SAFE WAVE

STREAMLIING THE ASSESSMENT OF ENVIRONMENTAL EFFECTS OF WAVE ENERGY

DELIVERABLE 6.1
GATHERING, EDITING AND MANAGEMENT OF RELEVANT INFORMATION GATHERING, EDITING AND MANAGEMENT OF RELEVANT INFORMATION FOR IDENTIFYING SUITABLE AREAS FOR THE DEVELOPMENT OF WAVE ENERGY PROJECTS

Co-funded by the EMFF programme of the European Union

WP 6

Deliverable 6.1 Gathering, editing and management of relevant information for identifying suitable areas for the development of wave energy projects

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SUBMISSION DATE
1 | December | 2021

DISSEMINATION LEVEL

PU	Public	X
CL	Classified – EU classified (EU-CONF, EU-RESTR, EU-SEC) under Commission Decision No 2015/444	
CO	Confidential, only for members of the consortium (including Commission Services)	

DOCUMENT HISTORY

Issue Date	Version	Changes Made / Reason for this Issue
24/11/2021	0.1	First version
30/11/2021	0.2	Reviewed version (Juan Bald)
30/11/2021	0.3	Reviewed version (Anne Marie O´Hagan)
1/12/2021	1	Final version (Ibon Galparsoro)

CITATION

Galparsoro, I., G. Mandiola, S. Pouso, I. de Santiago, R. Garnier and J. Bald. 2021. Deliverable 6.1 Gathering, editing and management of relevant information for identifying suitable areas for the development of wave energy projects. Corporate deliverable of the SafeWAVE Project co-funded by the European Union, Call for Proposals EMFF-2019-1.2.1.1 - Environmental monitoring of ocean energy devices. 21 pp.

This project has been co-funded by the European Union.

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This project has been co-funded by the European Union.

CONTENTS

1. SafeWAVE project synopsis

The Atlantic seaboard offers a vast marine renewable energy (MRE) resource which is still far from being exploited. These resources include offshore wind, wave and tidal. This industrial activity holds considerable potential for enhancing the diversity of energy sources, reducing greenhouse gas emissions and stimulating and diversifying the economies of coastal communities. As stated by the European Commissioner for Energy, Kadri Simson, during the Energy Day in the framework of the climate conference (COP25) held in Madrid (2-13 December 2019), "the European experience shows that the benefits of clean energy go beyond reduced greenhouse gas emissions and a healthier environment. Clean energy transition boosts the economy and creates jobs. The European Green Deal is also a growth strategy". In the same framework of COP25 and during the Oceans Day, the European Commissioner for Environment, Oceans and Fisheries, Virginijus Sinkevičius explained that "fighting climate change and protecting marine life biodiversity is a centrepiece of the EU's Ocean policy. Due to climate change, our oceans are facing serious challenges, which require an urgent and comprehensive response. But oceans are also a part of the solution". Therefore, ocean energy is one of the pillars of the EU's Blue Growth strategy. Ocean energy could provide clean, predictable, indigenous and reliable energy and contribute to the EU's objective of reaching a share of renewables of at least 32% of the EU's gross final consumption by 2030. As underlined by Virginijus Sinkevičius, "Marine renewable energy has an incredible potential. The offshore wind sector is growing strongly enough to compete with traditional energy sources. The emerging technologies such as wave and tidal energy will take the same pathway".

The nascent status of the Marine Renewable Energy (MRE) sector and Wave Energy (WE) in particular, yields many unknowns about its potential environmental pressures and impacts, some of them still far from being completely understood. Wave Energy Converters' (WECs) operation in the marine environment is still perceived by regulators and stakeholders as a risky activity, particularly for some groups of species and habitats.

The complexity of MRE licensing processes is also indicated as one of the main barriers to the sector's development. The lack of clarity of procedures (arising from the lack of specific laws for this type of projects), the varied number of authorities to be consulted and the early stage of Maritime Spatial Planning (MSP) implementation are examples of the issues identified as resulting in a delay to the permitting of projects.

Finally, there is also a need to provide more information on the sector not only to regulators, developers and other stakeholders but also to the general public. Information should be provided focusing on the technical aspects of ocean energy, its effects on the marine environment, the role in local and regional socio-economics and effects on a global scale as a sector producing clean energy and thus having a role in contributing to decarbonise human activities. Only with an informed society will it be possible to carry out fruitful public debates on MRE implementation at the local level.

