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SOWFIA Project - Work Package 2 Final Report

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Streamlining of Ocean Wave Farms Impact Assessment (SOWFIA) Project

Deliverable 2.6

Work Package 2 Final Report

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Streamlining of Ocean Wave Farms Impact Assessment

D.2.6 – Work Package 2 Final Report

"Report on the analysis of the Work Package 2 findings regarding barriers and accelerators of wave energy"

May 2013

SOWFIA project synopsis

The Streamlining of Ocean Wave Farms Impact Assessment (SOWFIA) Project (IEE/09/809/ SI2.558291) is an EU Intelligent Energy Europe (IEE) funded project that draws together ten partners, across eight European countries, who are actively involved with planned wave farm test centres. The SOWFIA project aims to achieve the sharing and consolidation of pan-European experience of consenting processes and environmental and socio-economic impact assessment (IA) best practices for offshore wave energy conversion developments.

Studies of wave farm demonstration projects in each of the collaborating EU nations are contributing to the findings. The study sites comprise a wide range of device technologies, environmental settings and stakeholder interests. Through project workshops, meetings, on-going communication and networking amongst project partners, ideas and experiences relating to IA and policy are being shared, and co-ordinated studies addressing key questions for wave energy development are being carried out.

The overall goal of the SOWFIA project is to provide recommendations for approval process streamlining and European-wide streamlining of IA processes, thereby helping to remove legal, environmental and socio-economic barriers to the development of offshore power generation from waves. By utilising the findings from technology-specific monitoring at multiple sites, SOWFIA will accelerate knowledge transfer and promote European-wide expertise on environmental and socio-economic impact assessments of wave energy projects. In this way, the development of the future, commercial phase of offshore wave energy installations will benefit from the lessons learned from existing smaller-scale developments.

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Work Package 2 Final Report

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Executive Summary

The wave energy industry is an innovative and developing industry which aims to contribute to meeting EU renewable energy targets. Consenting processes across the EU and Environmental Impact Assessment (EIA) legislation were not designed with the wave energy industry in mind. During SOWFIA Work Package 2 wave energy developers (wave energy test centre developers, device and project developers) and regulators with experience of the wave energy consenting process have identified barriers and accelerators (things which are working well), based on their experiences to date. These barriers and accelerators have been compiled and analysed in this document along with suggestions provided by these key actors for improving the situation.

It is important to note that only a relatively small amount of wave energy capacity, in comparison to 2020 ocean energy targets for Member States, has been installed to date. This implies that the consenting process for wave energy developments in Member States has not yet been seriously tested. Wave energy capacity that has been installed has largely been single devices deployed at specially built wave energy test centres in different Member States. As such, any accelerators identified cannot yet be judged to be robust and although there is a possibility that some of the barriers identified will diminish as the sector expands, it is more judicious to assume that some, if not most, of the barriers discussed will become more serious as the size of proposed developments increases and their environmental impacts and effects on other users of marine areas also increase. With this in mind, recommendations are presented for ameliorating barriers in the consenting process in Europe. The barriers, accelerators and recommendations are presented within three thematic areas:

1. Administrative Procedures
2. Environmental Impacts (EIA Process and Environmental Monitoring)
3. Human Dimensions

1. Administrative Procedures

Administrative procedures relating to the granting of consents for wave energy developments have been identified as a barrier to the development of the industry. Many different authorities are stakeholders in the maritime environment. Different permits are required from different authorities to undertake a development. The permits required vary between EU Member States. This is inevitable, to an extent, for development consent but should be less common for EIA where there is a common legal framework across the EU. Developers frequently suggested that new consenting regimes, such as the 'one-stop shop' system which was cited to be operating successfully in Scotland, are required for wave energy.

For the wave energy industry to develop, it is necessary to ensure that consenting procedures for wave energy developments are fit for purpose and viewed to be fit for purpose. This is important to maintain and increase investor confidence while at the same time ensuring that stakeholders remain engaged with consenting procedures. The establishment of new or amended consenting regimes may not be practical in all Member States and should be based on a realistic level of resources and legislative amendments. Other actions which should be easier to achieve for Member States who are interested in the development of the wave energy industry include: (i) The allocation of a dedicated

co-ordinating body (this does not have to be a new body) in Member States for wave energy consents; (ii) Implementation of a clear process with clear procedures including responsibilities, timelines and ability to appeal; (iii) Introduction or amendment of statutory timeframes in existing legislation and (iv) All test centres should provide guidance to developers on the consenting process so that developers are encouraged to deploy there and gain experience which they can then apply to future developments.

2. Environmental Impacts (EIA Process and Environmental Monitoring)

Both the EIA process and environmental monitoring requirements have been identified as barriers to the development of the wave energy industry. Much of this relates to the unknown effects of wave energy devices on the marine environment. In terms of the EIA process, there is inconsistency in the way in which the EIA Directive is applied to developments across different Member States. There is a feeling within the industry that the EIA process is overly burdensome given the nascent state of the industry. In terms of monitoring requirements, developers feel that they are too onerous for the current state of the industry. There is sometimes not enough guidance provided from regulators as to the scope of EIAs and monitoring requirements subsequent to EIAs can be too vague. The desire of developers for confidentiality reduces the rate at which understanding of environmental impacts can be obtained.

The proposal for amendments to the EIA Directive published by the Commission of the European Communities has the potential to improve procedural aspects of the EIA Directive as it is applied to wave energy developments. It is also recommended that competent authorities adopt a stricter approach to EIA screening whereby only those developments likely to have significant environmental effects, as outlined by Directive 2011/92/EU (the EIA Directive), are subject to a full EIA. Clearer environmental assessment requirements should be provided by consenting authorities to developers. Site specific impacts, whereby only impacts likely to be caused by a project deployment at a certain site, should be the priority for small scale projects.

Various actions can be taken to increase understanding of the effects of wave energy devices on the environment. This can be done through the facilitation of an adaptive management approach, EU funding for research programmes on the environmental effects of wave energy devices, especially in test centres, and by requiring EIA data for wave energy developments to be made publicly available. Baseline and impacts data should be made available, at least for deployments at test centres.

3. Human Dimensions

There are many stakeholders and other users of the maritime environment with whom there is potential for conflicts of use. To date, developers are satisfied with the consultation they have undertaken with these groups. Conflicts of use have arisen but have generally been identified and resolved at relatively early stages in projects. There is, however, the potential for the consultation process to be time and resource consuming for small wave energy developers.

There are a number of recommendations based on the experiences of wave energy developers to date which will help future developers navigate the consultation process. These include engaging with stakeholders at an early stage, selecting suitable representatives to engage with stakeholders,

giving them realistic timelines to respond / make submissions and presenting them with credible, evidence based information in an accessible and understandable format.
There is much potential for increased conflicts of use as the number of wave energy developments increases. Integrated planning could ensure greater coordination and communication between the authorities involved in wave energy consenting and hence reduce the potential for conflicts of use. There are, however a number of barriers related to integrated planning: (i) There is a lack of strategic planning involving and integrating all uses in the marine space; (ii) There are different levels of Maritime Spatial Planning (MSP) implementation in Member States and there is usually a disconnect between MSP, Strategic Environmental Assessment (SEA) and EIA processes and (iii) MSP tends to reflect existing uses more fully than future potential uses like ocean energy developments.

Responsible government departments at national level should integrate and coordinate their policies and implement these policies through a dedicated MSP supported, where necessary, by an appropriate consenting system. SEAs of specific plans and programme areas should be undertaken to ensure strategic government oversight and avoid conflicts between sectors and ultimately marine users. Guidance documents should be produced to advise wave energy developers and other stakeholders on the siting of their developments within a given area and how to negotiate the consenting process applicable to their activity. Public databases should be developed with information on marine natural resources and uses respectively, including information on coastal infrastructure and socio-economic aspects.

Glossary

Acronym	Meaning
AA	Appropriate Assessment
AMETS	Atlantic Marine Energy Test Site
BIMEP	Biscay International Marine Energy Plant
CZM	Coastal Zone Management
Danwec	Danish Wave Energy Centre
DEA	Danish Energy Association
DG Mare	Directorate-General for Maritime Affairs and Fisheries
EBM	Ecosystem Based Management [Approach]
ECJ	European Court of Justice
EIA	Environmental Impact Assessment
EMEC	European Marine Energy Centre
EU	European Union
EWEA	European Wind Energy Association
GES	Good Environmental Status
GW	Gigawatt(s)
IA	Impact Assessment
ICM	Integrated Coastal Management
ICZM	Integrated Coastal Zone Management
IDA	Danish Society of Engineers
IEE	Intelligent Energy Europe
IMP	Integrated Maritime Policy
km	kilometre
MSP	Maritime Spatial Planning
MSFD	Marine Strategy Framework Directive
MSPF	Marine Spatial Plan Framework
MW	Megawatt(s)
NREAP	National Renewable Energy Action Plan(s)
OREDP	Offshore Renewable Energy Development Plan
SEA	Strategic Environmental Assessment
SEMREV	Site D'Experimentation En Mer (Marine Test Site)
TFEU	Treaty on the Functioning of the European Union
UKERC	United Kingdom Energy Research Centre
WP	Work Package

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1 Introduction

1.1 Background and Context

The SOWFIA (Streamlining of Ocean Wave Farms Impact Assessment) project is a three year Intelligent Energy Europe (IEE) funded project which began in October 2010. It brings together ten project partners from across Europe who share an interest in planning for wave farm developments.

Wave energy is an innovative and developing industry which aims to contribute to meeting EU renewable energy targets. Consenting processes across the EU and Environmental Impact Assessment (EIA) legislation were not designed with the wave energy industry in mind and have previously been identified as a barrier to the development of the industry[1]. The aim of the SOWFIA project is to investigate whether this is the case and if required, to provide recommendations for the streamlining of approval processes and impact assessment requirements for wave energy developments in Europe. This should help to protect marine ecosystems and safeguard stakeholder interests while simultaneously encouraging the development of renewable energy. This report describes the main findings from SOWFIA Work Package 2, 'Identifying barriers and accelerators for European prototype wave farms.'

1.2 SOWFIA Work Package 2 - Identifying barriers and accelerators for European prototype wave farms

There is an increasing amount of practical experience from wave energy consenting processes being gained as wave energy projects are being deployed across Europe. To date, this growing experience and knowledge has not been compiled in a structured way and made widely accessible to regulators, project developers, policy makers or stakeholders. The aim of SOWFIA Work Package 2 was to compile, analyse and make available information and derive lessons from these experiences.

To reach this objective, workshops, meetings and questionnaires were undertaken with key actors in the consenting process from across Europe. The key actors mainly focused on were wave energy developers and those in charge of consenting their developments. The term 'wave energy developers', includes wave energy test centre developers, device developers and commercial wave farm developers. At the outset of the project, it was hoped that there would be a large input from commercial wave farm developers. To date (February 2013), however, apart from one short term deployment, no commercial scale wave farms have been deployed. This means that the experiences presented and lessons learned from wave energy developers in this project come mainly from wave energy test centre developers and device developers and consequently are representative of the nascent state of the industry.

From these experiences, barriers common to different actors in the wave energy consenting process across various EU Member States have been identified. Accelerators, or elements that are working well in the consenting process, were also identified. The main barriers and accelerators identified are

[1] WAVEPLAM. Non-technological barriers to wave energy implementation. Report published as part of Intelligent Energy Europe funded WAVEPLAM project. Available at http://www.waveplam.eu/page/default.asp?la=1&id=5

presented in this document. Actions which could ameliorate the barriers have been suggested by key actors. A critical analysis of the barriers and the suggested actions is also included in this document. Based on the analysis, recommendations have been produced that can be implemented across Europe to address these barriers to accelerate the development of the wave energy industry in a sustainable manner.

1.3 Scope of the Report

Section 2 of this report describes the methodology used to compile the information needed to meet the objectives of Work Package 2. Section 3 first presents the current state of the wave energy industry in Europe which sets the context for the rest of the information gathered during Work Package 2. The rest of Section 3 presents barriers and accelerators in the wave energy consenting process identified by key actors in the wave energy consenting process. Actions suggested by these actors which could ameliorate the barriers are also presented. Section 4 provides a critical analysis of possible alternatives for improving the wave energy consenting process. Based on this analysis Section 5 presents the key conclusions and recommendations from SOWFIA Work Package 2.

This report aims to focus on the main barriers and accelerators related to the wave energy consenting process based on experiences which were mainly related by wave energy developers and regulators. There are many other technological (e.g. device reliability, grid issues, etc.) and non-technological (economics, supply chain infrastructure, etc.) barriers to the development of the wave energy industry, which are outside the scope of this report. Further information from SOWFIA Work Package 2 can be found in Work Package reports 2.1 to 2.5 which are available on the SOWFIA project website (http://www.sowfia.eu/).

2 Methodology

2.1 Introduction

The methodology used during Work Package 2 is illustrated in Figure 1. The current status of the wave energy industry was first investigated. This work provided the context for the experience and knowledge gathering tasks carried out during the rest of the Work Package. Findings from the questionnaires and workshop involving wave energy developers were used as an input into the design of the second workshop which focused on improvements that could be made to the consenting process. Outcomes from a SOWFIA Work Package 4 workshop which focussed on stakeholders opinions were also used as an input into the design of this workshop. This report provides recommendations from SOWFIA Work Package 2 based on analysis of barriers and accelerators and lessons learned from the key actors interacted with during the Work Package tasks. The remainder of this section describes the tasks undertaken during the Work Package.

