COMMISSION OF THE
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Equitable Testing and Evaluation of Marine Energy Extraction Devices in terms of Performance, Cost and Environmental Impact

Grant agreement number: 213380

EquiMar

Deliverable D6.1.1
Existing legislation, perspectives and evolution of other similar technologies

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Existing legislation, perspectives and evolution of other similar technologies

Teresa Simas, André Moura
Wave Energy Centre
Robert Batty
Scottish Association of Marine Sciences
Gérard Vernont, Michel Paillard
Institut Français de Recherche pour l'Exploitation de la Mer
Cyrille Abonnel
Electricité de France SA
David Thompson
University of St. Andrews, Sea Mammal Research Unit
Jennifer Norris
European Marine Energy Centre

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Summary

This report includes a revision of the legal instruments regarding the environmental requirements of the consent procedure for ocean energy schemes in European Union, its Member States and other countries where tidal and wave energy schemes are operating. The perspective of incoming future European legislation (e.g. the role of the Water Framework Directive and the future Marine Directive) in the development of ocean energy schemes is discussed and examples of legislation requirements for other technologies such as wind offshore are presented in order to find similarities.

CONTENTS

1 INTRODUCTION

As the concepts of energy extraction technologies for currents, tides and waves in the oceans are maturing, few devices have been deployed and tested and even fewer environmental studies of these technologies have been carried out. There is a lack of appropriate legislation specifically for these projects and a need to establish some coherency in this field in order to promote an international standardization of environmental legislation requirements. Furthermore, the specifications of the Environmental Impact Assessment (EIA) of tidal and wave energy projects is not only a legislative requirement but also an assurance of the projects sustainability, a promoter of public acceptance and a benefit for industry, making the project more attractive to investors and governments who traditionally have seen environmental concerns as a barrier.

A common baseline for environmental legislation requirements could help in the establishment of future legislation so that no country could benefit from a more environmentally permissive legislative framework to deploy projects. If this is to occur, the first step to achieve compliance between environmental legislation requirements, within European countries, can be the review of the existing legislation at National level as well as the context of incoming legislation at the European level (Water Framework Directive and Future Marine Directive). The potential environmental impacts of the converters installation and operation should accompany this process according to the technical specifications of their concept. In addition, the evolution of the environmental legislation developed to accommodate other technologies namely offshore wind energy, can also play an important role to drive the process and prevent potential legal gaps.

This report includes the results of an environmental legislation revision for both in the European Union and Member States where tidal and wave energy schemes are operating (Denmark, Portugal, Spain and United Kingdom). The environmental legislation on marine energy extraction in other countries outside Europe (United States, and Canada) will also be considered for comparison. The legislation requirements for offshore wind will be also reviewed for United Kingdom, Netherlands and Denmark. The perspective of incoming future legislation (the role of the Water Framework Directive and the future Marine Directive) in the development of ocean energy schemes is also discussed and examples of legislation requirements for other technologies such as wind offshore are presented in order to find similarities in paths to legislative compliance.

2 A REVIEW OF EXISTING LEGISLATION

There are a number of international treaties and instruments which regulate some aspect related with environmental impact of energy activities. These range from access to energy resources, through to the conduct of energy activities and finally to regulation of the movement and sale of the end product.

The development of legal instruments to regulate the environmental impacts of a given activity is normally based on the procedures for the Environmental Impact Assessment. These usually cover the range of the activity from the construction through the operational phase to final decommissioning.

2.1 EUROPEAN AND INTERNATIONAL LEVEL: INSTRUMENTS WITH IMPACT ON OCEAN ENERGY

2.1.1 Environmental Impact Assessment Directive and the related Habitats and Wild Birds Directives

The concept of EIA, developed in United States in 1970 in the context of the National Environmental Policy Act (NEPA), has spread widely. In the European context, this concept is used in the Directive 85/337/EEC (so called the EIA Directive) on assessment of the effects of certain public and private projects on the environment. Amendments to the EIA Directive have been introduced (Directive 97/11/EC and Directive 2003/35/EC) and a consolidated version is currently available on the EU website [1]. The EIA Directive refers to other two Directives (Wild Birds Directive and Habitats Directive) on the nature conservation policy in the European Union (Table 1). All areas classified under these Directives form an ecological network known as Natura 2000.

Although the EIA Directive has been reviewed, it does not specifically address wave and tidal energy projects due to the relatively recent development of this technology. The EIA Directive outlines which project categories shall be made subject to an EIA, which procedure shall be followed and the content of the assessment. Project categories are split between Annex I for which EIA is compulsory and Annex II for which EIA is dependent on whether significant environmental effects may occur. Although a number of energy project categories are included in Annex I, wave and tidal energy projects could only be within Annex II under the category of “Energy industry: (a) Industrial installations for the production of electricity (...)”. Projects outside Annex I may still be subject to EIA depending on their nature, size and location either in accordance with (nationally) pre-determined thresholds or on a case-by-case basis (Article 4 (2); [1] , [2]). For such pre-determined thresholds or case-by-case examination, the developer should include the relevant selection criteria set out in Table 2 (Annex III of the EIA Directive).

As can be seen in Table 2, the proximity to the coast or to a site designated under an EU Directive on Wild Birds or Habitats (Table 1) will be significant factors in assessing the impact of the proposed activity and whether EIA is required [2]. The distribution of the types of inshore and offshore habitats classified under the Habitats Directive within EU Member States is presented in Table 3. The protected offshore habitats are those in Annex I of the Habitats Directive that occur beyond 12 nautical

miles offshore. Under this situation, there are at least two classified offshore Habitats: "Reefs" (Natura 2000 Code 1170)[1] and "Submerged sandbanks" (Natura Code 1110)[2]. The Habitat "Sub-marine structures made by leaking gases" (Natura 2000 Code 1180)[3] can also occur beyond the 12 nautical miles. It is also important to note that several marine species, including the harbourporpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*) and monk (*Monachus monachus*), common (*Phoca vitulina*) and grey (*Halichoerus grypus*) seals are listed in the Habitats Directive for potential site selection. Bird species listed in the Birds Directive may also qualify [4].

Table 1 European legislation to be considered for environmental impact assessment of wave and tidal energy schemes. * All areas that are protected under the Birds and Habitats Directives form an ecological network known as NATURA 2000.

Directive		Content
85/337/EEC	EIA Directive	Requirement of an environmental impact assessment before building permission. Does not mention specifically marine energy technologies
92/043/EEC	Habitats Directive*	Requirement on the conservation of natural habitats and of wild fauna and flora; establishes the creation of Special Areas of Conservation (SACs are protected sites assigned under this Directive; the habitat types and species concerned are listed in the Annexes I and II; the list concerns habitat types and species that are considered to be most in need of conservation at the European level).
79/409/EEC	Wild Birds Directive*	Requirement on the conservation of wild birds; establishes the creation of Special Protected Areas (SPAs are high level protected sites classified in agreement with this Directive; the species which are involved are listed in Annex I as well as additional regularly occurring migratory species).

Table 2 Text of the Annex III, with respect to the selection criteria referred in article 4(3) of the EIA Directive (85/337/EEC).

Topics	Criteria
1. Characteristics of projects The characteristics of projects must be considered having regard, in particular, to:	- The size of the project - The cumulation with other projects - The use of natural resources - The production of waste - Pollution and nuisances - The risk of accidents, having regard in particular to substances or technologies used
2. Location of projects The environmental sensitivity of geographical areas likely to be affected by projects must be considered, having regard, in particular, to:	- The existing land use - The relative abundance, quality and regenerative capacity of natural resources in the area - The absorption capacity of the natural environment, paying particular attention to the following areas: (a) Wetlands (b) Coastal zones (c) Mountain and forest areas (d) Nature reserves and parks (e) Areas classified or protected under Member States's legislation; special protection areas designated by Member States pursuant to Directive 79/409/EEC and 92/43/EEC (f) Areas in which the environment quality standards laid down in community legislation have already been exceeded; (g) Densely populated areas; (h) Landscapes of historical, cultural or archaeological significance.
3. Characteristics of the potential impact The potential significant effects of projects must be considered in relation to criteria set out 1 and 2 above, and having regard in particular to:	- The extent of the impact (geographical area and size of the affected population) - The transfrontier nature of the impact - The probability of the impact - The duration, frequency and reversibility of the impact

[1] Reefs: submarine, or exposed at low tide, rocky substrates and biogenic concretions, which arise from the seafloor in the sublittoral zone but may extend into littoral zone where there is an uninterrupted zonation of plant and animal communities. These reefs generally support a zonation of benthic communities of algae and animals species including concretions, encrustations and corallogenic concretions ([3], [4]).

[2] Sandbanks which are slightly covered by seawater at all times: Sublittoral sandbanks, permanently submerged. Water depth is seldom more than 20m below Chart datum. Non-vegetated sandbanks or sandbanks with vegetation belonging to the *Zosteretum marine* and *Cymodoceion nosodae* ([3], [4]).

[3] Submarine structures made by leaking gases: Spectacular sub-marine complex structures, consisting of rocks, pavements and pillars up to 4 metres high. These formations are due to the aggregation of sandstone by carbonate cement resulting from microbial oxidation of gas emissions, mainly methane. The methane most likely originated from microbial decomposition of fossil plant materials. The formations are interspersed with gas vents that intermittently release gas. These formations shelter a highly diverse ecosystem with brightly coloured species ([3], [4]).

A report of the World Wildlife Fund ([6], [7]) identifies those sites that potentially qualify as reefs and submerged sandbanks in Northeast Atlantic and North Sea, in accordance with the Interpretation Manual and Requirements of the EU Habitats Directive [4].These sites are presented in Figure 1 to Figure 3 and their delimitations (not presented) are detailed in tables of the referred report. The avoidance of environmentally sensitive areas and the location of the project further offshore are less likely to impact near shore currents and communities.

Table 3 List of existing marine habitat types for different Member States [5]. P means Present; A means Absent; ? means that no data are available. The analysis includes presence, absence or "not-applicable (-) for both inshore and offshore habitats.

Habitats type			**European Union Countries**												
			Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	Sweden	United Kingdom
Number	Description		Inshore/Offshore												
1110	Sandbanks	Baltic	-	P/?	P/?	-	P/P	-	-	-	-	-	-	P/?	-
		Atlantic / North Sea	P/P	P/P	-	P/P	P/P	-	P/P	-	P/P	P/P	P/?	-	P/P
		Mediterranean	-	-	-	P/?	-	P/?	-	P/?	-	-	P/?	-	?/-
1120	*Posidonia* beds	Mediterranean	-	-	-	P/A	-	P/A	-	P/A	-	-	P/A	-	?/-
1130	Estuaries	Baltic	-	P/-	P/-	-	P/-	-	-	-	-	-	-	P/-	-
		Atlantic / North Sea	P/-	P/-	-	P/-	P/-	-	P/-	-	P/-	P/-	P/-	-	P/-
		Mediterranean	-	-	-	P/-	-	P/-	-	P/-	-	-	P/-	-	A/-
1140	Mudflats and sandflats not covered by sea water at low tide	Baltic	-	P/-	P/-	-	P/-	-	-	-	-	-	-	P/-	-
		Atlantic / North Sea	P/-	P/-	-	P/-	P/-	-	P/-	-	P/-	P/-	P/-	-	P/-
		Mediterranean	-	-	-	P/-	-	P/-	-	P/-	-	-	P/-	-	?/-
1150	Coastal lagoons	Baltic	-	P/-	P/-	-	P/-	-	-	-	-	-	-	P/-	-
		Atlantic / North Sea	A/-	P/-	-	P/-	P/-	-	P/-	-	A/-	P/-	P/-	-	P/-
		Mediterranean	-	-	-	P/-	-	P/-	-	P/-	-	-	P/-	-	?/-
1160	Large shallow inlet and bays	Baltic	-	P/-	P/-	-	P/-	-	-	-	-	-	-	P/-	-
		Atlantic / North Sea	A/-	P/-	-	P/-	P/-	-	P/-	-	P/-	P/-	P/-	-	P/-
		Mediterranean	-	-	-	P/-	-	P/-	-	P/-	-	-	P/-	-	?/-
1170	Reefs	Baltic	-	P/?	P/-	-	P/P	-	-	-	-	-	-	P/?	-
		Atlantic / North Sea	A/A	P/A	-	P/P	P/P	-	P/P	-	A/A	P/P	P/P	-	P/P
		Mediterranean	-	-	-	P/P	-	P/?	-	P/P	-	-	P/P	-	P/-
1180	Submarine structures made by leaking gases	Baltic	-	P/?	A/A	-	A/A	-	-	-	-	-	-	A/?	-
		Atlantic / North Sea	A/?	P/A	-	A/?	A/A	-	A/?	-	A/?	A/?	?/?	-	?/-
		Mediterranean	-	-	-	A/?	-	A/?	-	A/?	-	-	?/?	-	-
8330	Submerged or partially submerged caves	Baltic	-	P/?	A/?	-	A/A	-	-	-	-	-	-	P/?	-
		Atlantic / North Sea	A/?	P/A	-	P/?	A/A	-	P/?	-	A/?	P/?	P/?	-	?/-
		Mediterranean	-	-	-	P/?	-	P/?	-	P/?	-	-	P/?	-	-