These non-technological barriers that could hinder the future development of wave energy (WE) in EU, are being addressed by the WESE project funded by EMFF in 2018. The present project builds on the results of the WESE project and aims to move forward through the following specific objectives:

1. Development of an **Environmental Research Demonstration Strategy** based on the collection, processing, modelling, analysis and sharing of environmental data collected in WE sites in different European countries where wave energy converters (WECs) are currently operating (Mutriku power plant and BIMEP in Spain, Aguçadoura in Portugal and SEMREV in France). The SafeWAVE project aims to enhance the understanding of the negative, positive and negligible environmental effects of WE projects. The SafeWAVE project will build on previous work, carried out under the WESE project, to increase the knowledge on priority research areas, enlarging the analysis to other types of sites, technologies and countries. This will increase information robustness to better inform decision makers and managers about real environmental risks, broaden the engagement with relevant

stakeholders, related sectors and the public at large and reduce environmental uncertainties in consenting of WE deployments across Europe;

2. Development of a **Consenting and Planning Strategy** through providing guidance to ocean energy developers and to public authorities tasked with consenting and licensing of WE projects in France and Ireland; this strategy will build on country-specific licensing guidance and on the application of the MSP decision support tools (i.e. WEC-ERA[1] (Galparsoro *et al.*, 2021) and VAPEM[2] tools) developed for Spain and Portugal in the framework of the WESE project; the results will complete guidance to ocean energy developers and public authorities for most of the EU countries in the Atlantic Arch.
3. Development of a **Public Education and Engagement Strategy** to work collaboratively with coastal communities in France, Ireland, Portugal and Spain, to co-develop and demonstrate a framework for education and public engagement (EPE) of MRE enhancing ocean literacy and improving the quality of public debates.

[1] https://aztidata.es/wec-era/
[2] https://aztidata.es/vapem/

2. Executive summary

The present deliverable identifies the information and data sources of relevance for the identification of suitable areas for the establishment of WE projects in the European Atlantic region, which considers the Exclusive Economic Zones (EEZ) of Portugal, Spain, Ireland, France and UK. The aim of the present deliverable is the collation of the most relevant information when identifying suitable areas for the development and deployment of WE projects.

Identified sources of information deals with:

- Technical aspects such as wave energy resource, depth, seafloor type distribution, distance to ports and good weather windows. Those factors are of high relevance for the identification of suitable areas in terms of their technical viability.
- Legal constraints representing the spatial distribution of areas that could be under different management and legal restrictions that could affect the development or establishment of WE facilities.
- Environmental aspects for the consideration of the potential ecological risk that the establishment or development of WE facilities may have.
- Maritime activities and uses that potentially could conflict or pose limitations to the development or establishment of marine WE facilities.

It should be noted that the process of generation of relevant information for site suitability will be a continuous process throughout the SafeWAVE project, and that the information sources that we have identified at this stage, should be considered as the starting point in the analysis of identification of suitable areas for the development suitability maps.

3. Objectives

Within WP6 the main objective is the identification of the most suitable areas for the development and deployment of WE projects in the European Atlantic region. Suitability maps will be provided for more efficient planning of future WE deployments in these countries. For this purpose, the specific objective of the present deliverable consists of the identification and collation of the information that could be of relevance for the assessment and identification of suitable areas for the establishment of WE developments.

4. Material and methods

4.1 Spatial scope

The spatial scope of the analysis and identification of suitable areas for the development of WE projects, is the European Atlantic region which covers the EEZs of Ireland, UK, France, Spain and Portugal (Figure 1)[3]. The total area of the study area is 3,676,970 km^2.