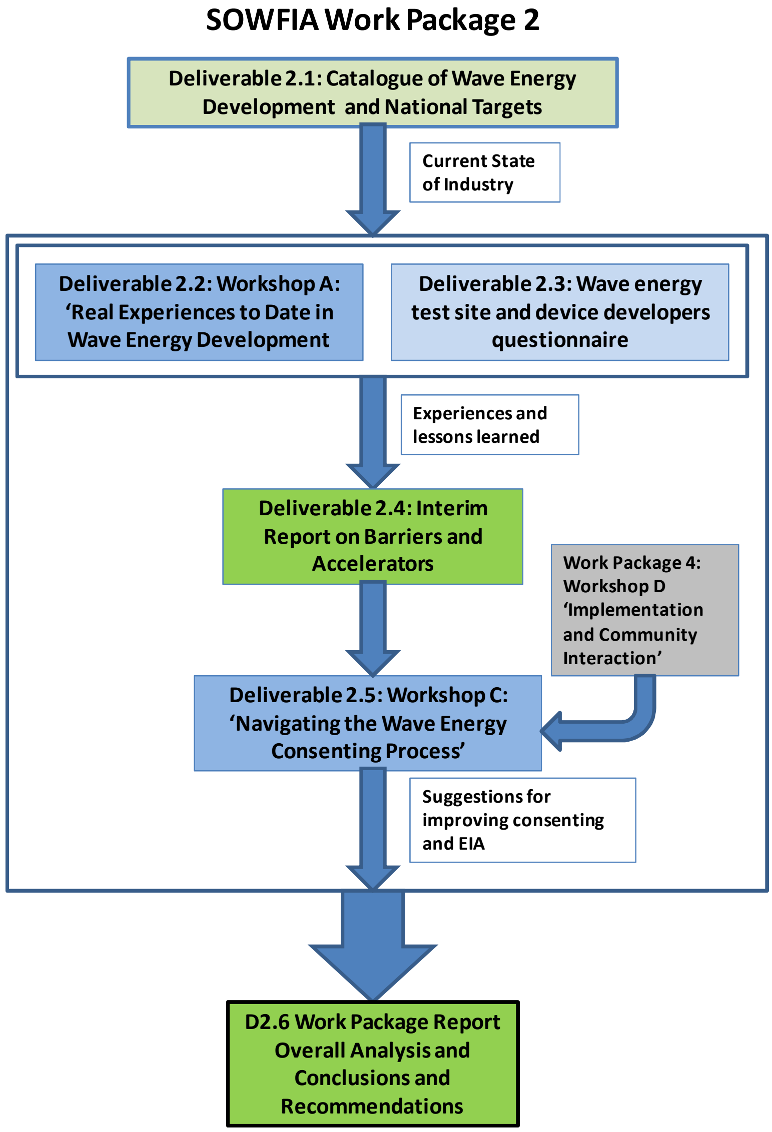

Figure 1: Work Package 2 Methodology

2.1.1 Catalogue of Wave Energy Development and National Targets

The objective of the first task was to provide context for the future development of wave energy in Europe. The EU Renewable Energy Directive (2009/28/EC) has set renewable energy targets for all Member States to achieve by 2020. The Directive requires Member States to submit National Renewable Energy Action Plans (NREAPs) that establish pathways for the development of renewable energy sources to the Commission by June 2010. This includes technology mix and installed capacity targets for each year up to 2020.

Numerous Member States are aware of the opportunities surrounding the development of the ocean energy industry. Targets separate from those in the NREAPs have been set for wave and tidal energy by some Member States. These are commonly put forward by interested bodies or potential stakeholders in 'roadmaps' and associated 'action plans'.

These action plans and road maps were examined along with the NREAPs for each coastal Member State of the EU to investigate the potential contribution of ocean energy (tidal and wave) required to meet different targets and scenarios in each of the Member States up to 2020. These contributions were then compared with what has been achieved by the wave energy industry to date in terms of deployments. This includes deployments at dedicated wave energy test centres, demonstration projects and planned commercial wave farm projects. The extra capacity of wave energy farms required to meet 2020 targets was then established for each coastal Member State. The number and spatial extent of wave energy farms required to meet these targets was estimated based on the current state of the technology and operational experience. These estimates can be used to assess the amount of wave energy projects that are likely go through the consenting process in different Member States up to 2020.

2.1.2 Workshops

2.1.2.1 SOWFIA Workshop A – 'Real Experience to Date in Wave Energy Development'

Two workshops were organised as part of Work Package 2. The first workshop was entitled 'Real Experience to Date in Wave Energy Development' and was held in Manchester in October 2011. The aim of the workshop was to identify barriers to wave energy development based mainly on the experiences of wave energy test centre, device and project developers. The barriers focussed on in particular were difficulties experienced in permitting, planning consents and financing of projects.

Presentations were made by representatives from wave energy test centres, a regulator, device developers, a project developer and environmental consultants. Test centre developers shared their experiences, lessons they had learned and changes they thought were required to facilitate the development of the wave energy industry. Other presentations focussed on necessary parts of the consenting and approval process, lessons that could be incorporated from other maritime industries, environmental uncertainties and whether licensing and environmental issues could be a barrier to project financing. After these presentations, round table discussions were held allowing all workshop participants to share their opinions on Impact Assessment, consenting legislation and changes required to aid the development of the wave energy industry.

2.1.2.2 SOWFIA Workshop C – 'Navigating the Wave Energy Consenting Process'

The second workshop was entitled 'Navigating the Wave Energy Consenting Process' and was held in Dublin in October 2012. The aim of this workshop was to identify barriers, accelerators and suggestions for addressing the barriers, to the consenting of wave energy projects based mainly on the experiences of regulatory authorities.

Information was presented by speakers representing regulatory authorities from different EU Member States about how the consenting process is applied to wave energy projects. Suggestions were then made by the speakers on how the consenting process could be improved. Round table discussions were then held in which participants discussed how new and innovative management approaches could be applied to the wave energy consenting process.

2.1.3 Questionnaires

In order to gain further insight into both constructed and planned ocean energy development, a questionnaire was designed and circulated to European wave energy test centre developers and wave and tidal device developers with experience of the consenting process. The objective of the questionnaire was to gather their in-depth experiences of the consenting process, in particular how stakeholders were consulted with and how their concerns were addressed.

Responses were received from all wave energy test centres associated with the SOWFIA project (AMETS, Ireland; Bimep, Spain; Lysekil, Sweden; SEM-REV, France; Ocean Plug, Portugal; and WaveHub, England). In addition responses were received from two other test centres (EMEC in Scotland and Runde in Norway). Responses were also received from two demonstration wave energy projects (Mutriku, Spain and WestWave, Ireland), four wave energy device developers (Aquamarine Power, Scotland; Pelamis Wave Power, Scotland; WaveRoller, Portugal and WaveStar, Denmark) and two tidal device developers (Marine Current Turbines, UK and Tidal Generation Ltd., Scotland).

A complementary questionnaire, relating to financing and funding of wave energy projects, was circulated to the same wave energy test centre developers mentioned above. The aim of this survey was to investigate the reasons test centre developments in Europe gained approval and funding.

3 Results

3.1 Introduction

This section presents the main findings from Work Package 2 tasks outlined in Section 2. Section 3.2 provides a context for future ocean energy development in Europe and for the rest of the findings from SOWFIA Work Package 2. Key barriers, accelerators and suggestions for addressing these barriers compiled from the associated workshops and questionnaires are presented in the remainder of Section 3. The presentation of barriers incorporates experiences and possible causes of barriers as well as suggestions compiled from the workshops for addressing the barriers. A critical analysis of these suggestions is presented in Section 4.

3.2 State of the Art

3.2.1 EU Member States Ocean Energy Targets

Several coastal EU Member States have set targets and scenarios for ocean energy (wave and tidal) development to 2020. These are outlined in Member State NREAPS and/or various roadmaps and action plans, presented in Table 1. Also included in Table 1 is the estimated spatial extent of wave farms required to meet these targets and scenarios.

Country	**NREAP Target for ocean energy (MW)**	**Targets/ Scenarios presented in Roadmaps/ Action Plans (MW)**	**Estimated spatial extent to meet targets (km²) (based on extraction of 5MW/km²)** NREAP Targets/ (Roadmap and Action Plan Targets)
Denmark	**0**	400[2] (Target for 2030)	**0**/(80)
France	**380**	N/A	**76**/(N/A)
Ireland	**75 (base case)** **500 (fast growth case)**	75-500[3]	**15-100**/(15-100)
Portugal	**250**	300[4]	**50**/(60)
Spain	**100**	1000[5]	**20**/(200)
Sweden	**0**	N/A	N/A
UK - all	**1300**	2000[6]	**260**/(400)
Scotland	**N/A**	1300[7]	**N/A**/(260)
N. Ireland	**N/A**	N/A	N/A

Table 1: Summary table of 2020 targets for ocean energy from NREAPs and other documented scenarios

[2] Mathiesen et al., (2009) - IDA's Climate Plan 2050 Background Report
[3] Department of Communications, Energy and Natural Resources, (2010) – DRAFT Offshore Renewable Energy Development Plan (OREDP)
[4] Associacao de Energias Renovavels, (2010), Roteiro Nacional das Energias Renovaveis Aplicacao da Directiva 2009/28/CE
[5] Asociación de Productores de Energías Renovables, (2010) Hoja de ruta del sector de energías renovables en España
[6] UK Energy Research Centre, (2008) – UKERC Marine (Wave and Tidal Current) Renewable Energy Technology Roadmap – Summary Report
[7] Scottish Executive, (2004) – Harnessing Scotland's Marine Energy Potential

Publishing targets for ocean energy show that some coastal EU Member States are keen to support ocean energy development. This has been backed up with incentives, both financial and legislative, by some national governments. The ocean energy targets extracted provide a scenario of the number of ocean energy developments regulators will potentially be faced with in the EU up to 2020.

For most of the countries, if they are to be achieved, the ocean energy targets will comprise mostly of wave energy. This is because, apart from the UK and France, the tidal resource in these Member States is not sufficient for commercial tidal energy developments. NREAP targets do not distinguish between, or permit separate targets for, wave and tidal energy, which is problematic. At present it is difficult to ascertain with any certainty how realistic these targets are and how they will be met in terms of wave energy farm size, location and technology type. Because of this, the estimate of spatial extent presented in Table 1 is based on a number of simplifying assumptions including an extraction rate of 5MW/km^2 which is based on the plans for two proposed Pelamis wave farms[8,9] and an assumption that ocean energy targets will be completely met by wave energy. Nevertheless, the spatial extent of wave energy farms presented can be used as a first estimate of how much conflict can be expected with other maritime users. To put the area into context, the spatial extent required to meet the offshore wind energy target of 43GW[10] by 2020 is 4300km^2 (based on an extraction rate of 12MW/km^2 which has been deemed to be possible for offshore wind by 2020[11]).

3.2.2 Catalogue of Wave Energy Deployments

The catalogue of wave energy deployments to date in Europe shows the progress of the industry and highlights the progress required to meet 2020 ocean energy targets. Table 2 shows the estimated cumulative number of wave energy deployments that have taken place in Europe along with the estimated number and capacity of deployments in place at present (February 2013). It should be noted that the data in the table is based on deployments for which information is widely available.

	Estimated cumulative no. of wave energy deployments to date (since 1996)*	Estimated no. of wave energy deployments at present	Estimated capacity of wave energy deployments at present (MW)
Denmark	7	3	0.3
France	0	0	0
Ireland	4	0	0
Portugal	5	1	0.4
Spain	3	1	0.3
Sweden	2	1	0.1
UK	10	5	2.8
Norway	3	1	0.02
*Note: This compilation may have missed out on some very short term deployments and consequently underestimate the cumulative number of wave energy deployments.			

Table 2: Cumulative and present wave energy deployments to date

[8] http://www.pelamiswave.com/our-projects/project/4/Bernera-Wave-Farm Accessed April 2013
[9] http://www.aegirwave.com/the-shetland-project.aspx Accessed April 2013
[10] EWEA, 2010. Seaenergy 2020 Final project report – Delivering offshore electricity to the EU: spatial planning of offshore renewable energies and electricity grid infrastructures in an integrated EU maritime policy
[11] European Environment Agency, 2009. Europe's onshore and offshore wind energy potential. An assessment of environmental and economic constraints. European Environment Agency Technical Report.

Wave energy developments thus far have been medium to full scale deployments of single devices with the aim of testing or demonstrating different technology types. Most of these deployments have taken place at established wave energy test centres (e.g. EMEC in Scotland, Danwec in Denmark).

The catalogue of deployments highlights the nascent state of the industry. There are many different generic types of device being deployed (onshore, nearshore, offshore, floating, bottom mounted, etc.). No single device or generic type has been proven superior to others and it is likely that different types will suit the various deployment zones that can be exploited. This will be discussed further later, in relation to how this creates a potential barrier in the consenting process.

The progress required by the industry to meet ocean energy targets can be seen by comparing Table 1 and Table 2. Through this comparison it can also be seen that the experience obtained by regulators to date is very small in comparison to what will be required if 2020 ocean energy targets are to be met.

Experiences and perceived barriers to the development of the industry, presented in the following section, should be placed in the context of the current state of the industry. Further information can be found in SOWFIA Work Package 2 Deliverable 2.1[12].

3.3 Barriers and Accelerators

The rest of this section presents key barriers, accelerators and suggestions for addressing the barriers compiled from SOWFIA Work Package 2 workshops and questionnaires. These barriers have been categorised in three thematic areas: (i) Complex administrative procedures; (ii) Barriers relating to environmental impacts (EIA process and environmental monitoring) and (iii) Human dimensions. It is important to note that the suggestions presented are based on the experiences and perceptions of wave energy developers and regulators with experience of the wave energy consulting process. Critical analysis of these barriers and the suggestions for addressing them can be found in Section 4.

[12] SOWFIA. Catalogue of Wave Energy Test Centres and Review of National Targets. Deliverable 2.1 report published as part of SOWFIA project. Available at: http://www.sowfia.eu/index.php?id=22

3.3.1 Administrative Barriers and Accelerators

Complex Administrative Procedures

Background to/ Description of barrier:

Administrative procedures relating to the granting of consents for wave energy developments have been identified as a barrier to the development of the industry. Many different authorities are stakeholders in the maritime environment. Different permits are required from different authorities to undertake a development. The permits required vary between EU Member States. This is inevitable, to an extent, for development consent but should be less common for EIA where there is a common legal framework across the EU.

Experiences of this barrier:

In different Member States, wave energy test centre and device developers have found that the consenting process takes too long and often involves numerous authorities responsible for different permits. Some permits cannot be applied for until others have been granted so a delay in one permit can cause long delays in the consenting process. There is often limited communication between these different authorities and this can lead to a duplication of work done by the developer.

Complex and long administrative procedures delay the progress of wave energy test centre developers, device developers and project developers. They can also put pressure on the often limited resources of these groups. It is possible that investors view complex administrative procedures as an additional risk to a project and become less likely to invest.

While this remains a barrier in the short term, it is however important to note that the experiences of the wave energy consenting process to date have mostly been based on wave energy test centres and single device developments. Future large developments will have greater resources to dedicate to applying for consents and this barrier may not be as much of an issue. To secure the involvement of large project developers in the future, however, it is necessary to ensure that consenting procedures for all developers are fit for purpose and are viewed to be fit for purpose, regardless of scale.

Possible causes of barrier:

Many different sectors and authorities are stakeholders in the maritime environment. This results in management and administrative procedures being structured on a strongly sectoral basis. As a result it is perhaps inevitable that the administrative procedures associated with consenting of wave energy developments is complex and involves numerous authorities. Likewise wave energy developments are multi-facetted incorporating terrestrial, marine and electrical elements. There is an opinion amongst some developers that responsible authorities only have expertise in traditional maritime sectors. They are not yet comfortable dealing with wave energy because of the nascent state of the industry and its uncertain/undocumented effects. It has been expressed that this situation could improve as the number of consents applied for increases.