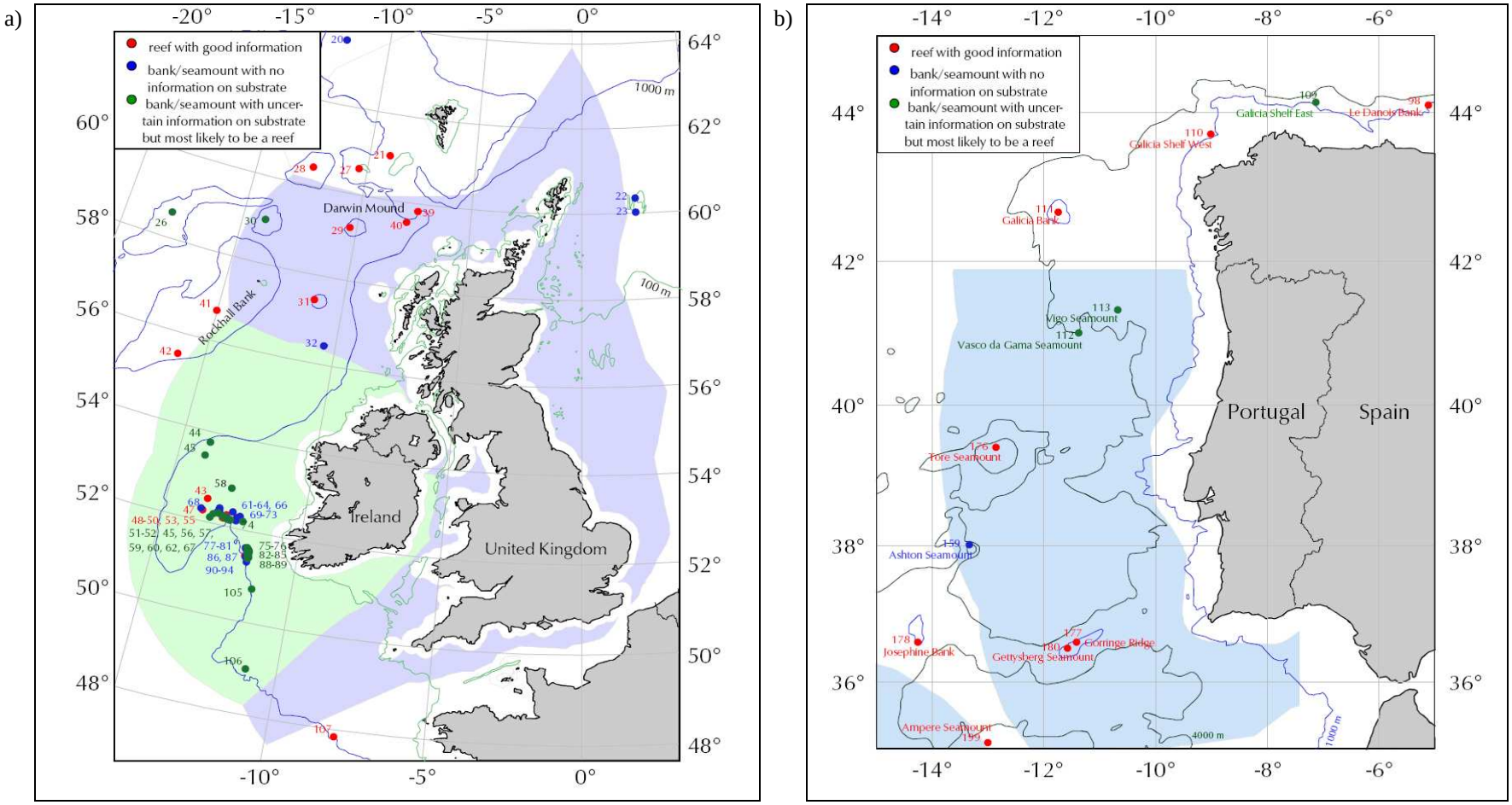


Figure 1 Implementation of the European Union Habitats Directive Offshore [7]. Reefs around: a) United Kingdom and Ireland; b) Portugal.

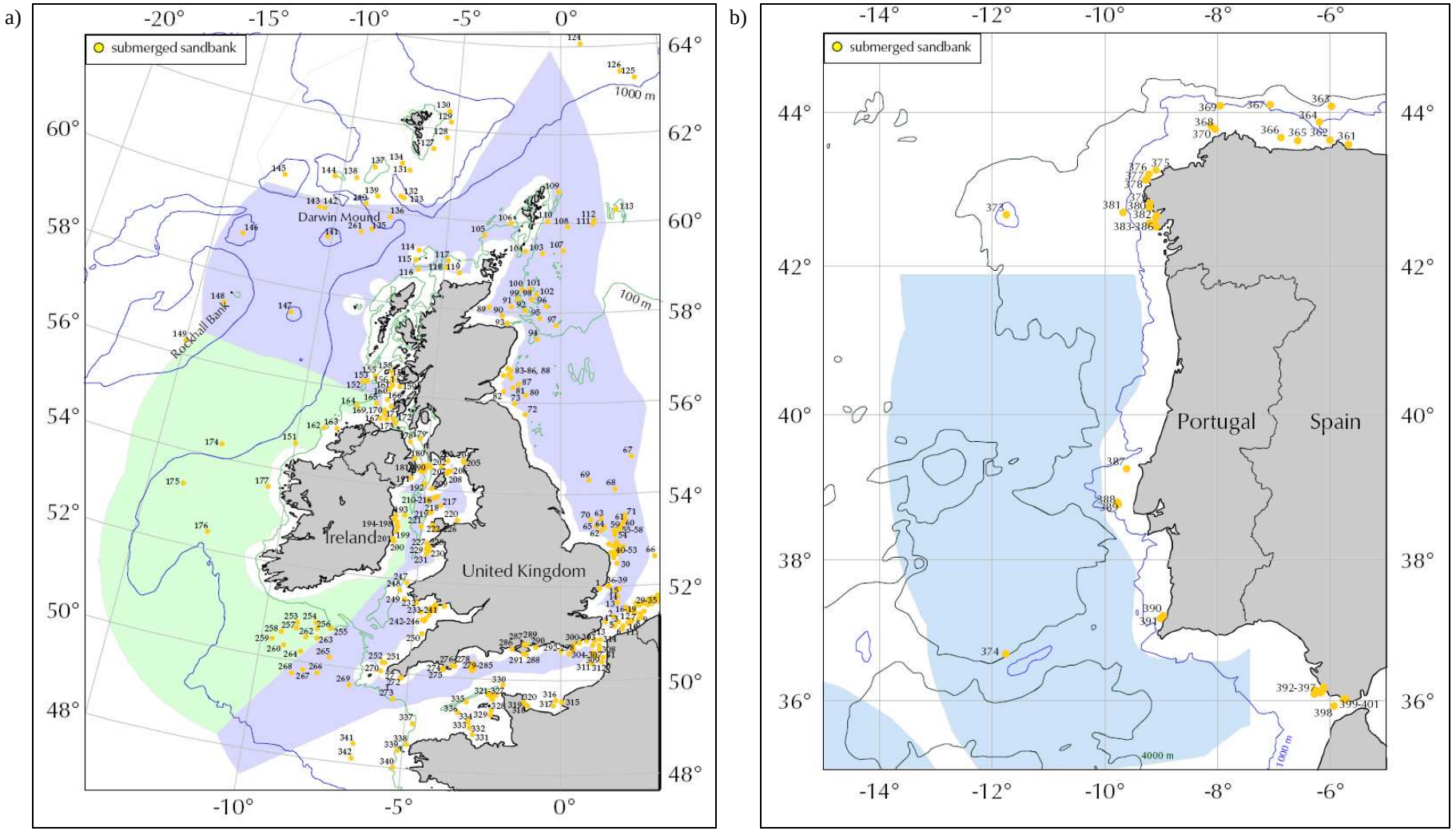
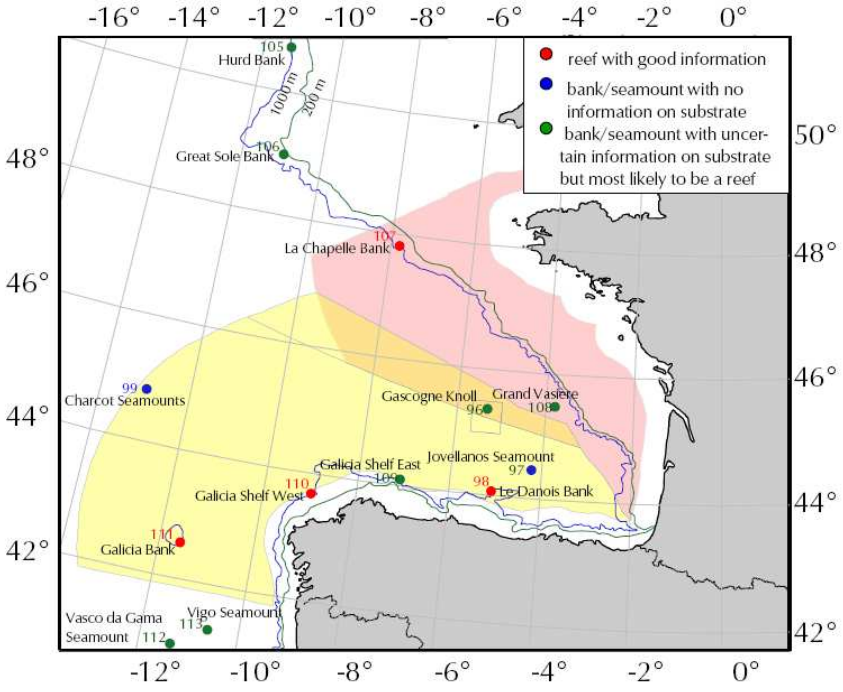
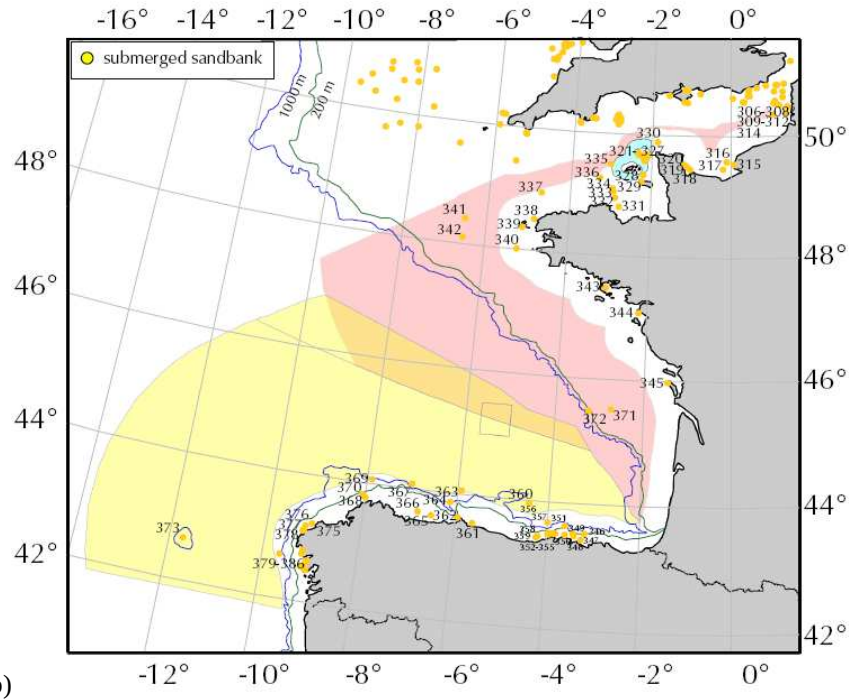


Figure 2 Implementation of the European Union Habitats Directive Offshore [7]. Submerged sandbanks around: a) United Kingdom and Ireland; b) Portugal and Spain.



a)



b)

Figure 3 Implementation of the European Union Habitats Directive Offshore [7]. a) Reefs and b) submerged sandbanks around Spain and France.

