



## **Joint Programme on Ocean Energy**

### **Environmental Impacts Workshop, 12-13<sup>th</sup> December 2011**

IFREMER (French Research Institute for the Exploration of the Sea),

Technopôle Brest-Iroise, BP 70, 29280 Plouzané, France

Workshop report prepared by:

Antoine Carlier, Ifremer, Centre de Bretagne, France.

Yann-Hervé De Roeck, Ifremer, Centre de Bretagne, France.



## **Background:**

The *Ocean Energy* Joint Programme (JP) of the European Energy Research Alliance (EERA) was launched in May 2011. The JP aims to develop coordinated European research that will underpin the development of the emerging marine renewable energy (MRE) sector (which includes wave and tidal current energy). The JP has five principal objectives:

1. Contribute to strategic leadership of the underpinning research;
2. Joint prioritization of research tasks and infrastructure;
3. Alignment of European and national research efforts;
4. Coordination with industry; and
5. Sharing of knowledge and research infrastructure.

The *Ocean Energy* JP is based around six key research themes:

- Resource;
- Devices and Technology;
- Deployment and Operations;
- Environmental Impact;
- Socio-economic Impact; and
- Research Infrastructure, Education and Training.

As initial activities for the JP, each of these six key research themes will hold a workshop before the end of 2011 to bring together the experts working in the field from across the JP partners across Europe. This will act as a catalyst, providing a forum and a mechanism for the valuable collaboration and coordination which is at the heart of the EERA and which underpins all of the objectives of the *Ocean Energy* JP. This Environmental Impact workshop is the fourth of these six research theme workshops, and has been hosted by France (who has been designated as the coordinator of the Environmental Impact research theme).

At the outset of the *Ocean Energy* JP, a number of sub-topics have been identified as key long term research objectives within each of the six key research themes. For the Environmental Impact, these are:

- Physical impacts;
- Biological impacts;
- Benchmarking; and
- Monitoring and Measurement to support consenting.

## **Workshop Objectives:**

The workshop had four principal objectives:

- To act as a forum to communicate what research is being done within different countries;
- To identify areas where overlap exists between research taking place in different countries and therefore where synergies and opportunities for collaboration exist;
- To identify areas where gaps exist - i.e. areas where research is required but which are currently not being sufficiently investigated by any countries; and
- To prioritise the research areas identified as gaps and opportunities for synergies by level of importance.

**List of Attendees:**

Country	Attendees	Institution
<b>UK</b>	<ul style="list-style-type: none"> <li>Andrew Want (A.Want@hw.ac.uk)</li> </ul>	<ul style="list-style-type: none"> <li>Heriot-Watt University, Stromness, Orkney, Scotland</li> </ul>
<b>Spain</b>	<ul style="list-style-type: none"> <li>Oihana Solaun (osolaun@azti.es)</li> </ul>	<ul style="list-style-type: none"> <li>AZTI-Tecnalia</li> </ul>
<b>France</b>	<ul style="list-style-type: none"> <li>Yann-Herve De Roeck – Ifremer (Yann.Herve.De.Roeck@ifremer.fr)</li> </ul>	<ul style="list-style-type: none"> <li>IFREMER, Centre de Bretagne.</li> </ul>
	<ul style="list-style-type: none"> <li>Antoine Carlier (Antoine.Carlier@ifremer.fr)</li> </ul>	
	<ul style="list-style-type: none"> <li>Sébastien Ybert (Sebastien.Ybert@ifremer.fr)</li> </ul>	
	<ul style="list-style-type: none"> <li>Pierre Watremez (pierre.watremez@aires-marines.fr)</li> </ul>	<ul style="list-style-type: none"> <li>Agence des Aires Marines Protégées (<i>Marine Protected Area Agency</i>).</li> </ul>
	<ul style="list-style-type: none"> <li>Gérard Thouzeau (Gerard.Thouzeau@univ-brest.fr)</li> </ul>	<ul style="list-style-type: none"> <li>Institut Universitaire Européen de la Mer (IUEM) - Université de Bretagne Occidentale (UBO) / Centre National de le Recherche Scientifique (CNRS).</li> </ul>
	<ul style="list-style-type: none"> <li>Laure Robigo (laure.robigo@laposte.net)</li> </ul>	<ul style="list-style-type: none"> <li>Comité Départemental des Pêches en Mer et des Elevages Marins (CDPMEM) (<i>Local fishery committee</i>)</li> </ul>
<b>Ireland</b>	<ul style="list-style-type: none"> <li>Anne Marie O'Hagan (a.ohagan@ucc.ie)</li> </ul>	<ul style="list-style-type: none"> <li>Hydraulics and Maritime Research Centre; University College Cork</li> </ul>
<b>Portugal</b>	<ul style="list-style-type: none"> <li>Teresa Simas (teresa@wave-energy-centre.org)</li> </ul>	<ul style="list-style-type: none"> <li>Wave Energy Centre; Centro de energia das Ondas</li> </ul>

