Yes	No*	14	14	0
Portugal	No	No	Skipped	0	0	0
France	Yes	Yes	Yes	173	173	Unknown
Norway	No	No	N/A	0	0	Unknown
UK	Yes	Yes	No*	45	45	EUR370,000

No = No, there is no ring-fenced support. Ocean energy competes against all other renewable technologies.*

This table was adapted by the study team and the data was sourced in the OceanSET (2020) OceanSET First Annual Report.

[188] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

Improved administrative practices and environmental monitoring

Administrative practices

According to recent estimates[189], only three Member States, namely France, Italy and Portugal, reported having consented wave or tidal projects in 2018. Average licensing time among Member States is about three years and average consenting time is around two years for wave and tidal projects. The length of the process has been recognised as a possible deterrent for the willingness of developers to test and operate ocean energy technologies[190]. According to most of the stakeholders consulted, limited to no progress has been made on the improvement of the efficiency of planning and licensing procedures to date and these procedures are still considered to be time-consuming[191][192].

The evidence collected suggests that there has been an increase in the number of EU-funded studies that have collected best practice and lessons learned in support of the ocean energy sector, including in relation to consenting processes[193, 194, 195, 196]. The extent to which these lessons learned reach authorities or entities involved in consenting processes is, however, still unclear, and there is scope to improve in dissemination approaches, removing language barriers and centralising knowledge and data created in the context of these studies according to the stakeholders consulted in the course of the study.

At the European level, there is still a lack of uniform procedures or guidance with regards to licensing and consenting for ocean energy. This is because licensing is a national competence and largely depends on the governance system that operates in a given jurisdiction. In this context, the recast **Renewable Energy Directive**[197] provides some general guidance on the matter as it requires Member States to ensure that the national rules concerning the authorisation, certification and licensing procedures applied to renewable energy are "proportionate and necessary and contribute to the implementation of the energy efficiency first principle". The Directive also mandates that the procedures put in place should be streamlined, objective, transparent and non-discriminatory, among other things.

[189] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

[190] OceanSET (2020) OceanSET First Annual Report. Retrieved from: https://www.oceanset.eu/wp-content/uploads/2020/04/OceanSET_1st-Annual-Report_April-2020.pdf

[191] SETIS magazine (2019) "Ocean energy"

[192] European Commission (2017) "Study on lessons for ocean energy development"

[193] Ecorys and Fraunhofer (2017) Study on lessons for Ocean Energy Development. Final Report. A Report for DG for Research and Innovation. Available at: https://op.europa.eu/en/publication-detail/-/publication/03c9b48d-66af-11e7-b2f2-01aa75ed71a1

[194] Risk Based Consenting of Offshore Renewable Energy Projects (RiCORE) (2015 – 2016) was a Horizon 2020 funded project that promoted a risk-based approach to the consenting of offshore renewable energy. It considered the practices, methodologies and implementation of pre-consent surveys, post-consent and post-deployment monitoring. Available at: https://ec.europa.eu/inea/en/horizon-2020/projects/h2020-energy/wind-energy/ricore

[195] The Multi-Use in European Seas (MUSES) project (2016 – 2018) was a Horizon 2020 funded project that explored the opportunities for Multi-Use in European Seas across five EU sea basin, reviewing existing planning and consenting processes used for marine and coastal development of European seas. More information at: https://muses-project.com/

[196] ETIP Ocean (2019) Powering Homes Today, Powering Nations Tomorrow. Available at: https://www.etipocean.eu

[197] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Text with EEA relevance.) available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

In 2016, it was reported[198] that only a few European countries had streamlined the consenting process for ocean energy developments by introducing a single point of contact or 'one-stop-shop' system (such as Denmark, the United Kingdom or Portugal). Other countries, including Spain and Sweden still rely on multiple authorities to process consenting applications for ocean energy and other marine activities.

At the same time, over the last six years, there has been significant progress made in the implementation of the **EU Maritime Spatial Planning Directive**[199], which requires the adoption of maritime spatial plans in Member States by March 2021 and is identified as an important tool for the sustainable development of marine areas and coastal regions, with potential to de-risk and unlock potential areas for ocean energy deployment.

To date, most marine plans considering ocean energy have focused on offshore wind development (such as Denmark, Germany or Sweden)[200] and do not make reference to other forms of ocean energy in their plans. Exceptions, however, exist and wave and tidal energy are likely to become increasingly considered in planning processes, as indicated in the Irish National Marine Planning Framework Baseline Report (published in November 2019)[201] or the Spanish Draft Maritime Spatial Plan (published in February 2020)[202]. According to the stakeholders interviewed, other Member States prefer to use marine plans to set a framework for development and use sectoral plans to identify suitable areas and infrastructure needs for wave and tidal energy development (e.g. Scotland), in Portugal, although marine plans do identify zones for specific uses, they allow certain flexibility for alternative uses to be proposed.

Environmental monitoring

Knowledge and understanding of the environmental impact associated with different ocean energy technologies are important factors when it comes to facilitating licensing and consenting processes. The main potential impacts[203] so far associated with the deployment of ocean energy relate to potential collision with marine biodiversity, the creation of underwater noise and electromagnetic fields that can disturb marine species, changes in marine habitats (e.g. seabed conditions, sedimentation patterns etc.) that can occur as a consequence of the installation of devices. The assessment of environmental impacts largely depends on the type of conversion technology used, on their operation mode and on the specific location of the device. Due to the fact that most impacts are site-specific, and that there is a limited number of ocean energy devices installed and monitored in EU waters, there is still substantial uncertainty with regards to the environmental impacts of ocean energy. The "lack of coherent, generalised information, strategies and the lack of monitoring and mitigation plans" are considered to be obstacles to the development of ocean energy around the world to date[204], and the proliferation of real-world observations and long-term monitoring of

[198] Ocean Energy Systems (OES) (2016) Consenting Processes for Ocean Energy. Update on Barriers and Recommendations. Available at: https://tethys.pnnl.gov

[199] Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0089

[200] Ocean Energy Systems (OES) (2016) Consenting Processes for Ocean Energy. Update on Barriers and Recommendations. Available at: https://tethys.pnnl.gov

[201] Available at: https://www.housing.gov.ie [Accessed 150520]

[202] Available at: https://servicios.mapama.es [Accessed 180520]

[203] ETIPOcean (2020) Ocean energy and the environment: Research and strategic actions. Available at: https://www.etipocean.eu/resources/ocean-energy-and-the-environment-research-and-strategic-actions/

[204] Mendoza et al (2019) A framework to evaluate the environmental impact of OCEAN energy devices. Available at: https://www.sciencedirect.com/science/article/abs/pii/S1364032119303831

impacts are still highlighted as a key needs for the sector[205]. This signals that limited progress has been made on this objective of the Communication.

The stakeholders interviewed also reported that guidance on the assessment of certain impacts or on certain receptors has also been developed, but these do not necessarily reach relevant authorities or decision-makers. No specific guidance on the application of the EIA Directive or the Habitats and Birds Directive for the ocean energy sector has been found, but the Directives and their procedures are well established and transposed to National legislation, so receptor-specific or impact-specific assessment guidance may be more useful and transferrable to the diversity of technologies being considered.

Over the last years, the European Commission has funded a number of studies and projects looking to improve our understanding of environmental impacts associated with different technologies[206]. Two dedicated calls on monitoring environmental impacts of ocean energy devices have been published in 2017 and 2019 thanks to EMFF financing, and as indicated in section 5.2.1 three projects have been launched: Sea Wave project[207], WESE Project[208] and SafeWAVE project[209]. Although the three projects focus solely on wave energy and are still ongoing, they aim to improve the understanding of the environmental impacts of these devices, as well as to ensure this knowledge is transferred and up taken by relevant authorities and decision makers.

Overall, recommendations and best practice to baseline data collection, modelling and assessments have been extracted and the number of monitoring programmes on actual functioning prototypes has progressively increased. Although these individual efforts follow a common research goal and path, they are often treated individually according to the stakeholders interviewed in the course of this study, and there is a perceived lack of a common research agenda at the EU level or coordination among Member States. Limitations in relations to the dissemination, collation and access to data and knowledge produced are also highlighted.

The **Marine Strategy Framework Directive** (MSFD)[210] can also potentially play a role in the field of environmental monitoring for ocean energy devices as it requires Member States to assess and monitor impacts of human activities on their marine waters in order to determine whether these achieve good environmental status. Different descriptors[211] that need to be monitored under the MSFD can bear relevance for ocean energy devices, such as Descriptor 6 on Sea floor integrity, Descriptor 7 on Hydrographical conditions and Descriptor 11 on Energy and noise. The recently published assessment of Member States' monitoring programmes under the MSFD[212] however, reports that there is "relatively limited monitoring of energy, including underwater noise"

[205] ETIPOcean (2020) Ocean energy and the environment: Research and strategic actions. Available at: https://www.etipocean.eu/resources/ocean-energy-and-the-environment-research-and-strategic-actions/

[206] Mendoza et al. (2019): "A framework to evaluate the environmental impact of ocean energy devices"

[207] See http://www.emec.org.uk/projects/ocean-energy-projects/environmental-monitoring/sea-wave-strategic-environmental-assessment-of-wave-energy-technologies/

[208] See http://wese-project.eu/

[209] See https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/org-details/999999999/project/101000175/program/31098847/details

[210] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0056

[211] For more information see: http://msfd.eu/site/good-environmental-status/

[212] European Commission (2020) Report from the Commission to the European Parliament and the Council assessing Member States' monitoring programmes under the Marine Strategy Framework Directive. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2017:3:FIN

(Descriptor 11), and no mention of dedicated measures for ocean energy is made in the assessment of the Programmes of Measure[213].

5.2.4 EQ 6: What factors have influenced effectiveness (positively or negatively), how and to what extent?

Several factors influencing the effectiveness of the EU intervention in support of ocean energy overall have been identified via consultation of expert stakeholders. Often, these correspond with the developments taking place in the sector and in the context in which this operates since 2014, as indicated in the Relevance section 5.1.2.

The following factors appear to have influenced the effectiveness of the EU intervention in support of ocean energy **positively**:

- Increased societal awareness on climate change and increased interest in renewable energies, including thanks to developments such as the adoption of the Paris Agreement[214] and European Green Deal[215];
- The rapid improvement in performance, as well as reduction in cost, of offshore wind, presenting similar characteristics and facing similar challenges as ocean energy today, a process from which ocean energy development has learnt and will continue to learn from;
- Increased interest of the oil and gas sector in utilising ocean energy devices for offshore power production;
- Increased knowledge of the potential for multi-use of platforms by combining different marine energies (e.g. wind and wave energy);
- Increased knowledge of the complementarity of ocean energy with other renewable energy technologies to support the stability of the energy mix, given the predictability and stability of its energy supply.

The following factors have influenced the effectiveness of the EU intervention **negatively** according to the stakeholders consulted:

- High-profile failures in the industry, discouraging private investors and Member States from investing in the sector;
- Other sources of energy becoming considerably cheaper and more performant: with the costs of more established renewable energy technology dropping dramatically, investments in other sources of energy have been deprioritised;
- Member States previous substantial investments in other sources of renewable energy, reducing their willingness to subsidise yet another technology;
- Excessive focus on the levelized cost of energy (LCOE) measure to assess the technology and poor argumentation of the benefits of ocean energy towards policymakers and investors: ocean energy has been so far assessed on the same factors as more established technologies, while other factors should have rather been given more consideration e.g. benefits in terms of localised energy production in peripheral areas, proof of concept, predictability and reliability of the technology, potential for complementarity and synergies with other industries could have also been emphasised instead.

[213] European Commission (2020) Report from the Commission to the European Parliament and the Council assessing Member States' programmes of measures under the Marine Strategy Framework Directive. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:562:FIN&qid=1533034580736

[214] Paris Agreement (2015). Available at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf

[215] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS The European Green Deal (COM/2019/640 final). Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN

5.3 Efficiency

This section presents the *key findings* concerning the efficiency of the Communication and the wider EU support for ocean energy. It considers the costs incurred by the European Union, its Member States, the private sector or other stakeholders to implement the Communication and the Roadmap, compares the costs to benefits achieved, and outlines any inefficiencies characterising the investments in the intervention.

5.3.1 EQ 7: To what extent are the costs of implementing the intervention justified, given the benefits it has achieved?

The Blue Energy Communication set a two-phased action plan to assist with the development of the ocean energy sector. The costs related to the implementation of this action plan mainly relate to the setup and coordination of the Ocean Energy Forum, as well as the development and publication of the Ocean Energy Strategic Roadmap (First phase of action of the Communication).

The European Commission provided financial support for the setup and operation of the Secretariat of the Ocean Energy Forum. The Secretariat of the Forum was appointed in 2015 and it formed part of a Programme financed by the European Maritime and Fisheries Fund whose implementation was delegated to the Executive Agency for Small and Medium-sized Enterprises (EASME). The main role of the Secretariat was to ensure the timely delivery of the Roadmap by the Ocean Energy Forum members, that participated to the Forum in their own personal capacity. A series of events was organised in the course of the Forum, including several Steering Committee meetings, workshops and conferences. It was not possible to obtain any quantitative information with regards to the costs incurred by the European Commission for the organisation of the Forum and related activities, nor the costs incurred by the Ocean Energy Forum members for their participation to the initiative.

For what concerns the Roadmap itself, this established four action plans along the lines of the different workstreams of the Forum, and namely the Environment & Consenting, Finance and Technology workstreams. The implementation of Action Plan 1 to 3 required action by both the European Commission, Member States/EU Regions as well as industry players. While indicative budgets for the implementation of the different action plans were included in the Roadmap, it was not possible to identify comprehensive quantitative information relating to the actual costs incurred by stakeholders for the implementation of these actions. Details are only available concerning the funding allocated by the EU to calls that contribute to the objectives of Action Plan 1 and Action Plan 4, respectively:

- 20.7 million EUR for a 2018 call for proposals issued under Horizon 2020 and titled 'European Pre-Commercial Procurement Programme for Wave Energy Research & Development' (contributing to Action Plan 1);
- 3 million EUR for the co-funding, via the EMFF, of Sea Wave project[216], WESE Project[217] and SafeWAVE project[218] (contributing to Action Plan 4)

With regards to the Second phase of action of the Communication, costs could have been incurred by the European Commission, Member States, and industry and research organisations in establishing an European Industrial Initiative. However, this initiative was not established, therefore no costs were incurred by any of the stakeholders.

[216] See http://www.emec.org.uk/projects/ocean-energy-projects/environmental-monitoring/sea-wave-strategic-environmental-assessment-of-wave-energy-technologies/

[217] See http://wese-project.eu/

[218] See https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/org-details/999999999/project/101000175/program/31098847/details

The second action of the Second phase consisted in the development of sector-specific guidelines for the implementation of relevant EU legislation. The Communication did not specify which actor should undertake the development of these guidelines, however, some guidelines and recommendations have been produced by the European Commission with regards to the application of the EU Nature legislation[219] and of MSP processes[220] that are relevant for ocean energy. No quantitative evidence was identified providing indications of the costs incurred by the Commission for the development of the Nature legislation-related guidelines. The EU contribution to the two projects that produced recommendations on the MSP processes, respectively the MARINA Platform[221] and the MUSES project[222], amounts to 10.6 million EUR, although only part of the deliverables of these projects bear relevance for ocean energy.

Overall, it was not possible to identify comprehensive quantitative information with regards to the costs or administrative and regulatory burdens of implementing the actions inscribed in the Communication and Roadmap, especially for what concerns Member States and the private sector. As stated in previous sections of the report, the two documents represent "soft regulation" policy tools which do not prescribe specific behaviours or actions of organisations and individuals. Moreover, work is still ongoing on the projects financed by the Commission to achieve progress on some of the action plans inscribed in the Roadmap (as outlined above) and it is therefore not possible to assess the benefits gained by investing in these initiatives. As a consequence and taking into account the difficulty encountered in attributing specific developments and benefits yielded to the sector with the Communication and Roadmap, it is not possible to draw conclusions with regards to the efficiency of these policy tools.

In this context, it is important to note that no evidence was found with regards to the costs incurred by different stakeholders for the implementation of the actions inscribed in the Communication or Roadmap, aside for comments relating to the fact that the European Commission organised the Ocean Energy Forum. When asked about the efficiency of the EU intervention in support for ocean energy, most stakeholders referred to relevant EU funding instruments providing support for R&I.

5.3.2 EQ 8: What factors have influenced efficiency (positively or negatively), how and to what extent?

No clear evidence of factors influencing the efficiency of the Communication or Roadmap was identified in the course of the study.

Since many actions of the Communication and Roadmap were not implemented this does not allow for an assessment of cost-effectiveness and the driving factors.

In cases were the actions have been implemented it is not possible to clearly identify the direct impacts of those actions on the development of the sector as outlined in the effectiveness chapter. The uptake of ocean energy and other tangible benefits have not developed as assumed in the impact assessment and are limited; however, there are intangible benefits such as the signal of the European Commission that they support this sector or by bringing together the sector.

[219] Guidance on Energy Transmission Infrastructure and EU nature legislation . Available at : https://op.europa.eu/en/publication-detail/-/publication/82e2011b-be3e-11e9-9d01-01aa75ed71a1

[220] See: https://www.msp-platform.eu/sites/default/files/sector/pdf/mspforbluegrowth_sectorfiche_tidalwave.pdf

See: https://muses-project.com/?page_id=45

See: https://cordis.europa.eu/project/id/241402/reporting

[221] See: https://cordis.europa.eu/project/id/241402/reporting

[222] See: https://cordis.europa.eu/project/id/727451/it

5.4 Coherence

This section presents the *key findings* concerning the external coherence of the Communication compared to other relevant pieces of EU policy and support, as well as the extent to which it is internally consistent.

5.4.1 EQ 9: To what extent are the components of the intervention coherent internally; are there any overlaps, inconsistencies, or incoherencies?

Overall, the Communication and Roadmap appear to be internally coherent, as no evidence has been found demonstrating incoherence.

The actions build logically on each other and do not overlap or contradict each other.

In particular, the actions proposed in the Roadmap are in line with the needs and challenges faced by the sector at the time, as identified in the Impact Assessment and Communication according to the stakeholders consulted.

5.4.2 EQ 10: To what extent is the intervention coherent with wider EU policy and initiatives?

Overall, the Communication and Roadmap are coherent with the wider EU policy framework that supports Ocean Energy.

The Integrated Maritime Policy as overarching policy framework makes clear reference to the importance of marine-based energy infrastructures. The Communication and Roadmap refine this by putting a specific focus on Ocean Energy.

Most of the actions inscribed in the Roadmap were transposed in the SET Plan Implementation Plan[223], there is substantial alignment between these two documents, which represent the centre pieces of the EU action to support the uptake of ocean energy.

The objectives of the Communication and Roadmap are also clearly in line with the EU's efforts towards innovation in clean energy technologies.

There are a number of EU funds open to financing Ocean Energy development, including Horizon 2020 funding, the NER300 programme as well as Interreg funding (for more information, see paragraph on the "European Union's investments in ocean energy since 2014, including R&D funding", under EQ 4, in section 5.2.2).

In general, it is clear that the goal of increasing the uptake of ocean energy is in line with the wider renewable energy and climate policy targets. Ocean Energy is a renewable energy source with high potential with could be an important piece in the energy mix towards climate neutral Europe by 2050.

A possible inconsistency has been identified in the fact that the integration of ocean energy in National Renewable Energy Action Plans has not been sufficiently incentivised nor prioritised by Member States. Due to the perceived low level of development of the technology, the inclusion of ocean energy in the energy mix that should achieve the renewable energy targets has so far not been prioritised, and this is shown also in the limited commitment to ocean energy capacity in the National Energy and Climate Plans compared to 2010[224].

[223] SET-Plan: Ocean Energy – Implementation Plan. Available at: https://setis.ec.europa.eu/system/files/set_plan_ocean_implementation_plan.pdf

[224] European Commission (2020) Report on progress of clean energy competitiveness. Retrieved from: https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

Some stakeholders highlighted potential contradictions between the approaches adopted within the EU policy landscape and the EU intervention supporting the uptake of ocean energy which are listed below. It should be noted, however, that those statements could not be supported by further evidence.

- Contradiction with EU energy modelling: the current energy models favour the inclusion of established technologies in long-term policies rather than emerging technologies, because of the difficulty to estimate the costs of energy produced by the latter; in this context the focus on the Levelized Cost of Energy (LCOE) is also considered to be inappropriate for the assessment of an emerging technology such as ocean energy;
- Contradiction with EU competition policy and technology neutrality principle: these establish that the different technologies shall compete in the market and the ones presenting lower costs shall emerge, but this is often incompatible with the needs of an emerging technology such as ocean energy;

5.4.3 EQ 11: To what extent is the intervention coherent with other relevant EU (and national/regional initiatives) support schemes (e.g. funding, sectorial policies), in particular linked to renewables and innovation?

A part of the stakeholders mentioned that the wider EU policy framework in which ocean energy is situated might present some contradictions with the available support schemes, in that the communicated ambition on renewables and climate neutrality targets is not always matched by the way the funds are allocated e.g. stakeholders mentioned the substantial funding still disbursed to the fossil fuel industry instead of being channelled to renewables.

The evidence collected so far indicates that there is a certain degree of inconsistency between the overall EU intervention supporting the uptake of ocean energy and the support provided by Member States. In fact, the ambition of the EU with regards to ocean energy is not always reflected in national strategies, and even when this is the case it relevant support schemes are lacking to back the ambition (e.g. persistent lack of relevant revenue support schemes). In this context, the actions of single regions within some Member States (as outlined in Appendix 6 and Table 5.4) appear to me more aligned with the overall EU intervention.

5.5 EU added value

This section outlines the *key findings* on the EU added value of the Blue Energy Communication, and specifically it explores the value resulting from the EU intervention that is additional to the value that would have resulted from interventions initiated at other levels of governance (i.e. national level) and from the private sector.

5.5.1 EQ 12: What is the additional value resulting from the intervention, compared to what could have been expected from private initiatives and investments, and Member States acting at national/regional levels?

There is a widespread agreement among the stakeholders consulted that the Communication and Roadmap added value at the EU level. The majority of them affirm that the intervention achieved results that could not have been achieved at a different level of intervention at all, or at least not at the same cost or with the same result, in particular when it comes to stakeholder coordination, the consolidation of R&D activities, the monitoring of environmental impacts and the provision of a strategic direction to the sector and its stakeholders. Although not all stakeholders express positive views on the concrete results achieved by the intervention so far, in general, they agree that these instruments were only ever intended to be "strategic" and "soft regulation" policy tools, to be complemented by Member States and private sector's actions. The views on the exact extent of the

EU added value of the intervention vary, with some stakeholders considering that the situation would have been significantly worse than it is now, and others thinking it would have been only moderately worse. Notably, a minority of stakeholders indicates that the sector would have reached the current stage in any case. This notwithstanding, in general stakeholders agree that it was ultimately more helpful to have these instruments in place than to not having them. Overall, it appears that these tools served to provide momentum for the sector and give a common direction, to increase the cross-country collaboration among actors as well as the confidence of private investors compared to the baseline scenario according to some of the stakeholders interviewed. In addition to this, stakeholders within the Commission affirmed that the adoption Communication helped steer internal policy discussions and dynamic towards the provision of support for ocean energy. The perception of the stakeholders on the extent of the added value varies, from those believing that the sector would not exist in Europe now, to those affirming that it would simply be slightly less developed than it is now. When the overall EU intervention is taken into consideration (e.g. including H2020 or Interreg funding etc.) benefits of the EU intervention is perceived more clearly, with most stakeholders affirming that this was crucial for the sector to develop to the stage it has now. The fact that most of the current installed capacity and most developed technologies benefited from EU financial support[225] seems to confirm this opinion.

5.5.2 EQ 13: What would be the most likely consequences of stopping or withdrawing the existing intervention?

All stakeholders consulted overwhelmingly agree that the withdrawal of the EU support for ocean energy, intended both as strategic policy support and financial support, would have negative consequences on the development of the sector in Europe. In views of the majority of the stakeholders consulted, this would either substantially slow down the development of the sector or prevent the sector from developing at all from the stage where it is now. Different stakeholders also affirmed that the withdrawal of EU support would cause the disappearance of the sector in the EU. European ocean energy technology developers would move their companies and continue to develop their technologies abroad, where more favourable conditions can be found. Notably, several stakeholders have expressed the concern that this would represent a lost opportunity for Europe to capitalise on its current technology leadership in the sector and on the substantial efforts made so far, for the benefit of non-European actors. In fact, today, the EU hosts 58% if global tidal energy technology developers and 61% of global wave energy developers[226] and 70% of the global 34 MW of ocean energy installed capacity was located in EU waters in 2019[227]. Overall, EU companies hold 66% of patents in tidal and 44% of patents in wave energy[228]. Not only this, but European leadership in ocean energy importantly concerns the ocean energy value chain and innovation system as well[229]. Reportedly, most of the current installed capacity and most developed technologies benefited from EU financial support, and, when Member States' support is taken into account, it is noted that "internationally, no country has supported the development of ocean energy with similar funds"[230]. In this context, it has also been maintained that the withdrawal of the support would have consequences on the sector globally at least in the short term, as the EU is leading

[225] JRC (2019) Technology Market Report

[226] European Commission (2020) Blue Economy Report 2020

[227] Davide Magagna - JRC (2020) Ocean Energy in Europe Analysis of the state of play of the Ocean Energy sector in Europe and implications moving forward. Retrieved from: https://www.oceanenergy-europe.eu/wp-content/uploads/2020/10/2030-Vision-Launch-Davide-Magagna.pdf

[228] European Commission (2020) EU strategy on offshore renewable energy

[229] European Commission (2020) Report on progress of clean energy competitiveness. Retrieved from: https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf

[230] JRC (2019) Technology Market Report

most of the international tables of discussions on ocean energy and the majority of ocean energy technologies developed globally present a substantial part of "EU content".

6. CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

This chapter presents the conclusions and lessons learned derived from the findings of this support study. The conclusions are presented according to the five main evaluation criteria of relevance, effectiveness, efficiency, coherence and EU added value of the Blue Energy Communication and Ocean Energy Strategic Roadmap.

6.1 Relevance

Conclusion 1.1: The objectives of the Blue Energy Communication and Ocean Energy Strategic Roadmap were appropriate to address the needs and challenges faced by the sector in 2014 overall.

In general, the objectives identified in the Communication and Roadmap were considered appropriate to address the needs and challenges faced by the sector as identified in the impact assessment. These documents also created momentum and provided a common direction and priorities for the further development of the sector in a moment when this was much needed. This notwithstanding, it appears that the documents were overoptimistic on the stage of development of the technology and in the expectations of additional support to be provided by Member States and the private sector. A posteriori, certain elements could have been better considered or been expanded on at the time, for instance the link with Member States strategies and approaches to ensure their future interventions, the different business cases for ocean energy, the needs of certain technologies and the connection to specific funding instruments for the implementation of the actions described.

Conclusion 1.2: Most of the objectives of the Communication and Roadmap remain relevant today, although these would benefit from an expansion as recent developments in the sector have caused additional needs and challenges to emerge for the ocean energy sector.

Due to the insufficient progress registered in the achievement of certain objectives of the Communication and Roadmap (e.g. in terms of access to finance, de-risking of the technologies, improvement of administrative processes and environmental monitoring), most of the objectives and actions inscribed thereof remain relevant to address the bottlenecks of the sector today. In addition to this, developments took place since 2014 that would require an adaptation or expansion of the actions and approaches identified in these policy tools. For instance, additional efforts to ensure that dedicated support is provided to ocean energy to avoid that this needs compete for support with other more advanced technologies, to engage Member States and private companies in the investment for ocean energy, to adapt the financing to the new developments of the technologies (e.g. more focus on market pull mechanisms to stimulate commercialization), to exploit emerging synergies with other industries, and to avoid that the Brexit and the outbreak of COVID-19 have a negative impact on the development of the sector.

Recommendation: The European Commission, as well as its Member States and the private sector should continue to undertake activities aimed at achieving progress on the objectives set out in the Communication and Roadmap, in particular for what concerns the facilitation of access to finance, guarantee and insurance products, and the improvement of administrative practices and environmental monitoring. A comprehensive assessment study focusing on examining whether the needs of the sector have changed and whether additional objectives or actions shall be pursued to

address additional bottlenecks of the sector could be undertaken, perhaps in the context of collaborative initiatives such as OceanSET or other.

6.2 Effectiveness

Conclusion 2.1: Partial progress has been made in the implementation of the actions inscribed in the Communication and Roadmap, but relevant work is ongoing for two of the four action plans set out in the Roadmap, for what concerns wave energy.

The EU successfully implemented the actions included under Phase 1 of the Communication, by setting up the Ocean Energy Forum and supporting the adoption of the Ocean Energy Strategic Roadmap. For what concerns the actions under Phase 2, some progress has been made in the development of sector-specific guidelines for the implementation of relevant legislation, in relations to the EU Nature legislation and partially also MSP processes. No progress was registered in the establishment of and European Industrial Initiatives for ocean energy, although the intention to not move forward with this had already been communicated in 2014.

With regards to the four action plans inscribed in the Roadmap, work is ongoing thanks to European Commission funding on the development of a European phase-gate technology development process (Action Plan 1) and on the monitoring of environmental impacts of ocean energy (Action Plan 2), but only for what concerns wave energy. Although an Investment Support Fund for ocean energy farms (Action Plan 2), nor an Insurance and Guarantee Fund for ocean energy (Action Plan 3) have been created to date, and financing and de-risking of the technologies still represent major bottlenecks for the sector, some upcoming initiatives might represent relevant steps forward in this direction, such as the Blue Invest Fund and the InvestEU programme.

Recommendation: The European Commission, as well as its Member States and the private sector should continue with the ongoing work on the phase-gate technology development process and monitoring of environmental impacts, including by expanding current approaches to other ocean energy technologies. Further efforts should be made to improve access to funding for demonstration projects, as well as to provide insurance and guarantee products for the development and deployment of ocean energy technologies. Additional and more sector-specific guidance on the application of relevant EU legislation could be developed to help streamline administrative processes related to the licensing and consenting of ocean energy projects.

Conclusion 2.3 Progress on the achievement of the objectives of the Communication and Roadmap has been very limited, and it is challenging to establish a causal relationship between the achievements and these policy tools.

The main objectives of the Communication were to increase the uptake of ocean energy, to bring stakeholders together to foster the competitiveness of the sector through coordinated actions, to facilitate the industry's access to finance and to improve the administrative practices and environmental monitoring.

Overall, there has been an increase in the uptake of ocean energy in the EU, and the sector has made significant steps forward in terms of technological development over the past 5 years, in particular for tidal energy. However, this progress has been slower than expected, and current levels of installed capacity are far away from the expectations outlined in the Communication. While it is not possible to directly attribute these developments to the Communication and the Roadmap, the wider EU support has played a key role, as the majority of the current installed capacity and the most advanced technologies developed have benefited from EU financial support.

It is unclear to what extent the objective on enhanced stakeholder coordination has been achieved, as very little documentary evidence is available on this. While some sources indicate that

stakeholder coordination is still insufficient, the majority of the expert stakeholders consulted in this study maintain that the sector is much more structured, organized and synergetic than it was in 2014. This is also because of the multiple stakeholder coordination initiatives undertaken or supported by the EU, which however are not linked to the publication of the Communication or Roadmap and rather predate their adoption.

Access to finance is still one of the major bottlenecks for the ocean energy sector. Despite the substantial support provided by the EU and other actors, developers still find it difficult to access available funding because of high competition, restrictive requirements and burdensome application procedures. The availability of private funding for the sector is still limited by the high risks still associated with the development of the technology, particularly in the absence of an Insurance and Guarantee fund, and by the lack of revenue support schemes within Member States. Funding is particularly lacking for the demonstration of ocean energy technologies.

Administrative practices related to consenting and licensing of ocean energy are still long and characterized by uncertainties, and the monitoring of environmental impacts is still very limited. Despite relevant individual efforts being undertaken to collect data, best practices and lessons learnt in these fields, the progress registered is considered insufficient, and it still represents a deterrent for technology developers' willingness to test and operate devices.

Recommendation: Further efforts should be undertaken by the EU, Member States and private investors to facilitate access to finance, including by taking into account the specific needs of the ocean energy sector and the stage of development of the different technologies. Financial instruments to support the demonstration and pre-commercial projects should be put in place, including revenue support schemes within Member States. The creation of an EU Insurance and Guarantee fund, as foreseen in the Roadmap and in the SET-Plan Implementation Plan, or at least similar insurance products that could be used by ocean energy developers, should also be advanced. Ongoing work on the facilitation of administrative procedures and improvement of environmental monitoring should be continued and reinforced, in particular with a view to ensuring the results are disseminated and up taken by the relevant actors, including public authorities.

Conclusion 2.3: The effectiveness of the EU intervention in support of the development of ocean energy has been affected by several external factors.

Different factors have influenced the effectiveness of the overall EU intervention in support for ocean energy, and in the most part these coincide with developments that have occurred in the sector and in the context in which this operates since 2014. For instance, the increased societal awareness on climate change and increased interest in renewable energy, including by different industries, as well as the lessons learnt from the development of other offshore renewable energy technologies have had a positive impact for the development of the sector. On the other hand, factors such as high profile failures in the ocean energy industry, the increased competitiveness of other forms of renewable energy technologies, as well as the somewhat poor argumentation in favor of ocean energy have had a negative impact on Member States and private investors' willingness to support ocean energy. The limited support received by these actors compared to the expectations have had a negative influence on the overall effectiveness of the EU intervention.

Recommendation: The EU could assess the influence that current and future external factors, such as the ones outlined above, can have on the effectiveness of its intervention in support for ocean energy, and take them into account in the context of a possible future revision of its approach to support the sector.

6.3 Efficiency

Conclusion 3.1: It is not possible to identify quantitative information on the costs or administrative and regulatory burdens related to the implementation of the Communication and Roadmap, as these are "soft regulation" policy tools.

The costs related the implementation of the Communication and Roadmap relate to the costs incurred by the European Commission, Member States and private sector to implement the actions inscribed in these policy tools.

The European Commission provided financial support for the setup of the Ocean Energy Forum and for the related development of the Roadmap. It moreover provided funding support to launch calls under Horizon 2020 and the EMFF to realize the objectives of two out of four action plans outlined in the Roadmap. Quantitative information is only available on the amounts provided for the calls, but as work on those projects is still ongoing, it is not possible to assess the benefits gained by investing in these initiatives.

Overall, it was not possible to identify comprehensive quantitative information with regards to the costs or administrative and regulatory burdens of implementing the actions inscribed in the Communication and Roadmap, especially for what concerns Member States and the private sector. The two instruments are "soft regulation" policy tools, which do not prescribe specific behaviors or actions of organisations and individuals. In light of this, it is not possible to draw conclusions on the efficiency of the EU intervention.

6.4 Coherence

Conclusion 4.1: The Communication and the Roadmap are internally coherent and in line with the wider EU policy framework.

The actions within the Communication and the Roadmap, as well as the Communication and the Roadmap, seem to be coherent as no evidence for incoherencies could be found.

The Communication and the Roadmap are also coherent with the wider policy framework supporting Ocean Energy. While some potential minor misalignments between policy tools have been brought up by stakeholders, no further evidence could be found to support this.

Conclusion 4.2: A degree of inconsistency persists between the EU intervention on ocean energy and Member States' strategies and activities in the sector.

The Communication and Roadmap, as well as the broader EU intervention in favor of ocean energy development establish a common direction and ambition for the development of the sector. This ambition is not always reflected in national strategies, such as National Energy Climate Plans, that instead indicated a limited commitment of Member States to further develop ocean energy as a means to achieve their renewable energy targets. Where the ambition is reflected in national strategies, this is often not matched by the establishment of appropriate support mechanisms, such as revenue support, and this represents a considerable challenge for the advancement of the sector in practice.

Recommendation: Further efforts should be undertaken to improve alignment of Member States' strategies with the EU ambition on ocean energy and to enhance their engagement in support for the sector. This could be done by exploiting current dialogue initiatives such as ETIP Ocean and OceanSET or dedicated bilateral discussions. In this context, it will be crucial to improve the

understanding of the benefits of investments into the sector, as well as how national interventions can address current bottlenecks.

6.5 EU added value

Conclusion 5.1: The Communication and the Roadmap provide EU added value in particular in terms of defining a common strategic agenda for the sector, although it remains unclear whether the sector would be substantially different now had they not been adopted. The EU added value of the broader EU intervention for ocean energy is perceived more clearly.

The Communication and the Roadmap achieved results that could not have been achieved at different levels of intervention, in particular in terms of bringing the sector's stakeholders together around a specific strategic agenda. It remains unclear to what extent the implementation of these instruments is directly responsible for the limited progress witnessed in the sector up to now, and whether this would be much different had they not been adopted. This notwithstanding, it is important to note that the Communication and Roadmap were only ever intended to be "soft regulation" policy tools, representing only a part of the picture, to be complemented by additional interventions by the EU, Member States and the private sector. When the broader EU intervention, in particular the financial support provided, is taken into consideration, it is clear that this was crucial for the development of the sector.

Conclusion 5.2: The EU holds global leadership on ocean energy technologies thanks to the support provided by the EU and its Member States so far and a potential withdrawal of its intervention would have negative consequences for the sector internally, and also potentially abroad.

Driven by the substantial support provided by EU institutions and its Member States the EU-27 have gained undisputed global technological leadership in the ocean energy sector. Around 70% of global ocean energy installed capacity is located in EU waters, and EU companies hold around half of the patents for tidal and wave energy globally. As most of current projects still benefit or have benefitted from EU's support, the withdrawal of EU's financial (e.g. Horizon 2020 and Interreg) and strategic (including the Communication and Roadmap, but also general strategic support) intervention in favor of ocean energy would have very negative consequences for the sector. Given the high level of "EU content" in ocean energy technologies developed abroad, this might also have consequences in the rest of the world. What is more, this withdrawal would represent a missed chance for the EU to capitalize on its first mover advance and on the substantial investments made so far, for the benefit of global late comers.

Recommendation: The EU should continue to provide support for the implementation of the actions inscribed in the Communication and Roadmap, as well as to support additional initiatives promoting the development of ocean energy, in particular on matters where a coordinated and EU-level approach are most functional (e.g. the creation of an Insurance and Guarantee Fund, the development of sector-specific guidelines for the application of relevant EU legislation etc.).

Appendix 1 – Evaluation question matrix

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources
Relevance	EQ 1. To what extent have the objectives of the intervention proven to be appropriate for responding to the needs identified in the impact assessment?	• 1.1 To what extent were the specific and operational objectives of the Blue Energy Communication and the Ocean Energy Roadmap *appropriate* to address *cost reduction, financial and profitability needs? Has this changed over time and to what extent are they still appropriate?* • 1.2 To what extent were the specific and operational objectives of the Blue Energy Communication and the Ocean Energy Roadmap *appropriate* to address *infrastructure needs (e.g. grid planning, port facilities and vessels)? Has this changed over time and to what extent are they still appropriate?*	• Qualitative indicators: • Paper, evaluations, reports etc. agree that the Blue Energy Communication and the Ocean Energy Roadmap were appropriate for supporting the uptake of ocean energy technologies • Quantitative indicators: • % of stakeholders agreeing that the Blue Energy Communication and the Ocean Energy Roadmap were appropriate for supporting the uptake of ocean energy technologies • Qualitative indicators: • Identified current needs within the EU per category of stakeholders (public; private;	• There is evidence in the literature that the Blue Energy Communication and the Ocean Energy Roadmap were appropriate for supporting the uptake of ocean energy technologies • Stakeholders agree that the objectives have been appropriate and relevant for supporting the uptake of ocean energy technologies • There is evidence in the literature that the original objectives Blue Energy Communication and the Ocean Energy Roadmap correspond to the current needs of different stakeholders' categories • Stakeholders are able to identify their current needs	• Literature review • Stakeholder consultations: PC • Stakeholder consultations: targeted consultations •

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources
		• 1.3 To what extent were the specific and operational objectives of the Blue Energy Communication and the Ocean Energy Roadmap *appropriate* to address a*dministrative & regulatory needs (e.g. licensing and consenting procedures)? Has this changed over time and to what extent are they still appropriate?*	research community; citizens) • Identified changes in needs within the EU per category of stakeholders (public; private; research community; citizens) since 2014 • Papers, evaluations, reports etc. agree that the original objectives of the Blue Energy Communication and the Ocean Energy Roadmap still correspond to stakeholders' needs	• Stakeholders agree that the original objectives continue to correspond to their needs	
		• 1.4 To what extent were the specific and operational objectives of the Blue Energy Communication and the Ocean Energy Roadmap *appropriate* to address *environmental needs (e.g. research and development, better exchange of information on environmental impacts of OCEN installations)? Has this changed over time and to what extent are they still appropriate?*			
	EQ 2. To what extent do the objectives of the	• 2.1 To what extent do the *objectives* of the	• Quantitative indicators:		

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources

	intervention remain appropriate in the light of the evolution of the EU energy, climate, maritime and R&I policies?	Communication and the Roadmap *correspond* to the *current needs* of the ocean energy sector *in light of the evolution* of EU energy, climate, maritime and R&I policies (e.g. new renewable energy targets etc.)?	• % of stakeholders agreeing that the Blue Energy Communication and the Ocean Energy Roadmap remain relevant policy
			  • EU climate policy
			  • EU maritime policy
			  • EU R&I policies
			• evolution		

Effectiveness	EQ 3. What progress has been made in implementing the activities of the intervention?	• 3.1 What progress has been made in implementing the Ocean Energy Forum? • 3.2 What progress has been made in implementing the Ocean Energy Strategic Roadmap? • 3.3 What progress has been made in implementing the European Industrial Initiative? • 3.4 What progress has been made in implementing the sector-specific guidelines?	• Qualitative indicators: • Evidence on progress/achievement of actions • Quantitative indicators: • Actions and activities achieved in relation to the planned outputs	• There is evidence in the literature that actions and recommendations have been achieved	• Literature review

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources
	EQ 4. What have been the quantitative and qualitative effects of the intervention?	• 4.1 How many *new ocean energy projects* have been *installed* and *deployed* in Europe since 2014?	• Qualitative indicators: • Other papers, evaluations, reports etc. agree that the Blue Energy Communication and the Ocean Energy Roadmap contributed to the uptake of ocean energy • Quantitative indicators: • Number of projects deployed and planned compared to what could be expected in the baseline scenario • Installed capacity compared to what could be expected in the baseline scenario	• There is evidence in the literature that the Blue Energy Communication and the Ocean Energy Roadmap have contributed to the uptake of ocean energy technologies • Stakeholders agree that the objectives have been appropriate and relevant for supporting the uptake of ocean energy technologies • The intervention is found to have an effect (compared to the baseline)	• Literature review • Stakeholder consultations: PC • Stakeholder consultations: targeted consultations
		• 4.2 How much has been *invested* in the ocean energy sector since 2014 (both public and private investments)?	• Investment into the sector compared to what could be expected in the baseline scenario •		
		• 4.3 How much have *Member States supported* the uptake of ocean energy since 2014 (including revenue support schemes)?	• Amount of Member State financial support for ocean energy, including differentiated revenue support schemes, compared to what could be expected in the baseline scenario		

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources
			•		
		• 4.4 How much have the *capital costs* for the deployment of ocean energy been *reduced* since 2014?	• Capital cost reduction compared to what could be expected in the baseline scenario •		
		• 4.5 What is the extent of the *investments in R&D* for ocean energy since 2014 (public and private)?	• Capital cost reduction/R&D spending over the evaluation period compared to what could be expected in the baseline scenario •		
		• 4.6 To what extent has the development of the ocean energy sector contributed to *job creation*, *economic growth* or *EU's sustainability objectives* since 2014?	• Extent to which the sector is contributing to the EU's wider jobs, growth and sustainability objectives compared to what could be expected in the baseline scenario		
	EQ 5. To what extent have the objectives of the intervention been met so far?	• 5.1 To what extent has the *uptake* of ocean energy *increased*?	• Partly answered by EQ 4.1	• There is evidence in the literature that the Blue Energy Communication and the Ocean Energy Roadmap reached their objectives • Stakeholders agree that the Blue Energy Communication and the	• Literature review • Stakeholder consultations: PC • Stakeholder consultations: targeted consultations
		• 5.2 To what extent have the *stakeholders been brought together* and *coordinated their action* to enhance technological innovation and	• Qualitative indicators: • Papers, evaluations, reports etc. agree that the Blue Energy Communication and the Ocean Energy Roadmap reached their objectives		

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources
		competitiveness? (specific objective)	• Quantitative indicators: • % of stakeholders agreeing that the Blue Energy Communication and the Ocean Energy Roadmap reached their objectives •	Ocean Energy Roadmap reached their objectives • The intervention is found to have an effect (compared to the baseline)	
		• 5.3 To what extent has ocean energy's *access to finance* been facilitated? (specific objective)	• Papers, evaluations, reports etc. agree that the Blue Energy Communication and the Ocean Energy Roadmap improved access to finance for technology developers • % of stakeholders agreeing that the Blue Energy Communication and the Ocean Energy Roadmap improved access to finance for technology developers		
		• 5.4 To what extent have the *administrative practices* and *environmental monitoring* been improved? (specific objective)	• Proportion of the administrative cost compared to the total project costs compared to what could be expected in the baseline scenario[231]		

[231] Should the available sources not provide sufficient data the contractor will send a short survey to technology developers.

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources
		• 5.5 To what extent has *cost reduction* being achieved via the consolidation of R&D activities? (operational objective)	• Proportion of the administrative cost compared to the total project costs compared to what could be expected in the baseline scenario[232]		
		• 5.6 To what extent has the *efficiency of the planning and licensing procedures* been improved? (operational objective)	• Lead time length (i.e. the total time taken to get building consent and grid connection permits) compared to what could be expected in the baseline scenario[233]		
		• 5.7 To what extent has the *synergy with other industries* (e.g. offshore wind) been enhanced, including on grid planning matters? (operational objective)	• Number of collaborative undertakings compared to what could be expected in the baseline scenario		
		• 5.8 To what extent has the *monitoring of environmental impacts* of OCEN technology and *the application of the relevant environmental protection legislation*	• Availability of relevant baseline environmental data compared to what could be expected in the baseline scenario[234]		

[232] Should the available sources not provide sufficient data the contractor will send a short survey to technology developers.

[233] Should the available sources not provide sufficient data the contractor will send a short survey to technology developers.

[234] Should the available sources not provide sufficient data the contractor will send a short survey to technology developers.

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources
		been supported? (operational objective)	• • Time and resources spent satisfying the requirements of the EIAs compared to what could be expected in the baseline scenario[235]		
	EQ 6. What factors have influenced effectiveness (positively or negatively), how and to what extent?	• 6.1 What factors influenced the effectiveness of the Communication/Roadmap *positively*? *How* did they influence effectiveness, and *to what extent*?	• Qualitative indicators: • Factors identified on the basis of Literature review and interviews	• The factors are found to have had an impact on the effectiveness	• Literature review • Stakeholder consultations: targeted consultations
		• 6.2 What factors influenced the effectiveness of the Communication/Roadmap *negatively*? *How* did they influence effectiveness, and *to what extent*?			
Efficiency	EQ 7. To what extent are the costs of implementing the intervention justified, given the benefits it has achieved?	• 7.1 What have been the *costs of implementation* of the Communication/Roadmap for the different stakeholders?	• Qualitative indicators/quantitative indicators: • Costs of implementation (administrative costs as well as funding)	• The extent to which the benefits outweigh the costs of the intervention	• Literature review • Stakeholder consultations: targeted consultations

[235] Should the available sources not provide sufficient data the contractor will send a short survey to technology developers.

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources
		• 7.2 What progress has been made in terms of *EU funding* allocated to ocean energy?	• Information of EU funding for ocean energy (e.g. including INTERREG, ERDF etc.)		
		• 7.3 What progress has been made in terms of *Member States' funding* allocated to ocean energy?	• Information of Member States funding for ocean energy (e.g. national, regional etc.)		
		• 7.4 What *benefits* (direct, indirect) have been achieved to date for different stakeholders?	• Benefits of implementation (see effectiveness questions – specifically EQ4)		
		• 7.5 Are the *costs and benefits proportional* for the different stakeholders?	• Information on the comparison between costs and benefits of implementation		
	EQ 8. What factors have influenced efficiency (positively or negatively), how and to what extent?	• 8.1 What factors influenced efficiency *positively*?	• Qualitative indicators: • Factors identified on the basis of Literature review and interviews	• The factors are found to have had an impact on the efficiency	• Literature review • Stakeholder consultations: targeted consultations
		• 8.2 What factors influenced efficiency *negatively*?			
Coherence	EQ 9. To what extent are the components of the intervention coherent internally; are there any overlaps,	• 9.1 Are there *internal inconsistencies* within the *Communication*?	• Qualitative indicators: • The extent to which overlaps, gaps, contradictions or discrepancies exist within the intervention	• Absence of evidence of overlaps, gaps, contradictions or discrepancies within the intervention	• Literature review • consultations: targeted consultations
		• 9.2 Are there *duplications or overlaps*			

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources
	inconsistencies, or incoherencies?	within the Communication?			
	EQ 10. To what extent is the intervention coherent with wider EU policy and initiatives?	• 10.1 Are there *inconsistencies or contradictions* between the Communication/Roadmap and wider EU policy and initiatives? • 10.2 Are there *duplications or overlaps* between the Communication/Roadmap and wider EU policy and initiatives?	• Qualitative indicators: • The extent to which overlaps, gaps, contradictions or discrepancies exist with wider EU policy	• Absence of evidence of overlaps, gaps, contradictions or discrepancies with wider EU policy	• Literature review • Stakeholder consultations: PC • Stakeholder consultations: targeted consultations
	EQ 11. To what extent is the intervention coherent with other relevant EU (and national/regional initiatives) support schemes (e.g. funding, sectorial policies), in particular linked to renewables and innovation?	• 11.1 Are there *inconsistencies or contradictions* between the Communication/Roadmap and other EU support schemes (in particular linked to renewables and innovation)? • 11.2 Are there *duplications or overlaps* between the Communication/Roadmap and other EU support schemes (in particular linked to renewables and innovation)?	• Qualitative indicators: • The extent to which overlaps, gaps, contradictions or discrepancies exist with support in other sectors e.g. EMFF, INTERREG, ERDF etc.	• Absence of evidence of overlaps, gaps, contradictions or discrepancies with other Commission initiatives	• Literature review • Stakeholder consultations: PC • Stakeholder consultations: targeted consultations

Crit.	Evaluation questions	Sub-question	Indicators / descriptors	Judgement criteria	Sources
		• 11.3 Are there *inconsistencies or contradictions* between the Communication/Roadmap and national/regional initiatives?			
		• 11.4 Are there *duplications or overlaps* between the Communication/Roadmap and national/regional initiatives?			
EU Added Value	EQ 12. What is the additional value resulting from the intervention, compared to what could have been expected from private initiatives and investments, and Member States acting at national/regional levels?	• 12.1 Is there evidence for *added value* resulting from EU intervention in support of the ocean energy sector? • 12.2 To what extent would the *same results have been achieved* at international, national or regional level without EU intervention?	• Qualitative and quantitative indicator: • Extent to which stakeholders agree that additional value has resulted from the intervention compared to what could reasonably have been achieved at other levels	• A majority of stakeholders recognise the EU added value of the intervention	• Stakeholder consultations: PC • Stakeholder consultations: targeted consultations
	EQ 13. What would be the most likely consequences of stopping or withdrawing the existing intervention?	• 13.1 What would be the most likely *consequences of stopping or withdrawing the existing EU intervention* in ocean energy?	• Qualitative indicators: • Likely consequences identified on the basis of literature review and interviews	• Likely consequences are identified	• Literature review • Stakeholder consultations: PC • Stakeholder consultations: targeted consultations

Appendix 2 - Summary of evidence from the literature and overview of database assessment

Summary of evidence from Literature Review

This annex provides a summary of the evidence gathered literature review conducted by the study team. For all sources that provided evidence, key findings are reported and linked to the relevant evaluation question(s) they help to answer.