If the project is decided to be subject to an EIA, the developer should supply the information specified in Table 4 as soon as the Member State (or its competent authority) consider this information "relevant to a given stage of the consent procedure and to the specific characteristics of a particular project or type of project and of environmental features likely to be affected" and if "a developer may reasonably be required to compile this information having regard, inter alia, to current knowledge and methods of assessment" (Article 1(2)). In accordance to this, the information to be provided by the developer should include at least (Article 5(3)):

- "A description of the project comprising information on the site, design and size of the project,
- A description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects
- The data required to identify and assess the main effects which the project is likely to have on the environment,
- An outline of the main alternatives studied by the developer and an indication of the main reasons for his choice, taking into account the environmental effects,
- A non-technical summary of the information mentioned in the previous indents."

Table 4 Text of the Annex IV, with respect to the selection criteria referred in article 5(1) of the EIA Directive (85/337/EEC).

	Topics	Information to be supplied by the developer
1.	Description of the project including:	- A description of the physical characteristics of the whole project and the land-use requirements during the construction and operational phases - A description of the main characteristics of the main production processes, for instance, nature and quantity of the materials used, - An estimate by type and quantity, of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc) resulting from the operation of the proposed project.
2.	An outline of the main alternatives studied by the developer and an indication of the main reasons for this choice, taking into account the environmental effects	
3.	A description of the aspects of the environment likely to be significantly affected by the proposed project, including in particular:	- Population - Fauna - Flora - Soil - Water - Air - Climatic factors - Material assets including the architectural and archaeological heritage - Landscape - Inter-relationship between the above factors
4.	A description of the likely significant effects of the proposed project on the environment resulting from:	- The existence of the project - The use of natural resources - The emission of pollutants - The creation of nuisances - The elimination of waste and - The description by the developer of the forecasting methods used to assess the effects on the environment
5.	A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment	
6.	A non-technical summary of the information provided under the above headings	

Another important part of the EIA exercise is public participation. The EIA Directive "intends to align the provisions on public participation in accordance with the Aarhus Convention[4] (Economic Commission for Europe 1998) on public participation in decision-making and access to justice in environmental matters". In this context, Member States shall ensure that the determination made by the competent authorities is made available to the public (Article 4(2)). The effective opportunity given to the public to participate in environmental decision-making procedures is highlighted in Article 6(4) and detailed arrangements for incoming and consulting the concerned public are stipulated as well as the provision of reasonable time-frames for the different phases allowing sufficient time for informing the public and for its effective participation in decision-making. Public awareness of marine energy based on accurate information is important in order to limit negative misperceptions of environmental impact, which can be raised by the population when limited information is available.

2.1.2 Strategic Environment Assessment (SEA) Directive

The purpose of the Strategic Environment Assessment (SEA) Directive (2001/42/EC) is to ensure that significant environmental impacts of certain plans and programmes are identified and taken into account during their preparation and before their adoption.

[4]The Aarhus Convention is the first international instrument to address procedural human rights in an environmental context and sets a 'benchmark for environmental democracy'. It establishes international minimum standards in respect of its three pillars: Access to environmental information (Article 4); Public participation in environmental decision-making (Article 6); Access to environmental justice [2].

The main objective is to help integrate the environment into the preparation and adoption of plans and programmes liable to have significant effects on the environment, by subjecting them to a prior environmental assessment at the planning stage. It aims to extend the principles of the environmental impact assessment, carried out at the individual project level, to the decision making at strategic level. It is intended that at this level the alternative approaches and their implications for the environment can more easily and appropriately be considered.

The plans and programmes defined in the SEA Directive are those "which are subject to preparation and/or adoption by an authority at national, regional or local level or which are prepared by an authority for adoption, through a legislative procedure by Parliament or Government and which are required by legislative, regulatory or administrative provisions".

Under the SEA Directive the authority responsible for the plan and programme will need to follow a specific procedure during the preparation of a SEA which includes the development of an environmental report that examines the significant effects of the proposed plan or programme, including reasonable alternatives, as well as other information listed in the Annex II of the Directive (Table 5). The SEA content and level of detail should be decided after consultation of environment authorities, which should be identified by each Member State. The environment authority and the wider public must be early informed to effectively comment on the draft plan or programme and accompanying report.

The SEA Directive, requiring strategic environmental assessments and consultations at an early stage of certain plans and programs, may assist ocean energy developers in carrying out the EIA [8].

Table 5 Criteria for determining the likely significance of the effects referred to in Article 3(5) of the SEA Directive (Annex II).

Topics	Characteristics
The characteristics of plans and programmes, having regard, in particular, to:	- The degree to which the plan or program sets a framework for projects and other activities, either with regard to the location, nature, size and operating conditions or by allocating resources; - The degree to which the plan or program influences other plans and programs including those in a hierarchy - The relevance of the plan or program for the integration of environmental considerations in particular with a view to promoting sustainable development; - Environmental problems relevant to the plan or program; - The relevance of the plan or program for the implementation of Community Legislation on the environment (e.g. plans and programs linked to waste-management or water protection).
Characteristics of the effects and of the area likely to be affected, having regard, in particular, to	- The probability, duration, frequency and reversibility of the effects; - The cumulative nature of the effects; - The transboundary nature of the effects; - The risks to human health or the environment (e.g. due to accidents); - The magnitude and spatial extent of the effects (geographical area and size of the population likely to be affected); - The value and vulnerability of the area likely to be affected due to: o Special natural characteristics or cultural heritage; o Exceeded environmental quality standards or limit values; o Intensive land-use; - The effects on areas or landscapes which have a recognized national, Community or international protection status.

2.2 NATIONAL LEVEL: EXAMPLES OF CONSENT PROCEDURES ON OCEAN ENERGY

The progress of ocean energy has varied across several countries with the most advanced activities located in the UK and USA [9]. The recent policy developments concerning consenting procedures for demonstrations at sea in these countries and the public funding of an ocean testing facility (UK) are the main reasons to explain the results presented in Figure 4.

Legal frameworks are still under construction and vary between countries. Data from 2006 [9] shows that, among 26 countries in which ocean energy is being developed, the United Kingdom, the United States, Portugal and Canada were the countries identified to have specific regulatory and administrative rules for permitting ocean energy projects. However, there are other countries where this type of legal requirements is not yet developed but the licensing process followed the procedures already defined for other types of renewable energy. A revision of the legal requirements for ocean energy project permitting as well as examples of consent procedures in each concerned country are presented below.

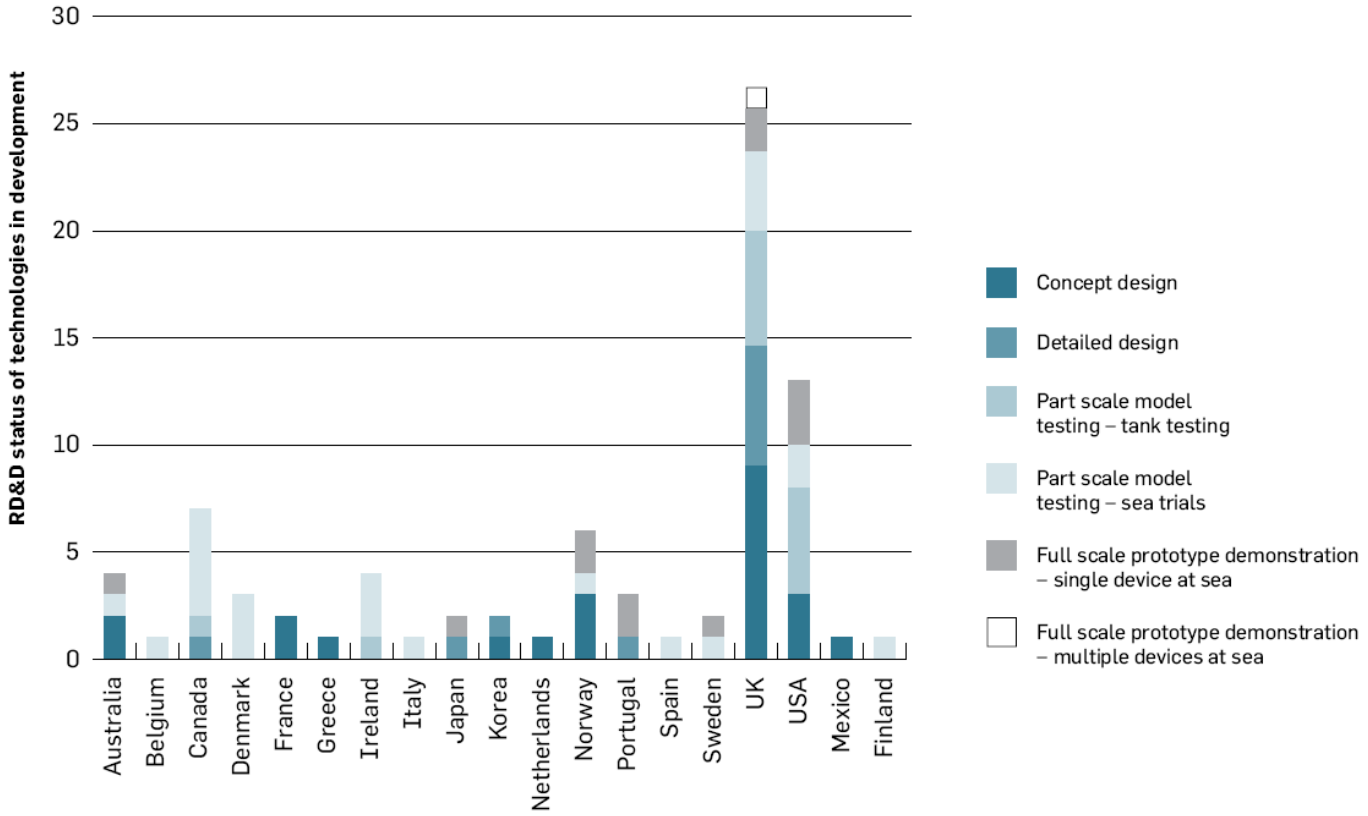


Figure 4 Current development status of ocean energy technologies by country (number of projects) [9].

2.2.1 Denmark

In an initial phase, the consent procedure of previous wave energy projects in Denmark [10] follow a one-stop-shop-procedure[5] which was also a procedure used for offshore wind energy projects. Since no official guidelines or administrative experiences exist, problems and challenges arose during the planning phase although the Danish Energy Authority proved to be very flexible during the approval process. The balance made at the end of the consent process, which lasted more than one year, shown that was difficult to follow a one-stop-shop-procedure and that the responsibility for the whole procedure changed during the process. Table 6 describes the consents needed for the test of the Wave Dragon technology in territorial waters.

Since the Wave Dragon prototype was considered a non-permanent R&D project with a relatively small size, the authorities decided that an EIA was not necessary. This decision was announced to the public and during a 4 week period the submission of protests against this decision was expected. No objections were expressed and therefore no EIA nor a demand for public consultation were fulfilled. However, an evaluation of the potential impact of the project on the three diving duck species that had caused the EU Bird Protection Area designation was perform as requested by the regional county.

In Denmark, a national strategy for ocean energy was planned but no specific policies or measures to support wave technology have been introduced other than the existing support available to all emerging renewable technologies [2].