Suggestions for ameliorating barriers:

Sectoral planning can result in delays. There is a definite need for stronger cooperation and communication between regulatory authorities so as to ensure an integrated planning approach in the longer term. It was suggested that simplification of the administrative system for dealing with wave energy consents could aid the development of the wave energy industry. A recurring

suggestion to improve the consenting process in the immediate future was the implementation of a 'one-stop shop' approach (See below 'Accelerators'). Another recurring suggestion was 'parallel processing'. This would allow developers to apply for multiple consents to different authorities at once instead of waiting to receive one consent before applying for another. Both of these administrative approaches will be discussed in Section 4 where the practicality of applying them across Member States will be looked at and, where appropriate, alternatives presented.
Accelerators: **Throughout Work Package 2, developers and regulators were of the opinion that Marine Scotland's administrative system for dealing with marine consenting is working well. This system is lauded as a 'one-stop shop' approach that aims to reduce the burden on applicants by bringing the required [environmental] permits for wave energy development into a single consent. This approach, along with strong government financial incentives, was cited in workshops as one of the reasons why the Scottish wave energy sector appears to be ahead of other Member States. The one-stop shop approach is discussed further in Section 4.**

3.3.2 Barriers Relating to Environmental Impacts (EIA Process and Environmental Monitoring)

Environmental Impact Assessment process
Background to/ Description of barrier: European Union law and associated national legislation requires that the environmental implications of decisions are taken into account before the decisions are made. In practice this results in the requirement for an Environmental Impact Assessment to be conducted for certain individual projects on the basis of Directive 2011/92/EU (known as the EIA Directive) or for public plans or programmes on the basis of Directive 2001/42/EC (known as Strategic Environmental Assessment Directive). Only the EIA Directive is included here. The Directive lists categories of projects for which EIA is mandatory in Annex I and in Annex II lists projects for which national authorities have to decide whether an EIA is needed. Ocean energy is not explicitly listed in either Annex though such developments may require an EIA as they could qualify as "industrial installations for the production of electricity", included as a category in Annex II. Certain EU Member States take a very literal interpretation of this, subjecting almost all wave energy developments to EIA. Throughout the SOWFIA workshops and the questionnaires surveys, the EIA process was highlighted as a barrier to wave energy development.
Experiences of this barrier: Criticisms of the EIA process covered a multitude of factors. It was suggested that there is widespread inconsistency in the manner in which the EIA Directive is applied to developments across different EU Member States in terms of information required and related monitoring requirements (see next section). One of the main reasons for this is that Member States have a certain amount of freedom in the implementation of these Directives: the result to be achieved is binding but the choice and form of methods to achieve the result is up to national authorities. It was also suggested that the process was overly burdensome on small-scale developers who may be deploying only one or a limited number of device units. This indicates that the operation of the 'screening' process for Annex II projects (i.e. where EIA is not mandatory but has to be decided based on 'screening') is insufficient.
Possible causes of barrier: The early stage of the wave energy industry means that currently there is a lack of scientifically robust, documented and available information on the environmental effects of wave energy devices. Regulators, when faced with this lack of information and consequent uncertainty, are understandably cautious and can place significant supplementary requirements on developers so as to reduce or avoid their own (State) liability from the Commission in terms of infraction proceedings.
Suggestions for ameliorating barriers: In some Member States a threshold is set for particular types of projects. In Ireland, for example, a wind energy development with more than 5 turbines or a total output greater than 5 MW must have an EIA. It was suggested during SOWFIA workshops that similar thresholds for EIA be set for wave energy. Wave energy is still at the pre-commercial stage so it is not advisable that this is done at this time. Competent authorities could, however adopt a stricter approach to screening whereby only those developments likely to have significant environmental effects are subject to a full EIA. Where developments could have an impact on an SAC, SPA or other designated site, an EIA will be required in accordance with existing law. It is suggested that if this is the case, the potential for a combined EIA/AA should be explored by competent authorities.

Environmental Monitoring Requirements

Background to/ Description of barrier:
Environmental monitoring can be imposed on a developer as a condition of consent for a development. Environmental monitoring requirements are informed by the Environmental Impact Assessment (EIA) process and have been identified as a major barrier to the development of the wave energy industry. There are many different important environmental receptors in the marine environment where wave energy devices will be deployed. Whilst the EIA Directive (2011/92/EU) is the main Directive covering the need for an EIA, other legislation may also have relevance e.g. the Birds Directive (2009/147/EC), the Habitats Directive (92/43/EEC) and the Marine Strategy Framework Directive (2008/56/EC).

Experiences of this barrier:
As stated above, there appears to be widespread inconsistency in the manner in which the EIA Directive is applied to developments across different Member States. In many cases, wave energy test centre, device and project developers felt that the environmental monitoring requirements that regulators set for them are too onerous especially since developments to date have been small-scale test or demonstration projects. They felt that the burden of all environmental unknowns is being placed on the ocean energy industry. In other cases developers felt that there is not enough guidance from regulators on the scope of EIAs and that the subsequent specified monitoring requirements are too vague.

Environmental monitoring that necessitates long term measurement of many parameters results in additional costs to wave energy developers. Investors may be deterred from investing due to the costs associated with and [regulatory] uncertainty of the EIA process. Again this problem is exacerbated by the nascent stage of the industry but could remain a barrier for, or discourage investment in, larger wave farm developments in the future.

Possible causes of barrier:
As already stated, the early stage of the wave energy industry means that currently there is a lack of scientifically robust, documented and available information on the environmental effects of wave energy devices. Regulators, when faced with this lack of information and consequent uncertainty, are understandably cautious and can place significant monitoring requirements on developers. There have been many studies on the effects of structures on the marine environment from other offshore industries (e.g. offshore wind), however, there is no facility for this information to be shared with the wave energy industry. Likewise, no mechanism exists for sharing of environmental monitoring data whereby information from one wave energy development can be used as information for a similar development elsewhere.

Suggestions for ameliorating barriers:
The lack of scientific data on environmental effects has been identified as the main cause of this barrier. As more wave energy developments go through the consenting process and environmental monitoring is undertaken, more data and information will be generated. There is a need to turn this information into knowledge on the environmental impacts of wave energy developments which can then be used to inform the design and operation of future consenting procedures. In the short term, it was suggested in Work Package 2 workshops that incentives should be provided for environmental monitoring information to be shared between developers. It was also suggested that a facility should

be set up whereby regulators can share experiences of the EIA process.

The key role that wave energy test centres can play in increasing environmental impact knowledge will be discussed in Section 4. Environmental management strategies such as adaptive management have also been suggested in order to manage, and learn more about, the effects of wave energy developments. Adaptive management is also discussed in Section 4.

Lack of design development in the consenting process

Background to/ Description of barrier:
The inability to substitute one device with, for example, an amended device design or more efficient version, has also been identified as a potential barrier to wave energy development. This lack of design flexibility ties a developer to a fixed consent for a specific project. If changes to the design are required, subsequent to the carrying out of requested environmental characterisation and monitoring, it may become necessary for the developer to undertake further monitoring studies. This is partly linked to the administrative procedures associated with consenting of wave energy device deployments, described previously, as there may be limited opportunities for a developer to liaise with a regulatory authority subsequent to the initial pre-application meeting.

Experiences of this barrier:
This barrier has been highlighted by wave energy test centre developers. Wave energy test centres are built with the aim of allowing developers of different devices to test their devices in situ for different lengths of time. During the consenting process, developers of wave energy test centres have encountered difficulties with regulators who want to know the exact details of devices that will be deployed there in order to scope potential impacts. These details are very difficult for test centre developers to provide because it is likely they will want to attract many different device developers who all have different device designs.

This may also be a barrier to commercial wave farm developments in the short term. At present there are many different designs of wave energy devices from different device developers. These devices are, as yet, not commercially available. Wave energy farm developers looking to gain consent for a project must gain consent using one of these devices. The duration of the consenting process means that by the time consent has been granted, extensive research may have caused significant changes in the device design or in its associated components. In some cases, the device developer may not be in a position to supply the required devices as previously agreed. If the new wave energy device design was not covered by the original consent, the wave energy farm developer may have to go back through the consenting process, delaying the project and adding cost to it.

Possible causes of barrier:
Once more, the main cause of this barrier is the burgeoning stage of the wave energy industry. Regulators are accustomed to consenting more established industries (e.g. offshore wind), for which there is greater certainty of farm and device design and the supply chain is more established. Whilst it is difficult for regulators to assess the impacts of a single type of device, it is even more difficult for them to assess the impacts of a range of devices that may be deployed. Developers wishing to obtain consent for a large design envelope that would enable greater flexibility could be faced with escalating costs for additional survey work and new or amended applications. These additional requirements may, in turn, identify environmental effects that would not have been identified if a smaller design envelope had been used.

Suggestions for ameliorating barriers: As for the previous barrier, the effects of specific devices and components (moorings, foundations, etc.) will become better understood as the industry develops. The key role of test centres and the potential for adaptive management to improve understanding of environmental effects of wave energy is discussed in Section 4.

3.3.3 Barriers and Accelerators related to human dimensions

Stakeholder Consultation[13]

Background to/ Description of barrier:
Many different stakeholder groups have an interest in the maritime environment. As part of the consenting process for wave energy development, public consultation with stakeholders is often a requirement. This enables stakeholders to give their input and opinion into the development planning process, to express their concerns or to safeguard their interests. This consenting process can be both time and resource consuming and could potentially pose a barrier to wave energy development.

Experiences of this barrier:
Public consultation is a legal requirement under EIA legislation. Informal stakeholder consultation has also been undertaken for many of the wave energy test centre developments and device deployments to date. Experiences gathered from the workshops and questionnaires have suggested that, in many cases, the stakeholder consultation process is deemed to be satisfactory (See below 'Accelerators'). Some responses suggest that the stakeholder consultation process can present a barrier to wave energy development.

Many device deployments to date have been at wave energy test centres, where the operators of the test centre undertake much of the stakeholder consultation process as part of their hosting arrangements. For the majority of these deployments, statutory and sometimes non-statutory consultations have been undertaken. Experience from these deployments suggests that, for the most part, developers have been satisfied with the consultation process. The process is however both resource and time consuming. For projects receiving large amounts of public funding, (e.g. wave energy test centres) and future commercial wave farm developments this may not be a problem. For the current scale of the industry, this presents a problem for smaller developers who, by definition, are less well resourced. Investors may be put off by perceived delays caused by the stakeholder consultation process, failing to see that it can ensure the sustainability of the project.

Possible causes:
As stated above, there are many stakeholder groups who share an interest in the marine environment. These groups can be national bodies, local bodies or individuals not affiliated to any representative group. Identifying and undertaking consultation with all of these groups will inevitably take time and resources.

Suggestions for ameliorating barriers:
Lessons from more established industries advocate the need to liaise with all stakeholders as early in

[13] Note: The barriers related to human dimensions (Stakeholder Consultation and Conflict of Use) presented in this document are based on these barriers mainly from the point of view of developers and regulators. There are also aspects of both which are problematic to stakeholders themselves. Details of barriers from the point of view of stakeholders can be found in the following SOWFIA project reports:

- SOWFIA. Short report on the stakeholder survey for each wave energy site. Deliverable 4.3 report published as part of SOWFIA project. Available at: http://www.sowfia.eu/index.php?id=22
- SOWFIA. Workshop B Report – Taking wave energy forward: implementation and community integration. Available at http://www.sowfia.eu/fileadmin/sowfia_docs/documents/SOWFIA_WorshopB_Report.pdf

the development planning process as possible. As evidenced from certain countries, provision of a stakeholder list by consenting authorities has proved useful to developers. It has been suggested that the implementation of Maritime Spatial Planning (MSP) could help reduce conflicts of interest through a thorough and participatory planning process. Given the differing levels of progress in implementing MSP across the EU it is difficult to ascertain whether this is a reality. Participatory governance and strategic spatial planning are discussed further in Section 4.

Accelerators:

In general, the point of view of wave energy developers was that the formal stakeholder consultation procedures in place are sufficient to address stakeholder concerns. Examples of this include the developers of the AMETS test centre in Ireland, the Lysekil test centre in Sweden and BIMEP in Spain who all felt that formal procedures provided enough guarantees for stakeholders.

Developers have found that approaching stakeholders from an early stage of development and establishing open communication with them is beneficial to ensuring the support of the project. Developers who provided experiences of this approach included the developers of EMEC and Aquamarine Power in Scotland. Wave energy developers have also found that for the most part, there is a positive attitude from stakeholders and from the public towards wave energy.

Conflict of Use

Background to/ Description of barrier:

As part of the consenting process for wave energy development, consultation events allow stakeholders to raise any concerns they have relating to the proposed development. Such concerns can relate to the marine environment and how it will be affected but can also relate to potential conflicts with other, more established uses such as fishing, recreation and shipping.

Experiences of this barrier:

Wave energy test centres and device deployments to date have been small in size, occupying only a relatively small portion of the overall maritime space. Even so, experiences from these deployments suggest that addressing stakeholder concerns relating to potential conflicts of use may be a barrier to wave energy development.

Until now concerns have concentrated on navigation and fishermen's concerns over navigation and loss of fishing areas. Navigation concerns have been addressed by adjusting the location of developments (See 'Accelerators'). Adjusting the location of a development may delay the consenting process if it has already started, reaffirming the need for a timely start to stakeholder consultation. It may also mean that a deployment has to move to a less favourable position in terms of wave resource or seabed type. Fishermen's concerns have been addressed either by moving the location of developments or providing compensation to affected fishermen. Both of these measures may have consequences for the economic viability of a wave energy project, especially for small developments.

Possible causes of barrier:

There are many stakeholders involved in the maritime space where wave energy devices are to be deployed. These may be national authorities, other industries, those who depend on the sea for their livelihood and those who use the sea for leisure activities. To date, site selection for the for wave energy developments has taken place in a fragmented non-systematic manner with no over-arching strategic planning approach adopted by government authorities in the majority of EU Member States.

There is lack of data as to how wave energy developments will impact certain sea users. For example, there is little data on the effect devices will have on fish stocks in an area which is important to fishermen, or on wave conditions which is important to surfers. In cases where there is little data available, there have been experiences in which false information has filled the information void. This information can then be used to gather support against wave energy developments.

