Ocean energy and the environment:

Research and strategic actions

December 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 826033.

ETIP OCEAN

European Technology & Innovation Platform for Ocean Energy

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Review of environmental impacts and consenting processes for ocean energy

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ACKNOWLEDGEMENTS:

The authors would like to thank the following experts for reviewing parts of the report:

Olatz Ajuria, Philippe Baclet, Gary Britton, Bruce Buchanan, Jessica Campbell, Patricia Comiskey, Anne Georgelin, Paul Haddon, Lenaig Hemery, Jon Lekube Garagarza, Pieter Mathys, Sam McCloskey, Diane McDonald, Sarina Motmans, Kelly Rosie, Julius Schay, Peter Scheijgrond, Jasmine Sharp, Teresa Simas, Paul Smith, Koos Uneken and Interreg 2SEAS MET-Certified project for support

PHOTOGRAPHIC CONTENT:

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GRAPHIC DESIGN: JQ&ROS Visual Communications

COVER PHOTO: CorPower Ocean and European Marine Energy Centre
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Executive summary

This report identifies the key environmental research needs and consenting challenges that require action at an EU and national level, to facilitate the roll out of ocean energy. It analyses the latest environmental research and the current EU and national level policies and regulations regarding ocean energy. It makes environmental research, policy and regulatory recommendations and puts forward a concrete Strategic Action Plan.

Balancing perceived negative impacts with proven positive impacts

Climate change has the single largest detrimental impact on the oceans. Climate change alters the chemical, biological and physical conditions of the ocean, causing serious damage to marine ecosystems and biodiversity, as well as to their dependent social and economic systems. Threats like temperature increases, acidification and oxygen depletion all need to be mitigated and ocean energy is part of the renewable solution.

Legislation to reduce potential local impacts of renewables is necessary, although it should always be proportionate and weighted against the greater benefits of reducing emissions from fossil fuel displacement.

No evidence of ocean energy installations posing a risk to ecosystems

As ocean energy is a relatively new sector, regulators naturally have questions about the hypothetical impact that installations could have on marine animals and habitats. The main concerns are collision risk, underwater sound, electromagnetic fields and changes to habitats.

To date, there is no evidence of ocean energy installations posing a serious risk to marine ecosystems. As more machines are put in the water, more real-world observations and long-term monitoring will be needed to assess the reality of the perceived risks.

Dedicated framework needed to speed up ocean energy consenting

Cautious approaches to risk assessment hamper consenting of ocean energy projects. An analysis of consenting processes and marine spatial planning in Europe reveals that the main challenges are:

- long and burdensome consenting processes,
- requirements for extensive monitoring data, and
- the absence of dedicated legislation for ocean energy.

Several, sometimes, simple solutions could significantly improve consenting of ocean energy projects. For example, having a single point of contact would make it easier for developers to obtain guidance throughout a streamlined consenting process.

Better guidance and stronger communication essential to avoid duplication of efforts and long processes

Good communication and better sharing of information and experience among consenting authorities, developers, researchers and other stakeholders would facilitate consenting processes.

Developers are not necessarily familiar with the different assessments required by the consenting process. Guidance documents would help them complete the process more efficiently. To help consenting authorities make informed decisions, environmental research results should be clearly and effectively disseminated to them.

An Action Plan for environmental excellence and simpler consenting

Based on the analysis and recommendations above, this Action Plan proposes four actions that will improve knowledge of real environmental impacts and enhance the consenting process.

Action 1: Provide financial support for research and monitoring

Developers of innovative technologies have to focus on technology development itself. They are, thus, not able to invest in environmental programmes beyond legal requirements, unless provided financial incentives to do so. Nevertheless, environmental monitoring is essential to understand potential impacts or absence thereof in the medium term. Monitoring and reporting activities should be appropriately resourced to optimise their collective contribution to de-risking consenting and reducing the burden on individual developers. This includes mechanisms to share knowledge to maximise its transferability from one site or technology to another, while protecting developers' IP.

Action 2: Simplify and shorten consenting processes for ocean energy

A supportive regulatory framework would speed up, rationalise and de-risk the consenting of ocean energy projects. 'Adaptive Management' – a decision-making process reducing uncertainty over time via monitoring – would reduce the uncertainty of potential environmental impacts of ocean energy, without delaying projects. Making sure that ocean energy is included in marine spatial plans would immensely support its deployment and facilitate multi-uses of the sea.

Action 3: Create national single points of contact

The 'single authority' would streamline the consenting process and help coordinate the actions of other authorities and agencies. The single point of contact would provide all the necessary information on the consenting process. Guidance for performing all the assessments, provided by the single authority, would help developers complete them more efficiently. This would result in faster consenting and reduced project costs.

Action 4: Set up a platform for developers to share experience on consenting

New developers learning from others' experiences with consenting processes would help them navigate through the system more quickly. Through a dedicated platform, developers could find answers to their questions from their peers who have previously undertaken consenting, even before starting the process.

Photo: Ocean Energy Ltd

1. Environmental impacts facing the oceans

Photo: Orbital Marine Power

Oceans have an important role in regulating the climate, fostering biodiversity and providing food and energy to people. The protection of the oceans has gained a lot of attention recently, as the impacts of climate change and pollution become more and more evident.

The European Commission has taken measures to help ensure healthy and resilient seas and oceans. The European Green Deal recognises the oceans' role in mitigating climate change. Offshore renewable energy, including ocean energy, is recognised as a key maritime sector to achieve this.

1.1 The wider risk context – threat of climate change

As with every new technology development, there can be risks associated with the deployment of ocean energy devices. Any actions that have never been undertaken before can have unforeseen impacts. These risks are considered further in this section, yet they must always be balanced against the environmental benefits that ocean energy delivers – specifically the contribution to climate change mitigation.

Climate change is humanity's biggest concern, and it is up to the current generations to find solutions to mitigate it. A 2°C increase in atmospheric temperature, as is predicted, will have irreversible effects on life on Earth. Impacts can already be seen in the form of more frequent heat waves, droughts, floods and extreme weather events [1]. These events are likely to become more and more severe as the climate continues to warm. Coastal regions, water reserves and agriculture are already in danger. Climate change will have devastating impacts on the ecosystems around the world, threatening the livelihood of many communities and even whole countries [2].

[1] Communication on the European Green Deal.

The development of new renewable energy technologies is key to reducing greenhouse gas emissions. Ocean energy contributes to the decarbonisation of the energy system by replacing fossil fuels with electricity from renewable sources. It does not only reduce CO_2 emissions but also the need for marine transportation of gas or petroleum, preventing the risk of spills that are extremely harmful to marine ecosystems [3].