Currently, eight countries are members of the EERA Ocean Energy JP. Among them, five countries (UK, Spain, Portugal, France and Italy) were initially involved in the Research Theme #4 “Environmental Impact”. Italy was not represented at the present workshop but is still involved, and Ireland finally intended the workshop and then should be included in the participants of RT#4.

## Agenda:

<b>Monday 12<sup>th</sup> December</b> (Room “Salon de l’Océan”)	
<b>14:00 – 14:10</b>	Welcome and presentation of the IFREMER institute: Antoine Dosdat, director of the Brittany’s Ifremer Centre.
<b>14:10 – 14:30</b>	Introduction. General presentation of the France Energies Marines project: Yann-Hervé De Roeck, Ifremer-Centre de Bretagne.
<b>14:15 – 16:30</b>	Presentations on the state of the art research from each of the countries represented at the workshop (25-30 min for each country) <ul style="list-style-type: none"><li>• France : Environmental research program of France Energies Marines: A. Carlier. Future pilot tidal project (ORCA): G. Thouzeau. A current environmental assessment linked to tidal projects: L. Robigo.</li><li>• UK</li></ul>
<b>16:30 – 16:45</b>	<i>Coffee-break</i>
<b>16:45 – 18:00</b>	Following of the countries’ state of the art (25-30 min for each country): <ul style="list-style-type: none"><li>• Spain</li><li>• Ireland</li><li>• Portugal</li></ul>
<b>18:00 – 18:30</b>	Preliminary discussions to identify research areas where collaboration is needed, and areas where gaps exist and further research is required.
<b>19:00 – 22:00</b>	<i>Dinner at the city of Brest and discussions.</i>
<b>Tuesday 13<sup>th</sup> December</b> (building of the “Institut de Recherche pour le Développement”)	
<b>9:00 – 10:30</b>	Prioritisation exercise to determine which 3 areas for collaboration are the most important (and why), and which 3 areas identified as research gaps are the most important (and why).
<b>10:30 – 10:45</b>	<i>Coffee-break</i>
<b>10:45 – 11:45</b>	Feedback to the workshop. Conclusion and summing up, Yann-Hervé De Roeck, IFREMER-Centre de Bretagne.
<b>12:30 – 14:00</b>	<i>Lunch at Ifremer</i>
<b>14:00 – 16:00</b>	Pursuing work on table of main research gaps with remaining participants.

## **Welcome and introduction:**

The workshop started with a brief *tour de table* to introduce each of the workshop participants and their individual areas of specialist expertise.

Antoine Dosdat, director of the IFREMER institute in Brittany welcomed the participants to Brest and presented the Ifremer institute and the context of its implication in the research on marine renewable energies.

Yann-Hervé De Roeck gave an introduction to the EERA *Ocean Energy* JP which set a clear context for the workshop and presented the main objectives of the France Energies Marines Project.