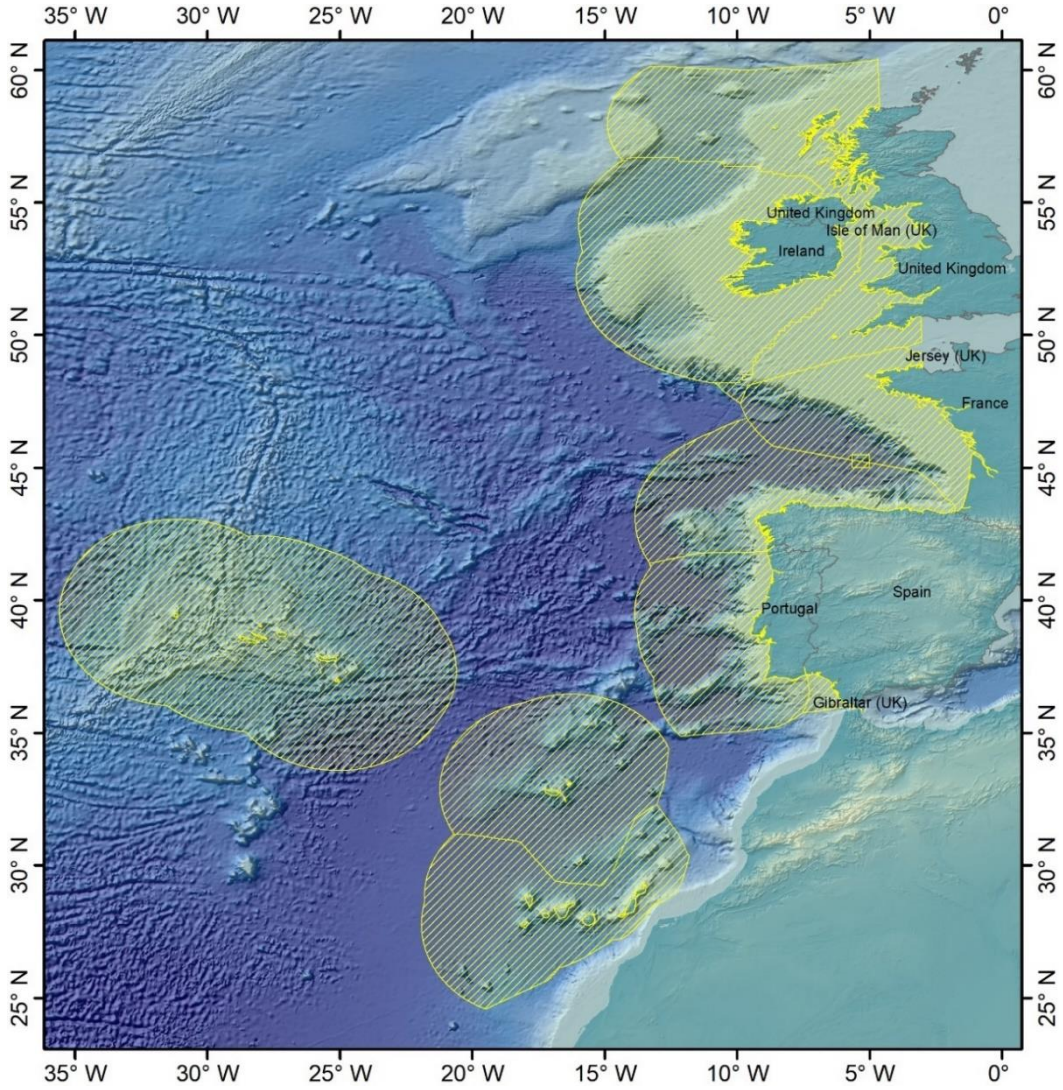

Figure 1. Spatial extension of the analysis area in the European Atlantic region which considers the exclusive economic zones of Ireland, UK, France, Spain and Portugal[3].

[3] Obtained from https://www.marineregions.org/

The areas corresponding to each of the countries considered within European Atlantic region defined for the suitability analysis are provided in Table 1, while Figure 2 illustrates the percentage of the coverage of the EEZs of each country within the study area[3].

Table 1. Areas corresponding to each country within the European Atlantic region considered as case study[3].

Country	Area (km²)
Portugal	1,871,040
Spain	773,418
Ireland	430,649
United Kingdom	371,792
France	230,071
Total	**3,676,970**

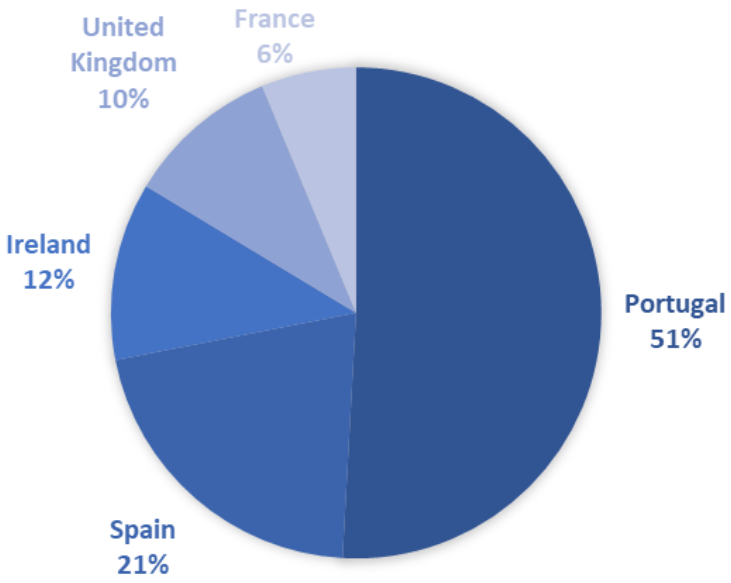

Figure 2. Percentage of coverage of each country within the European Atlantic region adopted as case study[3].