Climate change has a substantial impact on the oceans. It alters their chemical, biological and physical conditions, causing serious damage to marine ecosystems and biodiversity, as well as to social and economic systems that depend on them. These risks should be considered, when assessing the net environmental impacts of ocean energy developments. The biggest threats are **water temperature rise, acidification** and **oxygen depletion**. These phenomena are interlinked, and they act as positive feedback for each other, thus forming a vicious cycle of harmful impacts.

Rising temperatures caused by climate change have a particularly large effect on the ocean. Sea water has the ability to store large quantities of heat, and more than 93% of the excess heat linked to human activities has been absorbed by the ocean since the 1970s. Warming changes the ocean's currents and heat transport, which alters weather patterns and can result in extreme weather events [4]. It is predicted that climate change will increase the mean global ocean temperature by 1 to 4°C by 2100, depending on mitigation actions [2].

The rise of CO_2 levels in the atmosphere results in an increased amount of the gas being absorbed by the ocean. By interacting with water molecules, CO_2 molecules increase the ocean's acidity [5]. Ocean acidification reduces some marine organisms' ability to form shells or skeletons. This results in the destruction of coral reefs and shellfish that provide an important habitat to thousands of other organisms, having a devastating effect on the communities that rely on oceans for food [6].

Oxygen depletion is another consequence of global warming. Oxygen is crucial for the survival of aerobic marine organisms. Its depletion drastically alters many species' habitat quality. As ocean temperature rises, less oxygen is dissolved in sea water at the ocean/atmosphere interface. Warming of the ocean also increases stratification ('layering') and reduces mixing and ventilation of sea water. These factors result in a slower transfer of oxygen to deeper waters [2]. Oxygen depletion affects many species that are economically important to humans, leading to serious impacts on fisheries. Oxygen depletion is expected to worsen in the next decade, as climate change advances [7].


Photographer: Sergi Ferrete

1.2 Potential local environmental impacts of ocean energy

As ocean energy is a relatively new sector, regulators naturally have questions about the hypothetical impacts that installations could have on marine animals and habitats. Every project installing ocean energy devices in real sea conditions includes measures to monitor potential impacts. Moreover, in 100% of cases, Environmental Impact Assessments (EIA) are carried out as per European legislation (EIA Directive[2] and implementation). Despite this, there is not enough data today to be certain which – if any – of these hypothetical impacts pose a real risk. This can hamper consenting of ocean energy projects.

In this chapter, a review of scientific research will explore evidence to date on the environmental impacts of ocean energy deployment. Literature as well as EU projects (SI Ocean, SOWFIA) have considered potential impacts at length. This review will focus on **the four main potential impacts: collision risk, underwater noise, electromagnetic fields** and **habitat changes**.

1.2.1 Collision risk

Collision of marine mammals, fish, and seabirds with the rotating blades or the stationary foundations of an ocean energy device is one of the most referenced hypothetical concerns in the deployment of ocean energy [3]. This is a particular concern in areas with protected species that are more vulnerable to external factors. The Habitats Directive[3] ensures that these sites are managed according to the ecological needs of the species. To date, no collision has ever been observed by any of the monitoring programmes put in place when installing and operating ocean energy devices [8].

Research on animal behaviour around static structures in the ocean has been carried for many years and it is well known that marine animals are attracted to structures in the water [3]. However, there is still some uncertainty as to the real risk of collision of marine animals against ocean energy installations.

The severity of collision risk also depends on the type of ocean energy device – static or dynamic. 'Static' can qualify both the device and/or its components. This can include foundations, power cables or mooring lines and location: on the seafloor, in mid-water column or at sea surface. Dynamic devices and components include rotating turbine blades or oscillating wave energy converters. They can be located above or below the sea surface.

Experiences in field deployments of wave and tidal energy show that interactions with single static devices do not put the well-being of marine animals at risk. To date, there has not been any evidence of large marine mammals, seabirds or fish colliding with or becoming entrapped in power cables or mooring lines of static ocean energy devices [8].

The risk of collision with dynamic ocean energy devices or their components is the most challenging barrier for permitting. To date, there is not enough observational data to make definite assessments of such risks. This is because of, on the one hand, the small total number of machines installed in real sea conditions and, on the other, the technical challenge of obtaining observational data due to harsh conditions and the scarcity of appropriate instruments. The mechanisms by which collisions could happen have, therefore, been extensively studied in laboratory simulations and


Photo: Sabella

[2] Directive 2014/52/EU of the European Parliament and of the Council.
[3] Council Directive 92/43/EEC of 21 May 1992.

through modelling. These generally overestimate collision potential, as they do not factor in the animals' ability to detect and avoid underwater structures [3]. There is, thus, still a lot of uncertainty surrounding how marine animals behave around dynamic ocean energy installations.

To address this knowledge gap, a recent study [9] examines the series of behavioural events that could lead to a potential collision. It shows that the probability of a seal colliding with a turbine blade and suffering from serious or fatal injury is extremely low. Seals spend very little time in the mid-water column where the operational parts of bottom mounted tidal turbines or other common deployments are moving. The study also indicates that seals can deliberately avoid the area where the turbines are located, thus further reducing the risk of collision.

Research shows a very low collision risk with wave energy converters and there are no observed cases of collision [3]. This is because the movement of wave energy devices is relatively limited and can therefore be detected and avoided by marine mammals that often use sonar signals to detect objects. Additionally, devices are moved by the wave as opposed to moving independently ***within the wave***, so that sea animals are also affected by the same movement, thus reducing collision potential.

The research conducted to date on tidal turbines, similarly, hasn't observed any cases of marine mammals, fish, diving seabirds, or other marine animals colliding with an operational tidal turbine. Laboratory simulations, as well as test site studies, further show that fish are very unlikely to be injured when swimming around turbines [10] [3].

Some research has also been carried out on the impact of a potential collision. Tidal blades move much slower than conventional hydropower turbines. Hydropower can have blade tip velocities of several hundred meters per second [11] compared to tidal blades' 3-15 m/s, depending on the turbine size[4]. This highly reduces the potential impact of a collision and its severity. For example, a study [12] demonstrated that killer whales are unlikely to suffer from the collision with a turbine blade, and that the estimated impact is too small to damage the whale's jawbone. For wave energy devices, the potential impact of a collision is even lower [13].

Although research shows little impact around single devices, more information on animal behaviour around arrays is needed.

[4] The figure is an average acquired by consultation of several tidal stream developers.