The initial presentations also set out the objectives for the workshop.

## **Short presentations on the state of the art research being conducted in each country:**

Each of the five represented countries gave a 25-30 minute presentation on the state of the art research being conducted in their countries with regard to potential and evidenced impacts of tidal and wave technologies on the coastal environments.

These presentations set a good backdrop for the discussion next morning. Becoming familiar with what research is taking place in different countries across Europe is an essential first step in identifying areas where synergies exist and areas where gaps exist.

### ***Presentations were made by:***

- **Antoine Carlier** (France): Environmental research programme of France Energies Marines.
- **G rard Thouzeau** (France): Future pilot tidal project (ORCA).
- **Laure Robigo** (France): A current environmental assessment linked to tidal projects.
- **Andrew Want** (UK): Environmental Impact Research in the United Kingdom: will Ocean Energy Extraction contribute to ecological change?
- **Oihana Solaun** (Spain): Marine energy. Present & future.
- **Anne Marie O'Hagan** (Ireland): Activities and issues relating to environmental impacts of Ocean Energy: Ireland.
- **Teresa Simas** (Portugal): The context for Marine Renewable Energy projects in Portugal.

The presentations were very useful for everyone to get a thorough European overview of what is the current development stage of tidal and wave technologies deployment and related environmental research, and what are the common practices to assess the potential impacts.

### ***Key messages from each of the five country presentations:***

This overview of the state-of-the-art was useful to raise awareness of the specificities/originalities in each country:

- UK: the importance of considering concurrent global change (in particular sea temperature rise) has been highlighted; in terms of receptors of potential ecological impacts, marine birds evoke strong public support in the UK; monitoring marine vertebrate interaction with devices is being addressed (for example: hydrophonically); and littoral monitoring of high energy rocky shores may provide valuable long-term ecological data;
- Spain: a detailed guideline for Environmental Impact Assessment (EIA) of wave technology and a detailed national planning zone for deployment have been presented;

- France: it has been mentioned that marine renewable energies (MRE) development may co-occur with Marine Protected Area (MPA), especially specific category of MPA where human activities are allowed and supervised by the French MPA agency; both activities need a long term monitoring of marine environment which could be undertaken using a common framework;
- Ireland: activities and issues relating to environmental effects of MRE development have been detailed in light of a national economic crisis and consequent changes in Government priorities.
- Portugal: Legal framework of environmental assessment in Portugal; presentation of the Wave Energy Centre and its main objectives and activities.

### **Networking sessions: (Coffee and lunch sessions)**

These sessions were successful for informal discussions and networking between the workshop participants. Most of the participants were not acquainted, consequently many useful introductions were made and fruitful discussions took place, often disseminating further details of the activities taking place in different countries.

### **Dinner and evening discussions:**

The first day of the workshop concluded with dinner in a seafood restaurant near the commercial harbour of Brest. The dinner was sponsored by IFREMER.

### **Discussion sessions :**

#### ***Coordination among European projects:***

Throughout the discussions, a number of important projects focussed on the area of environmental impacts of MRE were identified. As an important objective of the Joint Programme is to facilitate coordination between researchers, between projects and between countries, participants feel necessary to list other parallel European projects that deal with environmental impacts of tidal and wave technologies. Details of some important projects are outlined below:

- EQUIMAR (2007-2011): Equitable Testing and Evaluation of Marine Energy Extraction Devices in terms of Performance, Cost and Environmental Impact;
- SOWFIA (2010-2013): Streamlining of Ocean Wave Farms Impact Assessment;
- Aqua-Ret2 (2009-2011);
- WaveTrain2 (2009-2012);
- FAME (2010-2013);
- MARINET (2011-2015): Marine Renewables Infrastructure Network for Emerging Energy Technologies; access to test facilities.

The available outputs of some of these projects will be useful to start collaborative work, and the group decided to consider the report of the ICES Study Group on Environmental Impacts of Wave and Tidal Energy (SGWTE) as a basis for the following discussions (ICES, 2011).