2.2.2 France

The trends of the energy policy in France are set by the law program of 13 July 2005. It is part of the sustainable development perspective for the energy needs, related to the economic and social development and environmental protection and preservation of natural resources. This law requires the development of renewable energy and set a target of 10% of production for the French global energy needs by 2010.

In France, the Department Prefecture in collaboration with the Maritime Prefecture manages the administrative records of projects. The Environmental Impact Assessment is conducted under the Water Act, Natura 2000 and the requirements concerning the authorization of the network. These are:

- An analysis of the initial state of the site and its environment;
- An analysis of direct and indirect, temporary or permanent impacts of the project on the environment;
- Why, especially in terms of environmental concerns, location and technical characteristics of the project have been selected among other alternative proposals;

[5]One-stop-shop procedure indicates that one authority takes the responsibility to “process” an application also covering legislative responsibilities/requirements of other authorities.

- The measures envisaged to eliminate, reduce and where possible, offset the harmful effects of the project on the environment;
- An analysis of methods used to assess the effects of the project on the environment for the construction, operation and decommissioning of installations.

The Environmental Impact Assessment is the basis of the public inquiry file. Beyond international regulations, including European Directives, it leans on the following national regulations:

- State-own concession for the use of public domain outside the maritime harbours governed by Decree No. 2004-308 of 29 March 2004, which specifies the contents of the consent application, the applicable procedure and set the convention to be approved by order of the prefect. In particular, it includes installations reversibility and the constitution of financial guarantees for any potential works for the rehabilitation of the site;
- Instruction under the environmental code, which provides a study of impact for any renewable energy offshore project (for those energy projects exceeding a production of 2.5 megawatts and has a submarine cable) and works for wind energy production with mast exceeding 50 meters high;
- Authorization under Planning Code. The public inquiry takes place during the building permit. The development shall conform to the principles of the Coastal Act.
- Operating license issued by the Department of Energy.

Considering the maturity of the offshore wind farm in Europe, the earliest national projects for installation of renewable energy production offshore logically relate to this technology. It is in this field that the legislation in place is a priority. It should be noted that, in the current state of development of procedures, most of the regulations might be extended to other forms of energy production.

The national legislative and regulatory framework is required to be amended in the coming months. Indeed, the objectives of the program law of 13 July 2005 have been revised upwards in the context of discussions of the "Grenelle of the Environment" which provides for at least 20% by 2020 the share of renewable energies in final energy consumption. This change should probably be accompanied by a simplification of procedures.

Table 6 Consent procedure followed in Denmark for the approval of the Wave Dragon prototype testing [10].

Subject	Responsible institution	Description / Observations
Use of sea territory	Coastal authorities	The consent was given by all relevant national and local authorities based on the conditions described to the location of the project including marking requirements, environmental impact assessment, consultation process, decommissioning
Electricity production	Danish Energy Authority (DEA)	DEA followed the consent procedure for offshore wind farms; the process was a bit more comprehensive than might have been necessary since some differences exist between technologies e.g. a 2MW wind turbine established for at least 20 years and a 20kW wave energy converter, deployed for 3 years of R&D.
Sea cables	Danish Energy Authority	The consent for deployment of sea cables was given on the condition that cables without oil should be used.
Connection to the local distribution grid	Local distribution network operator	Based on specifications of rated power and connection voltage, the local distribution company established a point of connection with charges based on a list price. Again the experience concerning wind offshore technology was valuable.
Safety-occupational health	Danish maritime authority	A permit regarding occupational health was needed, because the plant, including the control container, would be used in a regular basis by scientific and technical staff. No experience on rules for wave energy devices so new recommendations and regulations were considered. Existing regulations for offshore fish farms off Faeroe Islands proved to serve as a basis.
Insurance	Insurance Company	The device insurance was given based on the evaluation of the construction which was studied by Armstrong Technology Ass. (UK Naval Architects). To obtain a favourable insurance it was necessary to establish a CO2 fire extinguishing device in the control container, sealing of the container in order to protect the electronic equipment against sea-water and a log book to be updated once a week regarding mooring system.

2.2.3 Portugal

In Portugal the legislation requirements for the implementation of ocean energy projects were initially regulated by the DL 254/99 (7th July), which established the requirements for the installation of equipment or infrastructures within the territorial sea and the Exclusive Economic Zone. The installation of such equipment and infrastructures also require approval from several Ministries: Defence and Sea Issues, Environment, Spatial planning and Regional Development, Economy and Innovation, Agriculture and Fisheries, and Ministry of Public Works, Transport and Communications.

Furthermore, and considering the adoption of the EU Directive 2001/77/CE on the electricity production from renewable sources, the DL 51/2004 (31st January) establishes the licence process of renewable energy projects, including wave energy, and the obligation for an Environmental Impact Declaration produced by the regional development authority (CCDR; Comissão Coordenadora do Desenvolvimento Regional), the Nature Conservation and Biodiversity Institute (ICNB; Instituto da Conservação da Naturaza e Biodiversidade) and the Ministry of Town, and Environment. The DL also establishes the obligation for an Environmental Incidence Study if the project is not listed in the EIA DL 69/2000 (3rd May), which is the case of wave energy projects. The Environmental Incidence Study is a less demanding administrative instrument than the so called Environmental Impact Assessment and should contain the evaluation of the components presented in Table 7.

2.2.3.1 Portuguese Pilot zone

The Pilot Zone was created by the DL 5/2008 approved on 8 of January. In the same year the DL 238/2008 attributes the management of the Pilot zone to the national electric grid (REN: Rede Eléctrica Nacional) (Table 7). According to this legal framework the Management Entity of the Pilot zone has to conduct a geophysical and environmental characterization of the Zone in collaboration with public competent entities on the involved domains. Although the access of the WEC developers to the pilot zone has to be regulated by REN, it is already established that the licence process should be accompanied an Environmental Incidence Study referred above.

Table 7 Main Portuguese legislation on Wave Energy.

Legislation	Description / Observations
DL 51/2004	Regulates the licence process of electricity production from renewable energy sources including wave energy.
Joint decision 66/2005	Establishes the components to be described and evaluated in the Environmental Incidence Study for wave power projects. The components are: - **Gas emissions**: that are going to be avoided with the electricity production from wave energy converters during the life of the project; this calculation should be based on the National Program for Climate change and on the EU Directiove 96/62/CE; - **Seascape**: evaluation of the visual impact of the project; - **Geology and geomorphology**: Identification of the elements that should be protected; - **Natural values (flora, fauna and habitats)**: identification of and cartography of the areas of protected species and habitats in the context of the Birds (79/409/CEE) and Habitats (92/43/CEEE) Directives; if it is the case propose mitigation measures and a monitoring plan e a post-evaluation phase; - **Patrimony**: characterization and cartography of the archaeological, architectonical and ethnographical values and where applicable propose mitigation measures; - **Noise**: this analysis is dispensable when the projects are located far from 100m from houses; - **Soils**: evaluation, identification and cartography of the soil occupation; - **Territorial classification**: spatial classification of the project according to the classes in the national territorial management instruments and considering licences for other uses such as navigation, military and commercial; - **Population**: the analysis should focus on public acceptance of the project particularly the most affected social groups.
DL 5/2008	Establishes the legal framework for the utilization of the public natural marine resources including the wave exploitation for electricity production. Establishes the geographical limits of the Portuguese Pilot Zone (along S. Pedro de Muel) and the creation of a management entity as well as the licence process of the project within the Pilot Zone.
DL 238/2008	Attributes to the National Electrical Grid (REN: Rede Eléctrica Nacional) the management of the Pilot Zone and establishes the obligation for the creation of a regulation document on its use.

2.2.3.2 Examples of consent procedures on the Portuguese coast

Examples of consents procedures in the coast of Portugal which were accompanied by some kind of Environmental concern are:

- Pico OWC pilot plant in Azores
- AWS pilot plant in the wave energy park of Aguçadoura (Póvoa do Varzim);
- Pelamis in the wave park of Aguçadora (Póvoa do Varzim)
- Waveroller in the coast of Peniche (central coast of the country);

The European OWC pilot plant on the Island of Pico, Azores was completed in 1998. The license process for such a device was new to the authorities of Azores Autonomous Region who demonstrated serious concern regarding the environmentally

acceptability of the plant which proved very difficult to overcome. Due to the short operational periods of the plant, there are no systematic observations of environmental issues although acoustic (air) measurements are scheduled for the next months.

Regarding the licensing issues and EIA requirements of the AWS pilot plant, there still was no baseline for practice. However, according to the existing law (DL 254/99, referred above) the offshore operation license had to be undersigned by 5 ministers. The process was relatively fast since the project was considered positively by the government. An EIA was not required at that time due to the size and scientific character of the undertaking. However, observations on environmental issues were sporadic due to the short time of the test period. Dolphins were observed in the direct vicinity of the plant during the tests. Despite their scarceness, the observations indicate that at least for this technology not only negative impacts should be considered for park-scale deployment since limited areas with no access for net-fishing may have a habitat protection function [10].

The permitting process for the deployment of a small park of 3 Pelamis devices in the same area as the AWS pilot plant was concluded in 2006. The process followed the same approach as AWS pilot plant and, although not explicitly demanded at that time, an EIA was done for the small park [10].

The Waveroller technology is predicted to be operating in Peniche as a farm, producing between 50 and 100 MW, by the end of 2009. The first device was installed in April 2007 and the environmental impacts of the array of devices have been analyzed in an Environmental Incidence Study in 2007, as established in the current legislation.

2.2.4 Spain

In Spain ocean energy projects are not listed as projects that should be subject to an EIA. However, the competent authority (usually the Environment Ministry) can ask for such assessment if it deems it necessary [11]. At present, there are some EIAs being prepared for ocean energy projects that are to be located in coastal waters of the Basque country. Efforts have been made by public and private authorities in order to develop guidelines for EIA in the marine environment. A report developed in 2008 [11] informs about the EIA procedure in Spain and describes the information and best methodologies to be used in each stage of the EIA development.

2.2.5 United Kingdom

The consenting authorities in UK require a complete EIA for commercial deployments. For ocean energy projects there are a number of required licences under legislation presented in Table 8. To fulfil this legislation, developers should develop a proposal on the project with regard to its potential for environmental impact and navigation safety. UK already began (2007) a consultation exercise on the application of the EIA specifically to marine energy devices which revises the existing range of applicable legislation with a view to streamline the licensing process [12].

2.2.5.1 European Marine Energy Centre

The EMEC is the first built test site for wave and tidal energy converters. Since EMEC is a test facility site in the UK, the scenario of permitting consents is slightly different than it was described for UK in general. Developers do not have to conduct full EIAs but they need to apply for the licences described in Table 8.

EMEC has developed an advisory role with regard to the developers' consents which promote early communication with regulatory authorities in order to reduce efforts and improve approach consistency to possible risks [13]. EMEC developed a document on the Environmental Impact Assessment, which intends to guide the developers, interested in testing their devices at EMEC, on legislative and consent requirements as well as on the content of the Environmental Statement that should be carried out by the developer [13].

Table 8 United Kingdom legislation on Ocean Energy permitting [13].

Legislation	Description / Observations
Food and Environmental Protection Act, FEPA (1989)	Licence relating to the proposed deposits on the seabed
Electricity Act (Section 36; 1989)	Governs marine energy converters generating over 1 MW
Coast Protection Act, CPA (Section 34; 1949)	Concerns safety and navigation issues as well as environmental issues
European Protected Species EPS	Licence may be required if deemed necessary by the environmental regulator
Lease from the Crown state	Within territorial waters the ownership of the seabed and, with the exception of coal, oil and gas, the UK's rights to explore and exploit the Continental Shelf are vested in the Crown Estate
Planning Authority permissions	To connect to the electrical grid

2.2.5.2 Wave Hub consents and permitting

Wave Hub is a groundbreaking renewable energy project in the South West of England that aims to create the UK's first offshore facility for the demonstration and proving of the operation of arrays of wave energy generation devices [14]. This project is being promoted by the South West of England Regional Development Agency (SWRDA).