Suggestions for ameliorating barriers:
Experiences recounted by wave energy test centre and device developers and regulators in SOWFIA workshops have highlighted that early identification and engagement with stakeholders is vital to the success of a project. The importance of open and honest engagement with stakeholders has also been identified as being important so that they feel that their opinions and concerns are being taken into account. The timing of engagement is critical – stakeholders must feel that their input will be taken into account in the decision-making process accordingly it is essential that engagement happens as early as possible before decisions on final locations etc. have been decided.

The role of Maritime Spatial Planning (MSP) in identifying and allocating areas suitable for the extraction of wave energy was also highlighted during the workshops. Many respondents perceive MSP as a solution to all user conflicts. The function of MSP in this context is explored in Section 4**.**

Accelerators:
Many wave energy test centres have presented examples where conflicts of use were resolved, at an early stage of a development, to the satisfaction of both the test centre developer and the stakeholder in question. Examples include consultation with fishermen affected by the AMETS development to agree on a location for the test centre, the creation of a monetary fund by Wave Hub for the development of fishing activities in the Cornish North Coast and the movement of the traffic separation zone near Wave Hub to avoid navigational risks.

4 Discussion

This section provides a critical analysis of the main suggestions for ameliorating barriers that arose during SOWFIA project workshops and questionnaire surveys which were presented in Section 3. The analysis is divided into four main sections (i) Integrated planning; (ii) Administrative procedures (iii) the EIA process and (iv) Environmental monitoring requirements. The sections are presented according to scale of application.

The first is strategic planning which, by definition, should set the scene for coordinated and integrated development planning at regional and national levels. This was suggested as a means of reducing conflicts of use with other sectors. The second area is administrative procedures which encapsulate many of the frustrations developers have experienced to date with consenting and their suggested solutions. The consenting process, and associated administrative procedures, for wave energy installations has been identified by product and project developers as the main non-technological barrier hindering the development of wave technology. More succinctly the predominant opinion is that administrative procedures associated with consenting are factors that inhibit deployment of devices in real-sea conditions, thereby hindering progress to larger scale. Developers are of the opinion that current consenting arrangements are more applicable to large, commercial scale wave developments and do not reflect the existing status of technology readiness[14] [15]. Next, the role of EIA is discussed, concentrating on difficulties cited during the workshop and survey findings as well as the proposed new EIA Directive. Finally, environmental monitoring requirements for wave energy developments are looked at. The key role that wave energy test centres can play in improving the understanding of baseline and environmental impacts is discussed as is the potential application of adaptive management.

4.1 Integrated planning

4.1.1 Introduction

As outlined above, management of the marine environment and activities therein, is highly sectoral and often fragmented. This results in a need for more integrated planning whereby the authorities involved have established formal or informal approaches to coordination and communication with each other. Strategic spatial planning is one such approach; the aim of which is to provide a vision, set priorities, dedicate resources and ultimately ensure that all actors are working towards a common goal. Strategic plans can be described as frameworks for action in contrast to project plans which are blueprints and form an unambiguous guide to action[16]. By definition strategic spatial planning requires a long-term view and coordinated approach to delivery. In the context of marine renewable energy development, responsibility for strategic spatial planning rests partly with the EU as the over-arching EU energy policy maker and partly with national governments as the national policy maker for planning. One issue that arose repeatedly during the workshops and in the

[14] Munoz Arjona, E., Huertas Olivares, C.H., Magagna, D., Greaves, D., O'Hagan, A.M., Holmes, B., Sundberg, J., Simas, T., Patricio, S. and Torre-Enciso, Y., 2012. SOWFIA Deliverable 2.3 – Site/ Technology developers, project financers and authorities questionnaires

[15] SOWFIA. Report on existing available data of wave energy experiences. Deliverable 2.2 report published as part of SOWFIA project. Available at: http://www.sowfia.eu/index.php?id=22

[16] Albrechts, L., 2004. Strategic (spatial) planning re-examined. Environment and Planning B: Planning and Design 31(5) 743-758

questionnaire responses was the seemingly conflicting objectives set at EU and national level in relation to energy and conservation. The majority of developers felt that if renewable energy targets were to be achieved this should take priority over conservation interests. Conversely certain stakeholders were concerned that, due to the focus on achieving those targets, developments would be fast-tracked without sufficient regard to the receiving marine environment. This segregated situation can be attributed, in part, to a lack of integrated planning as currently the approach to planning remains sectoral with little connection between, and integration of, different uses. Maritime Spatial Planning (MSP) and Integrated Coastal Zone Management (ICZM) are two planning approaches which seek to achieve better integration between sectors and their associated management.

4.1.2 Maritime Spatial Planning (MSP)

Maritime[17] Spatial Planning (MSP) is defined as a "public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process"[18]. More simply it is an integrated, participatory and adaptive process that facilitates planning and management of maritime activities, balancing ecological objectives with economic and social ones. Accordingly, it is intended to promote rational use of the sea by providing a stable and transparent planning system for maritime activities and users[19]. Stability and transparency should reduce regulatory risk and thereby encourage investment and associated economic development.

In the EU, MSP tends to focus on marine waters under national jurisdiction and does not include coastal management or planning of the land-sea interface. The latter should, in the opinion of the EU, be addressed through the implementation of Integrated Coastal Zone Management (ICZM). The EU have recognised the need for a common approach to MSP and put forward a set of common principles to "facilitate the process in a flexible manner and to ensure that regional marine ecosystems that transcend national maritime boundaries are respected" (COM (2007) 575 final, p.6)[20]. Competency for the design and implementation of MSP resides with individual Member States and not with the EU *per se*. This also explains why progress varies between Member States. The Directorate-General for Maritime Affairs in Europe (DG Mare), in the European Commission, published a proposal for a Directive establishing a framework for Maritime Spatial Planning and Integrated Coastal Management in March 2013.[21] Should this Directive be adopted, Member States will be obliged to carry out MSP and ICM in accordance with national and international law. The

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[17] Different terms tend to be used synonymously in current practice, for example, marine planning, ocean planning, and marine spatial planning. In the EU 'Maritime' Spatial Planning is preferred, as it is thought to capture the holistic, cross-sectoral approach of the process (COM(2008) 791 final). For this reason, the term Maritime Spatial Planning is used throughout this document.

[18] Ehler C, Douvere F. 2009. Marine Spatial Planning: a step-by-step approach toward ecosystem-based management. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides No. 53, ICAM Dossier No. 6. UNESCO, Paris.

[19] O'Hagan, A.M. 2011. Maritime Spatial Planning (MSP) in the European Union and its Application to Marine Renewable Energy. IEA-OES Annual Report 2011. Available at: http://www.ocean-energy-systems.org/ocean_energy/in_depth_articles/msp_in_the_european_union/

[20] Commission of the European Communities, 2007. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – An Integrated Maritime Policy for the European Union (COM (2007) 575 final).

[21] See further in COM (2013) 133 final.

purpose of these plans will be to integrate and link the objectives defined by national or regional sectorial policies, to identify steps to prevent or alleviate conflicts between different sectors and to contribute to the achievement of the EU's objectives in marine and coastal related sectorial policies.

Until such times as the new legislation is adopted by the EU and transposed by Member States, MSP is likely to proceed in an *ad hoc* manner. Only a small number of Member States have dedicated MSP legislation or an over-arching coordination authority whilst considerably more have some form of MSP programme.[22] The approach taken to MSP will vary according to the size and nature of the maritime space, the types of activity and uses going on there, as well as the pertinent legal and institutional arrangements[23]. As a result, a variety of mechanisms can be used to implement MSP including specific regulations and zoning of sea areas. MSP is just one element of broader ocean management and should be viewed as a 'strategic vision' for a maritime area that is supported by a range of other policies, including sector specific policies.[24] In Germany and Belgium, for example, dedicated MSP legislation has been enacted which effectively provides for a zoning approach to regulate activities at sea rather than for a broader MSP process. The process element is important as it ensures the necessary participatory aspect, actively involving stakeholders in the design and operation of the process.

Workshop participants and questionnaire respondents appeared to regard MSP as a solution to conflicts of use within the maritime space. The evidence base for this is somewhat lacking given the varying levels of MSP implementation at this time. In theory through increased clarity, certainty and identification of compatible uses within the same area of development, MSP could lead to less user conflicts. It is important to note that MSP is not, however, a replacement for sectoral planning rather it seeks agreement between the plans that each sector develops for a given area.[25] It is this ability to pursue a central overarching vision, which is that of implementing sustainable development in an integrated manner, which distinguishes it from other more traditional planning approaches. The participatory aspect of MSP necessitates that everyone involved in the process must understand that interests are negotiated. Interests are much broader than positions and require identification, exploration and prioritisation.[26] Once this happens, options and/or solutions to conflicts can be generated based on common interests for the users affected or from the divergence of interests between them. These proposed solutions must be aligned with the over-arching values and the vision contained in the MSP.

4.1.3 Linking Environmental Assessment Procedures

MSP has a strong environmental component. As an initial step in the development process, MSP requires identification of biological and ecological important areas so as to incorporate biodiversity objectives into plan design. This can then be taken forward through planned areas for nature conservation, such as Marine Protected Areas or nationally applicable designations. This element of

[22] See footnote 16.
[23] MRAG/European Commission. 2008. Legal Aspects of Maritime Spatial Planning; Framework Service Contract No. FISH/2006/09 – LOT2 for DG Maritime Affairs and Fisheries, European Commission.
[24] See footnote 15.
[25] Jiménez, J.A. 2013. Marine Spatial Planning - A Guide to Concepts and Methodological Steps. MarViva Foundation, Government of Spain and UNEP. Available at: http://openchannels.org/literature-library/1360174790
[26] See footnote 22.

MSP therefore enables existing environmental assessment information to be taken into account. A number of Strategic Environmental Assessments, as well as more localised Environmental Impact Assessments and Appropriate Assessments (under Habitats Directive) have already been carried out by national governments and developers across Europe.[27] This information should inform the development and implementation of MSP. There seems, however, to be a disconnect in some locations between strategic level spatial planning (MSP) and SEA and EIA processes. The exception to this is in Scotland and Northern Ireland where strategic level SEAs have fed directly into MSP design.

In recognition of the extensive ocean energy resources around the Pentland Firth and Orkney waters, there was a need to examine how future ocean energy development could progress in a manner that avoided conflict with those users. MSP was the obvious solution of choice, but the legal framework setting out the requirements and content of regional marine plans was not in place at that time. A *de facto* Marine Spatial Plan Framework (MSPF) was put in place, which set out a process for the development of future plans, covering the areas from the mean high water mark out to the limit of the Territorial Sea (12 nm)[28]. The Framework document is complemented by a Regional Locational Guidance document, which provides guidance and advice to marine renewable energy developers and other stakeholders on the siting of wave and tidal developments in the Pentland Firth and Orkney Waters.[29] In Northern Ireland an extensive SEA was carried out in 2009[30] which has informed the development of an Offshore Renewable Energy Strategic Action Plan 2012-2020[31] and a subsequent leasing round by The Crown Estate[32]. In Ireland a SEA has also been conducted but the final version of the associated Offshore Renewable Energy Development Plan (OREDP) has yet to be approved by government. Consequently it remains to be seen whether the SEA work will inform site selection for wave energy project developments.

Two issues can potentially arise here. Firstly there can be poor coordination between responsible government departments at national level resulting in a parallel process of policy development. This can result in fragmented application of policies and little or no integration of objectives. The second issue is, arguably, more serious. There is no legal obligation on Member States to forward plan. The result of this is that many countries do not carry out SEAs of specific policy areas, as evidenced from the lack of SEAs of marine renewables from many [continental] European countries. The impact of this is that development proceeds in an *ad hoc* manner with little or no strategic oversight by

[27] SOWFIA. Interim Work Package 3 report. Deliverable 3.3 report published as part of SOWFIA project. Available at: http://www.sowfia.eu/index.php?id=22

[28] Marine Scotland, Scottish Government AECOM and Metoc. Pentland Firth and Orkney Waters Marine Spatial Plan Framework and Regional Locational Guidance for Marine Energy. Final Report. Marine Scotland, Edinburgh, Scotland. 2010. Available from: http://www.scotland.gov.uk/Topics/marine/marineenergy/wave/rlg/pentlandorkney/mspfinal

[29] See footnote 25.

[30] DETI, AECOM and Metoc. 2009 Strategic Environmental Assessment (SEA) of Offshore Wind and Marine Renewable Energy in Northern Ireland. Environmental Report Volume 1: Main Report. Department of Enterprise, Trade and Investment (DETI), Belfast, Northern Ireland. December 2009.

[31] DETI. 2012. Offshore Renewable Energy Strategic Action Plan 2012-2020. Department of Enterprise, Trade and Investment Northern Ireland (DETI), Belfast, Northern Ireland. March 2012. Available at: http://www.detini.gov.uk/ni_offshore_renewable_energy_strategic_action_plan_2012-2020__march_2012_.pdf

[32] See http://www.thecrownestate.co.uk/news-media/news/2012/northern-ireland-offshore-energy-successful-bidders/

government and possibly more conflicts between sectors and ultimately marine users. MSP can address both issues as in essence it provides forward planning and participation in that process. It is also an adaptive process meaning it can react to changing circumstance; a feature which is important for developing industrial sectors such as marine renewable energy. Adaptive management, more broadly, is discussed further below.

4.2 Improving Administrative Procedures

4.2.1 Introduction

The frustrations expressed by developers, and some stakeholders, tend to centre on the procedures relating to consenting rather than the actual consent(s) required. The frustration stems from bureaucracy, timeframes and perhaps perceived duplication of effort. Throughout the workshops and questionnaire work, one-stop shop and parallel processing approaches have been cited as alternatives to be utilised for streamlining consenting. This section explores the genesis of both approaches with a view to determining their applicability to the ocean energy sector and any barriers to their implementation. Relevant examples are included where appropriate.

4.2.2 One-stop shop

The term 'one-stop shop' has become common parlance in recent years. It is essentially derived from business-related disciplines and particularly organisational theory. The concept is self-explanatory, however, it is often misused and misinterpreted. A one-stop shop seeks to provide a single point of contact or location where a multitude of services are available. The advantage of this being that the service provided is efficient and convenient saving a person time and money.

In the context of the consenting process for ocean energy a one-stop shop should offer a developer the services needed to enable a development proposal to obtain all development consents. This should, therefore, incorporate consents needed for environmental, land and marine-based elements as well as any required electrical permits. How one-stop shops evolve and operate in practice seems to depend on the definition given to 'services needed'. A truly inclusive and holistic approach would include all elements of the development. This is currently rare, even in places where one-stop shops are understood to exist. Usually one-stop shops dealing with ocean energy in particular, or more commonly all marine developments, will address only the marine environmental elements of a project, namely the EIA process and licence of the sea space. This can be quite complex in certain jurisdictions given the level of regulatory requirements involved, deriving from numerous pieces of legislation.