The evidence for each question is assessed at the sub-question level and is based on the analysed evidence collected. As such, it includes 45 documentary sources. A list of the sources consulted is provided below. Each source has been schematically coded using the coding software NVivo to ensure a sound evidence base which will be used in the triangulation of the data in the draft final report.

Source type	Author(s)/Publisher	Year	Title
Commission publications	European Commission	2020	Report on progress of clean energy competitiveness
	European Commission	2020	Blue Economy Report 2020
	European Commission	2020	EU strategy on offshore renewable energy
	Joint Research Center	2020	Ocean Energy in Europe Analysis of the state of play of the Ocean Energy sector in Europe and implications moving forward
	European Commission	2019	Interreg report on Pegalos: Strategic research Agenda towards innovation in Blue energy
	European Commission	2019	Guidance on Energy Transmission Infrastructure and EU nature legislation
	Joint Research Center	2019	Ocean energy Technology Market Report
	Joint Research Center	2019	Ocean energy Technology Development Report
	Joint Research Center	2019	Ocean energy supply chain
	European Commission	2019	Study on impacts of EU actions supporting the development of Renewable Energy technologies
	Temporary Working Group on Ocean energy	2018	SET-Plan Ocean energy – Implementation Plan
	European Commission	2018	The 2018 annual economic report on the EU blue economy
	European Commission	2017	Study on lessons for Ocean energy
	European Commission	2017	Leadership in renewables – Ocean energy: the impact of EU R&D funding
	European Commission	2016	Ocean energy Strategic Roadmap
	European Commission	2014	Impact Assessment accompanying the Communication on Ocean energy
	European Commission	2014	Blue Energy Communication
Scientific papers	Jacques Delors Institute	2020	The Member State compartment of the InvestEU Fund: how does it work? Will it fly?
	Mendoza et al.	2019	A framework to evaluate the environmental impact of ocean energy devices
	Dalton	2018	Ocean energy Wave and tide
	Magagna et al.	2018	Ocean energy in Europe
	Copping	2018	The state of knowledge for environmental effects – driving consenting and permitting for the marine renewable energy industry
	Pisacane	2018	Marine Energy Exploitation in the Mediterranean Region: Steps Forward and Challenges
	Melikoglu	2017	Current status and future of ocean energy sources: A global review
	Esteban	2017	Recent developments in ocean energy and offshore wind: financial challenges and environmental misconceptions
	Kingston	2017	Examining the effectiveness of support for UK Wave Energy Innovation since 2000
	O'Hagan et al.	2016	Wave energy in Europe – Views on experiences and progress to date
	Wright et al.	2016	Establishing a legal research agenda for ocean energy

Source type	Author(s)/Publisher	Year	Title
	Magagna et. al	2015	Ocean energy development in Europe: Current status and future perspectives
Other documents/reports	ETIPOcean	2020	Strategic Research And Innovation Agenda For Ocean Energy
	ETIPOcean	2020	Ocean energy and the environment: Research and strategic actions
	OceanSET	2020	OceanSET First Annual Report
	Ocean Energy Europe	2020	Ocean energy key trends and statistics 2019
	SETIS Magazine	2019	Ocean energy
	DT Ocean	2019	Advanced Tools for Ocean energy Systems Innovation, Development and Deployment
	Ocean Energy Systems	2019	Annual Report 2019
	IRENA	2018	Renewable Energy and Jobs Annual review 2018
	ETIP Ocean	2018	Powering homes today, powering nations tomorrow
	Seanergy, EY	2016	Ocean energies, moving towards competitiveness: a market overview
	Ocean Energy Systems	2016	Consenting Processes for Ocean Energy. Update on Barriers and Recommendations
	SI Ocean	2014	Wave and Tidal Energy Market Deployment Strategy for Europe
Websites	Thethys website	n/a	Regulatory Frameworks for Marine Renewable Energy
	Ocean Energy Forum Website	n/a	Ocean Energy Forum
	DG MARE website	n/a	European Maritime and Fisheries Fund
	CORDIS website	n/a	Specific projects

The tables below are organised into three columns. The first column provides a 'snapshot' of the key findings which have emerged from the coding. The second column displays the sources used and the final column provides information on the strength of the evidence found. This judgement will help to identify any eventual gaps of evidence and thus inform where other data collection methods may be better suited to cover.

The analysis of the evidence's strength is based on the following criteria:

Ranking of Evidence	Explanation of ranking of quality of evidence
Satisfactory	There are several different sources of evidence with variety in document types, and all the indicators within each sub-question are addressed.
Indicative but not conclusive	There is more than one source, or very clear evidence in one source of good quality, but the sources stem from similar document types; additionally, the evidence available needs to be confirmed by stakeholders' opinions through interviews or quantitative evidence.
Weak	Evidence is limited to a single source.
Null	No evidence is available

RELEVANCE

EQ 1: To what extent have the objectives of the intervention proven to be appropriate for responding to the needs identified in the impact assessment?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
1.1 To what extent were the specific and operational objectives of the Blue Energy Communication and the Ocean energy Roadmap *appropriate* to address *cost reduction, financial and profitability needs*[236]*? Has this changed over time and to what extent are they still appropriate?*		
The **specific objective of bringing together stakeholders** seems to remain appropriate to address cost needs. Recent publications report that the lack of coordination among stakeholders still causes duplications of efforts and the repetition of errors, and this can hamper the technical development of devices and therefore ultimately slow down cost reductions [1]. The lack of coordination among funding bodies can also be responsible for inefficient funding allocation, as grants may be allocated to projects that are too similar for this reason [2] [3]. At the same time, this specific objective can generate suspicion in private stakeholders trying to preserve their competitive advantage on the market. Sharing knowledge and sensitive information on the technologies often represents an issue for these actors [1]. Interest of Mediterranean countries for the development of ocean	[1] European Commission (2017): "Study on lessons for Ocean energy" [2] SI Ocean (2014): "Wave and Tidal Energy Market Deployment Strategy for Europe" [3] Temporary Working Group on Ocean energy (2018): "SET-Plan Ocean energy – Implementation Plan" [4] Interreg report on PELAGOS (2019): "Strategic research Agenda towards innovation in Blue energy" [5] JRC (2019): "Ocean energy Technology Market Report" [6] G. Pisacane et al (2018) Marine Energy Exploitation in the Mediterranean Region: Steps Forward and Challenges	Satisfactory

[236] Cost reduction needs:

- Reduce cost of electricity generated from ocean energy (cost is higher than other renewables because of high technology costs caused by residual technical uncertainties, lack of know-how, high operation and maintenance costs) and due to the high risk of damage to ocean energy devices due to extreme and adverse weather condition)
- Improve profitability of ocean energy (ocean energy is not profitable without grants or revenue support at the moment)
- Reduce risk related to investments in ocean energy (it is risky because of the novelty of the technology, small project sizes, high capital costs relative to operating costs, lack of full competitiveness on the market, strong dependence on supportive policy)
- Reduce number of ocean energy technologies – the high number of ocean energy technologies in place dilutes R&D efforts and this slows down progress towards capital cost reduction for the sector.

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
energy has revived only in recent years [6].		
The **specific objective to facilitate the industries access to finance** has been repeated many times as an important measure to reduce costs both in 2014 and in more recent publications. It has been stressed, that the influx of private funds into the industry must be increased [1] [3] [4]. Also, market-pull measures (e.g. feed-in tariffs etc.) are important to help ocean energy projects with commercialization, as well as public investments to ensure further R&D activities [3]. In this context, it has also been noted that the uncertainty about the continuity of support policies for ocean energy technologies discourages private investors and thereby reduces the spectrum of funding available to technology developers [5] This is not yet reflected adequately in the objectives.		Satisfactory
The **operational objective to increase synergies** with other industries to reduce ocean energy costs is still considered as relevant today. In particular, synergies with the offshore wind industry have been regarded as being potentially instrumental to achieve cost reductions [4].		Weak
The **operational objective of consolidating R&D investment** seems to still be adequate to address the financial and profitability needs. However, it has been mentioned that the lack of market support mechanisms hinders the commercialisation of ocean energy technologies. Many market support mechanisms are tailored towards established renewable energies such as offshore wind. [5]		Weak

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
1.2 To what extent were the specific and operational objectives of the Blue Energy Communication and the Ocean energy Roadmap *appropriate* to address *infrastructure needs (e.g. grid planning, port facilities and vessels)*[237]*? Has this changed over time and to what extent are they still appropriate?*		
The **specific objective of increasing stakeholder coordination** is considered appropriate to address infrastructure needs to date, as ocean energy problems still face notable infrastructure challenges e.g. issues with grid connection [1]. Coordination of stakeholders (in the form of consortia) can be regarded as a mean to improve access to capital intensive infrastructure such as testing facilities. Access to testing infrastructure [1] and adequate knowledge transfers [2] are important for the commercialisation for ocean energy technologies.	[1] SETIS Magazine (2019): "Ocean energy" [2] Seanergy, EY (2016): "Ocean energies, moving towards competitiveness: a market overview" [3] Interreg report on PELAGOS (2019): "Strategic research Agenda towards innovation in Blue energy"	Indicative but not conclusive
The **operational objective of improving synergies with other industries** is still considered as being relevant to address the infrastructure needs of the ocean energy sector. In particular, it appears that synergies with the ports and harbour industries should be encouraged [3].		Weak

[237] Infrastructure needs:

- Improve grid connection (increase grid capacity and improve access to the transmission network for ocean energy technologies that are often located in low population density and peripheral regions) also in light of future needs
- Strengthen grid interconnections in Europe
- Clarify who bears the costs of grid connection and access
- Reduce lead time (time to get building consent and grid connection permits) and costs
- Improve availability of suitable port facilities and specialised vessels (for transportation, assembly, installation, repair of OCEAN ENERGY devices)

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
1.3 To what extent were the specific and operational objectives of the Blue Energy Communication and the Ocean energy Roadmap *appropriate* to address a *administrative & regulatory needs (e.g. licensing and consenting procedures)*[238]*? Has this changed over time and to what extent are they still appropriate?*		
The operational objective **to improve the efficiency of planning and licensing procedures** was widely recognised as appropriate to address the administrative and regulatory needs in the period 2014-2016, as testified by a number of market analysis and strategic reports [1] [2] [3]. The needs was expressed at the time that the number of authorities that are responsible for the consenting processes could be reduced. One-stop-shop licencing procedures (a procedure where only one public agency or authority is responsible for all aspects of licensing an ocean energy project) would reduce costs and duration of receiving permits for ocean energy projects [2]. The objective of reducing the complexity of consenting and improving coordination between authorities can be considered to remain relevant nowadays, particularly in Member States where no dedicated process exists for ocean energy developments or the centralisation of the process is yet to be realised [5].	[1] Seanergy, EY (2016): "Ocean energies, moving towards competitiveness: a market overview" [2] SI Ocean (2014): "Wave and Tidal Energy Market Deployment Strategy for Europe" [3] Magagna et. al (2015) "Ocean energy development in Europe: Current status and future perspectives" [4] Ocean Energy Systems (2016) "Consenting Processes for Ocean Energy. Update on Barriers and Recommendations" [5] Thethys website (2020) "Regulatory Frameworks for Marine Renewable Energy"	Satisfactory
1.4 To what extent were the specific and operational objectives of the Blue Energy Communication and the Ocean energy Roadmap *appropriate* to address *environmental needs (e.g. research and development, better exchange of information on environmental impacts of ocean energy installations)*[239]*? Has this changed over time and to what extent are they still appropriate?*		
The **specific objective to improve administrative practices and environmental monitoring** is still appropriate to address environmental needs. It has been stressed already in 2014 [2], 2015 [5], 2016 [6] and reiterated in 2019 [1], that a harmonised approach to environmental impact assessment of ocean energy projects is needed. A streamlined environmental impact assessment process would significantly reduce the licensing process and would result in better choices for location and set-up of ocean energy devices. It was suggested to include ocean energy planning into MSPs. [1]	[1] Interreg report on PELAGOS (2019) "Strategic research Agenda towards innovation in Blue energy" [2] SI Ocean (2014) "Wave and Tidal Energy Market Deployment Strategy for Europe" [3] Melikoglu (2017) "Current status and future of ocean energy sources: A global review" [4] Mendoza et. Al. (2019) "Renewable and Sustainable Energy Reviews" [5] Magagna et al. (2015) "Ocean energy development in Europe: Current status and future perspectives" [6] Ocean Energy Systems (2016) "Consenting processes for ocean energy. Update on Barriers and Recommendations"	Satisfactory
There is still uncertainty about the impact of ocean energy technologies on the environment. More research is needed in order to reduce the uncertainty. [3] [4] The uncertainty might constrain future development		Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
of ocean energy technologies, as well as increase costs and delay licensing procedures. The **operational objective to assist with environmental monitoring** is therefore still appropriate to address environmental needs.		

EQ 2: To what extent do the objectives of the intervention remain appropriate in the light of the evolution of the EU energy, climate, maritime and R&I policies?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
2.1 To what extent do the *objectives* of the Blue Energy Communication and Ocean Energy Strategic Roadmap *correspond* to the *current needs* of the ocean energy sector *in light of the evolution* of EU energy, climate, maritime and R&I policies (e.g. new renewable energy targets etc.)?		
The **EU R&I policy** have been instrumental for the development of ocean energy technologies, particularly with funding instruments such as Horizon 2020. Other funding instruments liked to the **EU regional policy** (e.g. Interreg) or **EU climate policy** (e.g. NER300) have also significantly contributed to research and innovation in the sector. However, this support, also taken in combination with national and regional support, has not always been able to secure the success in	[1] JRC (2019) "Ocean energy Technology Market Report" [2] OceanSET (2020) OceanSET First Annual Report [3] European Commission (2017): "Study on lessons for Ocean energy [4] Temporary Working Group on Ocean energy (2018): "SET-Plan Ocean energy – Implementation Plan	Satisfactory

[238] Administrative & Regulatory needs:

Reduce length and complexity of consenting procedures

Improve coordination among public bodies responsible for reviewing applications

Increase knowledge of ocean energy

Include ocean energy in Maritime Spatial Plans (to mitigate conflicts over the use of marine space)

[239] Environmental needs:

Improve R&D and flow of information on ocean energy's environmental impacts

Clarify application of EU environmental legislation (to avoid placing additional administrative burdens on project developers in relations to consenting procedures for the installation of ocean energy technology)

the development and commercialisation of ocean energy technology [1]. Some of the objectives of the Communication and Roadmap remain relevant today (e.g. objectives on cost reduction) because insufficient progress has been registered in their achievement so far, compared to what was expected. Several recent publication reiterate some of these objectives [1] [2] [3] [4].		

EFFECTIVENESS

EQ 3: What progress has been made in implementing the activities of the intervention?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
3.1 What progress has been made in implementing the Ocean energy Forum?		
The Ocean energy Forum **was created** in 2014. The Forum brought together more than 100 ocean energy experts and stakeholders over a period of two years. The forum was formed by three working groups covering the topics of Technology, Finance and Environment and Consenting. Each of the working groups had a Steering Committee and a Chair. A Secretariat supported the work of the Forum, and it ensured the delivery of the Ocean Energy Strategic Roadmap, as foreseen in the Blue Energy Communication [1] [2].	[1] Dalton (2018) "Ocean energy Wave and tide" [2] Ocean Energy Forum Website (2020)	Satisfactory
3.2 What progress has been made in implementing the Ocean energy Strategic Roadmap?		
In November 2016, the Ocean energy Forum created the 'Ocean energy Strategic Roadmap'. The Roadmap put forward four key Action Plans [1]. This was considered to be a 'Declaration of Intent' of the ocean energy industry, agreed by the EU Commission, Regions, Member States, Stakeholders and the Ocean energy Industry itself	[1] Dalton (2018) "Ocean energy Wave and tide" [2] ETIP Ocean (2019) "Powering homes today, powering nations tomorrow" [3] JRC (2019) "Technology Market Report"	Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
[4]. The evidence with regards to the progress in the implementation of the four key action plans is outlined below.	[4] Temporary Working Group Ocean energy (2018) "SET-Plan Ocean energy Implementation Plan" [5] OceanSET (2020) OceanSET First Annual Report [6] Cordis website (2020) [7] InnovFin EDP website (2020) [8] InvestEU website (2020) [9] Jacques Delors Institute (2020) The Member State compartment of the InvestEU Fund: how does it work? Will it fly? [10] DG MARE Website (2018) Ocean energy - A new source of green, blue power [11] EASME website [12] SeaWave project website [13] WESE project website [14] SafeWave project website	
Action Plan 1 - A European phase-gate technology development process for sub-systems and devices: • Work has begun on stage gate funding structure for *wave* energy. A Horizon2020 call (2017) invited national funding authorities to propose a Pre-Commercial Procurement Programme, with up to EUR20m contribution from the European Commission [2] [6]		Satisfactory
Action Plan 2 - An Investment Support Fund for ocean energy farms: • The European Commission is leading work on setting up a European 'Blue Economy' Investment Platform. It will focus on maritime-based industries, including ocean energy. It has been noted that this platform will most likely require projects to be bankable, and thus have access to revenue support on top of electricity sales [2] • The European Commission established the InnovFin EDP facility , which enables the EIB to finance innovative first-of-a-kind demonstration projects at the pre-commercial stage that contribute to the energy transition, including in the fields of renewable energy technologies, with the aim of contributing to de-risking the technologies and reassuring financial investors of their commercial viability [7] • Member States' initiatives such as France's Bpifrance can be relevant in providing targeted support for ocean energy [5] Access to these instruments is still challenging for ocean energy actors, due to the eligibility requirements. [5]		Satisfactory
Action Plan 3 - Demonstration & Pre-Commercial: An EU Insurance and Guarantee Fund to underwrite project risks: • No evidence on progress has been found. Sources inform that insurance costs for ocean energy projects remain		Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
prohibitive to date, and that an EU-level instrument to address this issue is not yet available at the moment [2] • In 2018 Ocean Energy Europe submitted a project proposal under Horizon 2020 aimed at defining how the EU Insurance and Guarantee Fund would work. While the proposal was selected for funding, the grant agreement preparations were terminated by the consortium due to the withdrawal of one key member of the project consortium. [5] • For the next Multi-annual Financial Framework (MFF) covering the 2021-2027 period, the European Commission proposed to bring together under one roof the different EU financial instruments currently available that provide financing in the form of loans and guarantees. This will lead to the creation of InvestEU, a platform that will boost investment, innovation and job creation by triggering at least EUR650 billion in additional investments thanks to the EU budgetary guarantee. The guarantee will cover part of the risk of investment projects of EU strategic interest with the aim of mobilising additional amounts of private and public capital for these projects . The InvestEU Programme will finance projects in different domains, including sustainable energy, and as such, it can provide support and guarantees for emerging technologies such as ocean energy.[8] [9] InvestEU can represent an important opportunity for the ocean energy sector in terms of increasing the confidence of investors and reducing costs [10]		
Action Plan 4 - De-risking environmental consenting through an integrated programme of measures: • The European Commission has awarded contracts to two international consortia, who will gather, analyse and share data on the environmental impacts from 7 wave energy device deployments. [2] • In 2017 and 2019 the European Commission published two calls on "Environmental monitoring of wave and tidal devices" under the EMFF. Following the publication of the		Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
2017 call for proposal, the Sea Wave project and the WESE Project were cumulatively funded with 1.5 million EUR from the EMFF and launched in October-November 2018. Both projects are under way and will run until 2021. The 2019 call gave light to the SafeWAVE project, started in October 2020 and running until 2023. The three ongoing projects focus on increasing the amount of environmental data available and to improve the knowledge on assessing possible impacts of ocean energy devices, including to improve the planning and consenting procedures. [11] [12] [13] [14]		
Based on recommendations from the Ocean energy Strategic Roadmap, the **SET Plan on Ocean energy has put forward two actions, recalling the initiatives set for in the Roadmap**: • It proposed the creation of an Investment Support Fund for ocean energy farms • It proposed the creation of an EU Insurance and Guarantee Fund [3] [4]		Indicative, but not conclusive
3.3 What progress has been made in implementing the European Industrial Initiative?		
		Null
3.4 What progress has been made in implementing the sector-specific guidelines?		
In 2019 the European Commission published the "Guidance on Energy Transmission Infrastructure and EU nature legislation", with the aim to provide guidance to project developers, transmission system operators and authorities responsible for the permitting of energy transmission plans and projects on how best to approach the installation, operation and decommissioning of energy transmission infrastructure in relation to Natura 2000 sites and species protected under the EU Habitats and Birds Directive. [1] The MSP Platform published a document in 2018 outlining some general recommendations on how to support the development of wave and tidal energy projects alongside other sectors and interests. The MUSES project, yet to be completed, is going to develop an action	[1] European Commission (2019) Guidance on energy transmission infrastructure and EU nature legislation [2] MSP Platform website [3] MUSES project website [4] Cordis website	Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
plan to address the challenges and opportunities for Multi-Uses of the oceans, including by addressing issues relating to the deployment of wave and tidal energy. Moreover, the MARINA Platform Project , concluded in 2014, produced a set of protocols covering the engineering and economic evaluation of multi-purpose Marine Renewable Energy platforms, including wave and tidal devices, taking into account also non-energy uses and planning & consenting issues surrounding their deployment, which are relevant in the context of the spatial planning decisions [2] [3] [4]		

EQ 4: What have been the quantitative and qualitative effects of the intervention?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
4.1 How many *new* ocean energy *projects* have been *installed* and *deployed* in Europe since 2014?		
Installation and deployment In 2014, ocean energy combined operational capacity was 10 MW [9], and this grew to 16.4 MW in 2015 [1]. At the end of 2016, Europe had 13 MW of installed tidal power capacity [8]. At this stage, 52% of the companies developing *tidal* energy technology were in the EU (highest development: UK, ND, FR, IE – countries with major tidal resources; other DE, SE). At the end of that year, 21 tidal turbines were deployed in EU waters [8]. Other major players were US, CA. The UK had the highest number of developers of wave energy, followed by DK, USA, AUS, NO. At the time, between 70-100 wave energy design concepts were under development, but only a few actually made it to full scale prototype testing [1] [6]. While significant growth in the installation of ocean energy devices has been registered in recent years, and the EU has been leading particularly in tidal stream installations [7], current deployments are falling behind previous optimistic predictions for 2019 [1].	[1] Dalton (2018): "Ocean energy Wave and Tide" [2] ETIP Ocean (2019): "Powering homes today, powering nations tomorrow" [3] JRC (2019): "Ocean energy supply chain" [4] Magagna et al. (2018): "Ocean energy in Europe" [5] O'Hagan et al. (2016): "Wave energy in Europe – Views on experiences and progress to date" [6] Seanergy, EY (2016): "Ocean energies, moving towards competitiveness: a market overview" [7] DT Ocean (2019): "Advanced Tools for Ocean energy Systems Innovation, Development and Deployment" [8] Interreg report on PELAGOS (2019): "Strategic research Agenda towards innovation in Blue energy"	Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
Looking at the energy production overtime, it has been reported that the tidal energy sector produced 33.7 GW of electricity between 2002 and 2018. With a less mature industry, wave energy delivered 1.8 GW of electricity between 2008 and 2015 [7]. Interestingly enough, more power has been generated by tidal stream since the start of 2017 than in the previous 13 years combined [2]. It had been forecasted that 40 MW of tidal and 26 MW of wave area would be deployed by the end of 2018 [12], and that 160 MW of tidal capacity could be deployed by 2021, and additional 1.5 GW by 2025 [13]. Furthermore, significant deployments have been announced for the 2019-2023 period: • Tidal energy: up to 3.4 MW of tidal stream deployments are planned for 2020 [16]. Between 2019 and 2027, it is expected that around 1 GW of capacity will be deployed, 959 MW of which are expected to be deployed in EU [11] [4] • Wave energy: it is expected that up to 3 MW of wave energy devices will be deployed in 2020 in the EU [16] Most recent trends and statistics [16] on ocean energy installation in Europe provide the following picture: • Tidal stream: 1.52 MW have been added in 2019 tidal stream installed capacity. This is less than the capacity deployed in 2018 (3.7 MW) but this is supposedly caused by the fact that many developers are preparing substantial deployments for 2020. Installed capacity in EU waters amounts to 10.4 MW today, the largest share of which is located in France and the UK. Electricity production from tidal farms and demonstration projects grew by 50% from 2018. • Wave energy: 0.6 MW have been added in 2019 wave energy installed capacity. Installed capacity in EU waters amounts to 1.5 MW today. These devices are located in Belgium, France, Portugal and UK coasts in particular.	[9] European Commission (2014): "Impact Assessment accompanying the Communication on Ocean energy" [10] Trinomics (2019): "Study on impacts of EU actions supporting the development of Renewable Energy technologies" [11] JRC (2019): "Technology Market Report" [12] Melikoglu et. al (2018): "Current status and future of ocean energy sources, a global review" [13] SETIS magazine (2019): "Ocean energy" [14] Esteban (2017): "Recent developments in ocean energy and offshore wind: financial challenges and environmental misconceptions" [15] Kingston (2017): "Examining the effectiveness of support for UK Wave Energy Innovation since 2000" [16] Ocean Energy Europe (2020) "Ocean energy key trends and statistics 2019" [17] ETIPOcean (2020) Strategic Research And Innovation Agenda For Ocean Energy	