The consent for the Wave Hub installation involved an application to the Department of Trade & Industry (DTI) (under the Electricity Act in 1989, which incorporates deemed planning permission under the Town & Country Planning Act 1990), together with an application to the Department of the Environment, Food and Rural Affairs (DEFRA) under the Coast Protection Act

(1949) and a licence under the Food & Environment Protection Act 1985 (Table 8). An Environmental Statement was also required on the potential impacts of the project on various aspects of the natural and human environment and was finalised in 2006.

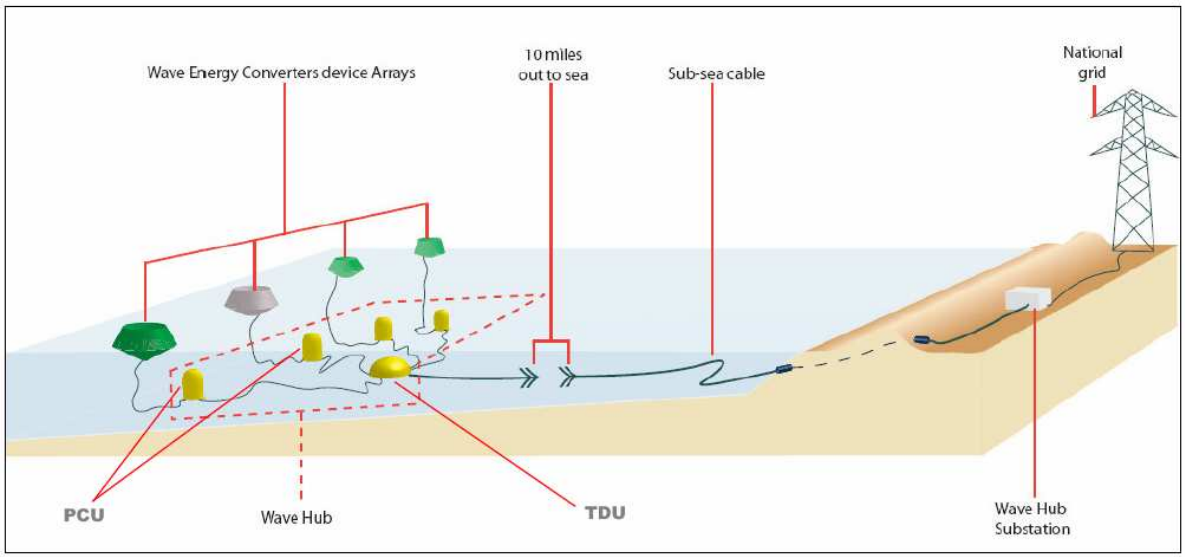


Figure 5 Conceptual illustration of Wave Hub [15].

The consent for Wave Hub was granted in September 2007 [14]. At present, an application for the establishment of a safety zone for the operational phase of the Wave Hub site has been submitted to the Department of Energy and Climate Change (January 2009). According to [16], an EIA will be required for any Section 36 (Electricity act) application, and this will need to describe the WEC's to be installed with sufficient precision to enable their environmental impacts to be assessed. The types of WECs to be installed in the Wave Hub are: oscillating water column, articulated tubular floats (Pelamis), floating platform with multiple point absorbers and buoy-mounted single point absorbers.

2.2.5.3 Examples of consent procedures on the UK coast

A demonstration site for Wave Dragon Technology was selected on the coast of Wales (Pembrokeshire) according to the good wind and wave exposure, the relative proximity to the land (for economic and operational purposes), the relative distance from commercial shipping interests, the exclusion from military exercise ranges and the proximity to potential grid connection locations. The permission applications for Wave Dragon in Wales included the submission of three offshore consents to DTI and DEFRA. A full EIA was also conducted since the site is located within a "Special Area of Conservation" (SAC). The environmental Statement was completed in April 2007 and work was developed with the Crown Estates and Pembrokeshire Coastal National Parks Authority towards a Lease and Planning Permission respectively. Technology deployment is expected during the summer of 2009 and environmental monitoring is going to be carried out until 2012 (the year for the end of the project demonstration phase).

2.2.6 Canada

The deployment and operation of ocean energy projects in Canada (mainly tidal energy projects) are approved and monitored by a series of federal and provincial environmental agencies and associated laws (Table **9**9). For environmental issues, three main authorization procedures have to be developed. The first refers to the Canadian Environmental Assessment Act which establishes the obligation to carry out an environmental assessment for ocean energy projects under one of the following different types [17]:

1) Screening (including class screenings): is a systematic documented assessment of the environmental effects of a proposed project. The screening will determine whether or not the proposed project is federally supported and therefore enable the project to proceed. The class screening is a special type of screening that can help streamline the environmental assessment of certain projects.
2) Comprehensive study: is a more intensive and rigorous Environmental Assessment required for large-scale, complex and environmental sensitive projects. The scope and depth of the analysis is often correspondingly greater as well and may demand highly specialized skills and experience. Comprehensive studies require an EA decision from the federal Minister of the Environment as well as compulsory public participation.
3) Mediation: is an Environmental Assessment when there are only a few interested parties and all them are willing to participate in a consensus negotiation. If the issues of concern are resolved the mediator must prepare a report to the responsible authority and the Minister of the Environment who, then, makes it public.
4) Review panel: this approach of Environmental Assessment has to be followed when a project has likely to have significant adverse environmental effects. This approach should also be appointed when the public concerns warrant such a review. A review panel application is exclusively ordered by the Minister of Environment and a report shall be prepared

and submitted by the review panel. This report has to be taken into consideration before making any decision with regard to the project.

Table 9 Canadian federal permits, licenses and agencies for ocean (tidal) power (from [17]).

Permit/Authorization	Agency	Intent or requirement
Environmental Assessment	Fisheries and Ocean Canada	Section 35 of the Fisheries Act (habitat protection provision) states that alteration of habitat requires authorization from Minister; Environmental Assessment required
Fish Habitat Protection	Canadian Environmental Assessment Agency	Administers the Canadian Environmental Assessment Act. Tidal energy project under 5 MW will likely need a screening level EA. Projects over 5 MW will require Comprehensive Study
Navigable Waters Protection Division Authorization	Transport Canada	Authorization required for construction of works in/over/through inland and coastal navigable waterways
Marine Protected Areas	Fisheries and Oceans Canada	Authorized under the Oceans Act; currently none in New Brunswick, Musquash Estuary, Bay of Fundy designated as area of interest in 2000
Marine Wildlife Areas	Environment Canada	Extend from 12 to 200 nautical miles offshore, not yet designated
National Marine Conservation Areas (NMCA)	Parks Canada	The only NMCAs are located in Quebec and Ontario
National Energy Board (NEB) Licence	National Energy Board	NEB has jurisdiction only if electricity would be exported out of Canada or if federal cabinet explicitly gives NEB jurisdiction over a project
Species At Risk Act	Canadian Wildlife Service of Environment Canada, Fisheries and Oceans Canada and/or parks Canada	To prevent wildlife species from becoming extinct, to provide for the recovery of wildlife species that are becoming extinct, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened

An authorization is also required under the federal Fisheries Act (FA) regarding the potential effects on fish habitats (harmful alteration, disruption or destruction) defined as “spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly to carry out their life processes”. The FA also states that there is no permission to deposit a harmful substance into water containing fish and requires an authorization (Section 35 FA) for works or undertakings in or around water where fish habitat may be negatively affected [17].

Under the Canada’s Oceans Act, the establishment of Marine Protected Areas (MPA) to conserve and protect unique habitats, endangered or threatened marine species and their habitats, commercial and non-commercial fishery resources and their habitats, marine areas of high biodiversity or biological productivity and any other marine resource or habitat requiring special protection, resulted in five marine protected areas:

- The Eastport Peninsula – located in Bonavista Bay, Newfoundland
- Gilbert Bay – located approximately 300 km from Happy Valley-Goose Bay on Labrador’s southeast coast
- Basin Head – located on the eastern tip of Prince Edward Island, near the town of Souris
- The Gully – located approximately 200 km off Nova Scotia, to the east of Sable Island, on the edge of the Scotian Shelf
- The Endeavour Hydrothermal Vents Marine Protected Area – located 250 km southwest of Vancouver Island.

Within these areas, certain classes of activities are prohibited especially those that would conflict with the MPA purposes. However some activities may be operating in a MPA depending on the individual MPA management plan.

Marine Wildlife Areas (MWA) are marine protected areas under the authority of Environment Canada administered by the Canadian Wildlife Service (CWS) which focuses on wildlife habitat protection, particularly for migratory birds. The CWS is regulated under the Canadian Wildlife Act and may take measures for the protection of any species on non-domesticated animal in danger of extinction or acquire lands for the purposes of wildlife research, conservation or interpretation. The CWS is allowed to create national wildlife areas out to the 200-nautical-mile limit so as to better address both coastal and marine conservation issues.

National Marine Conservation Areas (NMCA) are areas managed for sustainable use containing smaller zones of high protection which include seabed and water column above it and also wetlands, estuaries, islands and other coastal lands. Currently there are only two NCMA located in the Fanthom Five National Park in Georgian Bay, Ontario and Saguenay-St. Lawrence Marine Park in Quebec.

The Species At Risk Act (SARA; 2003) intends to “prevent wildlife species from becoming extinct, to provide for the recovery of wildlife species that are becoming extinct, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened”. SARA applies to federal jurisdiction lands, most freshwater habitats and marine habitats. Under this Act, critical habitats are identified and the Minister of Fisheries and Oceans may only authorize activities in these areas if the proposed marine activity is incidental and all of the pre-conditions are met:

1) All reasonable alternatives to the activity that would reduce the impact on the species have been considered and the best solution was adopted;
2) All feasible measures will be taken to minimize the impact of the activity on the species or its critical habitat or the residences of its individuals and;
3) The activity will not jeopardize the survival or recovery of the species (Section 73, 3).

According to this legal instrument, it is the responsibility of the developer to ensure that any project complies with it. The process requires that a project is reviewed by local, provincial, or federal authorities and authorized through formal approvals and permits [17].

2.2.7 United States

In the United States both federal and state agencies manage the installation of electrical facilities with state jurisdiction varying from state to state. This situation is similar to the layout in the European Union between EU and its members. While states jurisdiction goes up to three miles from shore (Submerged Lands Act), the federal government owns all lands beyond that to 12 nautical miles. However, under the Submerged Lands Act, the federal government reserves the right to develop water power in state waters as well. At present, there seems to be some overlap in supervision between federal and state government in the interaction with ocean energy developers. For example, the federal government supervise environmental impact assessments under the National Environmental Policy (NEPA) while approximately twenty states have their own little "NEPA" programs. In general, federal jurisdiction is expected when electricity crosses state boundaries, when federal lands and natural resources are used or affected or when the project site overlaps an endangered species habitat/migration corridor [18].

Table 10 Responsibilities of state and federal jurisdiction on offshore energy projects [18].

Jurisdiction	Responsibilities
State	1. Environmental impact assessment 2. Siting (varies from state to state – sometimes siting regulation is local instead of state-headed which involves county commissions, planning and zoning boards, or other local government departments responsible for conditions of approval 3. Safety: construction and maintenance 4. Laying of transmission cables
Federal	1. Environmental assessment if project overlaps endangered species habitat 2. Interstate transmission 3. Approval of wholesale electricity rates

Although there is no central licensing agency to direct the many agencies involved in ocean energy projects, the Federal Energy Regulatory Commission (FERC) has tried to assert jurisdiction over all projects, citing them as "power houses" within federal waters under the Federal Power Act [18].

The FERC licence application process is an extensive technical process. However, FERC decided to establish a preliminary permit or a "temporal exemption" to developers of demonstration projects to allow them to experiment with the technology, as long as they do not generate electricity for commercial purposes. This is because it was recognized that the application process required technology data that could only be gathered from demonstration, otherwise representing a regulatory barrier to development.

The preliminary permit is issued for up to three years but does not authorize construction since states maintain control over construction of new generation and transmission by issuing certificates of public necessity and convenience. The Minerals Management Service (MMS) has recently been assigned jurisdiction over ocean energy resource use, and is currently in the rulemaking process, attempting to define the regulations and process for ocean energy permitting.