Division of services can be attributed to the governance system in place in an area. Where marine responsibilities are fragmented and divided sectorally across a number of government departments and competent authorities it is more difficult to facilitate a coordinated approach in the existing administrative system. Conversely if all responsibilities reside with one department/authority it should obviously be much easier to coordinate information and application procedures.

Marine Scotland was frequently cited as the epitome of the desired 'one-stop shop' approach. Established in 2009, it sits within the Enterprise, Environment and Digital Directorate of the Scottish Government and has the purpose of managing Scotland's seas for "prosperity and environmental sustainability". At an operational level, Marine Scotland has responsibility for marine energy, sea and recreational fisheries, aquaculture, marine planning and licensing. With the enactment of the Marine

(Scotland) Act 2010, the Scottish Government was able to introduce a new streamlined marine licensing system that consolidates previous licensing arrangements derived from a number of legislative instruments. The subsequent formation of the Marine Licensing Operation Team in Marine Scotland now acts as a 'one-stop shop' for all Marine Licence applications in Scottish seas, other than for reserved matters which are licensed by the UK Marine Management Organisation and/or the Department of Energy and Climate Change (e.g. oil and gas).

Marine Scotland have been proactive in supporting infrastructure and guidance necessary for the operation of their approach. This includes:

- Producing an Offshore Renewable Licensing Manual that outlines the licensing process (May 2012[33])
- Developing Policy Guidance documents aimed at facilitating licensing, including the Survey Deploy and Monitor approach;
- Compiling guidance information on site monitoring and survey techniques that are deemed necessary within the consenting process.

As a consequence the implementation of a more streamlined process is not only achieved through a simplified licensing process, but also through the implementation of supporting initiatives that involve key actors of wave energy development. This includes over-arching support from the Scottish Government for marine renewable energy, and demonstrates strategic spatial planning, adaptive management and integrated management.

It is instructive to note that the development of a one-stop shop approach in Scotland has its basis in the enactment of new legislation. This perhaps suggests that it is an unrealistic option for many other EU countries where the reality of the economic climate, lack of priority of the marine agenda and broader governance and legal issues necessitate continuation of the current approaches to consenting. In Denmark the national Danish Energy Agency (DEA) operates as a 'one-stop shop' for the project developer in relation to the many, often opposing, interests connected to use of the sea. Importantly, the operation of this approach did not require the creation of a new agency but rather more formalised channels for communication between the various regulatory authorities involved; a model that could be rolled-out in other jurisdictions[34]. For a marine renewable energy development in Denmark, three licenses are required: a licence to carry out preliminary investigations; a licence to establish the marine renewable energy project and a licence for power generation. Before granting a licence to establish a marine renewable energy development the DEA conducts a hearing with other regulatory authorities and relevant local municipalities to elucidate any concerns surrounding development of the project.

4.2.3 Parallel Processing

An alternative proposition to the one-stop shop model is a parallel process of consenting. It would be most applicable to southern European countries such as Spain and Portugal.

In Spain, for example, at present developers submit their application to one central authority, the Department of Industry, who is then responsible for passing the application on to the other

[33] http://www.scotland.gov.uk/Resource/0039/00394406.pdf

[34] O'Hagan, A.M., 2012. A review of international consenting regimes for marine renewables: are we moving towards better practice? 4th International Conference on Ocean Energy, Dublin.

regulatory authorities for comment. Each authority returns their comments on the application to the central body (the Department of Industry) who then decides whether to proceed with granting consent or to ask for additional work or further studies. One of the main drawbacks of this system is that often the authorities' procedures are sequential and applicants are required to obtain one licence before being able to apply for the next one. If there is a delay making a decision on one license, this results in a delay in all subsequent licenses.

The situation is slightly different in Portugal as there is no one central authority for developers to submit their application. This means that the process is led by the developer who has to apply to each authority for each license separately. There are three main types of license that the developer must obtain before installing a project:

1) License for use of water resources (Título de utilização de recursos hídricos) led by the Portuguese Environmental Agency through their regional delegations;
2) Licenses to build infrastructure on land (e.g. substation, onshore electricity cable) led by regional authorities;
3) Licences related to the technical installation of the project and connection to the grid: the power production and grid connection licenses involve two regulatory authorities. These licenses are only required if the project is going to be connected to the grid.

A developer can apply for all of these license types at the same time, however, the procedure to obtain each of these licenses is sequential and there are legally prescribed time frames for each step of the procedure. The process that will be applied to the Ocean Plug (Portuguese Pilot Zone) is completely different from that outlined above as there is a desire to trial a one-stop-shop approach, however, discussions on how this could proceed in practice are still on-going.

In a parallel processing approach, delays due to sequential processing of applications are avoided as each element of the project is dealt with by the relevant authority contemporaneously. The hypothesis is that one step of the project planning would not depend on successful completion of an earlier step; rather procedures would occur in parallel. Such a system appeals to developers, as they feel they can monitor the stage of application more closely and understand clearly what needs to be provided to whom and when.

In the parallel processing approach each regulatory authority involved makes its decision and then sends that decision to both the central authority and the applicant simultaneously. In the case of Spain, the central authority would be the Department of Industry while in Portugal a dedicated coordinating body would have to be allocated for wave energy consents. A system for dealing with issues such as requests for further information or for appeals would have to be integrated into the process.

The implementation of a parallel processing system needs careful consideration to ensure that decision-making is integrated and coordinated, as advocated by the EU and national governments. Whilst applications for development consents may be processed simultaneously to expedite total review and processing time for a project, there will always be interdependence between the required consents. The idea of having one central authority to consider all the submissions and concerns of other regulatory authorities appears sensible, providing they have the expertise to act as a judge on the comments returned. There obviously needs to be an initial agreement between all authorities that the development is appropriate before spending further time on it. This could take the form of an initial administrative sanction to facilitate the application to go forward for the next stage of the parallel process.

4.2.4 Practical considerations

It is clear that the administrative procedures relating to consenting of wave energy developments could be streamlined to provide a more efficient licensing regime. Whilst many laud the one-stop shop approach implemented in Scotland, it should be also noted that its establishment has required significant levels of resources and legislative amendment which may be unrealistic for other jurisdictions. Parallel processing may be easier to implement in these jurisdictions. The practical operation of a parallel processing approach needs careful consideration before any implementation of this type of approach given the levels of interdependency between the various required consents. What is clear is the need for more formal mechanisms for coordination and integration between the various competent authorities. This is exemplified by the Danish Energy Agency and Marine Scotland.

4.3 EIA Process

The EIA process presents many stated frustrations for wave energy developers and also certain regulatory agencies. The reality is that the current EIA process was not designed with wave energy in mind and this can result in a lack of consistency in application across Europe (see SOWFIA D3.3). Coupled to this are the largely unknown impacts of wave energy devices on the marine environment. The key issues relating to EIA identified in the workshop and questionnaires relate both to procedural elements and broader implications such as environmental monitoring. Both elements are discussed here.

4.3.1 Procedural aspects of EIA

Lack of consistency in the application of EIA to wave energy developments can be attributed to national level implementation of the EIA Directive. In most countries, EIA is given legal effect through the national planning regulations and is required for certain types of projects to gain development consent. Under the Directive, wave energy developments are not Annex I projects i.e. an EIA is not mandatory for them. Annex II of the EIA Directive lists projects for which an EIA is at the discretion of the individual Member State. Usually wave energy developments are subject to an EIA as they qualify as “industrial installations for the production of electricity”, specified in Annex II, 3(a) of the Directive. Certain EU Member States take a very literal interpretation of this, subjecting almost all wave energy developments to EIA. Other countries suggest that, as wave energy is not specifically listed in the Annex, they are not subject to the EIA process. This is despite the fact that the European Court of Justice (ECJ) has already shown that the Directive has a wide scope and broad purpose and consequently it must not be assumed that a project is excluded simply because it is not expressly mentioned in either the Directive or associated regulations.[35] Given the novelty of wave energy, competent authorities tend to take a cautious approach to granting development consent. Some Member States have added more project categories to the Annexes than is stated in the original Directive. Member States have also set their thresholds for projects subject to a mandatory EIA lower in comparison with those specified at the EU level. Both these result in an increase in the number of

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[35] C-72/95 Kraaijeveld and Others; C-435/97 WWF and Others; C-2/07 Abraham and Others – Liège airport.

EIAs being undertaken. This over-implementation of the Directive is referred to as ‘gold-plating’ and is common in many EU Member States.[36] This can potentially have cost implications for developers.

The purpose of the EIA Directive is to assess significant environmental effects of developments. Article 1(1) states that “This Directive shall apply to the assessment of the environmental effects of those public and private projects which are likely to have significant effects on the environment.” Article 2(1) goes further stating that “Member States shall adopt all measures necessary to ensure that, before consent is given, projects likely to have significant effects on the environment by virtue, inter alia, of their nature, size or location are made subject to a requirement for development consent and an assessment with regard to their effects”. There is no explicit definition of ‘significant effects’ or ‘significant impacts’ in the Directive and Member States must decide this for themselves. Whether a project is or is not subject to an EIA should be determined by the outcome of the screening process applied by the Member State’s competent authority (EIA Directive, Article 4). The criteria for screening are defined in Annex III of the Directive and relate to the characteristics of the project; its location and the characteristics of the potential impact(s). Even a small-scale project can have significant effects on the environment if it is in a location where the environmental factors set out in Article 3 of the EIA Directive, such as fauna and flora, soil, water, climate or cultural heritage, are sensitive to the slightest alteration[37].

It would appear that in most EU Member States wave energy projects are subject to EIA because of their unknown or uncertain environmental effects rather than due to the scale of development. For this reason the proposals tend to be ‘screened’ in for EIA. Arguably this results in overly-onerous requirements for small-scale projects. It also means that significant environmental effects, the original purpose of EIA, take less of a priority. The European Commission has already acknowledged that the screening mechanism should be simplified and clarified, for example, by detailing the selection criteria listed in Annex III and by establishing Community thresholds, criteria or triggers (COM(2009)378 final)[38]. This is discussed in more detail below.

There is need to recognise that smaller developments require a less arduous procedure, without jeopardising environmental integrity. Where smaller projects have potentially less significant impacts but still require assessment, simplified procedures should be considered. Examples of this approach are evident from Germany, where the competent authorities have a greater level of discretion over procedures particularly in relation to consultation. This is also the case in France through their ‘*notice d’impacts’* statement and in Portugal where there is an environmental appraisal.

Uncertainty or unknown effects can also create a problematic issue for competent authorities who are aware of the need to apply a precautionary approach and also conscious of potential liability of the State for incorrect application of the provisions of the Directive. The increasing amount of case law, both at the domestic level and at European level (ECJ), has alerted Member States to the wealth

[36] GHK Technopolis. 2008. Evaluation on EU Legislation: Directive 85/337/EEC (Environmental Impact Assessment) and Associated Amendments - Final Report.

[37] C-392/96, Commission v. Ireland, paragraphs, 76, 82;C-142/07

[38] Commission of the European Communities, 2009. Report from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions - On the application and effectiveness of the EIA Directive (Directive 85/337/EEC, as amended by Directives 97/11/EC and 2003/35/EC)

of potential legal challenges which can be raised, by a range of stakeholders. This is perhaps the principal reason for the perceived over-precautionary approach taken by competent authorities. Many of the legal challenges relating to EIAs relate to procedural issues and not to environmental matters.[39]

The steps in the EIA process are shown in Figure 2. Scoping is the method of determining the content and extent of the matters that should be covered in the environmental information to be submitted to a competent authority for projects which are subject to EIA. Scoping is not mandatory under the provisions of the Directive, however, the Directive requires that Member States must have measures in place to ensure that, if the developer so requests before submitting an application for development consent, the competent authority shall give an opinion on the information to be supplied by the developer. This is known as a Scoping Opinion and does not preclude the competent authority from requiring the developer to submit further information at a later stage. Scoping opinions by the competent authorities are formulated in conjunction with other relevant authorities. Scoping can improve the overall quality of the EIA by ensuring only the impacts of most significance are included and concentrated upon.

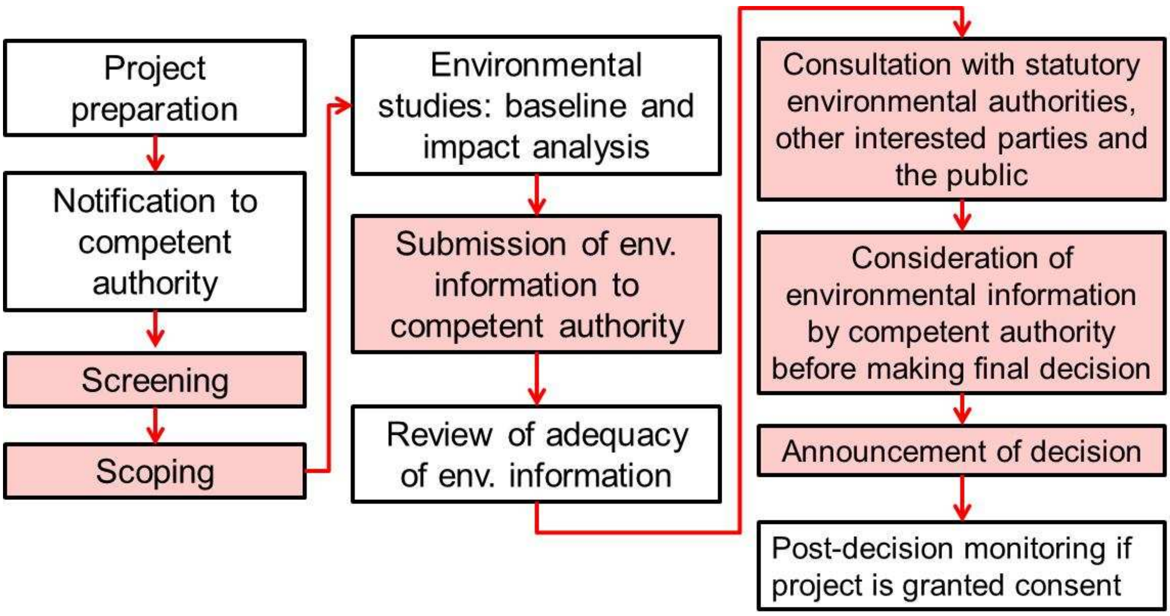

Figure 2: Steps in the EIA process[40]

4.3.1.1 Possible solutions to procedural issues

Since its introduction in 1985, the EIA Directive has been amended three times to take account of international legal requirements, but it has not significantly changed, despite the fact that the policy, legal and technical context has evolved considerably. The EC's reports on the application and effectiveness of the EIA Directive, including the latest one published in July 2009 (COM(2009) 378), have identified a number of shortcomings. These shortcomings relate to three specific problem areas: the screening procedure, the quality and analysis of the EIA and the risks of inconsistencies

[39] See footnote 33.
[40] European Commission. 2001. Guidance on EIA: Scoping. Office of the European Communities, Luxembourg.

within the EIA process itself and in relation to other legislation. In the context of Better Regulation[41], the EIA Directive has also been identified as a potential instrument for simplification. This, combined with widespread public consultation, has resulted in a proposal for an amended EIA Directive, published in October 2012.[42] The key changes proposed that could have an impact on wave energy development are shown in Table 3.