#### ***Forthcoming exchange opportunities:***

Participants also noted important upcoming dates that could be good opportunities continue scientific exchanges started during this workshop:

- Environmental Interactions of Marine Renewable Energy Technologies (EIMR) International Conference: 1-3 May 2012, Orkney;
- ICES Workshop on Wave and Tidal Energy Test Sites: 3 May 2012, Orkney;
- ICES Study Group Meeting on Environmental Impacts of Wave and Tidal Energy: 4-6 May 2012, Orkney;
- 4th International Conference on Ocean Energy (ICOE), 17th to 19th October 2012, Dublin.

***Tuesday's exchange / brainstorming:***

On the second day, the workshop proceeded in two successive steps. The morning session took place with all participants and was mainly devoted to identification of the main research gaps in terms of environmental impacts. After lunch, an unforeseen working session took place with the five remaining participants pursuing the organisation/presentation of the research gaps.

As the number of participants was rather limited, no breakout groups were organised and discussions were conducted with all participants. The key areas identified as gaps were condensed into broad headings and written onto a board at the front of the room.

Prioritisation exercise:

The group considered the list of research gaps in the recent report of the ICES Study Group on Environmental Impacts of Wave and Tidal energy (SGWTE). This list is preliminary and needs to be completed and re-organised according to the main categories of research gaps.

The participants first tried to establish a list (as exhaustive as possible) of important gaps, and in the second phase, to organise these ideas in a concise and easily understandable diagram.

Instead of a prioritisation exercise, the participants endeavoured to develop some consensus within the group regarding which areas identified as gaps and synergies were the most important and why.

**Important issues addressed:**

<b>Synergies</b>
<ul style="list-style-type: none"> <li>• There is likely to be many overlaps between the environmental impact and socio-economic research themes, and it was suggested by the participants that strong connections be established between these two research themes (or potentially that the two research themes could be merged).</li> <li>• Concurrent designations: MRE extraction areas and Marine Protected Areas are not necessarily exclusive each other. Participants mentioned several cases where both coexist on a same area (e.g. tidal turbines settled in MPA in France and Ireland).</li> <li>• Information and data-sharing: important to find a way to easily exchange scientific information easily (especially grey literature which is rarely accessible). Would a wiki-site be suitable for this purpose?</li> </ul> <p>Although not a specific research area, it was felt that through making information on data held by institutions across Europe available in a single database, research activities and potential collaborative work could be facilitated.</p> <p>Creating a European 'catalogue' of test sites – identify complementarities of sites with different characteristics and put everything in a similar format for comparison.</p> <ul style="list-style-type: none"> <li>• Developing a common/standardised methodology for environmental impact assessment.</li> </ul>

- Common vocabulary: In order to start collaborative projects, the participants feel necessary to adopt a common terminology regarding the definition of environmental impacts and the time and space scales at which they can be considered.

### **Gaps**

- Improving baseline and background information; Sentinel species for recording/monitoring environmental change;
- Instrumentation/equipment: no project on developing/selecting cost-effective and efficient instruments.
- Important categories of environmental impacts are linked to: (1) Noise and how it is currently uncharacterised; (2) electromagnetic fields (EMF); (4) Footprint of various device types; (5) Collision risk;
- Potential impact of drifting objects (in the water column), both anthropogenic (waste) or natural (drifting terrestrial plants or large macroalgae), on the devices. Is it something to consider? This topic is slightly out of scope (since it deals with the impact of the environment on MRE development), nevertheless rarely mentioned in the literature.
- Need to work according to scale: single device v. multiple device farms/arrays (see also discussion below).

Cumulative impacts: Important to consider concurrent global changes: all participants agreed on the importance of considering long-term global changes (due to other human pressure than MRE) in order to properly assess the impacts of wave and tidal technologies over large temporal and spatial scales. The talk by Andrew Want highlighted the potential influence of temperature rise on the environmental changes observed in areas devoted to marine energy extraction.