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
According to the Ocean SET report , compiling information from a survey directed to EU Member States, the average annual electricity production per installed capacity was 1,762 MWh/MW for tidal energy[17]. Notably, in the period 2014-2019, the ocean energy sector has also witnessed the decommissioning of a number of installed devices [6] [11]. A portion of the installed capacity was removed or decommissioned at the end of their testing and demonstration phase. In particular, according to recently collected data , 10.4 MW of tidal stream is currently operating, while 17.3 MW have been decommissioned following the successful completion of testing programmes. Of the 11.8 MW of wave energy deployed since 2010, only 1.5 MW is currently in the water, while 10.3 MW have been decommissioned as well. [17] In some cases, ocean energy companies also declared bankruptcy [2] [14] [15]. Notably, a downturn in UK wave energy innovation performance led to energy utilities, manufacturers, investors withdrawing from the sector [15]		
Manufacturing Ocean energy manufacturers (OEM) are **regaining interest** in the ocean energy sector, after a significant period where engagement was lacking on their side. It is expected that OEMs will be attracted back into the sector as confidence in the technology grows [3] Components are generally produced **ad hoc** for specific projects by manufacturers located in the country of origin of the testing device. Manufacturing and assembly facilities are expected to be located in high-resource areas where the device is going to be deployed. This will benefit local companies in coastal regions. So far, all pre-commercial tidal energy deployments use EU technology [3] **New manufacturing facilities** were announced in Normandy (Naval Energy, former DCNS), in Shetland (expansion of local tidal blades company) [3]. By 2020, the annual production of tidal turbines is expected to be above 200 [4]		Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
4.2 How much has been *invested* in the ocean energy sector since 2014 (both public and private investments)?		
Public support As of 2019, ocean energy is mostly funded by initial public support and private investors join when it transitions from R&D stage to demonstration stage. Public funding is used to leverage private capital [2]	[1] Dalton (2018) "Ocean energy Wave and Tide" [2] DT Ocean (2019) "Advanced Design Tools for Ocean energy Systems Innovation, Development and Deployment" [3] European Commission (2014) "Blue Energy Communication" [4] JRC (2019) "Technology Market Report" [5] SI Ocean (2014) "Wave and Tidal Energy Market Deployment Strategy for Europe" [6] Trinomics (2019) "Study on impacts of EU actions supporting the development of Renewable Energy technologies" [7] ETIP Ocean (2019) "Powering homes today, powering nations tomorrow" [8] OES (2019) "Annual Report" [9] SETIS magazine (2019) "Ocean energy" [10] European Commission (2017) Study on lessons for ocean energy development [11] Kingston (2017) Examining the Effectiveness of Support for UK Wave Energy Innovation since 2000 [12] JRC (2019) Technology Development Report [13] European Commission (2020) Report on progress of clean energy competitiveness [14] European Commission (2020) Blue Economy Report 2020	Weak
EU support In the period of 1980s – 2014, 90 million EUR have been spent on ocean energy by the EU under the Research Framework Programmes and Intelligent Energy Europe Programme [3]. Reportedly, in 2007-2018, the EU has invested 864 million EUR in ocean energy projects [8] [9]. EU sources of grant funding for ocean energy include [1] [7] [8]: • Horizon 2020: this has been the most important source of grant funding, disbursing around 140 MLN EUR to ocean energy projects in the period 2014-2020 [12] • EU structural funds e.g. European Regional Development Fund, Interreg [8] • EMFF -EASME • LIFE Programme • Ocean energy ERA-NET Cofound • InnovFIN EDP • NER300: largest push support fund EU-EIB, main market incentive scheme. It will be followed by the Innovation Fund (expected to be launched in 2020) EU entities such as InnoEnergy have taken equity into ocean energy companies to complement the funding needs [8] According to the energy competitiveness report, the total R&I expenditure on wave and tidal in the EU was 3.84 billion EUR from 2007 to 2019, with 2.74 billion EUR coming from private sources and 436 million coming from national R&I programmes. In this context, EU contribution from R&I funds was around 650 million EUR (this includes R&I programmes as well as contributions from NER300 and Interreg projects). [13]		Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
In terms of trends, while private investments in the sector decreased between 2010 and 2016, national and EU R&D funds increased. By contrast, between 2017 and 2019, private R&D investments started increasing again, while EU and national support slightly decreased. [14]		
Private support: Over **600-700 million EUR** have been invested in ocean energy by the private sector over the period of 2007-2014 [3] [5]. Reportedly, as of 2016, the ocean energy industry had invested **1 billion EUR** in capital to move concepts to deployment in EU waters [2]. As of 2019, OEE members reported having invested more than **1 billion EUR** in R&D activities in 2009-2019 period [6]		Indicative, but not conclusive
4.3 How much have *Member States supported* the uptake of ocean energy since 2014 (including revenue support schemes)?		
Member States: National investments in R&D have been growing slowly since 2011, with **56 million EUR** a year in 2014 and 2015, accounting for 21 % of total investment for the same years [4]. The JRC reported that Member States spent around 100 million EUR in ocean energy between 2014 and 2015 [14], while other sources inform that contribution from national R&I programmes amounted to 463 million EUR in the period 2007-2019 [13]. According to a recent report from OceanSET, the contribution from Member States amounted to 26.3 million EUR in 2018 [15]. Different Market support schemes with push and/or pull mechanisms are available [1]. **Examples of countries with push mechanisms** (FR, PT, UK)[2] • Brittany, Normandy, Wales regional governments invested in ocean energy projects [1] • National financial instruments e.g. Scottish Government Energy Investment Fund [1] **Examples of countries with pull mechanisms**: • Capital and revenue support mechanisms e.g. Feed in tariffs: France, Germany, Ireland, Italy, Netherlands [2] [5]	[1] Dalton (2018): "Ocean energy Wave and Tide" [2] DT Ocean (2019): "Advanced Design Tools for Ocean energy Systems Innovation, Development and Deployment" [3] European Commission (2014): "Blue Energy Communication" [4] JRC (2019): "Technology Market Report" [5] SI Ocean (2014): "Wave and Tidal Energy Market Deployment Strategy for Europe" [6] Trinomics (2019): "Study on impacts of EU actions supporting the development of Renewable Energy technologies" [7] ETIP Ocean (2019): "Powering homes today, powering nations tomorrow" [8] OES (2019): "Annual Report" [9] SETIS magazine (2019): "Ocean energy" [10] European Commission (2017) Study on lessons for ocean energy development [11] Kingston (2017) Examining the Effectiveness of Support for UK Wave Energy Innovation since 2000	Indicative, but not conclusive

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
Example of decrease in national support: Since 2018, the UK Government has moved from dedicated Renewable Obligations Certificates (ROCs) for ocean energy projects, to Contract for Difference (CfD) support schemes, in which ocean energy technologies have to bid in the same pool of projects with more advanced and established technologies, such as bottom fixed offshore wind. This resulted in no ocean energy technology projects being awarded support. [4] [11] Open Sea Test Sites, two to three per country, are available in the Netherlands, Ireland, Portugal, Spain, Denmark, Belgium, Sweden and France [8]	[13] European Commission (2020) Report on progress of clean energy competitiveness [14] JRC (2019): "Technology Development Report" [15] OceanSET (2020) OceanSET First Annual Report	
4.4 How much have the *capital costs* for the deployment of ocean energy been *reduced* since 2014?		
In 2013, high technology costs were associated with ocean energy [1] In 2018, CAPEX values varied for pilot projects for wave energy (e 10-50 M/MW) and tidal energy (e5-20 M/MW), with lower values being attributed to the latter in this stage. The CAPEX value converges when the commercial stage is reached, with e3-6 M/MW for both wave and tidal energy [2]. In 2019, the development of ocean energy is still associated with high capital expenditure (CAPEX) high operational expenditure (OPEX). This is also accompanied by low capacity factors and low reliability of the devices. [3]	[1] European Commission (2014) "Impact Assessment accompanying the Communication on Ocean energy" [2] Dalton (2018) "Ocean energy Wave and Tide" [3] JRC (2019) "Technology Market Report"	Satisfactory
4.5 What is the extent of the *investments in R&D* for ocean energy since 2014 (public and private)?		
The **EU is considered to have world-leading public R&D budget for ocean energy**, with the caveat that R&D budgets from China are not fully known. EU and Member States' R&D funding have been effective in establishing and maintaining a leading academic position globally on ocean technologies. This is also demonstrated by the fact that the EU has a leading position in publications on ocean energy [4]. The **European Energy Research** (EERA) was funded with the aim to expand and optimise EU energy research and capabilities by building	[1] Dalton (2018) "Ocean energy Wave and Tide" [2] DT Ocean (2019) "Advanced Design Tools for Ocean energy Systems Innovation, Development and Deployment" [3] OES (2019) "Annual Report" [4] Trinomics (2019) "Study on impacts of EU actions supporting the development of renewable energy technology"	Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
on national research initiatives, sharing national facilities and realising joint EU and national programmes. Within the EERA, a joint programme for investment in ocean energy has been set up, the NER 300 [1]. The **Research Framework Programmes** and Intelligent Energy Europe Programme provided up to EUR 90 MLN for ocean energy development from 1980-2014. Other sources report that 124 MLN EUR have been allocated to ocean energy from 2005 to 2014. Horizon 2020 has provided over EUR 60 million EUR to ocean energy R&D projects between 2014-2015 alone [1]. Since 2014, it has provided more than EUR 140 million EUR for ocean energy R&D [6] Continuity of research topics has allowed for high impact projects. There are numerous examples of successful projects that benefit from the results of previous EU-funded projects and show a clear succession in the work throughout the different Framework Programmes [4]. Access to R&D funding is sometimes considered challenging for ocean energy developers. It is difficult for them to directly compete for R&D funding with more mature technologies. It has been stated that if ocean energy is to be taken seriously, it cannot be assessed by the same criteria as other renewables. [5]	[5] European Commission (2017) "Study on lessons for ocean energy development" [6] JRC (2019) Technology Development Report	
Global public renewable energy R&D budget increased between the 1970s and started to decrease in 1980s. It remained essentially stable around 1% of the total share of renewable energy R&D budgets until 2008, when it started to increase again and reached a peak around 2% in 2014. It slightly decreased just below 2% after 2016. Between 1974 and 2018, IEA countries had a cumulative budget of EUR 2.5 BN for ocean energy R&D. In 2018, this share was EUR 88 MLN, accounting for 2.6 % of the total renewable R&D budget for that year [2].		Weak
4.6 To what extent has the development of the ocean energy sector contributed to *job creation*, *economic growth* or *EU's sustainability objectives* since 2014?		
Job creation		Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
In 2010, the EU and OES estimated that ocean energy would create over 26,000 direct and 13,000 indirect jobs, for a total of close to 40,000 by 2020. The European Commission in 2014 indicated that 10,500–26,500 permanent jobs and up to 14,000 temporary jobs could be created by 2035. In 2016, OES estimated that 680,000 direct jobs would be created by 2050 [8]. More recent estimates, report that ocean energy employed around **1000 people in 2018**. This is lower than 2017, for which IRENA reported 4,870 global ocean jobs, of which 723 in UK and 324 in Spain [5]. A study on the blue economy by DG MARE estimated that the EU ocean energy sector currently generates **1,350 direct jobs** across Europe, with total employment in the sector at about **2,000 jobs** [2] [7] Other estimates have been found reporting that the ocean energy sector has generated around 2,000 jobs, both through direct and indirect job creation, in 2018 [8]. Other sources [9] inform that TRL7+ projects in wave energy have created 121 jobs in 2018, and those in tidal energy have created 78. According to the Blue Economy Report [7], 2250 jobs were generated by the ocean energy sector in 2019, with over 430 companies being involved in different stages of the supply chain in the EU. In 2018, it was reported that **wave and tidal studies on jobs/MW were too limited and data and models were lacking** [8]. In 2019, OES reported that methodologies to assess the number of jobs created or maintained with the deployment of ocean energy was in the process of being prepared [6] Despite the lack of clear-cut statistics, the first ocean energy farms have demonstrated that the industry contributes to local economies, and that skills and infrastructure from legacy industries such as oil and gas can be repurposed for ocean energy. The impact of tidal energy has also benefited businesses across EU, not only coastal regions. [4]	[1] Ocean energy Forum (2016): "Ocean energy Strategic Roadmap 2016, building ocean energy for Europe" [2] SETIS magazine (2019): "Ocean energy" [3] Seanergy, EY (2016): "Ocean energies, moving towards competitiveness: a market overview" [4] ETIP Ocean (2019): "Powering homes today, powering nations tomorrow" [5] IRENA (2018): "Renewable Energy and Jobs Annual review 2018" [6] OES (2019): "Annual Report" [7] Trinomics (2019): "Study on impacts of EU actions supporting the development of renewable energy technology" [8] Dalton (2018): "Ocean energy Wave and Tide" [9] European Commission (2017): "Leadership in renewables – Ocean energy: the impact of EU R&D funding" [7] European Commission (2020) Blue Economy Report 2020 [8] European Commission (2020) The 2018 annual economic report on the EU blue economy [9] OceanSET (2020) OceanSET First Annual Report [10] European Commission (2020) EU strategy on offshore renewable energy	
Economic growth		Indicative, but not conclusive

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
In 2016, it was forecasted that ocean energy could create a market of up to EUR 653 billion EUR (or 575 BN EUR, according to Carbon Trust) between 2010 and 2050, with up to 53 billion EUR annually benefitting the EU economy [1]. Reportedly, ocean energy projects will particularly benefit islands, by creating new activities for the implementation of projects and their follow up operation [2]. **Patents** The number of EU patents filed for ocean energy technologies has been **reducing**. Since 2006, above 170 ocean energy patents have been filed every year. The number of EU patents increased until 2009, when 313 patents were filed, after which it decreased again to pre-2007 levels. The reason for this decrease appears to be a shift away for developing new devices to improving existing ones. In addition, incentives and (test) project sites outside of the EU have increased over the past years. [7] [9]		
Sustainability In 2019, it was reported that increasing ocean energy installed capacity would help reducing emissions and comply with the energy policy agenda of Member States [2]. There is widespread confidence in the fact that a developed ocean energy sector will contribute to providing economic benefits, in particular to EU peripheral areas, as well as to the reduction of EU GHG emissions and the achievement of the climate neutrality target by 2050, including by supporting the decarbonisation of EU islands. [7] [10]		Indicative, but not conclusive

EQ 5: To what extent have the objectives of the intervention been met so far?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
5.1 To what extent has the *uptake* of ocean energy *increased*?		

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
The EU remains a **global leader** in the development of ocean energy, as it is home to 50% of the world's tidal energy developers and 60% of wave energy developers. The EU has 70% of world's ocean energy research and testing infrastructure and maintains its leadership position with regards to installed capacity at global level [1]. Moreover, 78 % of the ocean energy installed capacity is located within European waters (24.7 MW) [2] In general, it is recognised that the EU ocean energy industry has made **significant steps forward** [2][5] [7]. According to the EU, tidal technologies 'can be considered as being at pre-commercial stage', with a number of projects and prototypes being deployed across Europe [7] (with TRL of most devices being around 6-8)[8]. The progress made by tidal energy has been judged superior to the expectations, in particular in terms of the reliability of the devices, as well as their ability to provide stable input to the grid [9]. By contrast, wave energy technologies appear to still be at the R&I stage (with most of the approaches being at TRL 6-7) [7], and substantially lagging behind in terms of performance, in particular when electricity generation is taken into account . In both cases, technological maturity varies amongst developers. [7] Installed capacity of ocean energy worldwide increased by 50% between 2016 and 2017 [2]. Progress of installed capacity worldwide: • 2015: 4.6 MW tidal vs 4.8 MW wave [2] • 2017: 25 MW [2] • 2018: 31.4 MW (10 MW wave vs 20 MW tidal) [2] **Tidal stream** has established its record of power production in 2019, and this shows "how far the technology has come": more power has been generated by tidal stream since the start of 2017 than in the previous 13 years combined. [1] Compared to 2016, the **wave energy** sector has shown slow but steady progress in the deployment of wave energy devices, with increasing concertation of devices at TRL 6 and 7 [2]	[1] JRC (2019): "Ocean energy supply chain" [2] JRC (2019): "Technology Market Report" [3] ETIP Ocean (2019): "Powering homes today, powering nations tomorrow" [4] O'Hagan et al. (2016): "Wave energy in Europe – Views on experiences and progress to date" [5] SETIS magazine (2019): "Ocean energy" [6] European Commission (2017): "Study on lessons for ocean energy development" [7] European Commission (2020) Report on progress of clean energy competitiveness [8] ETIPOcean (2020) Strategic Research And Innovation Agenda For Ocean Energy [9] European Commission (2020) Blue Economy Report 2020	Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
Less recent sources nevertheless report that the **progress in the uptake of ocean energy has been "limited" and "slow"** due to the technologies still being too costly to compete with the alternatives [2] [4]. Stakeholders raised the lack of long-term government ambitions as a major barrier in this context [6]		
5.2 To what extent have the *stakeholders been brought together* and *coordinated their action* to enhance technological innovation and competitiveness? (specific objective)		
In general, **EU support enabled the creation of platforms** aiming to facilitate the development of a European-wide coordinated, unified and streamlined ocean sector [5]. Relevant initiatives in this context are: • **The Enhanced European Innovation Council (EIC)** was established by the European Commission to support innovators, small companies and researches (Funded by Horizon 2020) [1] • **The ELBE project** (funded by DG GROW "Cluster Go International"), gathers five EU clusters and fosters the definition of a joint internationalisation strategy for OCEAN ENERGY [2] • **The Technology Collaboration Programme on** Ocean energy **Systems** (OES) started in 2001. As of December 2019, 24 Member Countries and the European Commission are active members [2] • The European Commission is leading a task to build global consensus on **stage gate metrics** (or evaluation criteria) for ocean energy [3] • The European Strategic Research Agenda (SRA) for Ocean energy, delivered by TP Ocean in November 2016. • Events such as: European Wave and Tidal Energy Conference, Offshore Energy Exhibition & Conference, WaveEC Annual Seminar, Marine Energy Week [2] Within Member States, the Dutch Marine Energy Centre fosters cooperation between business and universities [2].	[1] JRC (2019) "Technology Market Report" [2] OES (2019) "Annual Report" [3] SETIS magazine (2019) "Ocean energy" [4] Interreg report on Pegalus (2019) "Strategic research Agenda towards innovation in Blue energy" [5] Trinomics (2019) "Study on impacts of EU actions supporting the development of Renewable Energy technologies" [6] JRC (2019) "Ocean energy supply chain" [7] Kingston (2017) "Examining the Effectiveness of Support for UK Wave Energy Innovation since 2000"	Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
In 2017, stakeholders still expressed concerns with regards to the current **"do it alone" approach in ocean energy**, lamenting that there was not enough open source research, nor sharing on failures or successes, which ultimately resulted in slower progress being registered overall. Certain stakeholders in particular still show little interest in engaging in the sector, such as manufacturers, which ultimately contributes to hindering progress [6]. In the case of the UK, the lack of stakeholder coordination was exemplary in this context. Here, knowledge exchange was hindered by a lack of knowledge codification, meaning that knowledge generated from RD&D projects remained tacit and was limited to the experiences of their staff rather than the wider sector. Actor knowledge exchange was considered to be constrained by a combination of: a culture of developers operating secretively in order to protect IP; UK's decentralised model of innovation that prioritises competition over collaboration; strong focus on device-level innovation funding, which removed the incentive for actors to develop common solutions to shared problems. Industry–science collaboration here was constrained by **fundamental differences** in the working cultures and timeframes adopted by the two communities, as well as a lack of joint industry–science funding that offered a jointly acceptable working arrangement [7].		
5.3 To what extent has ocean energy's *access to finance* been facilitated? (specific objective)		
Access to finance is till perceived as a challenge for the ocean energy sector [1] [3] [] Evidence consulted to date reports that **support instruments for ocean energy are still lacking**, and this is reportedly still affecting the development of the sector. This is particularly true for commercial insurance products covering early development risks [2]. For this reason, the status of a number of projects that were expected to be deployed by 2018 and 2019 remains uncertain. The investors and policy-makers appear more reluctant to develop support systems, and put trust in forthcoming technology cost-reduction, though it has been reported that in many cases these	[1] JRC (2019) "Technology Market Report" [2] ETIP Ocean (2019) "Powering homes today, powering nations tomorrow" [3] European Commission (2017) "Study on lessons for ocean energy development [4] OceanSET (2020) OceanSET First Annual Report	Indicative, but not conclusive

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
actors are not aware of the full spectrum of innovation and development that is actually taking place [1] [3]. In particular, **revenue support schemes** are often available but inaccessible to an innovative sector such as ocean energy, as these instruments tend to be targeted to renewable energies in general rather than to specific technologies. This results in ocean energy having to compete for support against more established and cheaper technologies [2]. In this context, the lack of reflection of ocean energy targets (from the SET plan) in the National Energy and Climate Plans of Member States, also represents a problem with regards to access to finance as this reduces market visibility for ocean energy [2]. According to the OceanSET report, 5 EU Member States provide revenue support for ocean energy (wave and tidal), namely the Netherlands, Spain, Belgium, Sweden, France. Notably, France is the only country that ring-fences funding for ocean energy. In all other countries, "attempt to compete against other, more established, renewables, which have already been able to lower costs through deploying substantial capacity. As a result, where revenue support is not ring-fenced, the payment to ocean energy projects is typically EUR0. The absence of dedicated revenue support for ocean energy has been mentioned as one of the factors discouraging private investments in the sector by the stakeholders consulted in the course of the study, together with the scarcity of clear national strategies and targets for ocean energy deployment, that would give confidence on the existence of future potential markets for the technology [4]		
5.4 To what extent have the *administrative practices* and *environmental monitoring* been improved? (specific objective)		
According to recent estimates , only three Member States, namely France, Italy and Portugal, reported having consented wave or tidal projects in 2018. Average licensing time among Member States is about three years and average consenting time is around two years for wave and tidal projects. The length of the process has been recognised as a possible deterrent for the willingness of developers to test and operate ocean energy technologies [11].	[1] Copping (2018) "The state of knowledge for environmental effects – driving consenting and permitting for the marine renewable energy industry" [2] ETIP Ocean (2019) "Powering homes today, powering nations tomorrow" [3] Mendoza et al. (2019) "A framework to evaluate the environmental impact of ocean energy devices"	Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
In 2016, it was reported that **only a few European countries had streamlined the consenting process** for ocean energy developments by introducing a single point of contact or 'one-stop-shop' system (such as Denmark, the United Kingdom or Portugal). Other countries, including Spain and Sweden still rely on multiple authorities to process consenting applications for ocean energy and other marine activities [10] [6]. At the same time, it has been maintained that the variation in the interpretation and application of the environmental impact assessment directive and Habitats Directive requirements across the EU can have direct impacts on the operation of national consenting processes [5]. The **situation on administrative procedures differs across Europe**, depending the approach and resources of different licensing authorities [2]. There is **widespread variation in the application and execution of EIAs across the EU**. In Sweden, for example, all ocean energy projects are classified as ''environmentally harmful activities" and, thus, require an EIA. In Portugal, as the original transposing EIA legislation did not explicitly include marine renewable energy, a decision was made to include it in subsequent legislation. This stipulates that an EIA is required only if a deployment is within a Natura 2000 site, a national Ecological Reserve or Protected Area and if the regional licensing authority is in agreement [3]. Elsewhere, competent authorities take a more traditional approach and decide whether an EIA is required on the basis of size, nature and location of the development [5]. So far, impact assessment cases for ocean energy devices were only available for deployments in the UK, USA, Canada, Sweden, Portugal, Japan, Denmark, and Germany [3]. Many developers and institutions still **find it difficult to assess impacts**, partly because of the **lack of a comprehensive framework**, and this is widely known and accepted [3]. The collection of pre- and post-installation monitoring data still places **substantial cost burdens** on device and project developers, threatening the financial viability of this young industry. This is because regulators have interpreted laws as requiring a high degree of certainty, and collecting sufficient data to satisfy this level of	[4] OES (2019) "Annual report" [5] O'Hagan et al. (2016) "Wave energy in Europe – Views on experiences and progress to date" [6] Wright et al. (2016) "Establishing a legal research agenda for ocean energy" [7] European Commission (2017) "Study on lessons for ocean energy development" [8] Trinomics (2019) "Study on impacts of EU actions supporting the development of Renewable Energy technologies" [9] Muller et. al (2010) "Centres for Marine Renewable Energy in Europe and North America" [10] Ocean Energy Systems (2016) "Consenting Processes for Ocean Energy. Update on Barriers and Recommendations." [11] OceanSET (2020) OceanSET First Annual Report [12] ETIPOcean (2020) Ocean energy and the environment: Research and strategic actions [13] Mendoza et al (2019) A framework to evaluate the environmental impact of OCEAN energy devices [14] European Commission (2020) Report from the Commission to the European Parliament and the Council assessing Member States' monitoring programmes under the Marine Strategy Framework Directive [15] European Commission (2020) Report from the Commission to the European Parliament and the Council assessing Member States' programmes of measures under the Marine Strategy Framework Directive	

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
certainty can be challenging [1]. While there must be sufficient data to analyse potential effects, it **may not be possible to evaluate** certain risks until significant numbers of devices are deployed. Commercial-scale MRE development has been slow and data collected about the environmental effects of MRE deployments are generally limited to small-scale or single devices. [1] [8] Ocean energy falls within the mandate of multiple marine governance institutions as well as international technical organisations (institutional fragmentation); cooperation among those should be improved [5]. In this context, **Marine Spatial Planning** processes are considered capable of having a positive effect in enabling coordinated marine decision-making, providing clarity and transparency to consenting systems, reconciling conflicting sea uses, protecting the environment and encouraging investment. [6] [5] Knowledge and understanding of the environmental impact associated with different ocean energy technologies are important factors when it comes to facilitating licensing and consenting processes. The main potential impacts so far associated with the deployment of ocean energy relate to potential collision with marine biodiversity, the creation of underwater noise and electromagnetic fields that can disturb marine species, changes in marine habitats (e.g. seabed conditions, sedimentation patterns etc.) that can occur as a consequence of the installation of devices. The assessment of environmental impacts largely depends on the type of conversion technology used, on their operation mode and on the specific location of the device. Due to the fact that most impacts are site-specific, and that there is a limited number of ocean energy devices installed and monitored in EU waters, there is still substantial uncertainty with regards to the environmental impacts of ocean energy. The "lack of coherent, generalised information, strategies and the lack of monitoring and mitigation plans" are considered to be obstacles to the development of ocean energy around the world to date , and the proliferation of real-world observations and long-term monitoring of impacts are still highlighted as a key needs for the sector [12] [13]		