Proposed change	**Proposed mechanism**	**Potential result**
Clarification of the screening procedure	Amend Article 4; Modify criteria in Annex III; Specify content and justification of screening decisions	EIAs only for project with significant environmental effects; Avoid unnecessary administrative burdens for small-scale projects.
Mandatory scoping	Amend Article 5; Form and content specified in Annex IV	All competent authorities scope EIA content.
Quality control of EIA information	Amend Article 5; Form and content specified in Annex IV	Guarantees the completeness and sufficient quality of the environmental reports.
Mandatory assessment of reasonable alternatives [to the proposal in question]	Annex IV Amend Article 5	Largely neglected in EIAs currently and expected to improve overall EIA content.
EIA 'one-stop shop'	Article 2(3)	Facilitates coordination or integration of assessment procedures under the EIA Directive and other EU legislation.
Justification of final decisions	Amend Article 8	Explains reason for decision (result of case law C-50/09).
Mandatory post-EIA monitoring of significant adverse effects	Amend Article 8	Only for projects that will have significant adverse environmental effects, according to the consultations carried out and the information gathered.
Public information	Amend Article 9	The public is given a description of the monitoring arrangements when development consent is granted.
Address new challenges	Amend Article 3 to include biodiversity, climate change, disaster risks, use of natural resources	New priorities can be taken into account in EIA process.
Mandatory timeframes	Amend Article 6(6)	Reinforces role of environmental authorities and specifies concrete timeframes for public consultation.

[41] Commission of the European Communities. 2009. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Third Strategic Review of Better Regulation in the European Union (COM(2009) 15).
[42] Commission of the European Communities. 2012. Proposal for a Directive of the European Parliament and of the Council amending Directive 2011/92/EU on the Assessment of the Effects of Certain Public and Private Projects on the Environment (COM(2012) 628 final).

Table 3: Selected changes contained in the proposed new EIA Directive[43]

The changes outlined in Table 3 have the potential to vastly improve the procedural aspects of the EIA Directive as it is applied to wave energy developments. At the moment this is still a proposal and it will take some time to go through the EU institutions and get final agreement. DG Environment, who have responsibility for EIA, expect that it will be 2014 before the new Directive is adopted by the EU. Member States will then have two years to transpose its provisions into national legislation meaning it will be 2016 before any of the changes come into play. For technology developers this is potentially too far away and the compliance requirements, for example, environmental monitoring could still be prohibitive for them.

Whilst many of the barriers identified during the workshops and questionnaires have the potential to be addressed by the new EIA Directive, others will continue. These relate to costs associated with the EIA process, sharing of data and guidance on the process. The latter two barriers may be somewhat addressed using the wave energy test centres that have been built in different EU Member States as is described in Section 4.4.1. The costs associated with the EIA process may somewhat be addressed by improved knowledge of the effects of wave energy developments.

4.4 Ameliorating barriers associated with environmental monitoring requirements

Completion of an EIA usually informs the monitoring requirements attached as terms and conditions to the development consent. The current EIA Directive itself does not impose a monitoring requirement. It is the outcome of the EIA process which can dictate a need for monitoring in the eyes of the competent authority. The limited amount of scientific evidence on potential environmental impacts of wave energy due to the nascent state of the industry has been identified as the main cause of this barrier. Given the early stage of the industry, those developers involved in site development are usually less well-resourced than developers likely to be involved in commercial scale projects (e.g. large utility companies). Thus the EIA process can place a large strain on their limited human and financial resources.

To move the industry on from its present state, it is important that as much evidence and information relating to the effects of wave energy deployments is gathered and shared widely throughout the industry and amongst different Member States. To reduce the burden on developers in the short term, who will mostly be deploying single or small numbers of devices, it has been suggested that test centres play a more significant role in gathering and sharing environmental monitoring data. This is discussed in Section 4.4.1. It has also been suggested that management techniques such as adaptive management and risk based management are applied to environmental monitoring. This is discussed in Section 4.4.2.

4.4.1 The Key Role of Test centres

[43] See footnote 38.

4.4.1.1 Introduction

To date, most wave energy device deployments have been at dedicated large and full scale wave energy test centres. This is also likely to be the situation for deployments into the near future. Wave energy test centres have been, or are being, built in different EU Member States as part of an attempt by these Member States to support their indigenous wave energy developers by creating open water test centres for device deployment. The main focus of these centres is to allow device developers to test or demonstrate the performance of their devices in an open sea environment. Test centres can also play a key role helping to address the barriers associated with consenting and EIA.

4.4.1.2 Wave energy test centres and the consenting process

Most wave energy test centres have gone through the consenting process in the same way as that expected for commercial wave farm developments. This has involved consultation with regulators and stakeholders, scoping, EIA and public consultation. As a necessary precursor, baseline environmental characterisation and monitoring programmes have been, or are being, undertaken. In most cases, a reduced consenting requirement applies to wave energy devices deploying at test centres. These consents are simpler in procedure, and lesser in content, than they would be for deployments outside of wave energy test centres since all consents relating to the infrastructure and operations are likely to have been covered in the test centre consenting process. Guidance from the test centre is often available to the developer on stakeholder engagement, public consultation and important environmental receptors.[44] The monitoring programmes undertaken by the test centre provide valuable baseline data to developers required to do environmental monitoring with a device in place.

4.4.1.3 Environmental Monitoring Methodologies and Standards

Since most of the early experience of wave energy deployments will come from test centres, wave energy test centres have an important role to play in establishing environmental monitoring methodologies and standards. As mentioned previously, competent authorities tend to take a precautionary approach when granting development consent and arguably attach monitoring requirements that have a significant impact on small developers in terms of costs and resources. Results from SOWFIA Deliverable 3.3 confirm the variety of parameters that are monitored in existing test centres across Europe.[45] Many test centres have recognised their responsibility in this regard and consequently have established research programmes that aim to contribute towards the standardisation of methods for measuring environmental effects of wave energy deployments. Examples of this include acoustic monitoring research projects at EMEC[46] in Scotland, in Galway Bay[47] in Ireland and Wave Hub[48] in England, which seek to contribute to the standardisation of methods for measuring underwater noise.

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[44] See, for example, EMEC's Guidance for Developers at EMEC Grid Connected Sites: Supporting Environmental Documentation. August 2011.
[45] See footnote 24.
[46] See http://www.emec.org.uk/research/emec-site-specific-projects/ Accessed: 2012-02-28
[47] Kolar, H. 2012. The Smarts Behind Galway Bay http://asmarterplanet.com/blog/2012/09/galway.html. Accessed 2012-10-26.
[48] Witt, M.J., Sheehan, E.V., Bearhop, S., Broderick, A.C., Conley, D.C., Cotterell, S.P., Crow, E., Grecian, W.J., Halsband, C., Hodgson, D.J., Hosegood, P., Inger, R., Miller, P.I., Sims, D.W., Thompson, R.C., Vanstaen, K.,

4.4.1.4 Using test centres to further ameliorate barriers relating to environmental impacts

There is a lot of good work being done by wave energy test centres to simplify the consenting process for developers. There is also significant effort being invested into increasing knowledge and developing standards for environmental monitoring specific to wave energy device deployments. While the wave energy industry is developing, wave energy test centres can be used further to help remove barriers in the wave energy consenting process.

- As an interim measure, information on methodologies used to monitor impacts on common receptors should be shared between test centres. A key output from SOWFIA Work Package 3 is the **Data Management Platform (DMP)**, which is a tool for the collection and presentation of environmental assessment data and upon which environmental monitoring data from different test centres is being shared. Information on environmental effects that occur from certain activities (e.g. laying cable on seabed) should also be shared between test centres.
- There is a need, in the longer term, for a **pan-European EIA clearing house mechanism**. This would compile, maintain, and disseminate EIA-related information and knowledge in the EU, so that countries could learn from one another and make progress towards improved EIA practice and implementation. This would avoid duplication and promote the transfer of technology and lessons learned across marine industrial sectors.
- Wave energy test centres can make important contributions towards **standardising methodologies** for measuring environmental effects of wave energy deployments. Different methods are likely to be appropriate for different sites and device types but some level of common approach should be achievable. Standardisation is not the sole remit of any one individual test centre. Co-operation and communication should be improved between test centres so that resources can be used to concentrate on knowledge gaps and unnecessary duplication of work is avoided. Information from research projects aiming to standardise methods for monitoring the same effect should be shared between test centres.
- Test centres should put an onus on developers to identify likely potential environmental effects of their device and to propose mitigation measures. Test centres should ask device developers to produce an **environmental appraisal report** containing this information for their device deployment. Such a requirement is in place at EMEC.[44] Test centres should provide guidance to developers to help them with this undertaking.
- Where possible, **funding** provided by national or EU funding bodies to developers to test at wave energy test centres should be linked to addressing broader environmental impact knowledge gaps and provide for monitoring of specific effects. This information could then be used to help assess the risk of this environmental impact for developments of similar devices and dissemination of this information should be made a condition of funding.

4.4.1.5 Limitations of test centres

Wave energy test centres are likely to provide much of the information relating to environmental effects and impacts in the short term. There are, however, a number of limitations to relying on wave energy test centres to fill all knowledge gaps, including:

Votier, S.C., Attrill, M.J. and Godley, B.J., 2011. Assessing wave energy effects on biodiversity: the Wave Hub experience. Philosophical Transactions of the Royal Society A, 370 (1959), 502-529.

- Deployments at test centres are likely to consist only of single or small numbers of devices for relatively short periods of time. At best, it will only be possible to draw limited conclusions on the environmental effects of large arrays and the cumulative impacts of large numbers of developments. Long term environmental effects of deployments may not become evident at test centres as deployments are often temporary in nature, perhaps extending to a maximum of five years, often with the device removed and re-deployed many times during that period.
- There are only a finite number of wave energy test centres across Europe. It cannot be expected that these test centres will cover all location and habitat types which have the potential to be affected by wave energy developments.

4.4.2 Applying Adaptive Management

4.4.2.1 Introduction

Adaptive management is a decision process that has been used to manage natural resources for several decades. It is a process used to manage "resources that are responsive to management interventions but subject to uncertainties about the impacts of those interventions" [49] and has been described as "a structured process of learning by doing, and adapting based on what is learned."[50] Examples of natural resources to which adaptive management has been applied include forest management, habitat restoration and fisheries management.

It was frequently suggested during SOWFIA Work Package 2, and indeed elsewhere[51,52], that adaptive management should be applied to wave energy developments to learn about the impacts of wave energy on the environment and hence manage these impacts better. This section gives a brief overview of adaptive management including when and how it is best applied and discusses implementing adaptive management to improve the wave energy consenting process.

4.4.2.2 Practical Implementation of Adaptive Management

There remains considerable ambiguity about what adaptive management actually is, and how it is to be implemented by practitioners.[49] It is important to distinguish the implementation of adaptive management from a mere trial and error approach. The implementation of adaptive management is a structured approach in contrast to an approach of 'try something and if that doesn't work try something else'. The U.S. Department of the Interior has produced a technical guide on adaptive management which describes its implementation[53] in two key phases: a set-up phase and an iterative phase (See Figure 3).

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[49] Williams, B.K. 2011. Adaptive management of natural resources – framework and issues. Journal of Environmental Management 92, 1346-1353.
[50] Walters, C.J. and Holling, C.S., 1990. Large-scale management experiments and learning by doing, Ecology 71, 2060-2068.
[51] See, for example, Oram C. and Marriott, C. 2010. Using Adaptive Management to Resolve Uncertainties for Wave and Tidal Energy Projects. Oceanography Vol. 23, No.2.
[52] Hill, M.L. and Piltz, F.M. 2007. Environmental Risk Analysis and Wave Energy: Examples of How to Assess Potential Effects of Wave Energy on the Environment. Workshop on Ecological Effects of Wave Energy Development in the Pacific Northwest.
[53] Williams, B.K., Szaro, R.C. and Shapiro, C.D. 2009. Adaptive Management The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington DC.

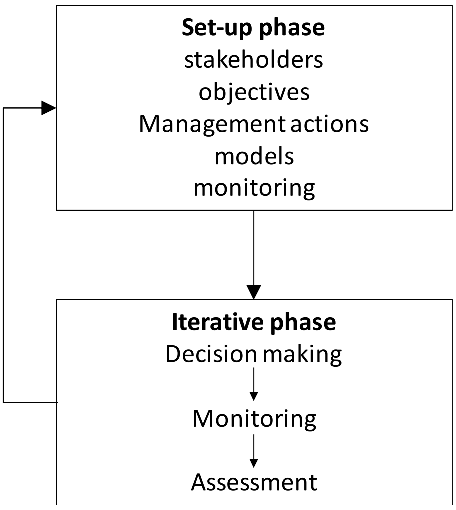

Figure 3: Two phase implementation of adaptive management [49]

There are five important components of the set-up phase. Stakeholders of the environment which is being managed must be identified and consulted with. This consultation is used to reach an agreement of the definition of the natural resource problem, its scope and objectives, and the management actions to be used in the adaptive management programme. It is important to be able to develop models which can link potential management actions to environmental outcomes. Finally it is crucial that it is possible to monitor resource response to management actions.

The key steps of the iterative phase of adaptive management are shown in Figure 4. The management action involves selecting which action from the set of management actions to put in place. The adaptive management objectives are used to guide which management action is chosen. Once the management action has been undertaken, monitoring is used to track subsequent changes in the natural resource. An assessment of desired and actual outcomes is then made using the information produced by the monitoring and modelled predictions. The understanding of the impact of the action on the resource is then used to select the next management action in order to progress towards the overall adaptive management objectives.