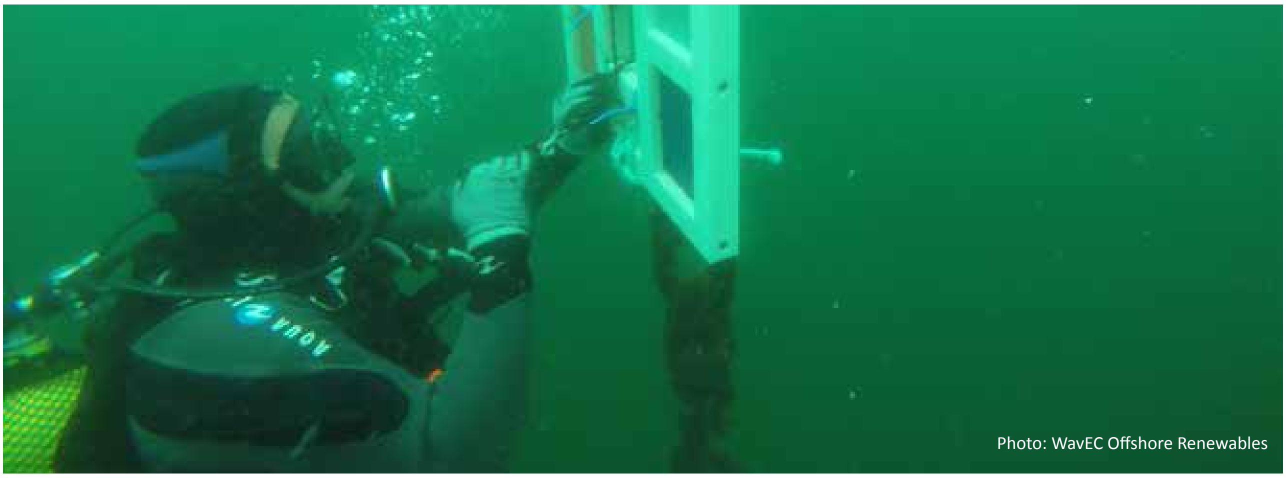
Photo: WavEC Offshore Renewables

1.2.2 Underwater noise

For many marine animals, hearing is the main sense used to interact with the marine environment, either for communication, social interaction, orientation, predation or evasion. The range of frequencies and amplitudes to which they are sensitive is wide and varies from species to species. Anthropogenic noise in the marine environment can potentially impact marine animals' hearing or ability to communicate and navigate with echolocation sounds [3].

Ocean energy devices can generate noise during installation and operation, though this noise is several orders of magnitude lower than noise generated by other maritime activities such as shipping, oil and gas or offshore wind. It is also below regulatory action levels and guidance [8].

Installation. Studies show that noise from wave and tidal device installation is unlikely to cause injury to marine organisms [8]. Wave and tidal devices are often anchored or placed on the seafloor, operations which generate very low levels of noise. Ocean energy does not use pile driving – a technique used in offshore wind and other industrial activities for which a large tube is hammered into the sea floor – because the seabed for bottom-mounted tidal turbines is generally very hard due to the high currents preventing formation of sand, mud and flora in general. Piles cannot be driven on rocks, so, if used, they will be maintained by four bolts drilled into the rock. This operation generates significantly lower noise than pile-driving that can go up to 140 decibels and be detrimental to marine organisms. Underwater noise impacts of ocean energy installation processes are, thus, very limited compared to other installation activities.

Operation. To date, there is no evidence of operational noise from ocean energy devices causing injury or significantly effecting marine animals' behaviour [8]. Some data shows that operational noise might attract or alienate animals but without causing damage [14], [15], [16], [17]. It needs to be noted that operating noise from devices is orders of magnitude below ambient sea noise, especially in areas where transport or fishing ships are a regular occurrence. As such, existing legislative limits applied to other sectors, are likely to be much higher than the levels ocean energy will output.

Most of the studies to date are based on limited data sets due to difficulties in measuring in the marine environment and the lack of coverage of punctual measurements. Moreover, the data collected to date focuses on single devices. Although operational noise from single ocean energy devices is not likely to be harmful to marine animals in a short-term, long-term effects and impacts of array deployments still need to be monitored.

1.2.3 Electromagnetic fields

Electromagnetic fields (EMFs) are magnetic fields created by moving electrically-charged objects. EMFs exist naturally in the environment from sources such as the Earth's magnetic field and the energetic particles from the sun. In the marine environment, EMFs occur naturally as a result of the interaction between the conductivity of seawater, the rotation of the Earth and the motion of tides or currents.

Anthropogenic EMF sources have been in the marine environment for over a hundred years; bridges, tunnels and subsea cables used for telecommunications and interconnections all generate EMFs in the ocean. Ocean energy deployments introduce additional EMFs into the marine environment. The main source of EMFs is cable connections between devices and export cables to shore [3].

Many marine animals from different taxonomic groups have the ability to sense and respond to EMFs. They can detect electrical or magnetic fields with electro- or magneto-receptors. Examples of these are sharks, lobsters, prawns, whales, dolphins and marine turtles [3]. A different magnetic field around the cable may attract animals to or divert them from the cable. It is important to understand if EMFs are detected by sensitive species and if they are of any biological relevance.

Currently, there is no evidence that EMFs from ocean energy installations have significant impacts on marine organisms [18]. Studies have mainly focused on behavioural effects, showing that some sensitive species are attracted by EMFs. Significant biological impacts have not been detected [8].

Monitoring of EMFs is a relatively new field. More research and exposure assessments are needed to better understand the long-term impact of EMFs, but this should be a cross-sectoral effort shared by all maritime industries that generate EMFs.

1.2.4 Changes in habitat

The installation of devices on the seabed and the movements of turbines, anchor lines and cables can have an impact on marine habitats [3]. Sedimentation patterns, hydrodynamics and seabed conditions can be altered, changing the benthic (the lowest level of a water body) ecosystem [19]. These changes are local and have similar impact as other marine industries that place structures in the water, and much lower impact than other human activities such as fisheries using bottom trawlers. It is difficult to distinguish which effects are caused by the devices and which occur naturally, because benthic communities are constantly undergoing changes under natural ocean conditions [3].

The studies conducted have not detected significant changes in benthic habitats or communities and populations surrounding an ocean energy device. Some loss of habitat can be seen directly under bottom-fixed devices [3], though bottom mounted tidal turbines generally operate in areas with very high currents that naturally prevent the formation of biodiversity leaving the seabed barren.

1.2.5 Marine reserve and artificial reef effects

As for offshore wind farms, fishing inside an ocean energy farm is generally restricted to very small fishing vessels. They exclude trawlers, which damage the seabed by using kilometre-long nets in direct contact with the ocean floor. As a result, and as observed in the wind industry, a "marine reserve" effect is created, as the farm represents an area where fish can live and reproduce unhindered [20]. In some cases, and as a result, fishing outside of the farm improves, as fish stocks use the "marine reserve" to rebuild themselves.

Ocean energy installations have also been shown to create new habitats for marine organisms. This phenomenon, the artificial reef effect, can diversify and grow the local flora and fauna by offering new areas for colonisation [21].

Positive impacts incurred by ocean energy devices can also be seen on the surface. A recent study showed that the wake of a tidal energy structure can create a feeding and resting area for animals, with a greater number of seabirds compared to an area of a natural wake [22].