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
The Marine Strategy Framework Directive (MSFD) can also potentially play a role in the field of environmental monitoring for ocean energy devices as it requires Member States to assess and monitor impacts of human activities on their marine waters in order to determine whether these achieve good environmental status. Different descriptors that need to be monitored under the MSFD can bear relevance for ocean energy devices, such as Descriptor 6 on Sea floor integrity, Descriptor 7 on Hydrographical conditions and Descriptor 11 on Energy and noise. The recently published assessment of Member States' monitoring programmes under the MSFD however, reports that there is "relatively limited monitoring of energy, including underwater noise" (Descriptor 11), and no mention of dedicated measures for ocean energy is made in the assessment of the Programmes of Measures. [14] [15]		
5.5 To what extent has *cost reduction* being achieved via the consolidation of R&D activities? (operational objective)		
Data on cost trends is still limited, due to the lack of commercial scale applications and estimates are mostly drawn by analysing baseline cases [1]. According to the sources consulted, the CAPEX costs of ocean energy are on a **decreasing** trend (except for OTEC) and the industry progresses up the learning curve. EU funding, and in particular Horizon 2020, has helped increase know-how and decrease CAPEX [1] [3]. In the case of tidal energy, a reduction of more than 40% has been registered between 2015 and 2019 (from 0.60 EUR/kWh to 0.34-0.38 EUR/kWh) [3]. Based on the collected baseline cases and with further successful development, it is expected that both wave and tidal energy will be able to reach the cost targets defined in the European Strategic Energy Technology Plan, where EUR150-100/MWh is projected by 2025-2030 for tidal and EUR150-100/MWh for wave by 2030-2035 [2]. Despite this, the **costs of ocean energy are still above the cost of other renewable energy sources**. It would appear that this situation is not likely to change in the short period as a large part of	[1] Trinomics (2019) "Study on impacts of EU actions supporting the development of Renewable Energy technologies" [2] OES (2019) "Annual Report" [3] SETIS magazine (2019): "Ocean energy" [4] JRC (2019) "Technology Market Report"	Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
the investments at the moment are still being directed towards more profitable technologies e.g. offshore wind and therefore away from ocean energy. Since **deployment at scale** is required to drive the cost-reduction necessary for the technology to be competitive, the limited investments allocated might limit the deployment of additional projects [4].		
5.6 To what extent has the *efficiency of the planning and licensing procedures* been improved? (operational objective)		
Procedures for consenting of ocean energy are still considered time consuming. The main obstacles to issuing consenting for ocean energy projects are represented by the uncertainty about environmental impacts of ocean energy and by the potential conflicts with other marine users, that requires the consultation of a number of stakeholders[2]. The lack of knowledge about the marine environment in the legal sector is also slowing down procedures, including contract management-related issues for technology developers [1]. See evidence under EQ 5.4	[1] European Commission (2017) "Study on lessons for ocean energy development" [2] SETIS magazine (2019) "Ocean energy"	Satisfactory
5.7 To what extent has the *synergy with other industries* (e.g. offshore wind) been enhanced, including on grid planning matters? (operational objective)		
Installation and grid connectivity have been, and remain, an important barrier. The lack of tailored grid connection components (cables, connectors, substations) and methods (cable laying and connection) persist. Installation difficulties are a mix of exogenous, technological and supply chain barriers, and these appear to remain challenging to date [1].	[1] European Commission (2017) "Study on lessons for ocean energy development"	Weak
5.8 To what extent has the *monitoring of environmental impacts* of ocean energy technology and *the application of the relevant environmental protection legislation* been supported? (operational objective)		
In the last years, there has been a **considerable increase in the number of studies undertaken** (193, compared to 164 in the previous 27 years) **on the environmental impacts of ocean energy** [3]. While uncertainties remain about how marine animals and habitats will be affected by and interact with single devices in the ocean, there is a reasonable understanding of likely environmental effects of ocean energy technology [1]. Several initiatives have been undertaken in this regard:	[1] SETIS magazine (2019) "Ocean energy" [2] Wright et al. (2016) "Establishing a legal research agenda for ocean energy" [3] Mendoza et al. (2019) "A framework to evaluate the environmental impact of ocean energy devices" [4] OES (2019) "Annual report"	Satisfactory

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
• The Thetys online management system was created, where information about environmental risks is collected, curated and disseminated [1] • The European Commission published two calls on environmental monitoring of wave and tidal devices, via the European Maritime and Fisheries Fund [2] • The EU is funding the WESE project, which aims to identify specific knowledge gaps and appropriate monitoring methodologies on the environmental effects of ocean energy and to improve existing modelling tools to contribute to overall understanding of the potential cumulative impacts of future larger scale wave energy deployments and to propose effective mitigation measures, among other things [1] • OES has established a project on the "assessment of Environmental Effects and Monitoring Efforts", that seeks to be the first international programme engaged in bringing together information and practitioners on environmental effects of marine renewable energy (MRE) development [4] • In Ireland, two draft **environmental guidance documents** were published to help developers and consultants conduct environmental assessments and to specifically outline data and monitoring requirements for deployments in Irish waters [1] Unfortunately, it appears that many of the issues raised by the early scholarship on environmental monitoring for ocean energy remain pertinent some 40 years later [2]		

EQ 6: To What factors have influenced effectiveness (positively or negatively), how and to what extent?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
6.1 What factors influenced the effectiveness of the Blue Energy Communication/Ocean Energy Strategic Roadmap *positively*? *How* did they influence effectiveness, and *to what extent*?		
		Null
6.2 What factors influenced the effectiveness of the Blue Energy Communication/Ocean Energy Strategic Roadmap *negatively*? *How* did they influence effectiveness, and *to what extent*?		
		Null

EFFICIENCY

EQ 7: To what extent are the costs of implementing the intervention justified, given the benefits it has achieved?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
7.1 What have been the *costs of implementation* of the Blue Energy Communication/Ocean Energy Strategic Roadmap for the different stakeholders?		
The European Commission provided financial support for the setup and operation of the Secretariat of the Ocean Energy Forum. The Secretariat of the Forum was appointed in 2015 and it formed part of a Programme financed by the European Maritime and Fisheries Fund whose implementation was delegated to the Executive Agency for Small and Medium-sized Enterprises (EASME). The main role of the Secretariat was to ensure the timely delivery of the Roadmap by the Ocean Energy Forum members, that participated to the Forum in their own personal capacity [1]	[1] Ocean Energy Forum website	Indicative, but not conclusive
7.2 What progress has been made in terms of *EU funding* allocated to ocean energy?		
See evidence under EQ4.2 and EQ4.5		Satisfactory
7.3 What progress has been made in terms of *Member States' funding* allocated to ocean energy?		
See evidence under EQ4.3		Weak
7.4 What *benefits* (direct, indirect) have been achieved to date for different stakeholders?		
While it is understood from previous analysis that a significant level of investment is required for the sector, it is estimated that an investment of circa EUR 1 billion EUR in the SET Plan [wave and tidal industries] would result in a net benefit to Europe due to the creation of a newindustry, which would profit from activity both within Europe and internationally [1]	[1] Temporary Working Group Ocean energy (2018): "SET-Plan Ocean energy Implementation Plan"	Weak
7.5 Are the *costs and benefits proportional* for the different stakeholders?		
		Null

EQ 8: What factors have influenced efficiency (positively or negatively), how and to what extent?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
8.1 What factors influenced efficiency *positively*?		
		Null
8.2 What factors influenced efficiency *negatively*?		
		Null

COHERENCE

EQ 9: To what extent are the components of the intervention coherent internally; are there any overlaps, inconsistencies, or incoherencies?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
9.1 Are there *internal inconsistencies* within the *Blue Energy Communication?*		
		Null
9.2 Are there *duplications or overlaps* within the *Blue Energy Communication*?		
		Null
9.3 Are there *any gaps* within the *Blue Energy Communication*?		
		Null

EQ 10: To what extent is the intervention coherent with wider EU policy and initiatives?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
10.1 Are there *inconsistencies or contradictions* between the *Blue Energy Communication /Ocean Energy Strategic Roadmap and wider EU policy and initiatives?*		
		Null
10.2 Are there *duplications or overlaps* between the *Blue Energy Communication /Ocean Energy Strategic Roadmap* and wider EU policy and initiatives?		
		Null

EQ 11: To what extent is the intervention coherent with other relevant EU (and national/regional initiatives) support schemes (e.g. funding, sectorial policies), in particular linked to renewables and innovation?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
11.1 Are there *inconsistencies or contradictions* between the *Blue Energy Communication /Ocean Energy Strategic Roadmap* and other EU support schemes (in particular linked to renewables and innovation)?		
The **complex relationship between the available EU funds** (Horizon 2020, Structural Funds, NER300, Juncker Funds) **and the funds on national and regional level** require principles to ensure that they are mutual supportive for ocean energy technologies. **Technology readiness** has been suggested as one possible principle [1] Internal inconsistencies have been reported between funding for R&D and strict regulations on competition and state aid for private enterprises [1].	[1] European Commission (2017): "Study on lessons for Ocean energy"	Weak
11.2 Are there *duplications or overlaps* between the *Blue Energy Communication /Ocean Energy Strategic Roadmap* and other EU support schemes (in particular linked to renewables and innovation)?		
		Null
11.3 Are there *inconsistencies or contradictions* between the *Blue Energy Communication /Ocean Energy Strategic Roadmap* and national/regional initiatives?		
		Null
11.4 Are there *duplications or overlaps* between the *Blue Energy Communication /Ocean Energy Strategic Roadmap* and national/regional initiatives?		
		Null

EU ADDED VALUE

EQ 12: What is the additional value resulting from the intervention, compared to what could have been expected from private initiatives and investments, and Member States acting at national/regional levels?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
12.1 Is there evidence for *added value* resulting from EU intervention in support of the ocean energy sector?		
		Null
12.2 To what extent would the *same results have been achieved* at international, national or regional level without EU intervention?		
		Null

EQ 13: What would be the most likely consequences of stopping or withdrawing the existing intervention?

Key findings	Relevant analysed desk research sources	Strength of desk research evidence
		Null

Overview of database assessment

Table 6.1 Overview of database assessment

Database		Dataset description		Dataset analysis		Evaluation relevance			Accessibility	Comment	
Name	**Owner**	**Website**	**Content**	**Source**	**Timeline**	**Granularity**	**Geographical coverage**	**Completeness**	**Reliability**	**Indicator**	
IRENA database on installed capacity trends	IRENA	https://www.irena.org/Statistics https://www.irena.org/Statistics/View-Data-by-Topic/Capacity-and-Generation/Statistics-Time-Series	The "Trends in renewable energy" dashboard provides data on electricity generation or installed capacity for selected countries and different renewable energy sources, including marine energy. Data on	This data is collected directly from members using the IRENA Renewable Energy Statistics questionnaire and is also supplemented by desk research where official statistics are not available. Renewable power-	2000 - 2017	The dashboard: - Provides information on "Marine energy" in general (it does not divide between different technologies) - Allows to distinguish between electricity generation and installed capacity	Australia, Brazil, Canada, China, Denmark, Faroe Islands, France, Ghana, Italy, Netherlands, New Zealand, Norway, Portugal, Republic of Korea, Reunion, Russian Federation, Singapore, Spain, Sweden, United	TBC	TBC	EQ6 - Installed capacity compared to what could be expected in the baseline scenario	Free access online Available for download	There are also statistics on: - "Renewable Energy Patents Evolution", including for Ocean Energy - "Global Trends in Renewable Energy Investment" (Source: Frankfurt School) - "Renewable Energy

Database			Dataset description			Dataset analysis		Evaluation relevance		Accessibility	Comment	
Name	Owner	Website	Content	Source	Timeline	Granularity	Geographical coverage	Completeness	Reliability	Indicator		
			renewable power capacity represents the maximum net generating capacity of power plants and other installations that use renewable energy sources to produce electricity. For most countries and technologies, the data reflects the capacity installed and	generation capacity statistics are released annually in March. Additionally, renewable power generation and renewable energy balances data sets are released in July.		- Allows to distinguish between cumulative and net additions (these include new capacity installed during a year minus any capacity decommissioned during that year) - Allows to distinguish between on-grid and off-grid connectio	Kingdom, United States of America					Finance Flows"

Database			Dataset description			Dataset analysis	Evaluation relevance		Accessibility	Comment
Name	Owner	Website	Content	Source	Timeline	Granularity	Geographical coverage	Completeness	Reliability	Indicator
			connected at the end of the calendar year. Capacity is presented in megawatts (MW), while generation is presented in gigawatt-hours (GWh).			n; however, for marine energy data is only provided for on-grid installed capacity and electricity generation - Allows to distinguish between regions (9 regions) and countries (21 countries are represented in the case of				

Database		Dataset description		Dataset analysis		Evaluation relevance			Accessibility		Comment	
Name	**Owner**	**Website**	**Content**	**Source**	**Timeline**	**Granularity**	**Geographical coverage**	**Completeness**	**Reliability**	**Indicator**		
						marine energy)						
National renewable energy action plans and progress reports data portal (NREAP and Progress Reports Data Portal)	JRC	https://visualise.jrc.ec.europa.eu/t/NREAPs/views/All_NREAPs_REData/SeeAllNREAPs-AllREData?%3Aembed=y&%3Adisplay_count=no&%3AshowWizHome=no	The "NREAP and Progress Report Database" provides data on the renewable energy share in gross final energy consumption (planned and achieved) in Ktoe (thousand tonnes of oil equivalent), including for marine	The data are sourced from EU Member States reporting under Article 4 and Article 22 of the Directive 2009/28/EC: national renewable energy action plans (NREAPs) and biennial progress reports. The NREAPs can be	Planned RES: 2005 - 2020 Achieved RES: 2004 - 2016	The database: - Allows to distinguish between renewable energy share planned and achieved for each energy source, including marine energy - Allows to distinguish between all 28 EU Member States	All EU Member States	TBC	TBC	TBC	Free access online Available for download	The 2009 Renewable Energy Directive required the EU to fulfil at least 20% of its total energy needs with renewables by 2020. EU countries set out how they plan to meet the agreed individual targets in their National Renewable Energy Action

Database			Dataset description			Dataset analysis		Evaluation relevance		Accessibility	Comment
Name	Owner	Website	Content	Source	Timeline	Granularity	Geographical coverage	Completeness	Reliability	Indicator	
			renewable energy, for all EU Member States.	found at the European Council Transparency Platform. The Data Portal includes also the EU Member States reporting on renewable energy at Eurostat SHARES Tool)							Plans (NREAPs). Progress towards these targets is measured every two years when countries publish national renewable energy progress reports. This data portal is an interactive tool for visualising and comparing the renewable energy data provided

Database		Dataset description		Dataset analysis		Evaluation relevance				Accessibility		Comment
Name	Owner	Website	Content	Source	Timeline	Granularity	Geographical coverage	Completeness	Reliability	Indicator		
												in the NREAPs and the progress reports. 60 energy indicators for each EU Member State covering 3 sectors: electricity, heating/cooling and transport.
Cordis data on R&I projects funded by the EU	EC	https://cordis.europa.eu/en	The "Cordis repository" provides information on the projects funded by the EU's framework	The project information is held by the EC.	1984 (FP1) - 2020 (Horizon 2020 - FP8)	The repository contains information on: - Project description (budget, funding source,	All EU Member States	All projects funded by the EU's Framework programmes for research and innovatio		EQ5 - Number of collaborative undertakings	Free access online Available for download	The Community Research and Development Information Service (CORDIS)

Database			Dataset description			Dataset analysis		Evaluation relevance		Accessibility	Comment
Name	Owner	Website	Content	Source	Timeline	Granularity	Geographical coverage	Completeness	Reliability	Indicator	
			programmes for research and innovation (from FP1 to Horizon 2020), including in the field of ocean energy.			project coordinators and participants, project website) - Project objectives and results - Project reporting (e.g. final reports)		n are included in the repository			is the European Commission's primary source of results from the projects funded by the EU's framework programmes for research and innovation (FP1 to Horizon 2020). It is a public repository of all project information held by the EC (e.g. project factsheet

Database		Dataset description		Dataset analysis		Evaluation relevance			Accessibility	Comment	
Name	**Owner**	**Website**	**Content**	**Source**	**Timeline**	**Granularity**	**Geographical coverage**	**Completeness**	**Reliability**	**Indicator**	
											s, participants, reports, deliverables and links to open-access publications)
IEA Energy Technology RD&D Budgets	IEA	https://www.iea.org/reports/energy-technology-rd-and-d-budgets-2019	The IEA's Energy Technology RD&D Budget Database allows users to track trends in spending by energy technology in IEA countries. All figures refer to total public	Data is collected from central or federal government budgets, as well as the budgets of state-owned companies.	2014 - 2018 for ocean energy	The database: - Provides information on total RD&D expenditure (Million USD / Million EUR) - Distinguishes between state-owned R&D	All IEA Member States	TBC	TBC	EQ6 - Amount of Member State financial support for ocean energy	The IEA Energy Technology RD&D Budget Database can be accessed for free through IEA Data Services by logging in as GUEST.	

Database			Dataset description			Dataset analysis		Evaluation relevance		Accessibility	Comment	
Name	**Owner**	**Website**	**Content**	**Source**	**Timeline**	**Granularity**	**Geographical coverage**	**Completeness**	**Reliability**	**Indicator**		
			energy RD&D expenditure data, converted from current prices in national currencies to US dollar PPPs in constant 2018 prices, using GDP deflators and 2018 PPPs.			expenditure (Million USD / Million EUR) and government demonstration expenditure (Million USD / Million EUR) All this data can be filtered specifically for ocean energy (ocean energy,other ocean energy, unallocated ocean energy)						
OES GIS Databas	OES - Ocean	https://www.ocean	The "Offshore	Data is provided	The database	The GIS database:	Denmark Portugal	TBC	TBC	EQ6 - Installed		The Ocean

Database		Dataset description		Dataset analysis		Evaluation relevance		Accessibility		Comment	
Name	Owner	Website	Content	Source	Timeline	Granularity	Geographical coverage	Completeness	Reliability	Indicator	
e "Offshore installations worldwide"	Energy Systems	-energy-systems.org/ocean-energy/gis-map-tool/	installations worldwide" GIS database is an interactive web-based GIS mapping application that gives access to detailed global information related to ocean energy. The available information comprises ocean energy facilities, resources, relevant	by OES member countries.	was created in 2014, but provides information on current installations.	- Distinguishes between stages of development of the different marine energy facility (e.g. concept, in planning, partly operational) - Distinguishes between the geopolitical and onshore layers (e.g. port, EEZ boundaries, marine	United Kingdom Ireland Japan Canada United States of America Belgium Germany Mexico Norway Italy New Zealand Spain Sweden Republic of Korea South Africa China China Monaco Singapore Netherlands Netherlands India France			capacity compared to what could be expected in the baseline scenario	Energy Systems Technology Collaboration Programme (OES) is an intergovernmental collaboration between countries, which operates under framework established by the International Energy Agency in Paris.

Database			Dataset description			Dataset analysis	Evaluation relevance		Accessibility	Comment
Name	Owner	Website	Content	Source	Timeline	Granularity	Geographical coverage	Completeness	Reliability	Indicator
			infrastructure and relevant general geopolitical and geographical information, altogether in conjunction with the respective location and distribution on a global map. This information is provided for the 25 OES member countries.			protected areas) - Distinguishes between marine energy resources (e.g. tidal range, wave power, water temperature difference, salinity) - For each facility, it provides information on project owner, project developer, construction and commissi	European Commission on European Commission on Australia			

Database		Dataset description		Dataset analysis		Evaluation relevance			Accessibility	Comment
Name	Owner	Website	Content	Source	Timeline	Granularity	Geographical coverage	Completeness	Reliability	Indicator
						oning period, converter type and capacity, link to website)				

Appendix 3 – Factual summary report on the public consultation

Factual summary report on the public consultation

Introduction

As part of the support study for the Evaluation of the development of ocean energy policies, the Commission carried out a public consultation. The consultation was accessible to all interested citizens and stakeholders for a period of 15 weeks (27th August 2020 – 10th December 2020) on the Commission's 'Have Your Say' portal[240].

The questionnaire consisted of two parts: one consisting of high-level questions about the ocean energy sector in general, and one with more detailed questions on the Blue Energy Communication and Ocean Energy Strategic Roadmap, intended with stakeholders who are more familiar with the EU policy framework supporting the development of ocean energy.

The purpose of the consultation was to provide all interested parties the opportunity to provide their views on whether or not they believe the EU should continue supporting the development of the ocean energy sector, as well as their opinion on the relevance, effectiveness, coherence and EU added value of the EU intervention in this field. The results will contribute to the evaluation of the EU policy supporting the development of ocean energy.

Methodological considerations

Public consultation is a tool which provides transparency in the policy-making process. However, because it is open to all rather than targeting specific stakeholders, the total population is unknown, and there is a degree of self-selection bias in respondents. The views of these respondents can thus not be considered representative of the views of EU citizens at large. This is especially true when only a small number of responses is received, as is the case for this public consultation.

Of the 71 responses received, 70 were considered in the analysis as one of the responses came from a member of the project team. A campaign of coordinated answers[241] was identified, including 18 of the respondents.

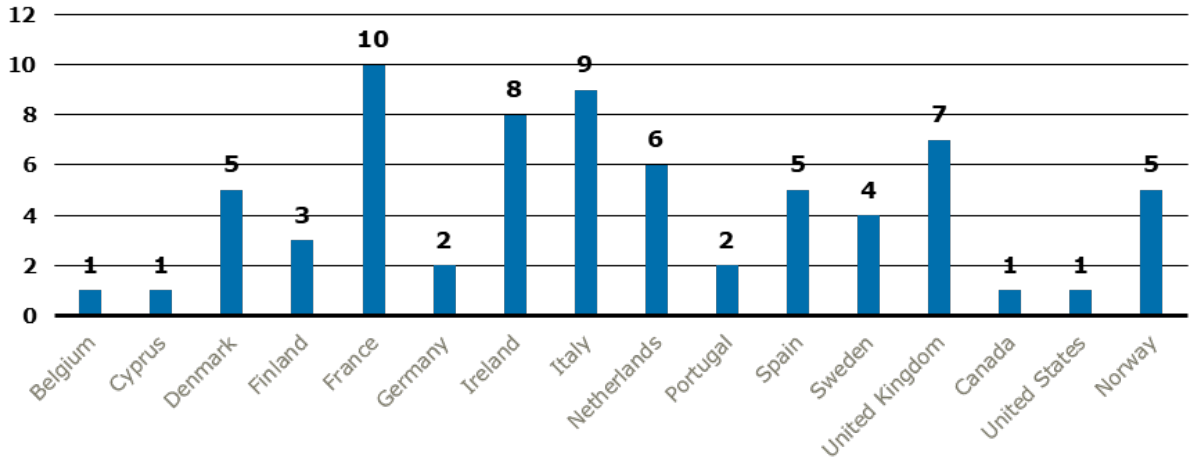
Overview of the respondents

The 70 responses considered in the analysis came from 16 different countries, of which 12 from within the EU-27. France is the most represented country among respondents, followed by Italy, Ireland and the United Kingdom. As such, the responses received are geographically unbalanced.

[240] The dedicated consultation webpage can be accessed via: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12061-Ocean-energy-evaluation-of-EU-renewable-power-generation-policy/public-consultation

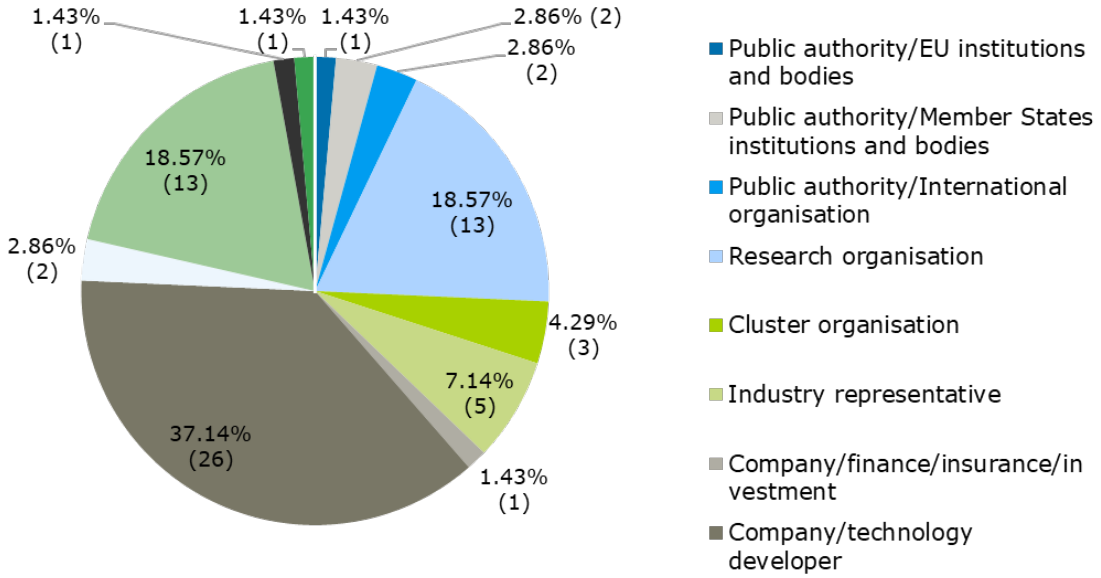
[241] A campaign of "coordinated answers" was identified according to the Better Regulations Toolbox. Better Regulation Tool #54, page 49. Available at: https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-54_en_0.pdf

Geographical balance of responses received (N=70)



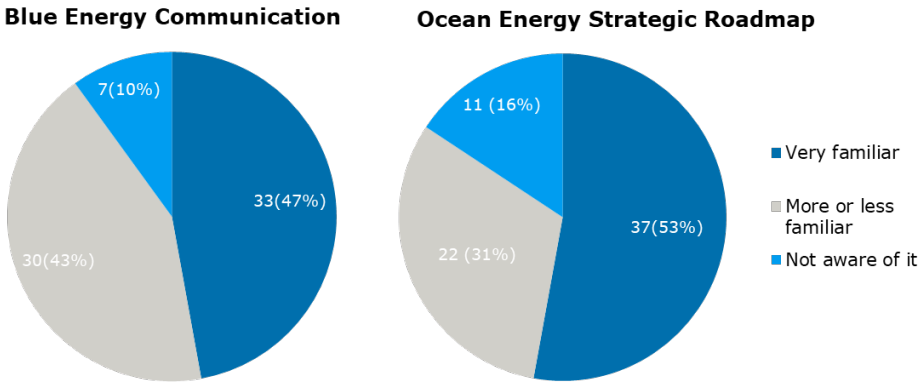
Most of the respondents identified themselves as ocean energy technology developers (26 out of 70), Research organisations (13 out of 70) or EU citizens (13 out of 70). Other groups were marginally represented: industry representatives (5 out of 70), cluster organisations (3 out of 70), Public authorities/Member States institutions and bodies (2 out of 70), Public authorities/International organisations (2 out of 70), Utility companies (2 out of 70), Public authority/EU institutions and bodies (1 out of 70), Company/finance/insurance/investment (1 out of 70), Non-EU/EEA citizen (1 out of 70), Non-governmental organisation (NGO) (1 out of 70).