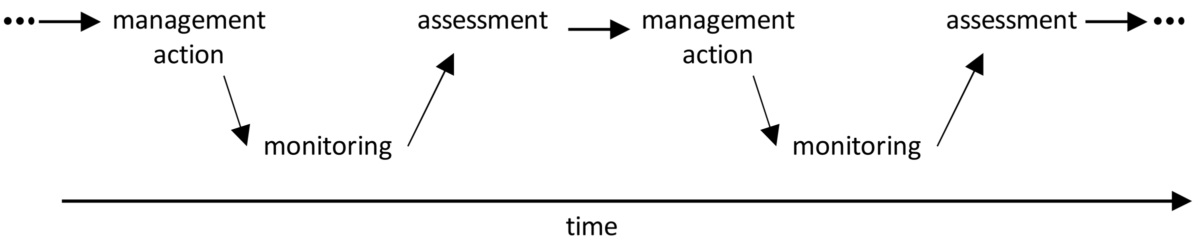

Figure 4: Iterative phase of adaptive management[49]

4.4.2.3 Applying Adaptive Management to Wave Energy Development

An initial assessment would indicate that, in theory, adaptive management could be used to manage and learn about the environmental impacts of wave energy developments. The U.S. Department of the Interior Technical Guide on adaptive management presents the conditions under which adaptive management should be used and how it should be implemented. This section will apply this guidance to wave energy projects to give a more detailed assessment of if and how adaptive management can be applied to wave energy development. Section 4.4.2.4 describes the legal situation regarding the implementation of adaptive management as part of broader EU and national consenting processes.

4.4.2.3.1 Conditions that warrant an Adaptive Management approach

There are two overarching conditions that should be met for an adaptive management approach to be implemented. The first is that there must be a mandate to take action in the face of uncertainty. This mandate should come from all stakeholders with an interest in the development. The second overarching condition is that there must be the commitment and capacity from all parties involved to undertake and sustain an adaptive programme. This is required to ensure that long term monitoring and assessment of outcomes takes place which will lead to improved management of the resource and learning.

It is important that developers of wave energy projects mandate adaptive management because, securing investment in a project may depend on a known financial risk profile for the project. A known financial risk profile may not be available when an adaptive management approach is adopted due to uncertainty relating to impacts, the timing of when management actions can be implemented and the level and duration of monitoring. Some developers may prefer having more onerous conditions placed on their licenses and permits at the beginning, anticipating problems and addressing them, whether or not they become the reality[54]. A commitment from wave energy developers to undertake an adaptive management programme may be dependent on funding to be made available for the programme and on a commitment that learning outcomes could be transferable to other projects in which they are involved.

As well as the two overarching conditions described above that warrant an adaptive management approach, there are six other conditions which should be met for the approach to be successful.

1. **A real management choice is to be made**

   This condition requires that there must be different management actions available, each of which can have an effect on the natural resource, for adaptive management to be implemented. Importantly these choices must be agreeable to all stakeholders in the development and are constrained by existing laws, regulations and policies. None of these choices should lead to irreversible changes.

   It is likely that there will be alternatives available to the management of wave energy developments that can affect the environment. Some of the available alternatives are likely to be similar to those used in the adaptive management programme put in place for the SeaGen tidal turbines, a tidal energy project, deployed in Strangford Lough in Northern Ireland. An example of management actions undertaken to avoid seal mortalities from the turbine involved initially manually shutting down the turbine when a marine mammal observer located a seal within 200m of the turbine. Marine mammal observers were later replaced by sonar units to detect the seals. Later iterations allowed seals to approach within 100m, then 50m and finally 30m of the turbine before shutdown was triggered. At the start of the project, there were on average three turbine shutdowns per 24 hours of operation. By the end of the project this had reduced to one

[54] Oram C. and Marriott, C., 2010. Using Adaptive Management to Resolve Uncertainties for Wave and Tidal Energy Projects. Oceanography Vol.23, No.2

shutdown per 24 hours of operation[55]. Similar actions could be implemented for wave energy devices, for example, they could be shut down if a particular species is observed within a certain distance. This distance could then progressively be reduced if adverse impacts were not observed.

Difficulties may arise in providing alternatives that are agreeable to all stakeholders. Limiting the operating time of devices may have implications for the economic viability of a project. Other alternatives may not be agreeable to those interested in the protection of certain species or habitats.

2. There is an opportunity to apply learning

The requirement of this condition is that resource management decisions can be revisited and modified over time or that multiple decisions of a similar nature can be made over time so that learning from the outcomes of decisions can be applied. For single wave energy projects, it should be possible to revisit and modify individual management decisions within that project. This is dependent on the resource manager having the ability to measure outcomes and use the results at a later date.

It is also dependent on being able to acquire understanding quickly enough to apply it to subsequent management decisions. The time required to obtain statistical certainty depends on a number of factors including the monitoring method, the amount of time monitoring data is available, the number of animals and the amount of background variation. In the SeaGen adaptive management programme in Strangford Lough, it was seen relatively quickly that seals were not going to collide with the tidal turbine when shutdown distances were in place. The 200m shutdown distance was reduced to 100m within eight months, to 50m after another four months and to 30m after a further six months. It may not be possible to obtain understanding of other potential impacts as quickly, such as long term effects on certain species populations.

In theory it should also be possible for some learning outcomes to be transferable between different projects. This is dependent on the willingness of developers and regulators to share outcomes from projects they are involved in and learn from the adaptive management outcomes of other projects.

3. Clear and measureable management objectives can be identified

This condition requires that explicit and measurable objectives for the adaptive management programme are agreed upon by all stakeholders involved in the process. If the management objectives are agreed by all stakeholders, there is a greater chance that they will have confidence in the process and remain interested the outcomes of the adaptive management approach. Measurable objectives allow progress towards their achievement to be assessed. It also means that if impacts on the natural resource deviate from the objectives, a change in the management direction can be triggered.

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[55] Copping, A., Hanna, L., Whiting, J., Geerlofs, S., Grear, M., Blake, K., Coffey, A., Massaua, M., Brown-Saracino, J., and Battey, H. 2013. Environmental Effects of Marine Energy Development around the World for the OES Annex IV, [Online], Available: http://www.ocean-energy-systems.org

It should be possible to identify explicit and measureable objectives for wave energy developments. This could include objectives for environmental receptors in the location of the development and objectives for energy output from the development. Some objectives for environmental receptors may be easier to identify than others, for example, it may be easier to agree on noise levels a certain distance from a farm than it would be to define an objective for a particular species of bird. Again these objectives will be constrained by existing laws, regulations and policies. The difficulty in defining objectives may be finding an agreement between the developer, the regulator and all stakeholders involved.

4. The value of information for decision making is high

The requirement of this condition is that for an adaptive management approach to be put in place, there needs to be the prospect of substantially improved decision making to justify the cost of monitoring and assessment. This is particularly important for the burgeoning wave energy industry. As a new sector with unknown and/or uncertain effects it is imperative from a regulator's point of view that they can have confidence in the information on which they are basing their decision and/or future management intervention. Currently experience from offshore wind and perhaps other maritime industries provide basic information on the types of potential environmental effect wave energy devices have on the receiving environment. Whilst there are some similarities between industries, wave energy technologies operate in different ways and different locations so it is imperative that there is a dedicated information stream from real-life sea conditions. Adaptive management can facilitate this process enabling decision makers to make evidence-based management interventions.

5. Uncertainty can be expressed as a set of testable models

The requirement of this condition is that models are developed which predict the effects of management actions that are relevant to the objectives. The models can be either conceptual or quantitative. These models are compared to monitoring data to determine which model best represents system responses. In this way, the reasons behind management actions can be expressed and tested. As monitoring data becomes available, models which represent the natural resource well can be identified and refined and be used as the basis for further management actions.

Models have been developed to predict a limited number of the environmental impacts of ocean energy devices. Examples include models which predict the encounters of fish or marine mammals with tidal turbines, models which predict the effects of sound coming from wave and tidal devices and models which show the effect of the removal of energy from the marine environment[56]. These models have largely not been validated with field data but models such as these could be used as the basis for developing alternative management actions and then validated or refined using monitoring data.

[56] IEA-OES. Annex IV – Environmental Effects of Marine Energy Development around the World – Draft Final Report.

6. A monitoring system can be established to reduce uncertainty

Adaptive management is not possible without effective monitoring. Effective monitoring is necessary to test alternative models and to measure progress towards achieving management objectives. The monitoring should involve high quality data collection and storage and the monitoring programme should be underpinned by rigorous statistical design.[57]

Monitoring in marine environments, especially in offshore and deep waters is costly and can be difficult. Monitoring some receptors requires advanced underwater technologies while others require physical surveys. Methodologies for monitoring the environmental impacts of wave energy developments are still being developed and in many cases standardised methodologies are not yet available. SOWFIA Work Package 3 looks at the monitoring methodologies for wave energy impacts in more detail. For an adaptive management approach to be successful, it is likely that more confidence will be required in environmental monitoring methodologies for wave energy developments.

The above conditions give the requirements necessary for adaptive management to be applicable to wave energy developments from a theoretical perspective; however, there are legal issues which affect its implementation in EU Member States. These are discussed in 4.4.2.4.

4.4.2.4 Adaptive Management in EU law and policy

Whilst the adaptive management process has been applied widely in North America, it is less prevalent in the EU to date. It is impossible to discuss adaptive management without also addressing the precautionary principle as both seek to assist in dealing with an increasing appreciation of uncertainty and the potential for unanticipated adverse impacts. Adaptive management, as previously outlined, acknowledges that scientific understanding of an ecosystem will always be incomplete. It also assumes that as scientific knowledge improves, so too will the accuracy and reliability of decision-makers' ability to predict outcomes. Decisions about the management of resources and the environment, therefore, present an opportunity to gain enhanced understanding of the environment. The precautionary principle asserts that when scientific uncertainty is high, and the potential for substantial negative (but possibly unexpected) effects exists, decision-makers should err on the side of caution.

Increasing recognition and calls for more integrated marine governance internationally and nationally have led the EU to develop an Integrated Maritime Policy (IMP),[20] which identifies the need for a joined-up approach to the management of the marine environment and the activities going on therein. At the heart of this is the ecosystem-based approach to management (EBM). There is no single agreed definition of the approach, but its overall aim is to ensure that the collective pressures of human activities do not exceed levels that compromise the capacity of ecosystems to respond. As explained by the FAO, the ecosystem approach requires adaptive management to deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge or understanding of their functioning.[58] The Marine Strategy Framework Directive (MSFD) explicitly refers to the ecosystem-based approach to management of the marine environment as a guiding

[57] Lindenmayer, D.B. and Likens G.E., 2009. Adaptive monitoring: a new paradigm for long-term research and monitoring. Cell Press.

[58] See http://www.fao.org/docrep/006/Y4810E/y4810e0f.htm

principle (Recitals 8 and 44), but also requires its application in marine strategies (Articles 1 and 3). This means that the ecosystem-based approach is now a legally-binding principle for the management of the marine environment.[59]

The MSFD is the environmental pillar of the over-arching IMP. The MSFD aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. Member States are required to draw up marine strategies for their regions addressing all impacts and pressures affecting the marine environment and this, in turn, will help achieve GES in that region. GES will be assessed on the basis of 11 qualitative descriptors[60]. One of these is the introduction of energy, including underwater noise, which is an important consideration for wave energy development. It should be noted, however, that assessment is carried out at a regional scale and is consequently less concerned with individual devices or small arrays.

Adaptive management is explicit in the MSFD (Article 3 (5)), which requires marine strategies to be updated on a six-year cycle. The Directive required Member States to conduct an initial assessment (Article 8) by July 2012 and monitoring programmes (Article 11) by July 2014. Furthermore, the Directive ensures that the knowledge gained from these procedures informs subsequent management measures by requiring that the environmental targets (Article 10) and the programmes of measures (Article 13) are based on the initial assessment. Effectively this corresponds to the concept of adaptive management, explicit in the MSFD. The rationale being that, for protection of the marine environment, there are still many uncertainties, and hence the need to take new information and knowledge into account.

The basis for the precautionary principle, and indeed the polluter pays principle, is arguably stronger in EU law, as both have a basis in the Treaty on the Functioning of the European Union (TFEU)[61]. The Treaty does not define the principle and has opted to expand upon its understanding, application and use in the form of a dedicated Communication.[62] The Commission state that the "principle should be considered within a structured approach to the analysis of risk which comprises three elements: risk assessment, risk management, risk communication" and stress that though the principle is essentially used by decision-makers in the management of risk, it "should not be confused with the element of caution that scientists apply in their assessment of scientific data."[62] According to the Commission measures based on the precautionary principle should be:

- proportional to the chosen level of protection,

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[59] European Commission. 2012. Contribution of the Marine Strategy Framework Directive (2008/56/EC) to the implementation of existing obligations, commitments and initiatives of the Member States or the EU at EU or international level in the sphere of environmental protection in marine waters (COM(2012) 662 final).

[60] The 11 descriptors are 1. Biodiversity is maintained; 2. Non-indigenous species do not adversely alter the ecosystem; 3. Populations of commercial fish species are healthy; 4. Elements of food webs ensure long-term abundance and reproduction; 5. Eutrophication is minimised; 6. Sea floor integrity ensures the functioning of the ecosystem; 7. Permanent alteration of hydrographical conditions does not adversely affect the ecosystem; 8. Concentrations of contaminants have no effects; 9. Contaminants in seafood are within safe levels; 10. Marine litter does not cause harm; 11. Introduction of energy (including underwater noise) does not adversely affect the ecosystem (MSFD, Annex I).

[61] Article 191, TFEU.

[62] Commission of the European Communities, 2000. Communication from the Commission on the precautionary principle (COM(2000) 1 final).

- non-discriminatory in their application,
- consistent with similar measures already taken,
- based on an examination of the potential benefits and costs of action or lack of action (including, where appropriate and feasible, an economic cost/benefit analysis),
- subject to review, in the light of new scientific data, and
- capable of assigning responsibility for producing the scientific evidence necessary for a more comprehensive risk assessment.

The precautionary principle should not be used as an excuse to protect something or indeed used to justify the adoption of capricious decisions I.e. decisions that are not based on any apparent reason. According to the Commission whether or not to invoke the Precautionary Principle is a decision exercised where scientific information is insufficient, inconclusive, or uncertain and where there are indications that the possible effects on the environment, or human, animal or plant health may be potentially dangerous and inconsistent with the chosen level of protection.[62] Additionally the Commission stress that reliance on the precautionary principle should be distinguished from the search for zero risk, which in reality is rarely to be found (op. cit). The precautionary principle has been criticised for potentially halting technological progress, which is a concern that could arise in relation to wave energy. This confuses the broad, common-sense precautionary approach to decision-making with a specific precautionary action. Precautionary action does not necessarily mean stopping an activity: it can also mean imposing a moratorium while further research is conducted, calling for monitoring of technologies and/or adopting safer alternatives.[63] Arguably the approach could also stimulate the development of better technologies.