Photographer: Colin Keldie Photo: EMEC

1.3 Recommendation: Real-world long-term monitoring is essential

To address the questions raised by regulators and other stakeholders, further **direct observations** of animal behaviour and interactions in the vicinity of ocean energy devices are needed. This data will help evaluate the real risks and impacts. Research should focus on different species and their behavioural responses, sensitivity thresholds and tolerance. **This monitoring should be continuous and long-term** to assess the effects of the potential stressors over time.

The modelling and observations of marine animals around ocean energy devices have to date focused on single devices, due to the early stage of the technology's deployment. As the sector moves towards array deployment, research should consider the **impacts of multiple devices**. It is important to understand how interactions between marine animals and ocean energy devices might change when multiple devices are installed instead of one.

Environmental monitoring programmes should be proportionate to the size of projects and remain supported by public funding. Such programmes can be costly and easily cripple small projects attempting to reach financial close. Without projects in the water, it will not be possible to carry out any monitoring at all.

2. Consenting processes and marine spatial planning

Photo: Sabella

The first chapter examined the potential environmental impacts of ocean energy. The results from environmental monitoring inform consenting, which is an important part of developing any ocean energy project. Consenting can significantly delay or even prevent project deployment.

Consenting processes usually consist of pre-installation, environmental monitoring including a potential EIA, stakeholder consultations, and applications submission for the various consents and licenses. Developers, then, have to wait for the decision on the consents and licenses, which can take several months, especially if specific issues arise and developers need to provide more information. As issues largely arise through consultation, pre-application stakeholder engagement can significantly reduce decision lead time.

Test centres such as EMEC or BiMEP have pre-consented sites, which means that developers do not need to prepare a full consenting application but only demonstrate that pre-defined test site conditions are met. This considerably shortens the process [24]. Outside of these test centres – where pilot farms such as MeyGen, Nova Innovation, Sabella and OpenHydro have mostly been developed – consenting processes are longer.

This chapter analyses current EU and national-level policies and regulations for marine spatial planning and the consenting processes of ocean energy. It first looks at the legislation at EU-level and then extends to the countries located on the Atlantic coastline with an interest in ocean energy: Belgium, France, Ireland, the Netherlands, Portugal, Spain and the UK. Finally, it gathers recommendations on what part of those processes should be addressed to facilitate the deployment of ocean energy.

2.1 European Union

The European Union has several directives that regulate the management and protection of marine areas. These, then, need to be transposed into national law, which can be complex due to different interpretations and access to guidance.

The main EU policies are the Marine Strategy Framework Directive[5] and the Maritime Spatial Planning Directive[6]. They aim respectively at protecting marine biodiversity and at coordinating sea-based activities. Both can have an impact on the deployment of ocean energy in European waters.

Additionally, the Birds Directive[7] and Habitats Directive[8] that form the Natura 2000 network, can also impact consenting processes, as they regulate the need for EIAs. The EIA Directive ensures that environmental implications are taken into account before authorising projects that could change the environment. Especially for single-device ocean energy deployments, these monitoring requirements can be burdensome and unreasonably costly compared to the actual environmental impact.

Marine Strategy Framework Directive

The Marine Strategy Framework Directive was adopted in 2008 and amended in 2017. It aims at protecting the European marine environment, achieving 'Good Environmental Status'[9] and preserving the resources that constitute the base of the European maritime economy [25].

This Directive is the first piece of EU legislation dedicated to protecting marine biodiversity. It creates a framework for the management of human activities that have an impact on the marine environment.

The Marine Strategy Framework Directive requires Member States to establish a Marine Strategy for their national waters and update it every six years. The Marine Strategies must include assessments of the marine waters and set up environmental targets, taking into account human activities, such as energy production [25].

These provisions can potentially impact the deployment of ocean energy, where, for instance, a Strategy identifies the impacts of ocean energy installations as a hindering factor in achieving Good Environmental Status. Considering the low environmental impact of ocean energy, this should not be the case.

Maritime Spatial Planning (MSP) Directive

The MSP Directive seeks to achieve sustainable and effective management of marine activities in the Member States by creating a framework for maritime spatial plans [26]. Maritime Spatial Planning brings together a range of maritime users to coordinate the use of oceans in a sustainable manner.

The MSP Directive allows Member States to choose freely the format and content of their plans, including institutional arrangements and the allocation of maritime activities. The main activities that should be covered are maritime transport, aquaculture, fisheries and energy [26], although ocean energy is not explicitly mentioned.

The MSP Directive was adopted in 2014 and it required coastal Member States to finish their national maritime spatial plans by 31 March 2021. At the time of writing, Member States are in different phases of the preparation process. Some of the plans are still being drafted or consulted upon, while some have been adopted [26].

MSP should be supported, via the MSP Directive and its implementing legislation. MSP can support the deployment of ocean energy by including it in maritime spatial plans. Zoning can help implement the results of marine planning. Zoning is extremely useful, as it clarifies the use of certain areas for a specific activity and can facilitate consenting processes [24]. However, when not included, there is a risk that existing users of the sea impede ocean energy deployment.


Photo: SIMEC Atlantis Energy

[5] Directive 2008/56/EC of the European Parliament and of the Council.
[6] Directive 2014/89/EU of the European Parliament and of the Council.
[7] Directive 2009/147/EC of the European Parliament and of the Council.
[8] Council Directive 92/43/EEC.
[9] "The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive" (Article 3 of 2008/56/EC).

2.2 Belgium

CONSENTING PROCESS

Required licenses and consents	Environmental permit, including EIA Domain concession Application for the laying of cables
Involved authorities	Scientific Service Management Unit of the North Sea Mathematical Models (MUMM) – *advises Federal Minister/Secretary of State responsible for the Marine Environment* General Energy Directorate of the Federal Public Service Economy, SMEs, Self-Employed and Energy – *advises Federal Minister responsible for Energy*
Single point of contact	No – *if no domain concession is needed (e.g. in some test fields), MUMM is a single point of contact*
Estimated time for the whole process	6 to 9 months

MSP AND OVERALL POLICY FRAMEWORK

MSP in place	Yes
Pre-allocated zones for ocean energy	Yes – *together with offshore wind*
Related policies	Law on the Protection of the Marine Environment of 20 January 1999 Royal decrees: KB VEMA of 7 September 2003 (amended on 26 December 2013) and KB MEB of 9 September 2003 (amended on 26 December 2013)

In Belgium, there is no dedicated consenting process for ocean energy projects, they are required to follow the same procedure as offshore wind [27]. There is also a lack of single point of contact, which can make the process more complex for developers.

The Maritime Spatial Plan in Belgium was adopted in 2014 and it foresees an area for offshore wind, wave and tidal energy [28]. The renewed 2020-2026 MSP entered into force on 20 March 2020. The main changes are three additional zones for renewable energy of 285 km² in total, industrial and commercial activities and coastal defence [29]. This gives ocean energy more opportunities to develop and deploy.