### **Prioritised research areas which require further research:**

The group has identified a number of priority areas with research needs; those are presented in detail in Table 1 and the most important categories are further discussed below. However the current state of discussions and the available time did not allow the group to rank them or to identify possible research synergies between them.

#### **1. Improving baseline and background information:**

- An essential prerequisite for environmental impact assessment is to get fairly good knowledge on (1) which species are present and what are their spatial distributions and (2) what are the most important environmental factors that explain these distribution. The second point is still a challenging task (e.g. for benthic compartments) even in undisturbed coastal areas. Since the description and understanding of an ecosystem need long time projects with respect to the rapid expansion of MRE, it could more efficient to focus on a relevant set of “sentinel species” for recording/monitoring environmental change. So, an important gap is to propose a relevant list of sentinel species which are relevant for each kind of habitats suitable for the settlement of tidal and wave technologies.

- Opportunity through Marine Protected Areas (MPA) designation:

MRE extraction areas and are not necessarily exclusive each other. Participants mentioned several cases were both coexist on a same area (e.g. tidal turbines settled in MPA in France and Ireland). As mentioned above, both activities imply that long term monitoring of marine environment are undertaken, and this common objective could be achieved using a common framework.



Table 1: Details of priority areas with research needs identified during the workshop:

Main type of gaps	Uncharacterised issues		Identified sensitive receptors	Remarks on receptors	Tools / methods
Ecological (Environmental)	Single device (test site)	Noise	Cetaceans Pinnipeds Cephalopods (Diving birds) (Humans)	Will be site-specific Additional sensitive species may exist Assess species-specific tolerance (frequencies/intensity)	Visual observation Passive acoustic methods (T-pods; C-pods) Active sonar Computational modelling and prediction tools for radiated noise
		EMF	Elasmobranchs Migratory fish (eels, salmon) Crustaceans Reptiles (turtle) (Humans)	Will be project and site specific Additional sensitive species may exist	Measurement of EMF sources and propagation Identification of site sensitive species
		Physical presence of device	Reef community (benthos, fish) Commercial species (fish, crustaceans)	The presence of opportunistic species should also be evaluated	Application of biological quality indices
		Local sediment dynamics	Local fine bathymetry Local erosion and deposition processes	Will be site specific	Visual observation Passive protection Scale model experiments/computational modelling
	Array of devices (industrial farm/park)	Role of climate change	Sentinel species	Will be site-specific	Monitoring plan that follows sentinel species
		Energy removal	Coastal processes (geomorphology) Ecological processes (e.g. community changes; food web change) Sentinel species	Will be site-specific	Computational modelling Monitoring plan that follows sentinel species
Other	Improve data exchange	n. a.	n. a.	More synergies between research institutes and areas of research	
	Data availability	n. a.	n. a.	Databases	
Socio-economic	Public awareness on environmental impacts of wave and tidal technologies	Humans: Public in general Relevant stakeholders	The public and stakeholders for each site are mainly dependant on the predominant uses of the site	Methods and techniques for public and stakeholders outreach When available the use of MSP and SEA for the area	
	Co-existing human activities Protected areas				

## **2. Information and data-sharing:**

- An important gap is to find a way to easily exchange scientific information easily (especially grey literature which is rarely accessible). Would a wiki-site be suitable for this purpose?

Data sharing appears to be general need, not just to make data available, but to share metadata on:

- (1) who is conducting what research,
- (2) what facilities are available,
- (3) what data are available, and
- (4) what publications have been produced on different research areas.

Although not a specific research area, it was felt that through making information on data held by institutions across Europe available in a single database, research activities and potential collaborative work could be facilitated.

- Creating a European 'catalogue' of test sites – identify complementarities of sites with different characteristics and put everything in a similar format for comparison. This could be achieved in link with the MARINET project.