Number and percentage of respondents by stakeholder type (N=70)



A total of 33 respondents indicated they were very familiar with the Blue Energy Communication. 30 respondents affirmed being 'more or less familiar' with the Communication, while 7 respondents were not aware of it. With regards to the Ocean Energy Strategic Roadmap, 37 respondents indicated being very familiar and 22 were 'more or less familiar' with it. 11 respondents were not aware of it.

Familiarity with the Blue Energy Communication and the Ocean Energy Strategic Roadmap (N=70)



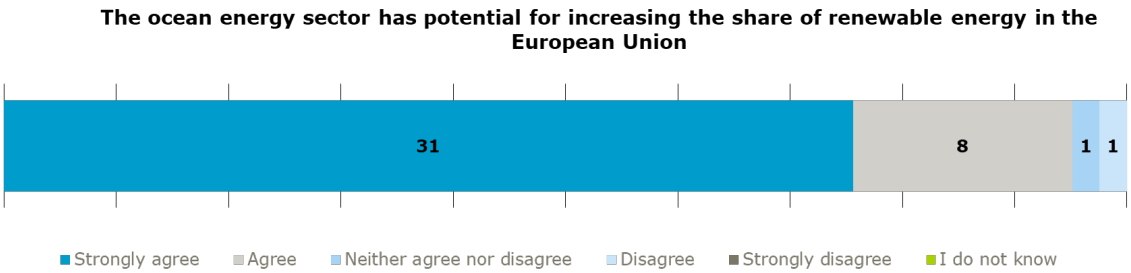
Following the profiling questions, respondents were split into groups based on those that wanted to provide their 'View on the sector of ocean energy' and those who wanted to provide a 'Detailed view on the Blue Energy Communication and the Roadmap'. Most of the respondents (41) belong to the first group, and their replies to the general questions are presented below. The replies of the remaining group of respondents (29) are presented further below under each evaluation criterion and correspond to the views of technology developers and research organisations. During data cleaning it was found that 18 out of these 29 responses correspond to "coordinated answers" according to the Better Regulations Toolbox and the decision was made to segregate the data and conduct a separate analysis so to not skew the results. These answers were segregated from the main dataset and the main differences will be highlighted in this report.

Replies to the consultation questions – Views on the sector of ocean energy

The respondents that replied to the high-level questions on the sector of ocean energy indicated being either very familiar (26 out of 41) or more or less familiar (15 out of 41) with ocean energy technology. None of the stakeholders that replied to these questions indicated not being aware of this technology.

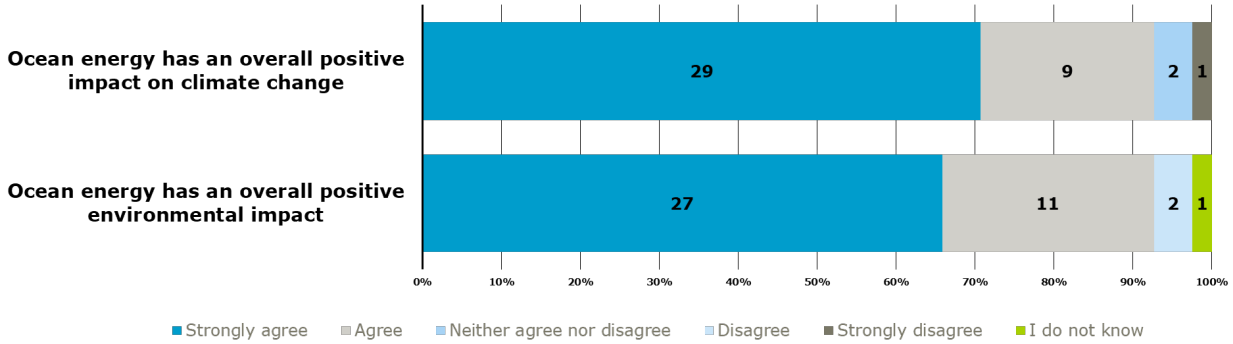
Almost all the respondents (39 out of 41) believe that the ocean energy sector has the potential for increasing the share of renewable energy in the European Union.

Assessment of the impact of ocean energy on the share of renewables in the EU (N=41)



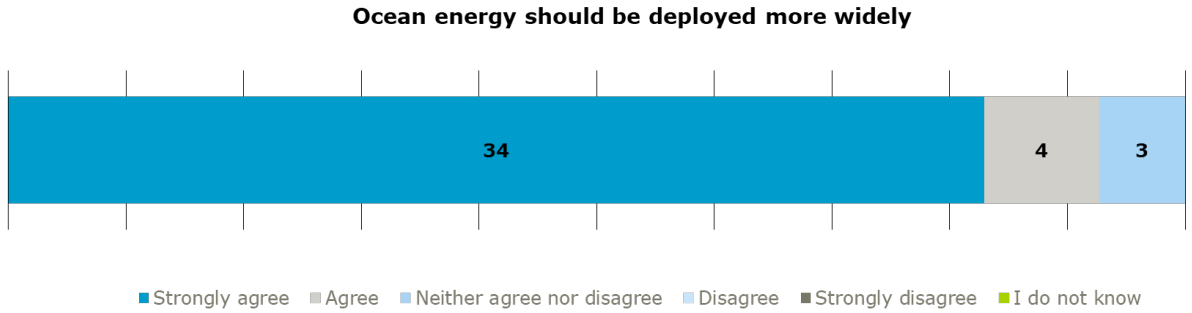
When asked about the impacts of ocean energy, the large majority of the respondents strongly agree or agree that ocean energy to have an overall positive environmental impact and a positive impact on climate change.

Evaluation of the impact of ocean energy on environment and climate change (N=41)



For what concerns the overall views on the future of the sector, 38 stakeholders stated that they strongly agree or agree that ocean energy should be deployed more widely. Only 3 stakeholders don't have strong views on this question.

Views on the further deployment of ocean energy (N=41)



Half of the respondents (21 out 41) also presented more detailed explanations for the feedback they provided to the questions above. The majority of these respondents (16 out of 21) highlighted the benefits of ocean energy, and consider that ocean energy should be further developed as part of the EU energy mix because it is a stable, low-impact, predictable and reliable form of energy that can play an important part in complementing solar and wind energy and can work synergistically with them. In their view, development of this technology is key for the EU to reach its climate and energy objectives, as well it can play an important role in job creation. A small part of the stakeholders (4 out of 21) indicated that for further uptake to take place, strong support is needed, together with de-risking actions and further proofs of concepts, to enable a commercial deployment of these technologies. The importance to further investigate the environmental impacts of the technology was also indicated by one stakeholder. Some respondents also highlight that ocean energy could be further developed in specific areas in Europe (e.g. Portugal) (2 out of 21) as well as that technologies developed outside of Europe (e.g. Canada) should be taken into consideration (1 out of 21).

Replies to the consultation questions – Detailed view on the Blue Energy Communication and the Roadmap

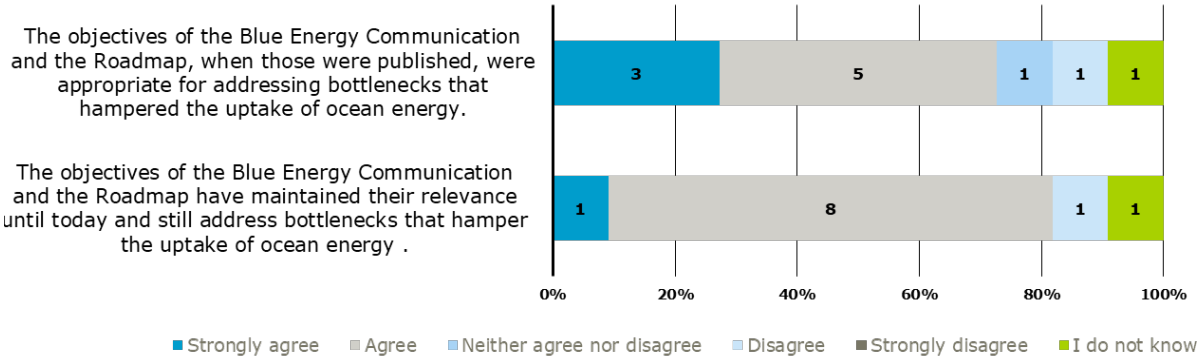
Out of the total 70 respondents, 29 provided their "detailed view on the Blue Energy Communication". 18 out of these 29 responses correspond to "coordinated answers" according to the Better Regulations Toolbox, and their answers have been segregated from the main dataset and are presented as separate in this report.

Relevance

A part of the stakeholders (8 out of 11) strongly agree or agree that the objectives of the Communication and Roadmap were appropriate to address the bottlenecks that hampered the uptake of ocean energy at the time of their issuance, and that they are still relevant today (9 out of 11).

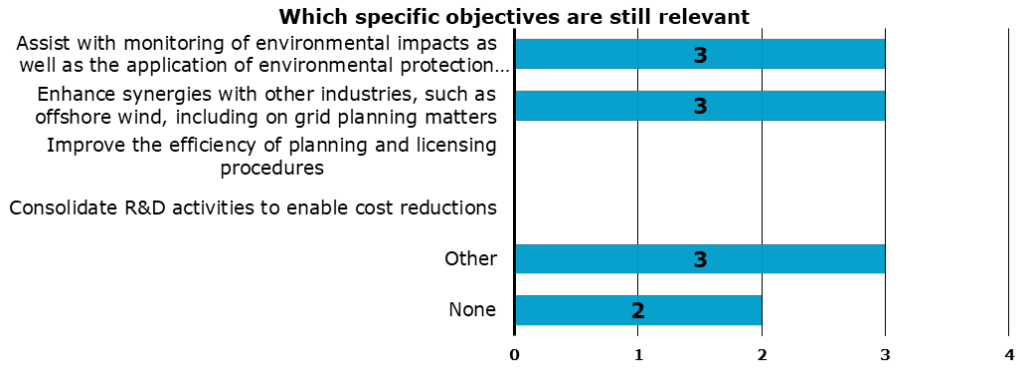
All the stakeholders from the coordinated answers strongly agree (16 out of 18) or agree (2 out of 18) that the objectives of the Communication and Roadmap were appropriate at the time of their publication, and that they still remain relevant today (2 out 18 strongly agree and 15 out of 18 agree). Only one stakeholder from the group of coordinated answers replied that they disagree with the continued relevance of the Communication and Roadmap.

Relevance of the Communication and Roadmap (N=11)



When asked which of the specific objectives of the Communication helped the most in addressing the bottlenecks of the sector since 2014, 8 out 11 respondents indicate that the objective to consolidate R&D activities to enable cost reductions was the most useful. One stakeholder considered that the objective to enhance synergies with other industries was useful, and two stakeholders consider that none of the objectives helped. The objective on assisting with the monitoring of environmental impacts as well as the application of environmental protection legislation, and the objective on enhancing synergies with other industries are still relevant today according to 6 stakeholders. Two out of 11 respondents affirm that none of the objectives of the Communication are still relevant today, while 3 respondents indicate other objectives would be more relevant now to address the current bottlenecks of the sector.

Continued relevance of the Communication's specific objectives (N=11)



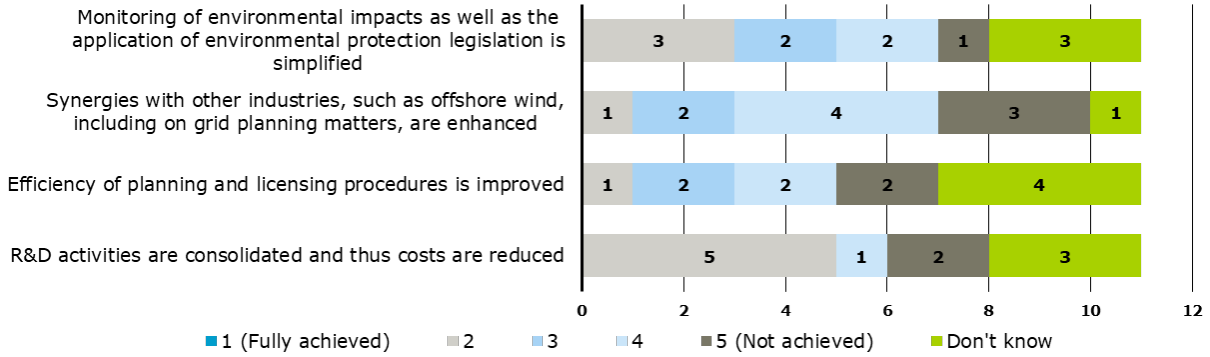
The respondents were asked in an open question to identify the current needs of the ocean energy sector that should be better addressed by the European Union. 3 out of 11 stakeholders indicated that financing needs should be addressed, via the establishment of revenue support, investment support and insurance support, including to allow for the demonstration of projects. De-risking and cost-reduction needs were also mentioned by two stakeholders, one of which highlighted that multi-use and joint projects (e.g. between wind and wave) could be a solution to increase confidence of the investors and attract more funding. The need to increase collaboration among Member States to speed up the development of ocean energy was also mentioned by two stakeholders. In addition to this, two stakeholders remark that more should be done to make sure the further development of ocean energy does not harm marine resources and the other economic sectors that depend on these. In their views, the environmental and social impacts of ocean energy should further be investigated, and the European Commission should provide further guidance on how to monitor and gather environmental data under the EIA Directive.

All the respondents from the group of coordinated answers (18 respondents) consider that the objective to consolidate R&D activities to enable cost reductions was the most helpful to address the bottlenecks of the sector at the time, and that other objectives should now be added to support the further development of ocean energy today. In light of the progress shown by the sector, in particular by tidal energy, they suggest that ocean energy technologies are now "ready for larger-scale deployment", and that the European Commission should now focus on engaging with Member States to grant revenue support for these technologies, as well as to enable access to sea required for this type of deployment. They mention that these objectives are also reflected in the recently published Offshore Renewable Energy Strategy, in particular the "key action" on coordinating with national governments to deliver 100MW with ocean energy by 2025.

Effectiveness

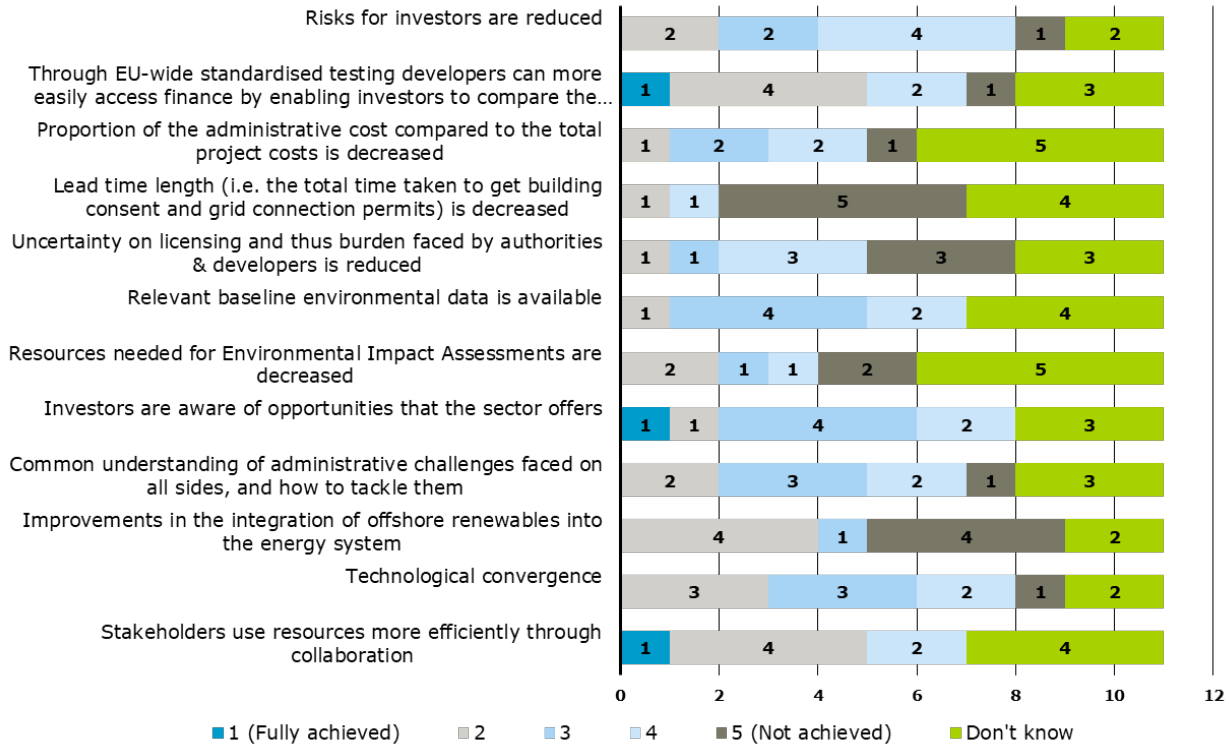
There is uncertainty with regards to the effectiveness of the Communication. The views regarding the achievement of the four operational objectives of the Communication are quite divergent among the stakeholders who replied to these questions (11), with a part of the stakeholders being convinced that the objectives on consolidating R&D activities and on assisting with monitoring of environmental impacts are close to being achieved (respectively, 5 and 3 stakeholders out of 11), and others affirming they have not been achieved at all, or at least to a lesser extent. Limited progress on the achievement of the objective on improving efficiency of planning and licensing procedures and on enhancing synergies with other industries is registered by the stakeholders (with progress being mostly rated as 3 or 4 on a scale where 1 is 'fully achieved' and 5 is 'not achieved at all'). Notably, none of the stakeholders consider that any of the objectives have been fully achieved, and a part of them affirms not knowing whether these objectives have been achieved at all (from 1 to 4 stakeholders, depending on the objective, with the objective on improving efficiency of planning and licensing being the one where the larger uncertainty exists).

Level of achievement of the objectives of the Communication (N=11)



The same scattered picture is present in the replies concerning some specific aspects of the objectives of the Communication. Close to half of the stakeholders believe that improvements have taken place in terms of stakeholder collaboration (5 out of 11), technological convergence (6 out of 11), integration of offshore renewables into the energy system (5 out of 11) and EU-wide standardised testing (5 out of 11). Partial improvements have been registered according to a part of the stakeholders on the establishment of a common understanding of administrative challenges faced by ocean energy technologies, on the increased awareness of investors on the opportunities offered by the sector, on the availability of relevant baseline of environmental data, on the decrease of the resources needed for EIAs and on the reduction of risks for investors. By contrast, improvements on the licensing procedures and lead time lengths have failed to materialise according to a part of the stakeholders (6 out of 11). In this case again, a varying number of stakeholders affirm not knowing whether the specific objectives have been achieved, with the largest degree of uncertainty being registered on the objective regarding the decrease of the administrative costs compared to total project costs (5 out of 11).

Level of achievement of specific objectives of the Communication and other relevant aspects (N=11)



Stakeholders were asked an open question regarding the current financing needs for the sector. Close to half of the stakeholders indicate that an Insurance and Guarantee Fund is needed (6 out of 11), and that dedicated grants should be devised for ocean energy, or grants from existing funds could be better tailored to match the needs of the sector (5 out of 11). The need for revenue support is also highlighted by a part of the stakeholders (4 out of 11). Single stakeholders mention the need for financing for demonstration projects and the need to use funding to ensure the acceptability of ocean energy by other users of the sea e.g. fishermen. The EIC Accelerator is mentioned by one stakeholder as a very good tool encourage the development of new approaches and technologies in this context. In terms of the current bottlenecks of the sector, these stakeholders indicate the shortcomings in financial support, including the lack of revenue support or financing for demonstration projects (6 out of 11), the long consenting processes (4 out of 11), the lack of insurance and guarantee (2 out of 11), the limited knowledge of environmental impacts (2 out of 11), the limited cooperation between academia and industry in R&D projects (1 out of 11), the limited dialogue with stakeholders from other blue economy sectors (1 out of 11), the stronger focus put on other forms of energy, which channels funding elsewhere (1 out of 11).

According to the respondents belonging to the group of coordinated answers (18 respondents), progress has been made primarily on the consolidation of R&D activities and on the monitoring of environmental impacts and application of environmental protection legislation, although none is considered as fully achieved. Moderate and limited progress are respectively reported on the improvement of synergies with other industries and on the improvement of the efficiency of planning and licensing procedures. With regards to the specific objectives, these respondents indicate that the objective on stakeholder collaboration has been fully achieved, followed, in terms of progress, by the objective on technology convergence, integration of offshore renewables, the decrease of resources for EIAs, EU-wide testing and the reduction of risks for investors. In this case again, the stakeholders affirm not knowing whether proportion of administrative costs compared to total project costs decreased at all.

In terms of financing needs, the stakeholders from the group of coordinated answers highlight that existing EU funds (e.g. Horizon Europe, Innovation Fund and InnovFin EDP) could support large demonstration projects, but the number of calls available under these programmes is insufficient to enable ocean energy to reach the 100MW target by 2025. The lack of commercial insurance products still represents a challenge for developers, and the institution of a European Insurance and Guarantee Fund to over an mutualise the technological risks of projects would be welcome. Revenue support is also on the list of financing needs for these stakeholders.

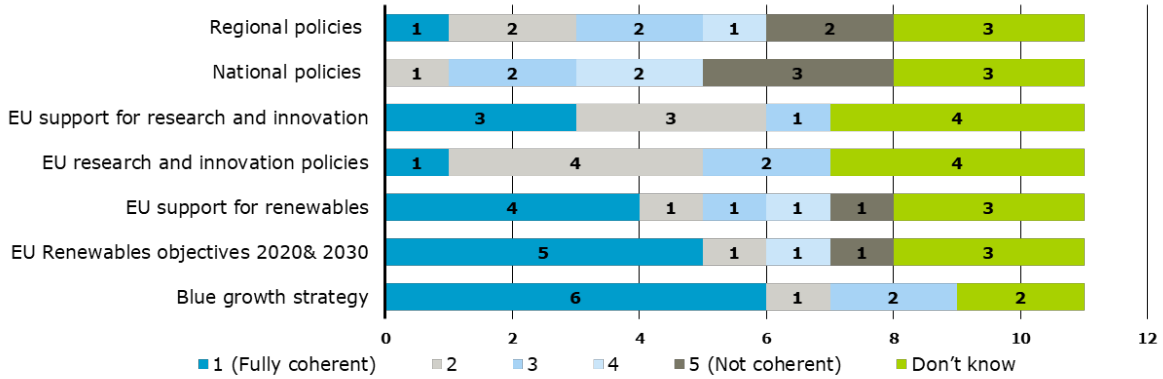
When asked about the main bottlenecks still faced by the sector, the stakeholders from the group of coordinated answers indicate the lack of revenue support at the national level and the slowness of permitting procedures for the access to the sea. These respondents state that both challenges can be tackled through the strong political drive of the EU offshore renewable energy strategy.

Coherence

There is little knowledge about the coherence of the Communication and Roadmap with the wider EU policy framework, with a number of stakeholders (up to 4 out of 11, for certain policies) affirming they do not know whether these instruments are coherent with certain specific policies. Overall, it appears that the objectives of these initiatives are particularly in line with the Blue Growth Strategy (according to 7 out of 11 respondents) and EU renewable energy policy (6 out of 11), followed by the EU research and innovation policies and support (6 out of 11). While according to a part of the stakeholders (5 out of 11) there is a certain level of coherence between the Communication and Roadmap and regional policies, moderate to little coherence seems to exist between the objectives of these tools and the national policies of EU Member States (according to 5 out of 11 stakeholders). Three respondents highlighted that ocean energy will be important for the decarbonisation of Europe, and as such "it needs to be advocated in all policies and legislation", including at the national level where currently the support

appears to be weaker. According to two stakeholders, support from regions within specific Member State is stronger because regional actors perceive more directly the potential benefits of the development of the sector, including in terms of employment.