Photo: Nova Innovation

2.3 France

CONSENTING PROCESS

Required licenses and consents	Environmental permit: • EIA • assessment for protected species
	License to occupy the maritime public domain – *for projects located in territorial sea*
	Authorisation to generate electricity – *for commercial farms above 1000 MW*
	Grid connection agreement – *with the French transmission system operator*
Involved authorities	Regional Prefect
	Maritime Prefect
	National ministries (Environment, Energy, Oceans, Industry)
	In case of appeal: Cour Administrative d'Appel de Nantes, Council of State
Single point of contact	No
Estimated time for the whole process	1-4 years

MSP AND OVERALL POLICY FRAMEWORK

MSP in place	Yes
Pre-allocated zones for ocean energy	Yes, pre-allocated zones for offshore renewables, including ocean energy
Related policies	Hydrocarbons Bill 2017
	Loi de transition énergétique pour la croissance verte (LTECV, 2015)
	Loi ESSOC 2018
	Décret n°2016-9 du 8 janvier 2016

The French Government has simplified legislation and regulation for ocean energy. Since 2016, it is possible to obtain a license to occupy the maritime public domain for up to 40 years, reflecting the lifetime of infrastructure and subsea installations [30].

The French consenting process ideally takes 1-2 years. However, in case an appeal is filed against the submitted application, the process can extend to 3-4 years due to the time it takes to go through the courts.

At the end of 2018, a new law entered into force creating a procedure for an all-encompassing permit ("*permis enveloppe*"). The permit allows developers to ask for technological flexibility in their permits rather than defining all technological choices at the beginning of the project. This simplifies the procedures for future farms, shortening the lead time and, thus, reducing the costs of the projects [30]. This permit is an excellent example of Adaptative Management – one of the recommendations for a dedicated framework for ocean energy – see Chapter 2.9.1. The leading test centre, EMEC, also uses this method.

In France, the National Maritime and Coastline Strategy establishes the marine spatial plans for different sea areas, which were adopted in 2019 [31]. They include pre-allocated zones for offshore renewables in general, but not specifically for ocean energy. More specific areas, but mainly for wind, are currently being defined.

2.4 Ireland

CONSENTING PROCESS

Required licenses and consents	Foreshore content – *for site investigation, construction & cabling and foreshore occupation* Permit for electricity generation and grid connection – *only projects over 1 MW; below that an application suffices* [32] Consent for onshore construction
Involved authorities	Department of Housing, Planning and Local Government Commission for Energy Regulation Irish Planning Authority (An Bord Pleanála) Local planning authorities EirGrid and Electricity Supply Board – *transmission and distribution operators, respectively*
Single point of contact	No
Estimated time for the whole process	4 years

MSP AND OVERALL POLICY FRAMEWORK

MSP in place	No
Pre-allocated zones for ocean energy	No zones in the draft plan
Related policies	Marine Planning and Development Management Bill – *approved but needs to be complemented with regulations* Offshore Renewable Energy Development Plan (OREDP) Climate Action Plan

The challenge of the ocean energy consenting process in Ireland is the lack of one specific authority responsible for the consenting process as a whole. However, Ireland is preparing new legislation, The Marine Planning and Development Management (MPDM) Bill, that will reduce the required consents to two: The Maritime Area Consent and planning permission. One single environmental assessment will be needed. The Irish Planning Authority will be the single point of contact [33]. The new legislation will remove duplication and facilitate the consenting process.

The Irish Government has approved the MPDM and it will be complemented with regulations and guidelines to bring it into operation in 2021 [33]. The Department's current position is to not accept new Offshore Renewable Energy applications other than for site investigation and demonstration projects, until the MPDM is in place [34].

Ireland is currently carrying out MSP, leading towards the production of a single plan for Ireland's entire marine area: the National Marine Planning Framework. The plan was launched in July 2021 [35]. The plan does not include pre-allocated zones for ocean energy.

2.5 Netherlands

CONSENTING PROCESS

Required licenses and consents	Navigation permit Water permit Water Act license Environmental permit – *includes the building permit* EIA Lease contract
Involved authorities	Central government Province Municipality Rijkswaterstaat Local harbour authorities Ministry of Defence Regional water board Regional Implementation Service Ministry of Infrastructure and Water Management Crowne's Real Estate (Rijksvastgoedbedrijf)
Single point of contact	No
Estimated time for the whole process	Normally 1 year but it depends on the complexity and could take several years for bigger projects

MSP AND OVERALL POLICY FRAMEWORK

MSP in place	Yes
Pre-allocated zones for ocean energy	No
Related policies	Environmental Management Act Nature Conservation Act Public Works and Water Management Act Inland Navigation Police Regulations Inland Shipping Police Regulations Nature Conservation Act Environmental Protection and Monuments Law

The Netherlands has a central consenting system. However, in practice it requires the involvement of a wide range of permitting authorities [36]. This can make the consenting process quite complex. From 2021 the Omgevingswet (Environment Act) will be implemented via a single point of contact, which will simplify the process. The formal timelines for decision are often extended for complex permits such as for ocean energy and can take more than six months [37].

In the Netherlands, the national MSP was adopted in the form of the Policy Document on the North Sea that was published in 2015. No large-scale areas for offshore tidal or wave energy are proposed for the planning period. However, room was explicitly made for innovations and experimental opportunities in this field [36], leaving the door open for potential ocean energy installations.

2.6 Portugal

CONSENTING PROCESS

Required licenses and consents	License for the private use of maritime space EIA – *only for projects above 1 MW* License for grid connection and power production Building license – *for infrastructure on land*
Involved authorities	Marine resources, security and marine services Directorate-General Portuguese Environmental Agency Energy and Geology Directorate-General EDP Distribution Coordination Committee on Regional Development Municipal council
Single point of contact	No
Estimated time for the whole process	1-2 years

MSP AND OVERALL POLICY FRAMEWORK

MSP in place	Yes
Pre-allocated zones for ocean energy	Yes
Related policies	Law no. 17/2014 of 10 April (MSP) Decree-Law no. 38/2015 of 12 March (MSP) Decree-Law 215-B/2012 (Energy production) Decree-Law 76/2019 (Energy production) Decree-Law 151-B/2013 (EIA) Decree-Law 152-B/2017 (EIA)

In Portugal, there is no specific consenting system exclusively for ocean energy [38]. The lack of a single point of contact can make the consenting process complex for developers. However, a simplified licensing procedure (EIA not required) is available for projects below 1 MW, which supports the development of smaller projects. There is also a four month limit for the decision on the license for the private use of maritime space to be made.

The Portuguese MSP was adopted in 2019 and it includes zones for ocean energy development [39].