To protect against any potential adverse impacts, the preliminary permit should contain a provision allowing FERC to shut down or remove the project if the operation unacceptably affects the surrounding environment and additional mitigation measures should be included:

- Development of an anchoring plan for the underwater transmission cable and monitoring the cable to ensure the line is stationary and free of any entangled debris;
- Assessing the intensity of the electromagnetic field emitted from the underwater transmission and buoy electrical cables;
- Conducting a noise assessment and monitoring marine mammals to evaluate any noise effects and interactions with the buoys;
- Development of a cultural resources plan;
- Preparing navigation and project safety plans.

As mentioned before the process for sitting a ocean energy device varies from state to state and each one has its own distinctive rules and regulations. Nevertheless, common site permitting issues include: 1) Energy transmission (new transmission lines and interconnections); 2) Resource assessments (logical place for such an installation); 3) Permitting processes (agencies involved); 4) Study of the population(s) affected (creation of local jobs, community benefits, hazards, public acceptance/opposition, etc); 5) Resource rights (ocean waves in this case, wind in the case of wind energy); 6) Environmental laws.

2.2.7.1 Makah Bay Offshore Wave Project

The Makah Bay Project, located in the Pacific Ocean off the coast of Washington State, is the first kind of pilot wave energy project in the nation and involved FERC licensing process which was concluded by the end of 2007. For this purpose, a FERC Alternative Licensing Process (ALP) was followed, combining into a single process the pre-filling consultation and environmental review processes under the National Environmental Policy Act (NEPA). A Preliminary Draft Environmental Assessment (PDEA)

was carried out and, together with the application for an original FERC license, was made available for public comment by 90 days. The PDEA included the assessment of the potential impacts of the demonstration project on the oceanographic, geophysical and biological conditions and it was concluded that the project would not significantly affect the quality of the human environment and there would be no cumulative effects from the proposed project. The license for the Makah Bay Offshore Wave Pilot Project, also include mitigation measures on environmental protection.

3 INCOMING LEGAL INSTRUMENTS WITH IMPACT ON OCEAN ENERGY

The instruments that are revised in this section do not directly regulate ocean energy deployment in coastal zones. However, the impacts of the activities related with wave and tidal energy exploitation must be taken into account for evaluation of good environmental status in territorial and offshore waters.

3.1 WATER FRAMEWORK DIRECTIVE

3.1.1 Aim, scope and definitions

The European Water Framework Directive (WFD; 2000/60/EC) establishes an innovative approach for water management based on river basins, the natural geographical and hydrological units and sets specific deadlines for Member States to protect aquatic ecosystems. The directive addresses inland surface waters, transitional waters, coastal waters and groundwater. It establishes several innovative principles for water management, public participation in planning and the integration of economic approaches, including the recovery of the cost of water services [19].

In the context of ocean energy deployment, this Directive applies to transitional and coastal waters that are defined as:

- Coastal waters: “surface water on the land ward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters“;
- Transitional waters: “bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows”.

Under Article 4(1) of the directive, Member States should aim to achieve “Good status” in all bodies of surface water and groundwater by 2015. Because a surface water type can has different sections with distinguishing features that set it apart from other sections of the same river, lake, transitional or coastal water, Member States shall identify separate water bodies at the scale needed to manage the objectives of the directive. According to the WFD, “good surface water status” means the status achieved by a surface water body when both ecological and chemical status is at least “good”. Thus, and according to the European guidance documents on the Implementation of the WFD, good status means low levels of chemical pollution as well as a healthy ecosystem. To achieve good ecological status, Member States will have to address the factors harming water eco-systems. Pollution is one, so are morphological changes such as dams built on rivers [19].

A river basin management plan must be set out with a detailed account of how the objectives set for the river basin (ecological status, quantitative status, chemical status and protected area objectives) are to be reached within the timescale required. The plan will include the results of the river basin's characteristics, a review of the impact of human activity on the status of waters in the basin, estimation of the effect of existing legislation and the remaining "gap" to meeting these objectives; and a set of measures designed to fill the gap. The quality elements that have to be used in ecological and chemical analysis are set in Annex V of the Directive and are presented in Table 11 a) for transitional and coastal waters. For each of the quality elements presented in Table 11 a) the classification must to fall within one of five classes which general definition is provided in Table 11 b). The timetable, which sets out the deadlines for each of the requirements of the WFD, is presented in Figure 6. At present, each Member State is supposed to be finalising the river basin management plan as well as the programme of measures (due on December 2009). Second and third revisions of the plan are going to be concluded by 2021 and 2027, respectively, and environmental quality meeting objectives should be attained at the end of the third management cycle ends.

The National and international river basin districts set in 2007 by Member States are presented in Figure 7. Coastal waters are defined in the WFD as extending 1 nautical mile from the coastline. However, some Member States have included a larger part of their coastal waters within the RBD boundaries.

3.1.2 Regulatory role of the Water Framework Directive on ocean energy projects

Since the WFD aims to achieve a good ecological and chemical status of the water, some of the potential negative impacts of marine energy farms can compromise these quality standards for a given water body. However, the extent to which such effects can apply is dependent on the dimensions of the operating area (number of the devices) as well as on the area where they are located. To comply with this Directive, ocean energy projects should not contribute to the classification of the water body falling below the category “Good”. Furthermore, and taking into account the quality elements for the ecological and chemical status assessment, special attention should be given to the effects on the quality elements underlined in Table 11 **Error! Reference source not found.**a).

Another aspect that should be considered is the current uncertainty related with the effects of some of the potential environmental impacts of marine energy devices. As regards the water chemical status evaluation, critical uncertainties exist about the effects of chemical nature of the converters equipment: toxicity of the compounds, the quantity that will be released, the response of the

natural (abiotic and biotic) receptors and the routes followed by the compounds. However, wherever possible the quality standards established under this Directive particularly those related with the discharge or release of priority substances (Annex X) in the water should be examined prior of marine energy converters deployment. Monitoring of the priority substances release during the converters installation and operating phases could be also part of the programme of measures to be established, under the WFD, to the concerned water body.

Table 11 a) Quality elements for the classification of ecological status of transitional and coastal surface waters; b) Normative definitions of ecological status classifications (WFD, Annex V). Potential pressures and impacts of marine energy deployment or operation are underlined.

a) Quality elements	**Transitional**	**Coastal**
Biological elements	Composition, abundance and biomass of phytoplankton Composition, abundance and biomass of other aquatic flora Composition, abundance and biomass of benthic invertebrate fauna Composition, abundance and biomass of fish fauna	-
Hydro-morphological elements supporting the biological elements	Morphological conditions - Depth variation - Quantity, structure and substrate of the bed - Structure of the intertidal zone Tidal regime - Freshwater flow - Wave exposure	Morphological conditions - Depth variation - Structure and substrate of the bed - Structure of the intertidal zone Tidal regime - Direction of dominant currents - Wave exposure
Chemical and physico-chemical elements supporting the biological elements	General - Transparency - Thermal conditions - Oxygenation conditions - Salinity - Nutrient conditions Specific pollutants - Pollution by all priority substances identified as being discharged into the body of water - Pollution by other substances identified as being discharged in significant quantities into the body of water	
b) Ecological status classifications	**General definition for rivers, lakes, transitional, waters and coastal waters**	
High status	There are no, or only very minor, anthropogenic alterations to the values of the physico-chemical and hydromorphological quality elements for the surface water body type from those normally associated with that type under undisturbed conditions. The values of the biological quality elements for the surface water body reflect those normally associated with that type under undisturbed conditions, and show no, or only very minor, evidence of distortion. These are the type-specific conditions and communities.	
Good status	The values of the biological quality elements for the surface water body type show low levels of distortion resulting from human activity, but deviate only slightly from those normally associated with the surface water body type under undisturbed conditions.	
Moderate status	The values of the biological quality elements for the surface water body type deviate moderately from those normally associated with the surface water body type under undisturbed conditions. The values show moderate signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status.	

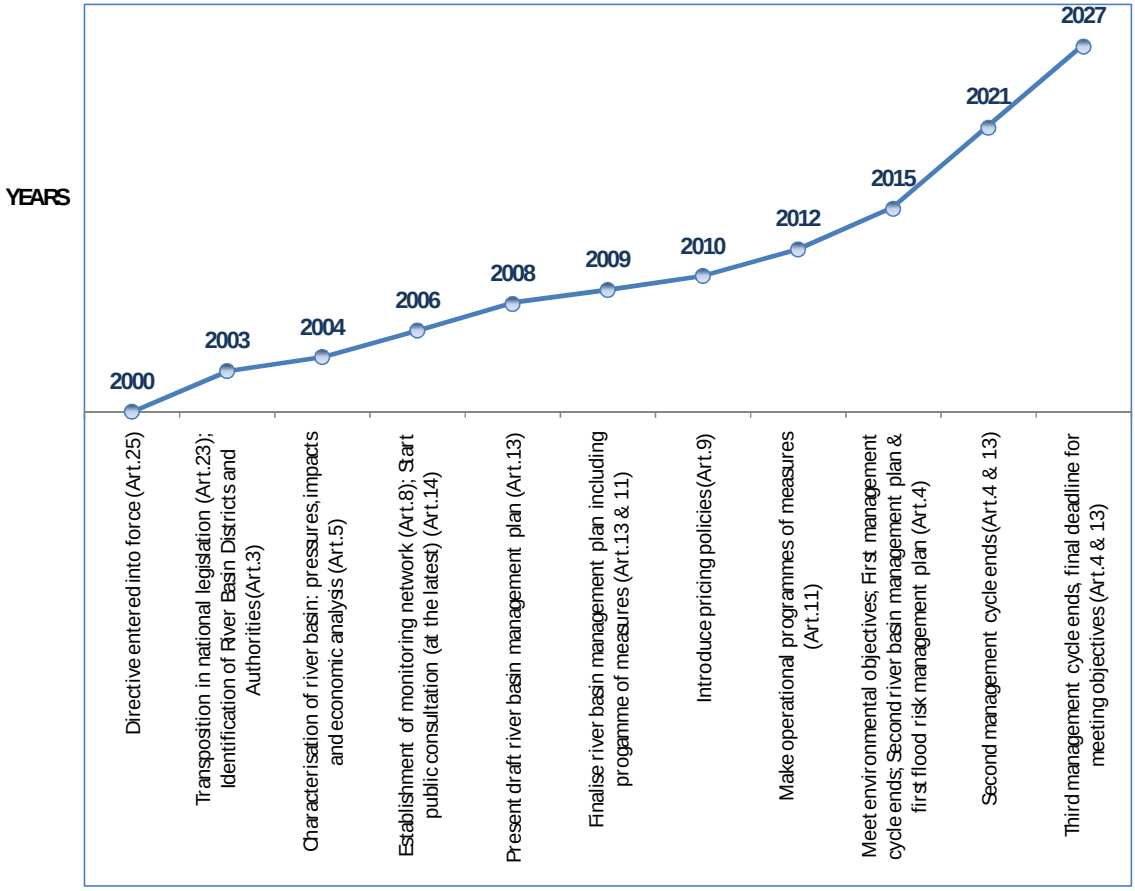


Figure 6 Timetable for the implementation of the Water Framework Directive. Deadlines and milestones for each of the requirements.