Coherence of the Communication and Roadmap with the wider EU policy framework (N=11)



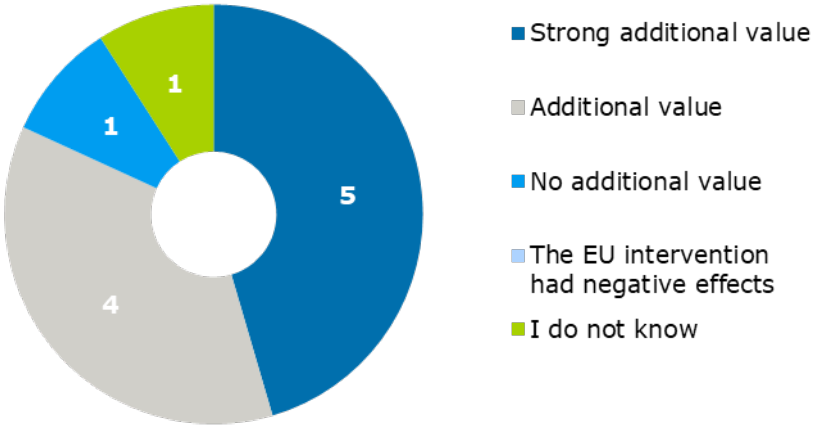
The stakeholders belonging to the group of coordinated answers affirm that the Communication and Roadmap are coherent with, and well complement, all the policies mentioned above, and only partially coherent with Member States policies. In their views this is because the further development of ocean energy contributes to the decarbonisation of the energy system, while at the same time ensuring an economically and socially just transition. Reportedly, ocean energy "ticks all the boxes and fits the objectives" of the policies listed in this question, because it will support the ecological transition, it would enable a wider penetration of variable renewables such as wind and solar PV, and it will create "thousands of local high skilled jobs on Europe's coastline and beyond". In their coordinated answer, these stakeholder state that political impetus, coherence and new solutions to reach commercial stage will be needed for the further development of the sector. In particular, they suggest the following as "missing elements to accelerate the development of the sector":

- "Making the best use of European money to encourage the emergence of European champions in wave energy through a PCP approach, the Europe Wave project,
- Filling gaps in funding to reach the commercial stage and investment fund for ocean energy and an Insurance guarantee fund,
- Gathering knowledge on environmental impacts through monitoring calls."

EU added value

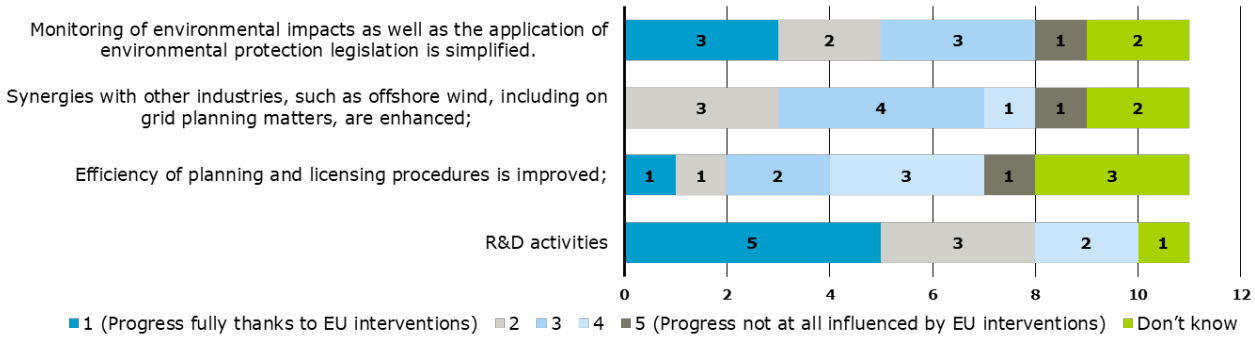
The majority of the respondents from non-coordinated answers (9 out of 11) believe that the EU intervention in support of ocean energy has (strong) additional value compared to what could have been expected from private initiatives and investments, and Member States acting at national/regional levels.

Evaluation of EU added value of the EU intervention in terms of increasing the uptake of ocean energy (N=11)



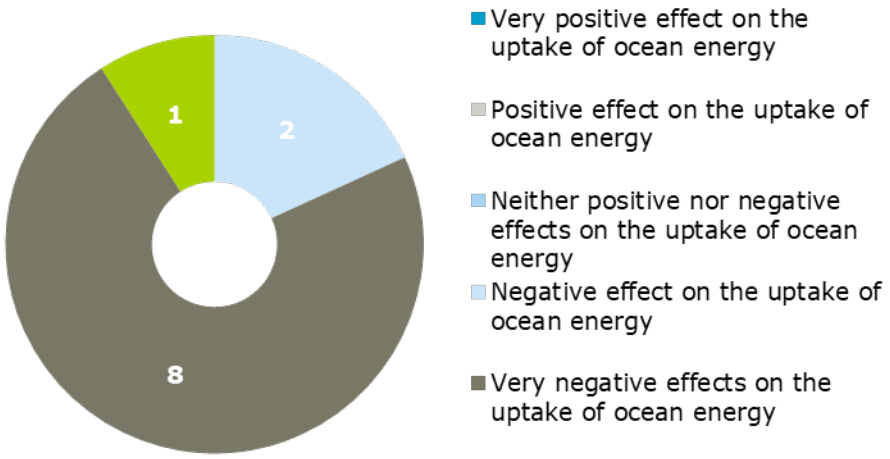
In particular, the EU support has been crucial for the consolidation of R&D activities (according to 8 out of 11 respondents) and for the improvement of the monitoring of environmental impacts and simplification of the application of environmental protection legislation (for 5 out of 11 respondents). When asked to provide further explanations on this answer, three respondents point out that the EU support, and especially research funding, has been critical for the progress of ocean energy technologies. The same can be said for the improvement of the understanding of environmental impacts, according to one stakeholder, although difficulties are encountered in ensuring the uptake of this results by policymakers. One stakeholder indicates that the exclusion of other blue economy sectors such as fisheries from the discussion relating to ocean energy, which has generated a certain lack of trust in this sector from their side. This stakeholder also highlights that knowledge of the environmental impacts of ocean energy should be further investigated, including through inclusive consultation activities with all relevant stakeholders. Another respondent instead highlights that while EU support has had a clear positive impact on ocean energy, stronger coordination with Member States is now needed to move forward.

Assessment of the contribution of the EU intervention on specific objectives, compared to what could have been expected from private or national initiatives and investments (N=11)



The majority of these respondents believe that the cessation of EU support for ocean energy would have very negative (8 out of 11) or negative (2 out of 11) effects on the uptake for ocean energy.

Assessment of the likely consequences of the cessation of the EU intervention (N=11)



In line with the above, the responses from the group of coordinated answers all indicate that the EU intervention in favour of ocean energy brought strong additional value, in particular in terms of the consolidation of R&D activities and the monitoring of environmental impacts. In their view, "beyond R&D", the existence of EU-wide calls "ensured the emergence of European leaders" in ocean energy technology and avoided duplications of calls. The "European environmental monitoring calls" helped to increase developers' knowledge of the sector and accelerated deployments. In addition to this, in general terms, the "EU seal of approval" for the technology helped to attract private funding. Also in their case, there is a widespread agreement that the cessation of EU's intervention would have very negative effects on the uptake of ocean energy.

Additional inputs

Two position papers were received in the course of this study. One was uploaded in response to the publication of the evaluation roadmap, by the industry association Ocean Energy Europe, and another one was uploaded in the course of the public consultation, by the technology developer Corpower. The content of these position papers is summarised in the below.

Position paper | Offshore Renewables Strategy Ocean energy – the next European Industry – Ocean Energy Europe

The position paper uploaded by Ocean Energy Europe describes the potential for future deployment of ocean energy, as well as presents the benefits of this deployment for Europe e.g. in terms of job creation, decarbonisation as well as leadership potential. The paper welcomes the publishing of an Offshore Strategy including ambitious long-term objectives for the sector, that could increase confidence in the sector from private investors. The paper also highlights that national revenue support mechanisms, blended EU financial instruments, an EU Insurance and Guarantee Fund, further support for ocean energy from the EIB and the launch of international partnerships with third countries could help the sector move forward. In their views, for this to happen it will be necessary to streamline project development and to enable large scale deployments in Europe.

Position paper | The role of Wave Energy – Corpower ocean

The position paper uploaded by Corpower ocean presents a summary of the role the company sees for wave energy in the future electricity markets, and the value offered for electricity producers and

electricity system owners. The paper highlights that wave energy is expected to have a "higher average value compared to wind and solar in future electricity markets", that the demonstration of wave technology pilot arrays is expected to make the technology bankable by 2024. The achievement of the bankability milestone will unlock significant investments into wave energy in their views, and this will enable the installation of 600 MW of wave energy capacity by 2030.

Appendix 4 – Stakeholder consultation synopsis report

Stakeholder consultation synopsis report

Overview of stakeholder consultation strategies

The overarching aim of the stakeholder consultation is to gather views, insights and information on the progress made by the ocean energy sector since the publication of the Ocean Energy Communication, including by considering the developments in the wider EU policies and instruments affecting and supporting ocean energy adopted since then.

The table below presents an overview of the key stakeholders and the consultation method utilised to reach them.

Stakeholder	Targeted interviews	Public consultation
European Institutions and bodies	X	X
International organisations	X	X
Member State Institutions and bodies	X	X
Industry representatives	X	X
Cluster organisations	X	X
Finance/Insurance/Investment stakeholders	X	X
Technology developers	X	X
Utility companies	X	X
Supply chain services providers	X	X
Research organisations	X	X
NGOs		X
Citizens/General Public		X

Public consultation

The aim of the public consultation was to ensure transparency in the evaluation process by involving the general public, in a way that is complementary to the targeted consultation activities.

Methodology and tools used to disseminate and process data

The public consultation questionnaire was finalised and approved by the Commission on 13th of July 2020. It was launched on 27th August 2020 and remained open for responses until 10th December 2020. The following dissemination strategies to advertise the launch of the Public Consultation on the EU Survey Portal were implemented:

- Publication on DG MAREs website;
- Dissemination and reminders through social media accounts[242];
- Dissemination and reminders through targeted emails;
- Snowballing with the support of key stakeholders[243];

242 DG MARE's twitter account: https://twitter.com/eu_mare

243 Ocean Energy Europe, ETIP Ocean.

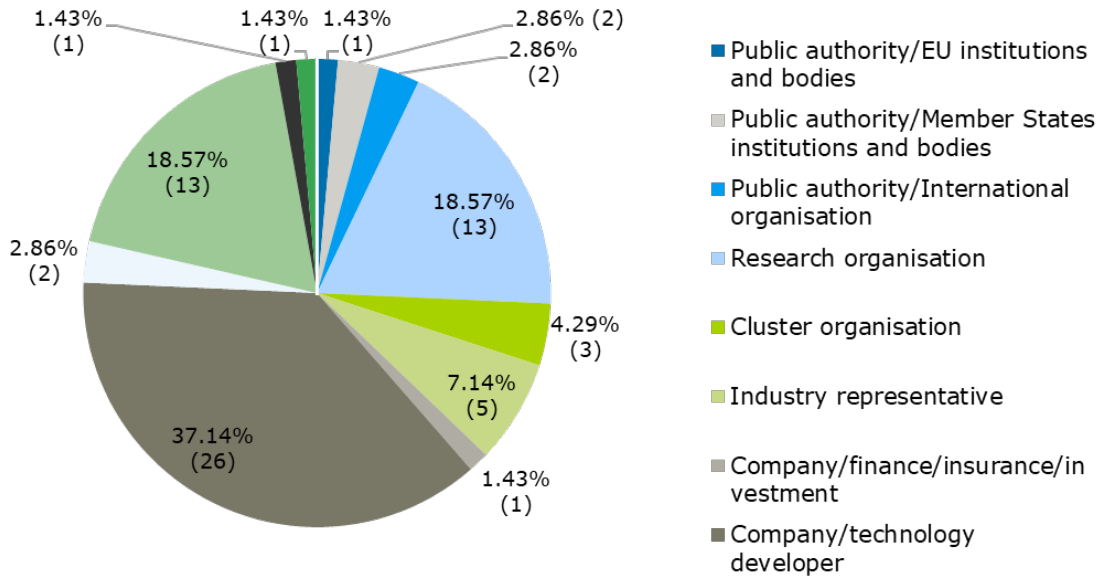
Our methodology for the analysis of the public consultation results combined **quantitative analysis** of closed-ended questions with **qualitative analysis** of responses to open-ended questions and position papers submitted using Excel. Prior to this, data was checked for errors, duplicates, and organised campaigns, and appropriate measures were taken to reduce bias – if any – introduced by these.

Stakeholders

A total of **71** respondents participated to the public consultation. Of these, one response was not taken into account as it came from a member of the project team, therefore the total number of responses analysed is **70**. Two stakeholders that were consulted in the course of the targeted interviews also replied to the public consultation (namely, one technology developer and one representative of the European Commission), and their responses are taken into account in the analysis below. All the responses received were complete.

Responses came from **16** different countries, of which **12** from within the EU-27. France is the most represented country among respondents, followed by Italy, Ireland and the United Kingdom. Most of the respondents identified themselves as ocean energy technology developers, Research organisations or EU citizens.

Number and percentage of respondents by stakeholder type



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another one was uploaded in the course of the public consultation, by the technology developer Corpower. The content of these position papers is summarised in the last section below.

Key results per evaluation criterion

Profiling questions

The majority of the respondents claimed to be 'very familiar' or 'more or less' familiar with the Blue Energy Communication (63) and the Ocean Energy Strategic Roadmap (59), while only a small portion of the respondents not aware of their existence (respectively, 7 and 11 respondents).

Following the profiling questions, respondents were split into groups based on those that wanted to provide their 'View on the sector of ocean energy' and those who wanted to provide a 'Detailed view on the Blue Energy Communication and the Roadmap'. Most of the respondents (**41**) belong to the first group, and their replies to the general questions are presented below. The replies of the remaining group of respondents (**29**) are presented further below under each evaluation criterion and correspond to the views of technology developers and research organisations. The moderate amount of detailed responses receive needs to be taken in due consideration when reading through the answers per evaluation criterion.

During data cleaning it was found that **18** out of these 29 responses correspond to "coordinated answers" according to the Better Regulations Toolbox[244] and the decision was made to segregate the data and conduct a separate analysis so to not skew the results. These answers were segregated from the main dataset and the main differences will be highlighted during the analysis.

General responses

Of the respondents providing general views on ocean energy, most of them considered themselves to be very familiar (26) or more or less familiar (15) with the technology.

The large majority of the stakeholders who completed this part of the PC believe that the ocean energy sector has a strong potential for increasing the share of renewable energy in the EU. Moreover, they also agree that the sector has an overall positive environmental impact, and that it has a positive impact on climate change. In general, they all agree that ocean energy should be deployed more widely (38).

When providing additional explanation on their feedback, the stakeholders highlighted that ocean energy should be further developed as part of the EU energy mix because it is a stable, low-impact, predictable and reliable form of energy that can play an important part in complementing solar and wind energy and can work synergistically with them. in this context, the further development of this technology is key for the EU to reach its climate and energy objectives, as well it can play an important role in job creation. For the further uptake to take place, the respondents mention that strong support is needed, together with de-risking actions and further proofs of concepts, to enable a commercial deployment of these technologies. The importance to further investigate the environmental impacts of the technology is also identified. Single stakeholders also highlight that ocean energy could be further developed in specific areas in Europe (e.g. Portugal) as well as that technologies developed outside of Europe (e.g. Canada) should be taken into consideration.

[244] Better Regulation Tool #54, page 49. Available at: https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-54_en_0.pdf

Relevance

A part of the stakeholders (8 out of 11) agree that the objectives of the Communication and Roadmap were appropriate to address the bottlenecks that hampered the uptake of ocean energy at the time of their issuance, and that they are still relevant today. In particular, the consolidation of R&D activities to enable cost reduction was key in helping the sector according to a part of them (8). Of the other objectives inscribed in the Communication, enhancing the synergies with other industries such as offshore wind, as well as assisting with monitoring of environmental impacts, would still be relevant to address the bottlenecks of the sector today according to a limited part of the stakeholders (6). 3 out of 11 stakeholders also believe that additional objectives would play a major role in addressing the bottleneck of the sector today. These stakeholders suggest that the focus should now be placed on establishing revenue support and on reducing risks to enable larger-scale deployments to demonstrate the technologies on a sufficient scale. To this end, one stakeholder suggests that it will be crucial to reduce costs related to operation, maintenance and grid-connection of offshore energy technologies, including potentially by exploiting synergies with one or more technologies i.e. by sharing common infrastructure. In addition to this, two stakeholders remark that more should be done to make sure the further development of ocean energy does not harm marine resources and the other economic sectors that depend on these. In their views, the environmental and social impacts of ocean energy should further be investigated, and the European Commission should provide further guidance on how to monitor and gather environmental data under the EIA Directive.

The respondents belonging to the group of coordinated answers strongly agree that the objectives of the Communication and the Roadmap were appropriate for addressing the bottlenecks that hampered the uptake of ocean energy in 2014, and that these remain relevant today. In particular, the consolidation of R&D activities to enable cost reduction was key in helping the sector. In light of the progress shown by the sector, in particular by tidal energy, they suggest that ocean energy technologies are now "ready for larger-scale deployment", and that the European Commission should now focus on engaging with Member States to grant revenue support for these technologies, as well as to enable access to sea required for this type of deployment. They mention that these objectives are also reflected in the recently published Offshore Renewable Energy Strategy, In particular the "key action" on coordinating with national governments to deliver 100MW with ocean energy by 2025.

Effectiveness

There is uncertainty with regards to the effectiveness of the Communication. The views regarding the achievement of the four operational objectives of the Communication are quite divergent among the stakeholders who replied to these questions (11), with a part of the stakeholders being convinced that the objectives on consolidating R&D activities and on assisting with monitoring of environmental impacts are close to being achieved (respectively, 5 and 3 stakeholders), and others affirming they have not been achieved at all, or at least to a lesser extent. Limited progress on the achievement of on improving efficiency of planning and licensing procedures and on enhancing synergies with other industries is registered by the stakeholders (with progress being mostly rated as 3 or 4 on a scale where 1 is 'fully achieved' and 5 is 'not achieved at all'). Notably, none of the stakeholders consider that any of the objectives have been fully achieved, and a part of them affirms not knowing whether these objectives have been achieved at all (from 1 to 4 stakeholders, depending on the objective, with the objective on improving efficiency of planning and licensing being the one where the larger uncertainty exists).

The same scattered picture is represented in the replies concerning some specific aspects of the objectives of the Communication. Close to half of the stakeholders believe that improvements have taken place in terms of stakeholder collaboration, technological convergence, integration of offshore

renewables into the energy system and EU-wide standardised testing. Partial improvements have been registered according to a part of the stakeholders on the establishment of a common understanding of administrative challenges faced by ocean energy technologies, on the increased awareness of investors on the opportunities offered by the sector, on the availability of relevant baseline of environmental data, on the decrease of the resources needed for EIAs and on the reduction of risks for investors. By contrast, improvements on the licensing procedures and lead time lengths have failed to materialise according to a part of the stakeholders. In this case again, a varying number of stakeholders affirm not knowing whether the specific objectives have been achieved, with the largest degree of uncertainty being registered on the objective regarding the decrease of the administrative costs compared to total project costs.

According to the respondents belonging to the group of coordinated answers, progress has been made primarily on the consolidation of R&D activities and on the monitoring of environmental impacts and application of environmental protection legislation, although none is considered as fully achieved. Moderate and limited progress are respectively reported on the improvement of synergies with other industries and on the improvement of the efficiency of planning and licensing procedures.

With regards to the specific objectives, these respondents indicate that the objective on stakeholder collaboration has been fully achieved, followed, in terms of progress, by the objective on technology convergence, integration of offshore renewables, the decrease of resources for EIAs, EU-wide testing and the reduction of risks for investors. In this case again, the stakeholders affirm not knowing whether proportion of administrative costs compared to total project costs decreased at all.

Efficiency

No questions pertaining to the criterion of efficiency were asked in the public consultation.

Coherence

There is little knowledge about the coherence of the Communication and Roadmap with the wider EU policy framework, with a number of stakeholders (up to 4) affirming they do not know whether these instruments are coherent with the other policies listed. Overall, it appears that the objectives of these initiatives are particularly in line with the Blue Growth Strategy and EU renewable energy policy, followed by the EU research and innovation policies and support. While according to a part of the stakeholders there is a certain level of coherence between the Communication and Roadmap and regional policies, moderate to little coherence seems to exist between the objectives of the Communication and Roadmap and the national policies of EU Member States.

According to one stakeholder this is because they perceive more directly the potential benefits of the development of the sector, including in terms of employment.

The stakeholders belonging to the group of coordinated answers affirm that the Communication and Roadmap are coherent with, and well complement, all the policies mentioned above, and only partially coherent with Member States policies. This is because, in their views the further development of ocean energy contributes to the decarbonisation of the energy system, while at the same time ensuring an economically and socially just transition.

EU added value

Overall, the EU intervention in support for ocean energy has an EU added value that justifies its existence and continuation. In fact, the majority of the respondents believed that the EU intervention has added to the support provided by private and national initiatives and investments. In particular, the EU support has been crucial for the consolidation of R&D activities and for the

improvement of the monitoring of environmental impacts and simplification of the application of environmental protection legislation. The majority of these respondents believe that the cessation of EU support for ocean energy would have negative or very negative effects on the uptake for ocean energy.

In line with the above, the responses from the group of coordinated answers all indicate that the EU intervention in favour of ocean energy brough strong additional value, in particular in terms of the consolidation of R&D activities and the monitoring of environmental impacts. In their view, "beyond R&D", the existence of EU-wide calls "ensured the emergence of European leaders" in ocean energy technology and avoided duplications of calls. The "European environmental monitoring calls" helped to increase developers' knowledge of the sector and accelerated deployments. In addition to this, in general terms, the "EU seal of approval" for the technology helped to attract private funding. Also in their case, there is a widespread agreement that the cessation of EU's intervention would have very negative effects on the uptake of ocean energy.

Recommendations

The respondents were also asked for additional feedback on the existing bottlenecks for the sector and recommendations to overcome them.

In terms of current bottlenecks of the sector, the following were identified by the stakeholders, with permitting and financing issues having the agreement of most stakeholders:

- Finance: the lack of revenue support at national level, the lack of an instrument to cover and mutualise the technological risks of projects and provide insurance and guarantee for them (e.g. such as EU Insurance and Guarantee Fund), the limited number of calls and grants dedicated to ocean energy;
- Permitting: the length of consenting processes and procedures, the understanding of environmental impacts;
- The availability of grid connection;
- Closer cooperation between academia and industry;
- Limited involvement of stakeholders from other blue economy sectors in the decision-making;

One stakeholder highlighted that the EU has partial traction on these topics, as some of them are shared competences with the Member States.

The stakeholders belonging to the group that provided coordinated answers identified two main bottlenecks preventing the further evolution of the sector:

- Finance: "The lack of revenue support at national level that prevents larger projects to attract private finance and reach financial close", the risks for the investors are still too high and there are no commercial insurance products covering "innovative offshore technology", the design and number of calls issued under programmes such as Horizon Europe, Innovation Fund and InnovFin EDP are insufficient to finance enough projects to reach the 100 MW target for ocean energy as set in the Offshore Renewable Energy Strategy;
- Permitting: The cumbersome permitting procedures, that make access to the sea for ocean energy technologies "very slow" and are caused by a limited understanding of the technologies and their potential by national authorities.

These stakeholders are confident that both challenges can be addressed by the Offshore Renewable Energy Strategy, called by them "the successor of the Roadmap", with the EU playing a strong coordination role with Member States to ensure the achievement of the strategy's targets for ocean energy.

Position paper | Offshore Renewables Strategy Ocean energy – the next European Industry – Ocean Energy Europe

The position paper uploaded by Ocean Energy Europe describes the potential for future deployment of ocean energy, as well as presents the benefits of this deployment for Europe e.g. in terms of job creation, decarbonisation as well as leadership potential. The paper welcomes the publishing of an Offshore Strategy including ambitious long-term objectives for the sector, that could increase confidence in the sector from private investors. The paper also highlights that national revenue support mechanisms, blended EU financial instruments, an EU Insurance and Guarantee Fund, further support for ocean energy from the EIB and the launch of international partnerships with third countries could help the sector move forward. In their views, for this to happen it will be necessary to streamline project development and to enable large scale deployments in Europe.

Position paper | The role of Wave Energy – Corpower ocean

The position paper uploaded by Corpower ocean presents a summary of the role the company sees for wave energy in the future electricity markets, and the value offered for electricity producers and electricity system owners. The paper highlights that wave energy is expected to have a "higher average value compared to wind and solar in future electricity markets", that the demonstration of wave technology pilot arrays is expected to make the technology bankable by 2024. The achievement of the bankability milestone will unlock significant investments into wave energy in their views, and this will enable the installation of 600 MW of wave energy capacity by 2030.

Targeted consultations

The targeted consultations feed into several aspects of this study. Primarily, they are a source of information to feed into the analysis. However, selected interviews will also be conducted where considered relevant for other aspects such as complex analytical problems, definition of the baseline or for forming/testing of conclusions and recommendations.

Methodology and tools used to disseminate and process data

The interviews served a dual purpose:

- To gather stakeholder specific qualitative evidence in relation to the evaluation questions for which qualitative data was judged to be an important source;
- To complement the other tasks of this study and fill data gaps emerging from other consultation tools.

The targeted interviews were semi-structured, following interview guides designed for the different stakeholder categories during the inception stage. Detailed interview notes were written for each interview, which were subsequently analysed using the Qualitative Data Analysis (QDA) software NVivo.

Stakeholders

A total of **25** interviews were conducted at the EU level, with European Commission staff (2), International Organisations (1), Member States and Regional institutions and bodies (7), industry representatives and cluster organisations (2), representatives of the finance and insurance sector (2), technology developers (7), supply chain providers and utility companies (1), research organisations (3).

Key results per evaluation question

Relevance

There is a widespread agreement among all different stakeholder groups that the objectives and scope of the Communication and Roadmap (the latter in particular) were aligned with the needs of the ocean energy sector at the time of its publication. Although none of the stakeholders were able to refer to the specific objectives of the Communication or the Roadmap, the majority of them asserted that the publication of a cohesive document by the European Union in favour of the development of the ocean energy sector was instrumental to create momentum around ocean energy, as well as to set a common direction and priorities and as such to give confidence to the investors, which was needed at the time. This was particularly true in the years immediately following their adoption. The documents provided visibility to the industry, as well as clear recommendations and guidance based on the needs expressed by the sector at the time. As such, they contained the "right elements" to guide the sector in identifying the workstreams where its resources should focus on. Some of the representatives of national and regional agencies pointed out that these documents were particularly helpful for the development of their own strategies with regards to ocean energy, or as elements to build 'the business case' for ocean energy towards key stakeholders (e.g. national authorities).