The areas corresponding to each region are provided in Table 2, while Figure 3 shows the percentage of the coverage of each region within the study area[3].

Table 2. Areas corresponding to each region within the European Atlantic region considered as case study[3].

Region	Area (km²)
Azores	1,080,084
Madeira	471,845
Canary Islands	469,843
Ireland	430,649
United Kingdom	371,792
Portugal	319,111
Spain	303,575
France	230,071
Total	**3,676,970**

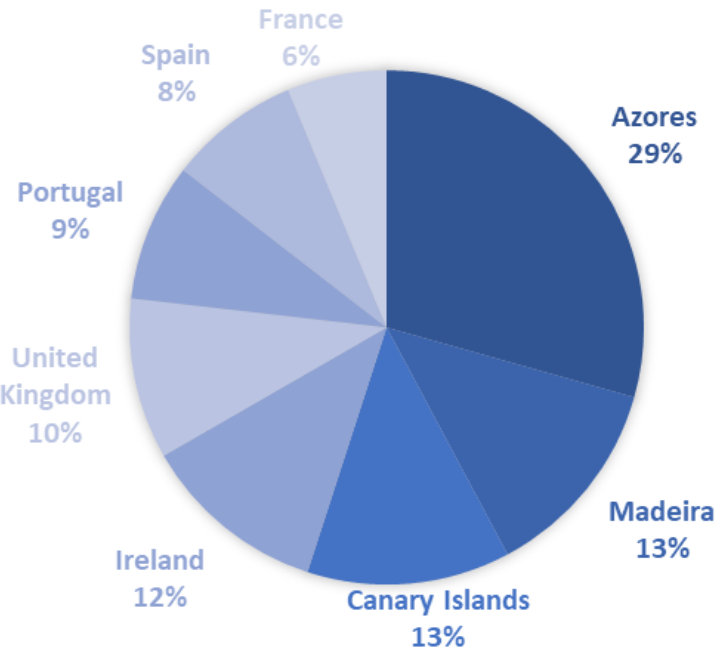

Figure 3. Percentage of coverage of each region within the European Atlantic region adopted as case study[3].

4.2 Data sources and repositories

The research focused on the identification of information that could be relevant for the assessment of suitable areas for the deployment of WE

projects following the information categories proposed by Galparsoro *et al.* (2012) and already implemented in WESE project by Galparsoro *et al.* (2019).

The information categories were defined as follows:

- **Technical aspects**: a set of information layers that are of specific relevance for WE farms, which include data, not only on wave energy resource, but also on depth and seafloor type distribution which could be of high relevance for the identification of suitable areas and for the design of mooring systems.
- **Maritime activities**: represent the spatial distribution of existing human uses that potentially could conflict or pose limitations to the development or establishment of WE facilities (i.e., fisheries, marine traffic, etc.).
- **Environmental aspects**: this set of data aims at describing the characteristics and spatial distribution of the main and most relevant ecosystem components of the area under analysis. Such information should play a role when analysing the potential ecological risk that the establishment or development of WE facilities could pose (Galparsoro *et al.*, 2021).
- **Legal constraints**: set of information layers representing the spatial distribution of areas that could be under different management and legal restrictions that could affect the development or establishment of WE facilities. These are mainly represented underwater infrastructure (e.g., pipelines), military areas, etc.

When identifying the relevant information and data sources, the predefined search criteria were that information should be spatially explicit and, if possible, with European level coverage. The identified and collated information should be useful for the feeding of modelling approaches to be developed under WP6.

For this purpose, research was carried out on publicly available data providers and sources:

- EMODnet (http://www.emodnet.eu/).
- Copernicus (https://www.copernicus.eu/en).
- DG-MARE's Atlas of the Sea (https://ec.europa.eu/maritimeaffairs/atlas_en).
- European Joint Research Centre (https://data.jrc.ec.europa.eu/).
- AquaMaps (https://www.aquamaps.org/)

5. Results

5.1 Relevant information for the identification of suitable areas for the development of wave energy projects

The list of information layers, environmental, technical and human activities collated for the subsequent analysis of suitable areas for the development of WE projects are provided in Table 3 to 5.

Table 3. List of information layers (environmental components) collated for the subsequent analysis of suitable areas for the development of wave energy projects.