3.2 MARINE STRATEGY FRAMEWORK DIRECTIVE

3.2.1 Aim, scope and definitions

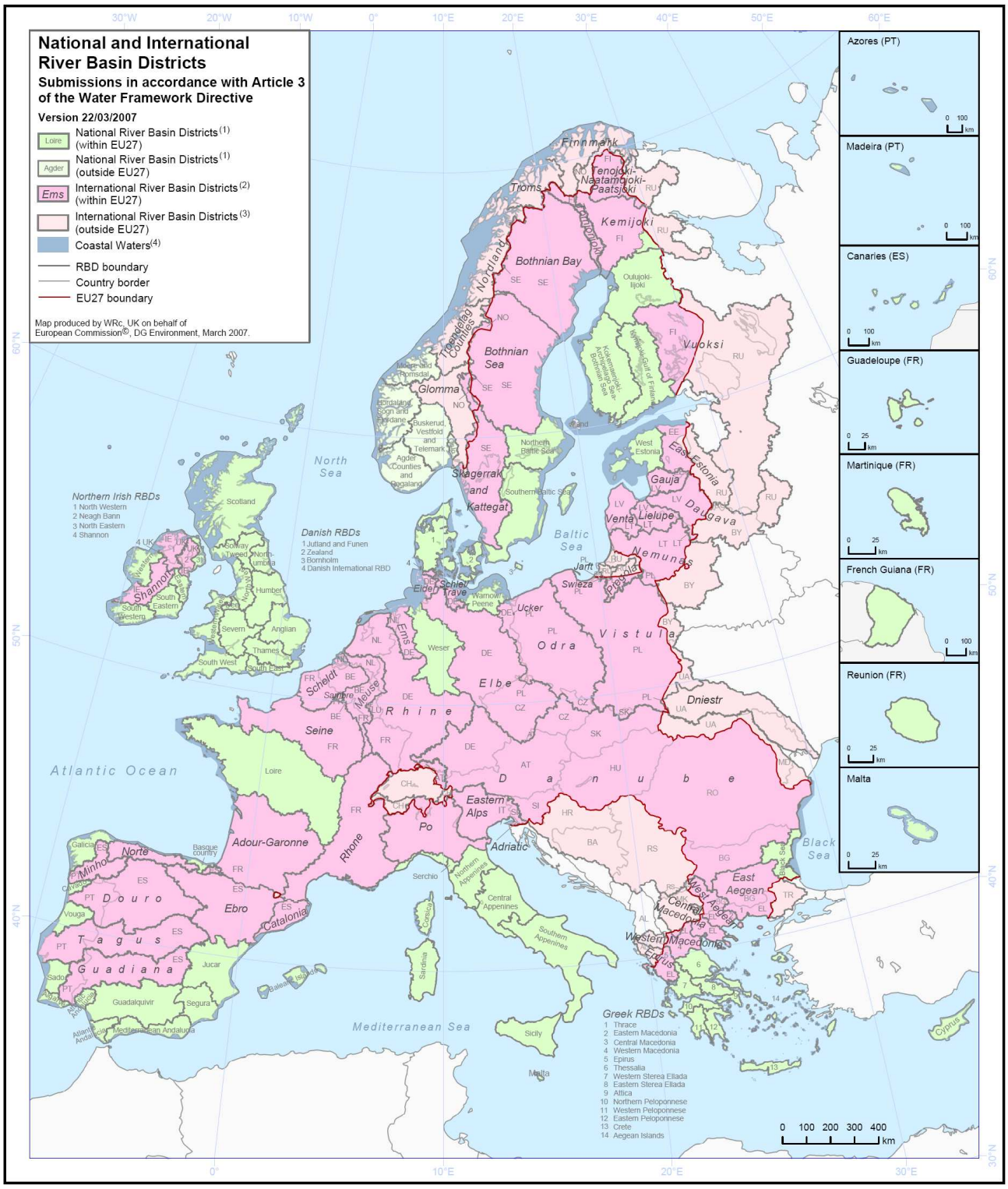
The Marine Strategy Framework Directive (MSFD; 2008/56/EC) constitutes the environmental pillar of the Union's Integrated Maritime Policy (IMP; [21]), designed to achieve the full economic potential of oceans and seas in harmony with the marine environment. It was adopted by the European Parliament in June 2008 and aims to protect the marine environment across Europe through the achievement of a "Good environmental status" of the marine waters by 2021 and to protect the resource base upon which marine-related economic and social activities depend.

The MSFD shall apply to all marine "waters, the seabed and subsoil on the seaward side of the baseline from which the extent of territorial waters is measured extending to the outmost reach of the area where Member State has and/or exercises jurisdiction rights" (Article 3). This directive should also apply to all coastal waters, which are not addressed under the WFD or other Community legislation.

The "Good environmental status" should be achieved for marine European regions established on the basis of geographical and environmental criteria. Each Member State is required to cooperate with other Member States and non-EU countries within a marine region, to develop strategies for their marine waters. The marine strategies to be developed by each Member State must contain a detailed assessment of the state of the environment, a definition of "Good environmental status" at regional level and the establishment of clear environmental targets and monitoring programmes [21]. According to the Directive's definitions (Article 3), "Good environmental status" means:

"The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations, i.e:

(a) The structure, functions and processes of the constituent marine ecosystems, together with the associate physiographic, geographic, geological and climatic factors, allow those ecosystems to function fully and to maintain their resilience to human-induced environmental change. Marine species and habitats are protected, human-induced decline of biodiversity is prevented and diverse biological components function in balance;



Footnotes:

1) Map based largely on submissions of digital River Basin Districts (RBDs) from EU Member States and Norway.

2) Some of the international RBDs shown on this map were not identified as being international by the Member States, i.e. the Adour-Garonne, Rhone and Seine in France; the Vistula in Poland; the Kemijoki and Vuoksi in Finland.
Both the German Eider and Schlei/Trave RBDs are shared with the Danish International RBD.
Part of the Italian Eastern Alps RBD is shared with the Slovenian Adriatic RBD.
It is understood that the Tornionjoki international RBD in Finland is shared with Sweden, most likely with part of the Bothnian Bay international RBD. As the Bothnian Bay covers several river catchments, the Tornionjoki and Bothnian Bay have been kept separate in this map.
The delineation of the Finnmark RBD between Norway and Finland is currently under review.

3) These are the boundaries of the river catchments extending beyond the EU27 border. They have been derived from the Catchment Characterisation and Modelling (CCM) database, developed by the Joint Research Centre (JRC), except the boundaries for the Danube international RBD which were supplied by the International Commission for the Protection of the Danube River (ICPDR).

4) Coastal waters are defined in the Water Framework Directive (WFD) as extending 1 nautical mile from the coastline. However, some Member States have included a larger part of their coastal waters within the RBD boundaries.

Figure 7 National and international river basin district as designated by Member States [20].

(a) Hydromorphological, physical and chemical properties of the ecosystems, including those properties which result from human activities in the area concerned, support the ecosystems as described above. Anthropogenic inputs of substances and energy, including noise, into the marine environment do not cause pollution effects;

Good environmental status shall be determined at the level of the marine region or sub-region as referred to in Article 4, on the basis of the qualitative descriptors in Annex I. Adaptive management on the basis of the ecosystem approach shall be applied with the aim of attaining good environmental status."

As mentioned above, the "Good environmental status" shall be determined based on several qualitative descriptors defined in Annex I of the MSFD, which are presented in Table 12. The initial assessment for Marine Strategies preparation should be carried out comprising (a) an analysis of the essential features and characteristics and current environmental status of the marine waters, (b) an analysis of the predominant pressures and impacts and (c) an economic and social analysis of the use of those waters and the cost of degradation of the marine environment. The analysis of the predominant pressures and impacts has to be based on the list of indicative elements set out in Annex III (Table 13), and should cover the qualitative and quantitative mix of the various pressures, as well as their trends and cumulative and synergetic effects.

Each Member State must draw up a programme of cost-effective measures and, before their implementation, shall conduct an impact assessment. Where Member States cannot reach the environmental targets specific measures tailored to the particular context of the area will be drawn up. The goal of the Marine Strategy Framework Directive is in line with the objectives of the Water Framework Directive which requires surface - such as lakes, streams, rivers, estuaries, and coastal waters - and ground water bodies to be ecologically sound by 2015 [21]. The timetable of the MSFD which sets out the deadlines for each of the requirements is presented in Figure 8.

Table 12 Qualitative descriptors for determining good environmental status of marine waters established in Annex I of the Marine Strategy Framework Directive.

Topics	Description
(1)	Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.
(2)	Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.
(3)	Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.
(4)	All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity
(5)	Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.
(6)	Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.
(7)	Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.
(8)	Concentrations of contaminants are at levels not giving rise to pollution effects.
(9)	Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.
(10)	Properties and quantities of marine litter do not cause harm to the coastal and marine environment.
(11)	Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

3.2.2 Regulatory role of the Marine Strategy Framework Directive on ocean energy projects

Although Member States are still in the period of bringing into force the laws, regulations and administrative provisions necessary to comply with this Directive (which should happen by July 2010), it is clear that the MSFD aims to regulate human activities in marine waters. The activities related with ocean energy deployment will certainly be included in this group.

Some of the negative environmental impacts of ocean energy farms are within the indicative pressures and impacts of the MSFD presented in Table 13 and can potentially interfere with the local "Good environmental status". However, clarification is needed on the reference values for some of the qualitative descriptors presented in Table 12, e.g. the levels of underwater noise that cause adverse effects on the marine environment. In analogy with other European Directives, guidance documents on the application of MSFD are expected.

In analogy with what is referred above for the WFD, difficulties in the application of this Directive can also arise from the uncertainties in some of the potential environmental impacts of marine energy devices such as those related with the risk of animals colliding with converters' moving parts and the effects of the converter's underwater noise on marine mammals and fish.

Table 13 Indicative list of elements of pressures and impacts referred in Annex III of the MSFD. Potential pressures and impacts of marine energy deployment or operation are underlined.

Topics	Pressures and impacts to be examined
Physical loss	- Smothering (e.g. by man-made structures, disposal of dredge spoil) - Sealing (e.g. by permanent constructions)
Physical damage	- Changes in siltation (e.g. by outfalls, increased run-off, dredging/disposal of dredge spoil) - Abrasion (e.g. impact on the seabed of commercial fishing, boating, anchoring) - Selective extraction (e.g. exploration and exploitation of living and non-living resources on seabed and subsoil)
Other physical disturbance	- Underwater noise (e.g. from shipping, underwater acoustic equipment) - Marine litter
Interference with hydrological processes	- Significant changes in thermal regime (e.g. by outfalls from power stations) - Significant changes in salinity regime (e.g. by constructions impeding water movements, water abstraction)
Contamination by hazardous substances	- Introduction of synthetic compounds (e.g. priority substances under Directive 2000/60/EC which are relevant for the marine environment such as pesticides, antifoulants, pharmaceuticals, resulting, for example, from losses from diffuse sources, pollution by ships, atmospheric deposition and biologically active substances) - Introduction of non-synthetic substances and compounds (e.g. heavy metals, hydrocarbons, resulting, for example, from pollution by ships and oil, gas and mineral exploration and exploitation, atmospheric deposition, riverine inputs) - Introduction of radio-nuclides
Systematic and/or intentional release of substances	- Introduction of other substances, whether solid, liquid or gas, in marine waters, resulting from their systematic and/or intentional release into the marine environment, as permitted in accordance with other Community legislation and/or international conventions
Nutrient and organic matter enrichment	- Inputs of fertilisers and other nitrogen — and phosphorus-rich substances (e.g. from point and diffuse sources, including agriculture, aquaculture, atmospheric deposition) - Inputs of organic matter (e.g. sewers, mariculture, riverine inputs)
Biological disturbance	- Introduction of microbial pathogens, - Introduction of non-indigenous species and translocations, - Selective extraction of species, including incidental non-target catches (e.g. by commercial and recreational fishing)