Photo: Orbital Marine Power

2.7 Spain

CONSENTING PROCESS

Required licenses and consents	EIA – *if relevant to site* Occupation of maritime-terrestrial areas Authorisation for activities affecting maritime safety, navigation and human life at sea Request for Administrative Authorisation Project Execution Approval Exploitation Authorisation
Involved authorities	Ministry for the Ecological Transition and the Demographic Challenge – *through the Energy Policy and Mines Directorate-General, and the Coast and Sea Directorate-General* Ministry of Transport, Mobility and Urban Agenda – *through the Merchant Marine Directorate-General* Central government Regional government Port authority – *if a project occupies public ports*
Single point of contact	No
Estimated time for the whole process	Over 2 years

MSP AND OVERALL POLICY FRAMEWORK

MSP in place	No
Pre-allocated zones for ocean energy	No
Related policies	Royal Decree 1028/2007 of 20 July Royal Decree 1955/2000 of 1 December Law 2/2013 of 29 May Royal Decree 363/2017 of 8 April

In Spain, there is no dedicated consenting process for ocean energy projects. Royal Decree 1028/2007 of 20 July on the processing of applications for electricity generating facilities in territorial waters focuses mainly on offshore wind, but it includes other marine renewable technologies in one of its articles [40].

The consenting process in Spain is lengthy and it can take two years to obtain approval, and even more if an EIA is needed. Despite the amended EIA law 21/2013 of 9 December that simplifies the process for all marine energy projects – with the aim to reduce lead time to four to six months – in practice the consenting process is longer [40].

The official decision-making body for granting authorisation is the Ministry for the Ecological Transition and the Demographic Challenge, through the Energy Policy and Mines Directorate-General. In practice there are many other bodies involved in the process and the competencies on maritime and coastal affairs are shared between central and regional governments [40]. This can make the process complex and complicate obtention of guidance for developers.

There is no specific MSP policy in place in Spain, but the Royal Decree 363/2017 of 8 April establishes a framework that transposes the European MSP Directive into Spanish legislation. To date, there are no pre-selected areas for ocean energy and the sites are selected on a case-by case basis [40].

2.8 United Kingdom

2.8.1 England

In England, the consenting processes and authorities depend on the size of the project.

CONSENTING PROCESS – UNDER 100 MW CAPACITY

Required licenses and consents	Marine License Electricity Act License Seabed lease Supporting documents, such as: • Environmental Statement • Habitats Regulations Assessment • Navigation risk assessments • Water Framework Directive assessments • Landscape and visual assessments
Involved authorities	Marine Management Organisation
Single point of contact	Yes – *Marine Management Organisation for the marine licence; the Crown Estate provides the seabed lease*
Estimated time for the whole process	13 weeks minimum but can vary depending on complexity of the project

CONSENTING PROCESS – OVER 100 MW CAPACITY

Required licenses and consents	Development Consent Order (DCO) that includes the Electricity Act License, the Planning Permission & Marine License Seabed lease Supporting documents, such as: • Environmental Statement • Habitats Regulations Assessment • Navigation risk assessments • Water Framework Directive assessments • Landscape and visual assessments
Involved authorities	Planning Inspectorate Secretary of State for Business, Energy and Industrial Strategy Marine Management Organisation The Crown Estate
Single point of contact	Yes – Planning Inspectorate for the DCO; the Crown Estate provides the seabed lease
Estimated time for the whole process	1-2 years

MSP AND OVERALL POLICY FRAMEWORK

MSP in place	Yes
Pre-allocated zones for ocean energy	Areas of tidal energy resource are highlighted
Related policies	Planning Act 2008
	Marine and Coastal Access Act 2009

There is no dedicated consenting process for ocean energy in England. Ocean energy projects must follow the general provisions of the Planning Act 2008, and Marine and Coastal Access Act 2009 [41]. This can make it difficult for consenting authorities to make appropriate decisions for ocean energy projects, potentially prolonging the process. Moreover, there is no formal timeframe for the consenting process for projects under 100 MW, which can further increase the waiting period.

England has a single point of contact for the consenting of offshore developments – the Planning Inspectorate for projects over 100 MW and the Marine Management Organisation for projects under 100 MW. This makes it easier for developers to get advice through the consenting process. The Planning Act 2008 regime reduces the number of required consents, streamlining and shortening the process [42].

England's Marine Spatial Plans were prepared by the Marine Management Organisation for 11 predefined areas [43]. There are wave and tidal stream specific policies and associated tidal stream resource areas in the East and South plans, the remaining plans have more generic renewables policies.

Photo: Hydroquest

2.8.2 Wales

In Wales, the consenting processes and authorities depend on the size of the project.

CONSENTING PROCESS – UNDER 350 MW CAPACITY

Required licenses and consents	Marine Licence – *the only licence needed for projects below 1 MW* Consent for energy generation projects – *S36 Electricity Act consent* Approval on the decommissioning scheme – *S105 Energy Act* Seabed lease
Involved authorities	Natural Resources Wales Welsh Ministers – *consenting for energy projects between 1 and 350 MW* Planning Inspectorate Wales UK Government's Department of Business, Energy and Industrial Strategy The Crown Estate
Single point of contact	No
Estimated time for the whole process	1-2 years

CONSENTING PROCESS – OVER 350 MW CAPACITY

Required licenses and consents	Marine License Development Consent Order (DCO) Approval on the decommissioning scheme – *S105 Energy Act* Seabed lease
Involved authorities	Natural Resources Wales Planning Inspectorate UK Government's Department of Business, Energy and Industrial Strategy The Crown Estate
Single point of contact	No
Estimated time for the whole process	2 years

Photographer: Colin Keldie

Photo: Magallanes Renovables

MSP AND OVERALL POLICY FRAMEWORK

MSP in place	Yes
Pre-allocated zones for ocean energy	The plan outlines areas of tidal stream and wave energy resources
Related policies	Wales Act 2017
	Electricity Act
	Marine and Coastal Access Act 2009
	Planning Act 2008
	Energy Act 2004
	Transport & Works Act

There is no dedicated consenting process for ocean energy in Wales. Ocean energy projects must follow the general provisions of the Planning Act 2008, Marine and Coastal Access Act 2009 and the Wales Act 2017 [41]. This can make it difficult for the consenting authorities to make appropriate decisions for ocean energy projects, stretching out the process. Moreover, the lead time for marine licences can be up to 18 months from submission for sectors where environmental impacts are less understood [44].

Currently, Wales does not have a one-stop shop for the consenting process. However, longer-term consenting arrangements for developments up to 350 MW are being developed under a new 'Welsh Infrastructure Consent' regime. It will establish a one-stop shop consenting process bespoke to Wales. These consenting arrangements have not yet been confirmed and are unlikely to enter into force before 2023 [42].

The Welsh National Marine Plan was adopted in 2019 and covers all the inshore and offshore regions in a single document [43]. The plan has separate policies supporting both tidal stream and wave energy development and a map indicating areas of tidal stream and wave energy specific resources.