- Developing a common/standardised methodology for environmental impact assessment. The adopted strategy could benefit from the outputs of EQUIMAR project.

- Common vocabulary: In order to start collaborative projects, the participants feel necessary to adopt a common terminology regarding the definition of environmental impacts and the time and space scales at which they can be considered.

For instance, a distinction has been proposed between “Farm” and “Array” with respect to the degree of related potential impacts. We could adopt the distinction proposed by the participants of the SOWFIA (Streamlining of Ocean Wave Farms Impact Assessment) project (Olivares et al., 2011):

- *Test site* – a location to test solo prototypes, or small arrays of energy devices that are not necessarily grid-connected.
- *Array* – set of marine energy converters arranged specifically so as to enhance energy capture;
- *Farm* – group of similar marine energy converters of the same type (either WECs or TECs) sharing a connection to the electric grid;
- *Park* – a designated geographical region containing one or more marine energy farms; may lead to cumulative impacts.

## **3. Assessing cumulative impacts:**

There are two kinds of cumulative impacts to be considered. The first is linked to the repetition (in space and/or in time) of impacts linked to a single device. As a result, there is need to work according to scale: single device vs. multiple device farms/arrays (see also discussion below).

The second are linked to the co-occurrence (in a same area) of impacts related to different disturbing activities (MRE development and other type of anthropogenic pressure). On this latter point, all participants agreed on the importance of considering concurrent long-term global changes (due to other human pressure than MRE) in order to properly assess the impacts of wave and tidal technologies over large temporal and spatial scales. Effects of climate change are one of these global change, and the talk by Andrew Want highlighted the potential influence of temperature rise on the environmental changes observed in areas devoted to marine energy extraction.

## **Conclusion:**

The workshop partially achieved its objectives:

- It acted as a forum for researchers conducting research into environmental impacts of tidal and wave energy devices to meet other researchers from across Europe and learn about the research which is taking place in each countries and research institutes.
- It began to identify research areas where multiple research institutions are active in the same area and there are opportunities for collaboration – ‘Synergies’.
- It identified research areas where further research is required but which need to be the focus of future funding opportunities – ‘Gaps’.
- It did not yet allow selecting main synergies which the participants felt to be the most important.
- The participants agreed with the idea of producing a collaborative research paper as a first output. A review on the potential ecological impacts of submarine electric cables has been identified as a possible topic for the paper.

## **Next steps:**

For next discussions, it would be necessary to clearly distinguish synergies and gaps by using the definition proposed by the participants of the Resource workshop:

- Synergies should be research areas in which work is already being undertaken and where there are therefore opportunities for collaboration across countries.
- Gaps should be research areas identified as important but where current work is limited and therefore increased funding to develop research is required.

Several relationships were established between participants at the workshop where opportunities for collaboration were revealed, and it is hoped that participants will pursue and further develop the ideas and opportunities which were discussed.

Over the coming months, remaining research themes within the Ocean Energy JP will hold a similar workshop to this one, led by the countries responsible for coordinating each research theme. Strong interactions (clear discussion/collaboration) between RT#4 (environmental impacts) and RT#5 (socio-economic impacts) are encouraged.

Since the idea of having an exchange platform (e.g. website) with some data sharing capability was suggested in at least two research theme’s workshop (#1 and #4), this should be investigated at the broader Ocean Energy JP’s scale. For instance, a Data Management Platform is being developed under the SOWFIA project and could provide such a mechanism since it already has a number of test sites involved.

References cited:

ICES, 2011. Report of the Study Group on Environmental Impacts of Wave and Tidal Energy (SGWTE) ( No. ICES CM 2011/SSGHIE:07.). 29-31 March 2011, Edinburg, United Kingdom.

Olivares, C.H., Holmes, B., O’Hagan, A.M., 2011. Catalogue of Wave Energy Test Centres and Review of National Targets (Deliverable D.2.1.). SOWFIA project.