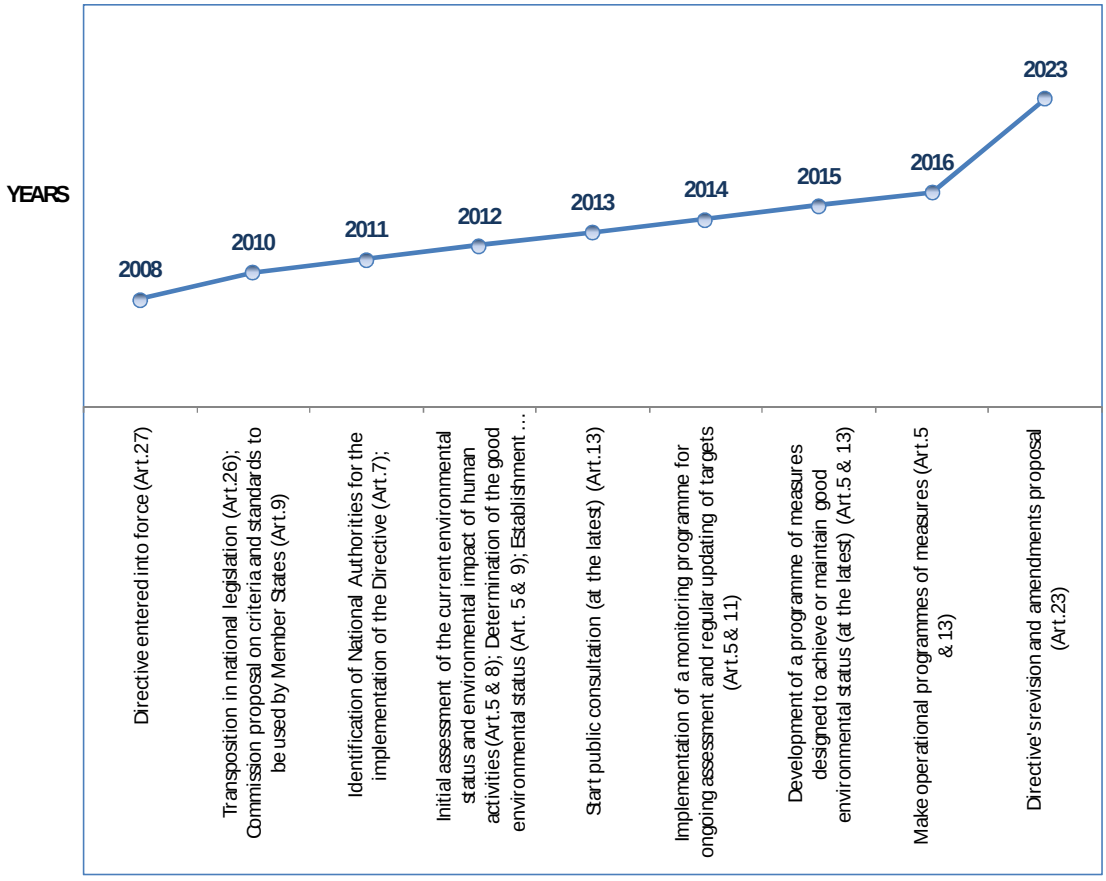


Figure 8 Timetable for the implementation of the Marine Strategy Framework Directive. Deadlines and milestones for each of the requirements.

3.3 MARITIME SPATIAL PLANNING

The Integrated Maritime Policy (IMP) for European Union and a detailed action plan were endorsed by the European Council on December 2007. About one year later (November 2008), and because Maritime Spatial Planning (MSP) is considered a key instrument for IMP, a communication from the European Commission on the common principles for Maritime Spatial Planning was released to help public authorities and stakeholders coordinate their actions and optimise the use of marine space to benefit both economic development and the marine environment. Maritime Spatial Planning is a tool for improved decision-making providing a framework for arbitrating between competing human activities and managing their impact on the marine environment. Its objective is to balance interests and achieve sustainable use of marine resources according to EU Sustainable Development Strategy. The plan for the marine areas should be based on the specificities of individual marine regions or sub-regions established under the Marine Strategy Framework Directive. The development of this plan is a process starting with data collection and stakeholder consultation. The subsequent stages of its implementation, enforcement, evaluation and revision should be developed under a participatory procedure involving all interested parties [22].

Although MSP is a very recent and new process, an increasing number of Member States are preparing to use it. Examples of projects that have already started to develop a range of tools and criteria are presented in Table 14. It is important to note that for some of the projects on MSP, the energy sector (offshore wind energy in particular) has stimulated its development and consideration of maritime areas for such activities. This is probably what is going to happen with ocean energy too.

Table 14 Examples of existing approaches to maritime spatial planning [22].

Country	Description	Reference
United Kingdom	Sets up a maritime planning system for all UK waters	[23]
Scotland	Drafted a Marine Bill for management of its seas. Together with the Marine Bill established in UK provide a new administrative structure (the Marine Management Organisation) to simplify permit and licensing procedures.	[24]
Sweden	The adoption of a Marine Bill is scheduled for early 2009.	-
Portugal	The National Strategy for the Seas (2006) seeks to integrate sectoral policies and to define principles for MSP and Integrated Coastal Zone Management (ICZM). An Inter-ministerial Committee for Sea Affairs was created in 2007.	-
Germany	Extended its terrestrial planning law and thus federal powers for MSP to the Economic Exclusive Zone. This extension was prompted by the development of the offshore wind energy sector. The recently developed MSP covers all three dimensions of MSP (surface, water column and sea bed), and identifies zones for specific maritime activities.	[25]
Belgium	Uses zoning in a “Master Plan” to allocate marine space for specific maritime uses. The driving forces are sand and gravel extraction and offshore wind energy. A second planning phase will determine sites for marine protected areas (Natura 2000 network). The plan allows permits and licences for a given type of activity to be granted only within the identified zones and is subject to regular monitoring and evaluation.	[26]
Poland	Regulates spatial planning in marine areas through the “Marine Areas of the Republic of Poland” and “Maritime Administration Act”. Poland intends to change its national planning law to give maritime spatial plans legal status and develop such plans for all Polish waters.	[27]
Netherlands	Developed an Integrated Management Plan for the North Sea 2015. The main motivation is the need to plan offshore wind energy. The plan introduces an integrated assessment framework for all activities requiring a permit. Opportunity maps have been created for maritime uses.	[28]
Norway	Developed an Integrated Management Plan for the Barrents Sea and the sea area off the Lofoten Islands. It provides a framework for sustainable resource use and for existing and new activities. Norway intends to develop integrated management plans for the Norwegian part of the North Sea.	[29]
France	Introduced the “Schéma de mise en valeur de la mer” for lake Thau in the Mediterranean and the Arcachon Basin in the Atlantic. The scheme focuses on coastal zone development, includes measures such as zoning activities and identifies areas for particular maritime uses. France is currently developing a framework law for the environment that will include specific provisions for the management of maritime activities.	-
Spain	Adopted a Strategy for the sustainability of the coast in 2007. The Spanish regions of Asturias, Cantabria and Andalucia have developed integrated plans to manage their coastal zones. Spain has also launched a study on zoning of its territorial waters for the use of offshore wind energy.	[30]
Canada	Adopted an objective-based approach to the management of maritime activities, which provides guidance for solving cross-sectoral conflicts	-
Australia	Advanced in the use of three-dimensional maritime zoning and involves a wide array of stakeholders in this process.	-

4 LEGISLATION IN OTHER TECHNOLOGIES

It is reasonable to admit that the process for permitting an ocean energy farm should be similar to the process for offshore wind installations. This is because both installations have many underwater components that may interfere with marine life. However a key difference between the two technologies is the above water visibility of offshore wind turbines which is a potential obstacle for complete public acceptance. Furthermore, and unlike ocean energy, offshore wind farms must meet airspace legal requirements

[18]. In this section the evaluation of the legal requirements for offshore wind energy are evaluated for some of the countries where it is already a reality.

4.1 UNITED KINGDOM

The consent procedure for wind offshore in United Kingdom follows a pre-qualification procedure in which developers are checked on their financial standing as well as on their offshore and wind turbine expertise. The qualified developers can make a bid for a chosen location and it is recommended to stay within the areas designated by SEA. The lowest bids get an Agreement of Lease from Crown Estate. An EIA has to be carried out and the consent can only be attained after public notice and consultation process. To support the developers, DTI has set up a one-shop-stop in the form of Offshore Renewables Consents Unit (ORCU) to aid with the consent applications http://www.mityc.es/energia/electricidad/Paginas/Index.aspx

[31].

4.2 THE NETHERLANDS

For the installation of an offshore wind farm in Netherlands the permit procedure starts with a developer sending his project initiative to the Ministry for Transport, Public Works and Water Management. The response includes guidelines for the permit request and the developer initiative is made public. The permit submission, established under the Public Works and Water Management Act (WBr), should contain the plans for construction, the plans for decommissioning and an EIA. For parks outside the 12 miles zone an Environmental Impact Assessment is required only for the areas where impacts are considered significant. The time and location choice is determined by the developer in his consent application http://www.mityc.es/energia/electricidad/Paginas/Index.aspx

[31].

4.3 DENMARK

In Denmark, whereas the utilization of wind on land territory is primarily subject to the general planning requirements on locations of industrial plants in the landscape, a special licence system is required for the utilization of wind offshore [32]. The Danish State has the exclusive rights to the utilization of offshore wind but combined with a special licence system as set out in the Electricity Supply Act. The Danish Energy Authority (DEA) is the main contact point in the established “one-stop-shop” permitting procedure for offshore wind projects. The DEA handles the consent procedure having the authority to award all licences and permits, for which it consults the other involved departments. However, there are limitations with respect to area and time and if the activity is assumed to have significant impact on the environment. Permission should only be granted on the basis of an EIA (EIA is described in Executive Order Nº 815 of 28 August 2000) [2]. The permitting procedure in Denmark involves a pre-qualification round based on its financial, legal and technical qualifications after which the chosen developers could place a tender offer. The successful applicant receives, from the DEA, the permits to survey the area, install the offshore farm and exploit wind energy but still has to do an EIA and await public consultation process after submission the complete application with the EIA http://www.mityc.es/energia/electricidad/Paginas/Index.aspx

[31].

5 CONCLUSIONS AND RECOMMENDATIONS

Although there is a lack in legislation on environmental impact assessment for ocean energy projects it is reasonable to presume that related legal instruments will be updated as the wave and tidal energy industry develops. Therefore, regulation on EIA is supposed to become an essential element for allowing large-scale ocean energy schemes [12].

At present, in countries where regulation on ocean energy schemes has already been implemented, and since it is generally assumed that ocean energy is a “clean energy”, the legal requirements for a complete EIA may be less demanding (e.g. Portugal), may not be required (e.g. Denmark) or, in some countries, required for some projects depending on its characteristics (e.g. United Kingdom – for commercial deployments; Spain, if the authorities deems it necessary; France for those projects exceeding a 2.5 megawatts production having a sea cable). Since the impacts of a project are strongly dependent on the characteristics of the device and the location, the emphasis of environmental assessment may be tailored to the specific project as in the protocol established in the Canadian legislation. A first analysis based on the characteristics of the project and its location is used to streamline the environmental assessment to be conducted.

Another important issue concerning the current status of EIA requirements for ocean energy consent is the overlap supervision between authorities. In United States federal and state government interaction with the developers is needed for ocean energy project approval with EIA required for both Federal Government licence (under the National Environmental Policy) State Government, if the project overlaps endangered species habitat. Over-regulation or conflicting regulatory policies can arise from this situation which can hold back wave energy development. For the wind offshore licensing process the set up of a one-stop-shop entity has been implemented in several countries to aid with the consent applications. The same was also tried in Denmark for wave energy (Wave Dragon technology) but, due to a lack in official guidelines and administrative experiences, the responsibility for the whole project changed during the process being difficult to implement a one-stop-shop procedure similar to

the national wind offshore permitting. Improved coordination between authorities or agencies would make the process less burdensome.

Public participation is also an issue included in most of the current legislation on ocean energy projects. This process usually occurs during the scoping procedure and it is essential to promote a consensus about the environmental questions through the public understanding on the effects / impacts of the activity. As a comparison with offshore energy, EIA and public consultation are both required for project approval in several countries.

As regards future legislation on environmental assessment requirements for ocean energy, special attention should be given to the incoming European legal instruments like Water Framework Directive and Marine Strategy Framework Directive. To comply with these instruments, ocean energy projects should not contribute to the classification of the marine environment (including water quality) below the category "Good". Under the Maritime Spatial Planning tool, a very recent and new process endorsed by the European Council, the establishment of maritime areas for the development of ocean energy schemes is expected to promote the activity as occurs for wind offshore energy.

As a final recommendation and for both practical and legal purposes it is important to streamline and focus the environmental assessment process defining the relevant impacts that should be considered in the analysis as well as the correspondent baseline descriptors which are going to be used for comparison during impacts valuation. The list of potential impacts to be evaluated should be prioritised with care and updated in the light of ongoing research since there are some generic and critical uncertainties of the device impacts on the environment that require further basic research. The legal framework should be designed to cover impact uncertainties and allow for amendment of protocols as and when the uncertainties are resolved. This approach is known as Adaptive Management and should be incorporated in the legal framework of ocean energy schemes.

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