Photo: Seabased

2.8.3 Scotland

CONSENTING PROCESS

Required licenses and consents	Seabed lease Marine licence Electricity Act Consent for the construction and operation – *if more than 1 MW in territorial sea or more than 50 MW in the offshore region*[10] Planning permission for onshore works EIA – *case-by-case* European Protected Species Licence – *if relevant to site*
Involved authorities	Marine Scotland Licensing Operations Team Crown Estate Scotland – *seabed lease* *Need to be consulted:* • Northern Lighthouse Board • Scottish Natural Heritage • Maritime and Coastguard Agency • Scottish Environment Protection Agency
Single point of contact	Yes – *Marine Scotland Licensing Operations Team*
Estimated time for the whole process	Target is 9 months but usually takes 1-2 years (often more environmental information is required)

MSP AND OVERALL POLICY FRAMEWORK

MSP in place	Yes
Pre-allocated zones for ocean energy	Yes
Related policies	Amended Town and Country Planning Act UK Marine Policy Statement Electricity Act 1989 Marine Scotland Act 2010 Marine & Coastal Access Act 2009

The consenting process in Scotland is facilitated by the one-stop-shop nature of the Marine Scotland Licensing Operations Team. It is a single point of contact for the whole consenting process. The process was simplified in 2013 with the amendment of the Town and Country Planning Act. It now includes consent for onshore works associated with offshore developments in the same application [45], which further reduces the administrative burden.

The consenting process does not have a strict deadline, but Marine Scotland aims at a nine-month lead time. The timeframe can vary if further consultation or a public inquiry is required [41]. In practice, the process usually takes 1-2 years.

Scotland's National Marine Plan was adopted in 2015, reviewed in 2017-2018 and in 2021 [46]. Regional Marine Plans will provide a greater level of spatial detail for their area. The National Marine Plan includes a sectoral chapter on offshore wind and marine renewable energy, but currently no pre-allocated zones for wave and tidal energy [45].

[10] 12-200 nautical miles.

2.8.4 Northern Ireland

CONSENTING PROCESS

Required licenses and consents	EIA Habitat Regulation Assessment Marine Conservation Zone Assessment Provision of a scoping opinion Review of an Environmental Statement Seabed lease Marine license Electricity Order consent Planning permission – *if part of the works conducted above the low water mark, including land fall of cable routes* Health Risk Assessment and Appropriate Assessment fulfilment Environmental Statement
Involved authorities	Marine Management Organisation for Northern Ireland offshore waters Marine and Fisheries Division of the Department of Agriculture, Environment and Rural Affairs (DAERA) Department for Enterprise Department for Infrastructure Crown Estate
Single point of contact	No
Estimated time for the whole process	Minimum 2,5 years

MSP AND OVERALL POLICY FRAMEWORK

MSP in place	No, in preparation
Pre-allocated zones for ocean energy	No zones in the draft plan
Related policies	Marine and Coastal Access Act Marine Act Strategic Energy Framework 2010-2020 includes the Offshore Renewable Energy Strategic Plan 2012-2020

In Northern Ireland, there is no single point of contact for the whole consenting process. The DAERA Marine and Fisheries Division lead on the marine licensing and marine plan aspects, Department for Enterprise on energy policy and regulation, Department for Infrastructure on strategic planning, and local council as local planning authority. This makes the process complex and complicates acquisition of guidance for developers.

If the project proposal is streamlined, one single Environmental Statement can be produced for three of the required consents (Marine License, Electricity Order consent and planning permission) [41], which would reduce the administrative burden. There is no official time limit for the consenting process, but the Marine and Fisheries Division aims at processing the complete application within four months of submission [47]. This may require more than two years of preapplication work including successful negotiations with stakeholders.

DAERA has published the draft Marine Plan and is now analysing the feedback from the public consultation. This will inform the final Marine Plan [48]. The draft Marine Plan does not include zones for ocean energy, though key resource areas may be re-examined and reviewed in the future.

2.9 Recommendations

Based on previous literature and consultations with the sector, the same challenges can be identified in different countries.

- **Consenting processes are often long, burdensome and costly**. This results partly from the lack of information about environmental impacts of ocean energy installations, as well as from the challenge of coordinating the many authorities involved in the process.
- **Regulators require extensive monitoring data both pre and post installation**, which imposes substantial cost and risk upon small enterprises.
- **There is an absence of tailor-made consenting processes for ocean energy**. The lack of supporting framework makes it difficult for the consenting authorities to take appropriate decisions for ocean energy projects. Finally, even where specific legislation exists, it is often unclear and complicated to follow.

There is significant room for improvement to facilitate the consenting of ocean energy projects. The offshore wind industry has made similar recommendations, as long consenting processes have been a challenge for the wind sector for several years [49]. Despite progress made in some countries, consenting of these technologies could be accelerated.

2.9.1 Dedicated framework for ocean energy needed

There is a clear need for a tailor-made process for the consenting of ocean energy projects [24], [3], [50]. A specific process would allow both the consenting authorities and developers to follow a clear set of rules tailor-made for ocean energy. This would significantly reduce uncertainty, regulatory risk and legislative burden [24].

The consenting processes should be **straight-forward and efficient** [50]. The procedures should be designed to facilitate the deployment of ocean energy and be proportionate to the low potential environmental impacts posed by a specific development [50], [24]. Notably, the EIA and environmental monitoring should be less burdensome, because the required time and associated costs are often too high for ocean energy developers, who already struggle to finance early stage deployments [3]. The responsibility for performing them must be shared between the developer and the environmental authority.

The consenting processes should also be limited in time, because developers rarely have the resources to wait for a consent for years. Staff, as well as investors' interests must be maintained during the entire project cycle, the longer the permitting and consenting process is, the higher the financial burden and risk. Consenting lead times for ocean energy projects vary between 2 to 5 years or even longer. Shortening the process can be done by simplifying and reducing the number of required applications and licenses, and by introducing a **time limit for the overall process**.

For example, Marine Scotland – the one-stop-shop of the Scottish consenting process – aims at completing the process in nine months. This shows that shorter consenting times are not only possible but also realistic. Marine Scotland offers guidance and checklists for developers throughout the process. Despite this, the process in Scotland usually takes 1-2 years in practice, because often more environmental information is required. This confirms that fit-for-purpose EIAs for new innovative technologies such as ocean energy are needed.

Time limits for every consenting decision from the date of submission would also reduce the overall consenting time. Currently, decision lead times vary between 4-8 months. In some countries, there is no time limit, and the decisions can take up to a year. To accelerate the development of ocean energy projects, there should be a time limit of 3 months from submitting the required documents for each consent or license. This would help shorten the whole process to one year.