This notwithstanding, a part of the stakeholders highlighted that the Communication and the Roadmap were not sufficient in and of themselves, but that they were only ever intended to be "a part of the solution" for ocean energy, in substance "strategy documents" that would need to be subsequently complemented by other tools, both EU's and Member States' (e.g. financing and other support instruments).

A part of the stakeholders identified the following aspects lacking in the Communication and Roadmap:

- Lack of a clear link with national interests and polices, as well as of an approach to facilitate or secure the engagement of and coordination among the European Member States and regions that are active in ocean energy;
- The limited consideration of some aspects, including the needs of OTEC and salinity gradient technologies, the need to support the business case for ocean energy (e.g. by highlighting its benefits in terms of predictability, the advantages of localised energy production), the importance of the sector for different regions in EU (e.g. including the Mediterranean);
- Lack of dedicated budget or link to a funding instrument for the implementation of the actions set in the Communication and the Roadmap.

While a part of the stakeholders maintain that the sector still faces some of the challenges identified in 2014 (e.g. risk, need to demonstrate projects and to cross the valley of death), the majority of the stakeholders involved pointed out that the EU policy in support of the uptake of ocean energy could benefit from a revision or adaptation, in light of the developments that took place in the sector and in the context in which this operates. These developments include: the progress made by ocean energy technologies (in particular tidal energy), the advancements in other renewable energy sources outcompeting ocean energy, the reduction in the support provided by the private sector and Member States, as well as wider developments such as Brexit and the outbreak of COVID-19.

In general, while the stakeholders consulted agree that there are different policy instruments at the EU level that can indirectly support the uptake of ocean energy (e.g. renewable energy policy, climate policy, maritime policy, R&I policy), most of them assert that due to its early stage of development, ocean energy necessitates targeted support if it is to play a role in the overall European energy mix. It has been reiterated several times that it will be extremely difficult for

ocean energy to progress if it needs to compete for support with other more established sources of renewable energy e.g. offshore wind.

Effectiveness

Only a part of the stakeholders consulted was able to provide feedback on the progress made in the implementation of the activities inscribed in the Communication, and this recalls the limited knowledge of stakeholders in general when it comes to the details of the Communication and Roadmap. In the view of these stakeholders, the first phase of activities included in the Communication took place, as the Forum was organised, and it produced a Roadmap. They were not able to provide feedback on the second phase. With regards to the actions inscribed in the Roadmap, in their view only actions 1, 2, 4 took place to a certain extent.

In terms of the objectives of the Communication, in the view of the stakeholders consulted the coordination of the players in the sector has been enhanced substantially, and in general it appears that the sector is more mature, informed and structured than it was in 2014.

With regards to the uptake of ocean energy, part of the stakeholders indicates that while the sector is not where it was expected to be at this time, considerable progress has been made in the development of these technologies. This can be linked to the fact that funding for research and development has significantly increased since 2014, and that in general access to funding has slightly improved, although not for all times of technologies. This notwithstanding, while some believe that this has been "reasonably good", "sufficient" or "adequate", at least at the EU level, other maintain that the funding has not been sufficient nor appropriate, and they assert that increased funding would be needed, particularly at the Member State level.

Little information has been provided with regards to the improvement of administrative practices and environmental monitoring.

According to the stakeholders consulted, several factors have influenced the effectiveness of the EU intervention in support of ocean energy, including that of the Communication and the Roadmap, both positively and negatively.

Among the positive factors influencing effectiveness, the stakeholders consulted have mentioned:

- Increased societal awareness on climate change and increased interest in renewable energies;
- The rapid development of offshore wind, sharing some characteristics and challenges with ocean energy and demonstrating that such marine technologies can rapidly improve performance beyond expectations with the appropriate level of support;
- Increased interest of the oil and gas sector in utilising ocean energy devices for offshore power production.

According to the stakeholders consulted, the abovementioned factors have contributed to increasing the confidence and interest of private and public sector stakeholders in ocean energy to a certain extent.

Among the factors influencing negatively the effectiveness of the EU intervention in favour of the uptake of ocean energy, stakeholders have mentioned:

- The limited support provided by Member States and private actors, potentially affected by factors such as high-profile failures in the industry discouraging investments, long time scale for the harnessing of the benefits of the investment, substantial previous investments in other forms of renewable energy etc.
- Other sources of energy (e.g. offshore wind, and the emerging floating offshore wind) becoming considerably cheaper and more performant, also because of the considerable funding they

previously received, and leading to a de-prioritisation of the investments in other sources of marine renewable energy;

- Inappropriate arguments used to advocate for ocean energy by industry stakeholders: different arguments should have highlighted better instead e.g. benefits to peripheral regions;
- Brexit, removing a strong actor, and investors, in ocean energy;
- COVID-19 crisis, that might cause the decrease or slowdown of funding but can also represent an opportunity, where states want to recover based on low carbon strategies.

Efficiency

While none of the stakeholders consulted were able to provide feedback with regards to the costs of implementation related to the Communication and the Roadmap, they all highlighted the importance of different EU funds in support of ocean energy. The most important for the development of the sector so far were Horizon 2020, Interreg and ESIF funds, NER 300, EMFF, InnovFin EDP.

With regards to the efficiency of the overall financial support provided so far by the EU, most of the stakeholders maintain that this was not always guaranteed, as some of the funding went to technologies that proved to be unfit for purpose. The efficiency of the funding was also affected by specific characteristics of the funding process, including the high level of competition, the time consuming and complicated application procedures, as well as the high expectations placed on project outcomes, which put excessive pressure on the technologies.

This notwithstanding, the majority of the stakeholders interviewed believe that the benefits of investing in ocean energy substantially outweigh the costs, in particular when the potential contribution of the technology to the achievement of the climate targets and the stability of the EU energy mix, as well as the potential job creation and the generation of EU added value (e.g. for export of the technology) are taken into account.

Coherence

None of the stakeholders were able to provide concrete examples of overlaps, inconsistencies or incoherence within the Communication or the Roadmap, aside for the fact that the development of OTEC and salinity gradient technologies were not granted sufficient consideration compared to the objectives set.

The opinions with regards to the coherence of the Communication and Roadmap with the wider EU policy framework are mixed.

A part of the stakeholders asserts that most of the current EU policies adequately complement each other and seem to "move in the same direction" "broadly coherent" e.g. renewable energy targets and climate neutrality targets. These stakeholders were unable to identify policies that contradict with the development of the ocean energy sector, also positively noting the Green Deal also favours the development of this technology.

Another part of the stakeholders consulted believes that there might be a certain degree of incoherence between the EU ambition on renewables and climate neutrality on the one side, and the allocation of EU funds on the other. In this respect, they mention that substantial resources are still allocated to the fossil fuel industry or to nuclear energy, and that this could in principle be seen as being incoherent with the intentions to develop ocean energy to a certain extent.

A limited portion of stakeholders mentioned additional potential contradictions between approaches adopted in the EU policy landscape and the interventions to favour the uptake of ocean energy:

- Contradiction with EU energy modelling: the current energy models favour the inclusion of established technologies in long-term policies rather than emerging technologies, because of the difficulty to estimate the costs of energy produced by the latter;
- Contradiction with EU competition policy and technology neutrality principle: these establish that the different technologies shall compete in the market and the ones presenting lower costs will emerge, but this is often incompatible with the needs of an emerging technology such as ocean energy;
- Contradiction with the EU State Aid rules: the notification threshold for state aid to renewable energy projects is quite low and this can discourage Member States from creation of substantial support schemes for ocean energy.

Lastly, an additional possible inconsistency has been identified in the fact that the integration of ocean energy in National Renewable Energy Action Plans has not been sufficiently incentivised. Due to the perceived low level of development of the technology, the inclusion of ocean energy in the energy mix that should achieve the renewable energy targets has so far been deprioritised.

With regards to the coherence between the EU intervention and available support schemes, rather than pointing at specific contradictions, the stakeholders interviewed mentioned that the abundance of different funds that can contribute to ocean energy might be confusing for technology developers. Also, they mentioned that the application requirements differ substantially among the funding instruments, and this signals a lack of coordination among these entities.

With regards to the relationship between the EU intervention and Member State support, none of the stakeholders were able to identify specific contradictions. Nevertheless, the large majority of them indicated that there is a certain level of incoherence between the EU and National policies, indicating that these are not always aligned. Specifically, relevant Member States don't take ocean energy sufficiently into account in the development of their national renewable energy strategies, or when this is done it is not linked to concrete support actions (e.g. the establishment of market pull mechanism). By contrast, the alignment between the EU intervention and single strategies at the level of relevant regions within Member States is more prominent, although substantial differences persist in the types of support provided across regions interested in developing ocean energy.

EU added value

The large majority of the stakeholders interviewed confirmed that the Communication and the Roadmap added value at the EU level. They all agree that the intervention achieved results that could not have been achieved at a different level of intervention at all, or at least not at the same cost or with the same result. Although not stakeholders express positive views on the results achieved by the intervention, and some believe that there wouldn't been significant differences, they all agree that the situation would have been worse than it is now. They suggest that at a minimum, it was able to:

- Provide momentum for the sector and set a common direction for the actors involved;
- Increase confidence of the investors;
- Increase collaboration and organisation of the sector.

The perception of the added value of the intervention varies among stakeholders, with some affirming that the ocean energy sector would not exist in Europe at the moment, others that there would certainly be less uptake in ocean energy. Only one stakeholder from a research organisation affirmed that other instruments would have taken the place of the Communication and the Roadmap had these not been published.

All stakeholders consulted overwhelmingly believe that the withdrawal of EU support would have negative consequences on the ocean energy sector in Europe. In their views, this would demonstrate that the EU does believe in the validity of the technology, and this would have the following consequences:

- Ocean energy activities in Europe would dramatically decrease or stop, and the sector itself could completely disappear, as investors would not be interested in investing in a technology in which the EU itself is not showing confidence
- EU technology developers would either shut down or move their companies abroad and continue developing the technologies in countries with more favourable conditions can be found e.g. Canada, USA, Japan, China – but capitalising on all the investments already poured in the sector by the EU
- The withdrawal of EU support could also have negative influence on the development of the sector overall (also abroad) given the importance they have also abroad "everybody is watching what the EU is doing" – the EU leads most international discussions on OCEN

Most of the stakeholders agree that this would be a lost opportunity for the EU, to exploit a technology with high levels of "EU content", and it would be a waste of the efforts made so far, considering the scale of the investments that have been made to date.

Recommendations

The stakeholders interviewed were also invited to provide suggestions and recommendations for the future of the EU support in the sector. Their suggestions can be summarised as follows:

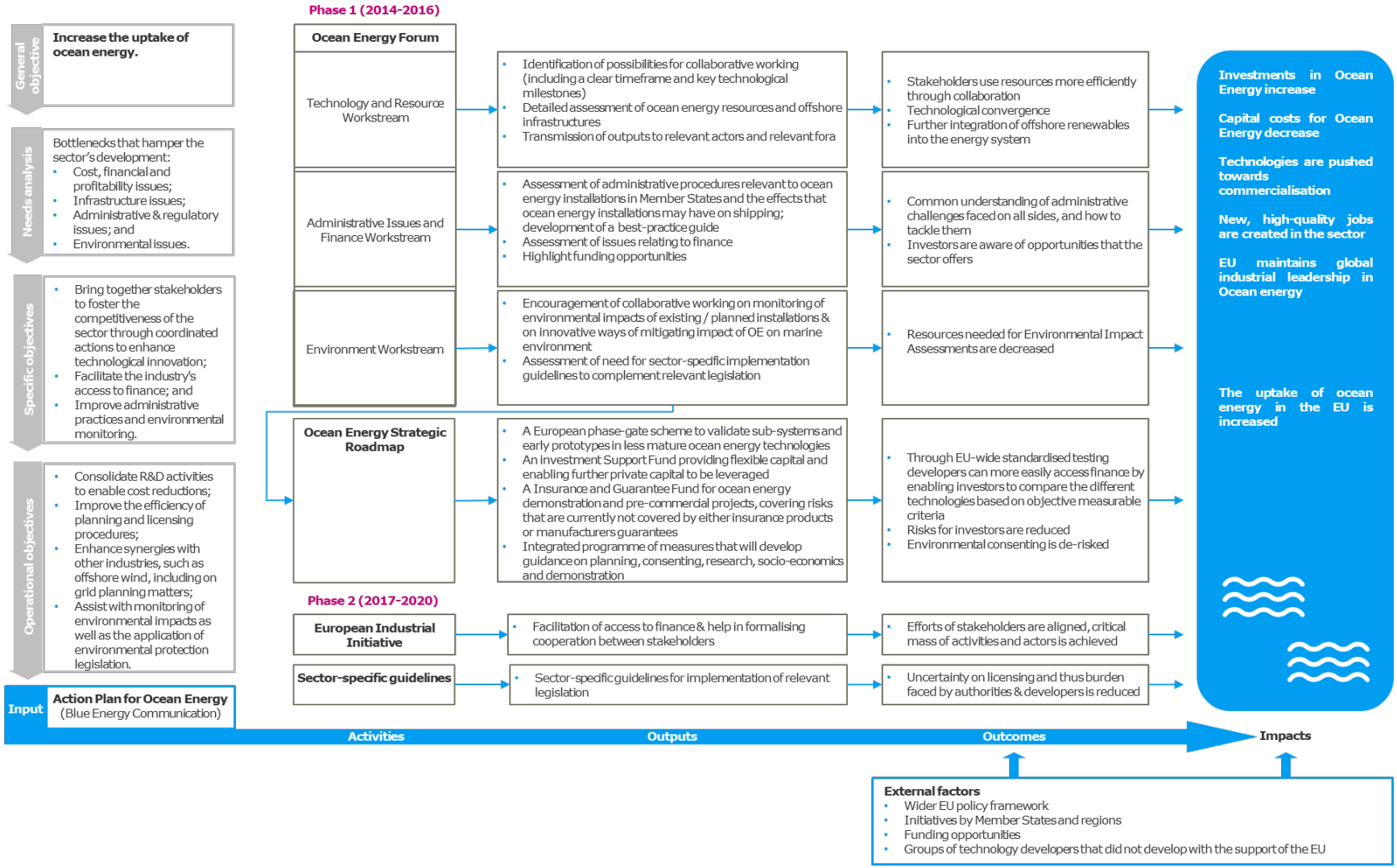
- The EU should continue to show leadership in the sector by providing political support to increase confidence in ocean energy by depicting a clear route for ocean energy technologies, including OTEC and salinity gradient;
- The EU should increase the collaboration with relevant Member States to stimulate their intervention (e.g. including in terms of revenue support) and involvement in the decision-making process regarding the sector, including by further highlighting the benefits of investing in the sector;
- The EU and Member States should improve efforts to help ocean energy technologies 'cross the valley of death', including by facilitating the achievement of an appropriate balance between market push and market pull mechanisms, and by fostering the de-risking of the technology.

Privacy

Precautions to secure the privacy of respondents were taken. For both, the PC and the targeted consultation the columns of the datasheets containing personal information (e.g. names, organisational names, and email addresses) were used for duplicate checks, but then deleted from the datasets on our system. Moreover, access to the folders containing the PC datasets were restricted to the analysts who analysed them. Whilst on our own system, the datasets were stored in encrypted form, safeguarding them from access by unauthorised persons. Once this assignment is over, the datasets will be deleted from our system in accordance with GDPR rules. Thus, we take rigorous steps to ensure the privacy of participants.

Appendix 5 – Intervention logic

Figure 6.1 Intervention Logic



Appendix 6 – Overview of Member States' support policies

Overview of the main national and regional support policies for ocean energy

This document provides and overview of the main national and regional support policies established by Member States, and regions within these, that contribute to the development of ocean energy. Where a sub-chapter on regional support is not available, this is because it was not possible to identify sufficient evidence on this type of support in the context of the study.

France

National support policies

The general strategy for renewable energies in France is laid out in the Energy Act (Loi de Transition Energétique pour la Croissance Verte) from 2015, which sets the target producing of 40% of the electricity with renewable energy technologies by 2030. While this law sets out targets for installed capacities for electricity productions from various renewable energy technologies, there is no specific objective towards the installed capacity of ocean energy technologies. [245]

Support policies for ocean energy are managed under the "Investment for the Future" programme, which is coordinated by the Ministry for the Ecological and Solidary Transition. Grants and loans are provided by the Public Investment Bank (BPI), the Environment and Energy Agency (ADEME), or the National Research Agency (ANR), depending on the TLR. In 2019, ADEME funded projects with an estimated amount of 68 million EUR, and the ANR spent 4 million EUR on ocean energy project. [246]

For commercial farms, the cost of the export cable is to be supported by the French Transmission System Operator, which also takes over more legal and financial responsibilities with respect to the availability of electricity exportation.

Two tidal energy projects have been provided a feed-in tariff of 173 EUR/MWh in the past. Both projects are on hold, showing that the provided support was insufficient for the commercial production of tidal energy.

Since 2017, a simplified consenting process is effective. Ocean Energy developers must provide an Environmental Impact Assessment, apply for a license to occupy territorial waters and an authorization from the Ministry of Energy (for projects >50MW)[247].

Regional support for ocean energy

Regional actors are also active in the support of Ocean Energy. The region of Brittany for instance channels European funds in favor of maritime renewable energy production and provides port and testing facility infrastructure.[248] A notable project is the tidal range energy power plant in the Rance

[245] See: https://www.legifrance.gouv.fr/affichLoiPublie.do?idDocument=JORFDOLE000029310724&type=general&legislature=14

[246] OES (2019): "Annual Report"

[247] See: https://tethys.pnnl.gov/regulatory-frameworks-marine-renewable-energy#France

[248] See: https://bretagneoceanpower.fr/wp-content/uploads/2019/10/plaquette-emr-gb-juin-2019-bd.pdf

estuary (Brittany)[249] which operates since 1966. It is currently the world's second largest tidal energy plant with a power capacity of 240 MW.

The region of Pays de la Loire has a very active ocean energy ecosystem, that focuses on tidal energy development. It is organized by the Solutions&Co[250], the economic development agency for the Pays de la Loire region.

Both regions are partners in the Ocean Energy ERA-NET Cofund.

Special interest in ocean energy lies among local authorities in the French overseas territories, which could be less constrained than onshore renewable energies such as solar in terms of land requirements. Energy self-sufficiency has become a major concern, since energy production is very costly on remote island locations.

Ireland

National support policies

In 2019, Ireland launched an ambitious Climate Action Plan, which states to increase the share of renewable energies of the electricity production to 70% by 2030, including a planned increase of offshore renewables from 25 MW to 3.5 GW by 2030. While the actions of the Climate Action Plan heavily focus on offshore wind energy production, the three actions (Action 25, 26 and 27) covering offshore renewable energies will also benefit tidal and wave energy development.[251]

Since 2014, Ireland also has a Offshore Renewable Energy Development Plan (OREDP), which identifies Ireland as the most fruitful coast in Europe for harnessing offshore renewable energies. The report predicts an installed capacity of wave and tidal energy being between 75 and 1500 GW by 2030.[252]

Under the OREP, Ocean Energy Ireland was founded. It serves as a platform for ocean energy technology developers and most importantly provides free and accessible data on wave, tidal and environmental impact studies.

The main framework for supporting ocean energy projects is provided by the Renewable Electricity Support Scheme (RESS). It is the main policy instrument in Ireland to support renewable energies – including ocean energy – with funding opportunities.

Besides, public funding programmes include the Sustainable Energy Authority of Ireland's Prototype Development Fund (65 projects subsidized since 2009, 15 new projects in 2015) and the OCEANERA-NET scheme, an innovative component of the European Union's Framework Programme which supports cooperation of national/regional research funding programmes.[253]

The Science Foundation Ireland (SFI) Research Centre for energy, climate and marine (MaREI), coordinated by the Environmental Research Institute (ERI) at University College Cork, coordinates 12 partner institutes with over 200 researchers. It delivers high quality research on maritime energy

[249] See: https://tethys.pnnl.gov/project-sites/la-rance-tidal-barrage

[250] See: https://www.solutions-developpement-paysdelaloire.fr/

[251] OES (2019): "Annual Report"

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

[253] OES (2019): "Annual Report"

technologies, including cross-cutting topics such as societal and economic impact of ocean energy.[254]

Regional support for ocean energy

Information on activities of regional authorities in supporting ocean energy are scarce, despite a number of INTERREG funded projects in Ireland.[255]

Portugal

National support policies

In Portugal, the Ministry of the Sea is responsible for defining policies encouraging the development of new activities in the sea that maximize the use of its resources. It is tasked with implementing the Industrial Strategy for Ocean Renewable Energies (EI-ERO).[256] While the strategy focuses on offshore wind power development, it recognizes possible synergies between offshore wind development and other ocean energy technologies (such as using the same sea cables etc.).

Portugal installed in 2014 a fixed feed-in tariff scheme for renewable ocean energy technologies, which includes (and focuses on) off-shore wind energy.[257]

Portugal funds R&D and technology demonstration projects under the Blue Fund ("Fundo Azure"), which provides direct funds but also facilitates private investments.[258]

Spain

National support policies

The Energy and Climate National Integrated Plan 2021-2030 of Spain sets ambitious targets for ocean energy of reaching 25 MW of installed capacity for 2025 and 50 MW for 2030.[259] The plan has been developed by the Ministry for the Ecological Transition, who is also in charge of permitting new ocean energy projects.

Spain does not provide specific support policies for ocean energy projects. A number of projects in Spain have been funded by European programmes such as Horizon2020, the ERDF or other sources such as grants from EASME or DG GROW.[260]

Regional support for ocean energy

The Basque Government approved in 2016 the Basque Marine Energy Plan for 2030, which included a specific initiative to speed up technology and commercial development for marine energy and set a target of 60 MW by 2030.[261]

[254] O ES (2019): "Annual Report"

[255] INTERREG programmes are often managed by regional and local authorities

[256] See: https://dre.pt/web/guest/pesquisa/-/search/114248654/details/maximized

[257] See: https://ec.europa.eu/commission/presscorner/detail/en/IP_15_4836

[258] See: https://www.dgpm.mm.gov.pt/fundo-azul

[259] See: https://www.miteco.gob.es/es/cambio-climatico/participacion-publica/pniec_2021-2030_borradoractualizado_tcm30-506491.pdf

[260] O ES (2019): "Annual Report"

[261] See: https://www.eve.eus/Actuaciones/Marina.aspx

Due to its geographic conditions, the coast of the Basque Country is well suited for harnessing wave energy. Aiming to find synergies with the local shipbuilding industry (which continues to be under economic pressure due to international competition), Wave Energy Basque Country forms a strong industry cluster which connects and coordinates the numerous actors in the sector.

Italy

National support policies

The National Research Council of Italy (Consiglio Nazionale delle Ricerche – CNR) leads the "Blue Italian Growth" (BIG) cluster. The BIG Action Plan includes encouraging the uptake and development of innovative ocean energy technology but does not specify any concrete targets.[262]

Italy does provide a fixed feed-in tariff scheme for renewable energy technologies, the latest update of it however excludes ocean energy and focuses on more mature renewable energy technologies.[263] Up to 2017, also ocean energy plants with power outputs of >60kW could benefit from fixed feed-in tariffs.

There are no specific funding instruments for R&D activities of ocean energy projects. Developers rely on generic funds that aim at supporting innovation, regional development, blue economy or renewable energies.

The Netherlands

National support policies

The Netherlands does not have a national strategy for ocean energy and nor are there specific targets. The ocean energy strategy is part of the national target of 16% renewables in 2023 and a 49% overall CO2 reduction in 2030[264].

The marine spatial planning process in the country is focused on offshore wind, and special areas have been appointed for this. No commercial offshore ocean energy projects are planned yet[265].

The Netherlands provides a generic national subsidy scheme (SDE) to stimulate the uptake of renewable energy, that ocean energy technologies can also benefit from. In 2020, the maximum subsidy for renewables has been reduced to EUR0,13/kWh[266].

In addition this feed-in tariff, there are generic funding programmes for all relevant types of renewable energy that are also available for ocean energy. These programmes have a tender system in which projects compete with each other and have a general condition that a cost reduction must be achieved by innovation[267].

[262] See: http://www.clusterbig.it/piano-dazione-2/

[263] See: https://cdn.qualenergia.it/wp-content/uploads/2019/08/decreto-fer1-4lug2019_GU1n186_9ago2019-1.pdf

[264] OES (2019): "Annual Report"

[265] OES (2019): "Annual Report"

[266] OES (2019): "Annual Report"

[267] OES (2019): "Annual Report"

Denmark

National support policies

No national strategy for ocean energy is present in Denmark. For what concerns wave energy, the activities in Denmark continue to be driven by the Strategy for Wave Power published 6 years ago and by the Danish Wave Power Roadmap from 2015.

The EUDP (Energy Technology Development and Demonstration Program) is the main source of public funding for wave energy in Denmark, and this has funded two wave energy projects in 2019[268].

Germany

National support policies

Germany develops its renewable energy portfolio as part of the Energiewende[269] initiative, as well as specific targets and agenda set in additional legislative documents. Germany has a consolidated strategy to develop offshore wind[270], but no dedicated policy or strategy for the development of ocean energy. This notwithstanding, some ocean energy technologies are being tested and demonstrated, and Germany delivers components and parts for a number of ocean energy devices in Europe[271].

[268] OES (2019): "Annual Report"

[269] See: https://www.energiewende-global.com/en/renewable-energy

[270] See: https://www.bmwi.de/Redaktion/DE/Downloads/E/windseeg-gesetz-en.pdf?__blob=publicationFile&v=9

[271] OES (2019): "Annual Report"

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