In the EU the precautionary principle has been utilised primarily in the areas of food safety and consumer protection reflected in ECJ case law. Both the precautionary principle and the polluter pays principle are included in the MSFD, as guiding principles for its implementation, in Recitals 27 and 44. In particular they are a basis for the programmes of measures Member States must develop to ensure their marine waters reach Good Environmental Status. As the MSFD assessments and programmes of measures are still at the discussion and development stage it is unclear how adaptive management, the precautionary principle and the polluter pays principle will transpire in a practical way to marine developments. The principles and approaches, as contained in the MSFD, have a regional application and are therefore more strategic than a site level application.

4.4.2.5 Practical considerations

From a theoretical perspective, it appears that adaptive management can be applied to wave energy developments in order to manage and learn about the impacts of wave energy developments. Implementing an adaptive management approach is not, however, as simple as adopting a trial and error approach and it may not be possible for all developments to meet the conditions, set out by the US Department of the Interior, for implementing an adaptive management approach.

For an adaptive management approach to succeed for a development, wave energy developers and their investors must be willing to accept the uncertainty and added risk associated with the approach. The approach, its objectives and the alternative actions set out in order to reach the

[63] Myers, N. 2000. Debating the Precautionary Principle. Environmental Commons, Science and Environmental Health Network. Available at: http://environmentalcommons.org/precaution-debating.pdf

objectives must also be agreeable to developers, regulators and stakeholders and all parties must be willing to sustain the effort involved in order to meet the objectives. For an adaptive management approach to be applicable to a receptor, models and monitoring methodologies must be available to predict and measure the effects of management actions on that receptor.

From a legal perspective, there is obviously a national legal requirement to adhere to the principles contained in EU Treaties and secondary legislation such as the Marine Strategy Framework Directive. The principles contained therein will have national level implications but are likely to have little impact at site level in the near future. This does not mean that they should be ignored. Embracing the concept of adaptive management could help to progress wave energy through enabling products and projects to get into the water. It can also help address the recognised information gaps and knowledge uncertainty. Adaptive management approaches and the precautionary principle on the surface can appear contradictory but in essence both focus on risk assessment and management. In terms of hierarchy some commentators would suggest that a 'principle' has a stronger legal meaning[64] than an 'approach', possibly suggesting that the precautionary approach should take precedence. Peel (2004) describes the former as an 'obligation' which would require decision-makers to take measures to address potential harm in the presence of scientific uncertainty. On the other hand, she opines that an 'approach' authorises regulators to take actions in certain circumstances, without dictating a particular response in all cases. This remains to be clarified at EU level.

Another potential issue arising from application of the adaptive management is the legal need for certainty. Adaptive management calls for decisions made in the context of uncertainty to be taken as hypotheses, to be tested and re-evaluated as additional information becomes available. By contrast, administrative decision-makers and reviewing courts have as one of their primary goals the final resolution of disputes. Fundamental legal principles such as the rule of precedent and *res judicata*[65], indicate that courts, as mechanisms of conflict resolution, must be certain and final. If administrative and judicial decisions, apart from measures specifically designated as interim, become temporary or tentative, the argument is that this will reduce the certainty, predictability and hence legitimacy of the legal system[66].

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[64] Peel, J. 2004. Precaution – A Matter of Principle, Approach or Process? 5 Melbourne Journal of International Law, 483.

[65] A matter that has been adjudicated by a competent court and may not be pursued further by the same parties.

[66] Benidickson, J., Chalifour, N., Prévost, Y., Chandler, J., Dabrowski, A., Findlay, C.S., Déziel, A., McLeod-Kilmurray, H. and Lane, D. 2005. Practising precaution and adaptive management: legal, institutional and procedural dimensions of scientific uncertainty. Submitted to the Law Commission of Canada. Available at: http://www.uottawa.ca/ie/English/Reports/JBPP_Final_Report.pdf

5 Overall Conclusions and Recommendations

This report has presented an analysis of the barriers and accelerators in the consenting process in EU Member States experienced by developers of wave energy projects and those in charge of consenting wave energy developments. An analysis of suggestions for ameliorating these barriers made by the above parties during SOWFIA Work Package 2 activities has also been presented. This section presents the overarching conclusions and recommendations from SOWFIA Work Package 2.

It is important to note that as presented in Section 2, only a relatively small amount of wave energy capacity, in comparison to 2020 ocean energy targets for Member States, has been installed. This implies that the consenting process for wave energy developments in Member States has not yet been seriously tested. Wave energy capacity that has been installed has largely been single devices deployed at specially built wave energy test centres in different Member States. There have been no wave energy farms installed apart from the interrupted deployment of three Pelamis devices in Portugal in 2008. As such, any accelerators identified cannot yet be judged to be robust and although there is a possibility that some of the barriers identified will diminish as the sector expands, it is more judicious to assume that some, if not most, of the barriers discussed will become more serious as the size of proposed developments increases and their environmental impacts and effects on other users of marine areas also increase.

There are two main reasons to argue that barriers will not necessarily become more of an obstacle to the wave energy sector: (i) wave energy developers and regulators are gaining experience in how to navigate consenting processes, conduct EIAs and consult with local stakeholders as a result of the deployments that have taken place; and (ii) the offshore wind sector has demonstrated that it is possible to gain consent for larger-scale projects. However, this does not mean that one should assume wave and tidal energy will follow a similar trajectory to offshore wind energy. With this in mind, the conclusions presented in this section focus on measures for addressing the barriers in the wave energy consenting process which have been previously discussed in this document.

Arguably the most pressing priorities are: (i) streamlining of the number of regulatory consents and authorities; (ii) consistency in the application of EIA to wave energy developments and the lack of knowledge of the potential environmental impacts of wave energy developments and (iii) development of maritime spatial planning systems so as to help to avoid conflicts of use with other users of the maritime environment. Conclusions and recommendations relating to these three priorities are discussed in the following sections under the broader themes of: (i) Administrative Procedures; (ii) Environmental Impacts (EIA Process and Monitoring Requirements) and (iii) Human Dimensions.

5.1 Administrative Procedures

In order to encourage the development of the wave energy industry in a sustainable manner it is necessary to ensure that consenting administrative procedures for wave energy developments are fit for purpose and are viewed to be fit for purpose. This is important to maintain and increase investor confidence while at the same time ensure that stakeholders remain engaged with consenting procedures. A summary of barriers related to administrative procedures and strategic and operational recommendations which can help to ameliorate these barriers are shown in Figure 5 while some discussion on the implementation of new consenting regimes for ocean energy is provided in Section 5.1.1.

Wave Energy Consenting Barrier

Administrative Procedures

Barrier: Complex Administrative Procedures

- Many authorities and stakeholders involved in maritime environment
- Many different permits required
- Permits vary across EU Member States
- In some Member States, some permits cannot be applied for until others have been granted causing long delays
- Developers find lack of fixed time frames to be frustrating

→ **Streamlining** →

Recommendations for Ameliorating Barrier

Strategic Recommendations

- It is necessary to ensure that consenting procedures for wave energy developments are fit for purpose and viewed to be fit for purpose.
- Consideration should be given to interdependency of permits before embarking on new approaches (e.g. one-stop shop, parallel processing)
- The establishment of new or amended consenting regimes should be based on a realistic level of resources and legislative amendments

Operational Recommendations

- Allocation of a dedicated co-ordinating body in Member States for wave energy consents. Note: This does not have to be a new body.
- Implementation of a clear process with clear procedures including responsibilities, timelines and ability to appeal.
- Introduction or amendment of statutory timeframes in existing legislation
- All test centres should provide guidance to developers on the consenting process so that developers are encouraged to deploy there and gain experience which they can then apply to future developments.

Figure 5: Barriers relating to administrative procedures and recommendations to ameliorate these barriers

5.1.1 Implementation of new consenting regimes for ocean energy

The establishment of new or amended consenting regimes will depend on the level of commitment of Member State governments to the development of the ocean energy industry. An example of government desire to develop the industry has recently (April 2013) been shown in Spain where the Spanish government has recently agreed to lead the process to streamline the consenting procedure of Spain's marine energy test centres (Bimep, Plocan and Irec).

It could be argued that in some Member States the poor economic climate, the uncertain future development path for ocean energy and broader governance and legal issues may necessitate current approaches to consenting. On the other hand, the prospect of creating a new, knowledge-economy sector and regional economic development may prove attractive to other Member States, particularly if Member States see countries that have developed, for example, the one-stop shop approach gaining a competitive edge in the marine energy sector. The operational recommendations presented should be easier to achieve for Member States who are interested in the development of the wave energy industry but for whom the implementation of new consenting regimes would be unrealistic.

5.2 Environmental Impacts (EIA Process and Monitoring Requirements)

It is necessary to ensure that the EIA process and environmental monitoring requirements are sufficient to ensure protection of the marine environment and stakeholder interests while at the same time, not prevent the development of the wave energy industry. A summary of barriers related to the EIA process and environmental monitoring and strategic and operational recommendations which can help to ameliorate these barriers are shown in Figure 5 while some discussion on the proposal for amendments to the EIA Directive is provided in Section 5.2.1.

Wave Energy Consenting Barrier

Barriers Relating to Environmental Impacts

Barrier: Environmental Impact Assessment process

- Inconsistency in the manner in which the EIA Directive is applied to developments across different EU Member States in terms of information required and monitoring requirements
- There is a feeling within the industry that the EIA process is overly burdensome on small scale developers

Environmental Monitoring Requirements

- Unknown effects of wave energy devices on the marine environment
- Developers feel that monitoring requirements are too onerous for the current state of the industry
- Not enough guidance from regulators on the scope of EIAs
- Monitoring requirements subsequent to EIA can be too vague
- Long term monitoring results in additional costs for developers which may put off investors
- Environmental data availability is often compromised by developers desire for confidentiality.

Lack of design development in the consenting process

- This ties developers to a fixed consent for a specific project which is a big difficulty for burgeoning industry which is rapidly changing.

Streamlining →

Recommendations for Ameliorating Barrier

Strategic Recommendations

- Accelerate the rate at which understanding of the impacts of wave energy developments is being obtained. This can be done through:
  (i) facilitation of an adaptive management approach
  (ii) EU funding for research programmes on environmental impacts, especially in wave energy test centres.
  (iii) Require EIA data to be made publicly available (This is already the case in Denmark)
- It is suggested that competent authorities adopt a stricter approach to EIA screening whereby only those developments likely to have significant environmental effects are subject to a full EIA.

Operational Recommendations

- Baseline and impacts data should be made available at least for test centres and this could be made a condition of funding
- Site specific impacts should be the priority for small scale projects
- Results from monitoring programmes should be analysed and synthesized so as to better inform management decisions.
- The environmental assessment should be based on site sensitivity (i.e. It should focus on things that are important in that particular location not things that should be included just for comprehensiveness). It should also be based on the size of the project and the type of device being installed.
- Clear environmental assessment requirements should be provided by consenting authorities to developers.

Figure 6: Barriers relating to environmental impacts (EIA process and monitoring requirements) and recommendations to ameliorate these barriers

5.2.1 Proposed amendments to the EIA Directive

The proposal for amendments to the EIA Directive (presented in Section 4.3.1.1) has the potential to improve procedural aspects of the EIA Directive as it is applied to wave energy developments. Potential results of this proposal which could affect wave energy development include the requirement of an EIA for projects with significant effects only, mandatory scoping, EIA 'one-stop-shop' and the provision that new priorities such as climate change can be taken into account in the EIA process. It will be 2014 before this new Directive is adopted which means it will be 2016 before it has to be transposed into national legislation. Given the current state of the wave energy industry, this may come in time for many wave energy developments. Member States who want to encourage quicker development of the wave energy industry have the option of transposing the Directive into national legislation once it has been adopted.

5.3 Human Dimensions

Successful consultation and interaction with other users and stakeholders of the maritime environment is crucial for the development of the wave energy industry. Developers have expressed satisfaction with stakeholder consultation for wave energy projects to date and it is important that lessons learned from these projects are transferred to future developments. Integrated planning can play a role in reducing the potential for conflicts of use, however, there are a number of barriers related to this. A summary of barriers related to human dimensions, including strategic planning, and strategic and operational recommendations which can help to ameliorate these barriers are shown in Figure 7.

Wave Energy Consenting Barrier

Barriers Related to Human Dimensions

Stakeholder Consultation

- In general developers have had good experiences of this to date, however, there is potential for this phase to be time and resource consuming which may put off investors.

Conflicts of use

- Many other users of the maritime environment with whom conflicts of use may arise.
- There is a lack of data as to how wave energy developments will impact on other sea users.
- Potentially conflicting objectives set at EU and national level in relation to energy and nature conservation
- Mitigation measures (e.g. adjusting location, compensation) may have consequences for the economic viability of wave energy developments.
- Integrated planning could ensure greater coordination and communication between the authorities involved in wave energy consenting and hence reduce the potential for conflicts of use. There are, however a number of barriers related to integrated planning:
  (i) There is a lack of strategic planning involving and integrating all uses in the marine space
  (ii) There are different levels of MSP implementation in Member States and there is usually a disconnect between MSP, SEA and EIA processes
  (iii) MSP tends to reflect existing uses more fully than future potential uses like ocean energy developments

Streamlining →

Recommendations for Ameliorating Barrier

Strategic Recommendations

- Credible, evidence based information, both scientific and socio-economic should be presented to stakeholders in an accessible and understandable format.
- Realistic timelines should be provided to stakeholders to respond/ make submissions
- In terms of strategic planning:
  (i) Responsible government departments at national level should integrate and coordinate their policies and implement these policies through a dedicated MSP supported, where necessary , by an appropriate consenting system. It is important to note that MSP is not, however, a replacement for sectoral planning rather it seeks agreement between the plans that each sector develops for a given area.
  (ii) Carry out SEAs of specific plans and programme areas to ensure strategic government oversight and avoid conflicts between sectors and ultimately marine users.

Operational Recommendations

- Developers should make sure that consultation with everyone takes place at an early stage
- Consenting authorities should provide developers with a list of stakeholders.
- Suitable representatives should be selected to consult with stakeholders to build trust
- Developers should have suitable consideration for the audience they are consulting with and arrange meetings at appropriate times
- In terms of strategic planning:
  (i) Guidance documents should be produced to advise wave energy developers and other stakeholders on the siting of their developments within a given area and how to negotiate the consenting process applicable to their activity
  (ii) Public databases should be developed with information on marine natural resources and uses respectively, including information on coastal infrastructure and socio-economic aspects.

Figure 7: Barriers relating to environmental impacts (EIA process and monitoring requirements) and recommendations to ameliorate these barriers