To facilitate the consenting process for the developers, a "one-stop-shop" approach should be adopted [50]. Having **a single point of contact** representing the various public authorities would make it easier for developers to obtain advice throughout the consenting process. This authority would also streamline the functioning of the consenting process and coordinate the actions of other agencies involved [24]. In the EU, the Revised Renewable Energy Directive[11] requires Member States to set up single points of contact for renewable energy projects

To overcome the risk uncertainty, an **Adaptive Management approach** should be adopted [51]. Adaptive Management is a decision-making process that reduces uncertainty over time via monitoring. It allows the developers to start building their project, while authorities monitor the progress to gather more information on a potential risk. This will progressively reduce the uncertainty of the potential environmental impacts of ocean energy, without delaying the projects. An excellent example of Adaptive Management is the "permis enveloppe" in France.

Pre-allocation of zones in MSP could potentially result in higher levels of deployment if it successfully shortens the consenting process and reduces risks for developers. This should, nevertheless, not result in banning ocean energy deployment from other non-allocated zones [24].

MSP can also pose problems if it is too prescriptive or if ocean energy is excluded from marine areas without good reason. Therefore, ocean energy developers and industry associations should effectively communicate to regulators the needs of the sector regarding pre-allocated zones, coexistence with other marine sectors as well as technology and spatial requirements [24].

[11] Directive (EU) 2018/2001.


Photo: Marine Power Systems

2.9.2 More guidance and stronger communication essential

Good communication and improved sharing of information and experience among consenting authorities, developers, researchers and other stakeholders are one of the key requirements in enhancing the consenting processes [11], [24]. Reliable information needs to be available to all actors and it needs to be clearly and effectively disseminated [11].

Firstly, **more information about the consenting process** is needed, as the assessments required are often unfamiliar to developers [24]. Especially new developers with limited knowledge require more guidance for the different steps of the process [50].

Secondly, **consenting authorities should inform developers about the specific roles and responsibilities of the different authorities** at every stage, and present how their actions are coordinated. In many countries, different consenting agencies are involved in sea use or environmental and electricity related issues, for example. Developers need to know which ones to contact and in what order. Where many authorities are involved in the consenting process, better communication between the authorities would greatly avoid duplication of efforts [24].

Finally, **information and guidance need to be available to regulators** at all levels of government, covering national, regional and local levels, to improve future decisions and processes [46]. EU level guidance to inform national decision-making on the implementation of the EU environmental directives, for example, would ensure better planning approaches in Member States [50]. Information sharing on common licensing issues would allow best practices in consenting procedures throughout the EU [50].

As discussed in Chapter 1, the lack of information on the environmental impacts of new technologies hampers the consenting processes. To provide the consenting authorities with appropriate information, **dedicated research needs to continue**. Better knowledge of the marine environment and marine animal impacts will help neutralise the perceived risks and will support project developers' consent applications.

3. Strategic action plan

Photo: Wello Oy

Drawing on findings from the previous chapters, this action plan ensures an integrated and consistent implementation of environmental research and policy recommendations. It lays out concrete actions to reduce uncertainties related to environmental impacts of ocean energy and to improve consenting processes.

3.1 Action 1: Provide financial support for research and monitoring

Expected outcome:

Most environmental research programmes are not 100% publicly financed. This limits their participation or slows down the research process, as the main research entities are usually academic institutions or NGOs. More funding for environmental research will allow the participation of those actors, resulting in greater amount of quality research and more rapid results. Moreover, financial support for pre- and post-installation data collection will help developers install and operate while respecting environmental requirements.

Developers of innovative technologies have to focus on technology development itself. They are, thus, not able to invest in environmental programmes beyond legal requirements, unless provided financial incentives to do so.

DG MARE has recently funded two environmental monitoring projects: SEA Wave and WESE. These calls should become a regular occurrence.

Required steps:

- Launch yearly well-funded calls for environmental monitoring and data gathering in the context of ocean energy.
- Favour proposals considering long-term environmental monitoring actions.

3.2 Action 2: Simplify and shorten consenting processes for ocean energy

Expected outcome:

A supportive regulatory framework would speed up, rationalise and de-risk the consenting of ocean energy projects. Adaptive Management – a decision-making process reducing uncertainty over time via monitoring – would reduce the uncertainty on potential environmental impacts of ocean energy, without delaying the projects. Making sure that ocean energy is included in marine spatial plans would immensely support its deployment and facilitate multi-uses of the sea.

Required steps:

- Aim at completing the whole consenting process in one year and introduce a 3-month limit for every consenting decision from the date of submission.
- Adopt an Adaptive Management approach for consenting decisions
- Include ocean energy zones in maritime spatial plans in a non-discriminatory manner

3.3 Action 3: Create national single points of contact

Expected outcome:

The 'single authority' would streamline the consenting process and help coordinate the actions of other authorities and agencies. The single point of contact would provide all the necessary information on the consenting process. Guidance for performing the various assessments required by the consenting process would help developers complete them more efficiently, resulting in faster consenting and reduced project costs.

Improved access to research results will decrease duplication of efforts and simplify consenting processes. A centralised database updated by the single point of contact to share research and monitoring data will help disseminate information on projects and their impacts [50]. The recently launched MARENDATA data sharing platform by the WESE and SEA Wave projects is a good example of a database with environmental data collected from several ocean energy test sites [52]. In addition, data collected from similar locations should be used as a reference for environmental impact studies as much as possible [11]. This could help tackle excessive monitoring requirements – especially for single device deployments [24].

Required steps:

- Establish one institution per country managing the entire consenting process from start to finish.
- Provide guidance documents managed by that institution and covering all technical aspects of the consenting procedure.
- Strengthen the use of existing databases such as MARENDATA or Tethys to share research, monitoring and EIA data for regulators and developers.

3.4 Action 4: Set up a platform for developers to share experience on consenting

Expected outcome:

New developers learning from others' experiences with consenting processes would help them navigate through the system more quickly. Through a dedicated platform, developers could find answers to their questions from their peers who have previously undertaken consenting, even before starting the process.

The platform for sharing experiences should include a forum for questions and discussion per country, as well as a data depository for developers to share useful documents.

Required steps:

- Launch a call that includes establishing a platform for knowledge-sharing on consenting.
- Organise workshops to reinforce knowledge-sharing and to inform developers of such platform.

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List of abbreviations

CO_2: Carbon dioxide

DAERA: Department of Agriculture, Environment and Rural Affairs in Northern Ireland

EIA: Environmental Impact Assessment

EMEC: European Marine Energy Centre

EMF: Electromagnetic field

EU: European Union

MSP: Marine Spatial Planning

NGO: Non-governmental organisation

OREDP: Offshore Renewable Energy Development Plan in Ireland

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ETIP Ocean's mandate was renewed by the European Commission for 2019-2021. For this phase OEE and the University of Edinburgh have been joined by TECNALIA and WavEC.