Type	Information layer	Data source	Measure
Environmental component	Fish	Probability of presence: Aquamaps[4]	Number of species
	Cephalopods	Probability of presence: Aquamaps[1]	Number of species
	Sea mammals	Probability of presence (elaborated by Korpinen *et al.* (2019)). Data sources: • Baleen whales and deep diving toothed cetaceans: Aquamaps[1] • Seal: Aquamaps[1], Ocean Biogeographic Information System (OBIS), HELCOM, IUCN; Marine mammals and sea turtles of the Mediterranean and Black Seas. • Small toothed cetaceans: Aquamaps[1], SAMBAH project, IUCN Marine mammals and sea turtles of the Mediterranean and Black Seas, Ocean Biogeographic Information System (OBIS).	Number of species
	Reptiles	Probability of presence (elaborated by Korpinen *et al.* (2019)). Data source: • Ocean Biogeographic Information System (OBIS)	Number of species
	Birds	Amount of breeding bird species (elaborated by Korpinen et al. (2019)[2]. Data sources: • European Breeding Bird Atlas (EBBA)	Sum of different breeding sea bird species

[4] https://www.aquamaps.org/

Type	Information layer	Data source	Measure
	Sensitive habitats	Presence of sensitive habitats (elaborated by Korpinen *et al.* (2019)). Data sources: • Cold-water corals and other coralligenous habitats: UNEP World Conservation Monitoring Centre, EMODnet Seabed habitats for the Mediterranean Sea. • Saltmarshes and seagrass: UNEP World Conservation Monitoring Centre.	Presence of at least one habitat

Table 4. List of information layers (Technical components) collated for the subsequent analysis of suitable areas for the development of wave energy projects.

Type	Information layer	Data source	Measure
Technical components	Seafloor type	EMODnet Geology Folk-5[5]	Substrate classification in 5 classes: 1-sand; 2-mud to muddy sand; 3-mixed sediment; 4-coarse sediment; 5-rock and boulders.
	Wave power	Self-production (see supplementary material)	Mean annual energy resource (MWh/m) raster
	Depth	EMODnet Bathymetry[6]	Meters
	Slope	Self-production from the EMODnet Bathymetry[4] layer	Degrees

[5] https://www.emodnet-geology.eu/data-products/seabed-substrates/
[6] https://www.emodnet-bathymetry.eu/

Type	Information layer	Data source	Measure
	Distance to port	Self-production	Km (distance from cell to port avoiding land)
	Distance to electrical substations	Self-production. Electrical substation points obtained from[7]	Km (straight distance from cell to electrical substation)
	Weather windows	Self-production (see supplementary material)	Number of periods of 5 days (from 6 to 18 hours) with significant wave heigh (Hs) lower than 1.5 m in a year.

Table 5. List of information layers (Human activities) collated for the subsequent analysis of suitable areas for the development of wave energy projects.

Type	Information layer	Data source	Measure
Human activities	Cables	EMODnet Human activities[8]	Presence/ absence cables (buffer 500 m)
	Dredging		Presence/absence dredging sites (buffer 500 m)
	Aggregate extraction areas		Presence/absence aggregates extraction areas (buffer 500 m)
	Ports		Presence/ absence ports (buffer 1 km)
	Ocean energy facilities		Presence/absence operational (or in development) ocean energy devices (buffer 500 m for point layer)

[7] https://www.entsoe.eu/data/map/
[8] https://www.emodnet-humanactivities.eu/

Type	Information layer	Data source	Measure
	Oil and gas		Presence/absence exploitation or exploration of oil and gas
	Pipelines		Presence/absence pipelines (buffer 500 m)
	Dredge spoil dumping		Presence/absence dredge spoil dumping sites (buffer 500 m)
	Dumped munitions		Presence/absence dumped munitions sites (buffer 500 m)
	Urban wastewater discharge		Presence/absence urban waste discharge sites (buffer 500 m)
	Bathing waters		Evaluation of bathing water in: excellent, good, sufficient, poor.
	Aquaculture		Presence/absence fish or shellfish aquaculture sites (buffer 500 m)
	Maritime traffic		Vessel density (Hours/km^2*month), discretized raster)
	Fishing effort	JRC[9]	Number of fishing vessels above 15 m length
	Protected areas	European Environmental Agency[10] • Nationally designated areas (CDDA) • Natura 2000 network	Presence / absence of protected areas

[9] https://data.jrc.ec.europa.eu/dataset/jrc-fad-ais1415
[10] https://www.eea.europa.eu/

6. Conclusions

In the first stage, the information layers categories have been defined and the data sources at European scale have been identified. Considering that the objective of WP6 is the identification of suitable areas for the development of WE projects in the European Atlantic region, homogeneous and continuous data sources have been identified. Fortunately, initiatives such as EMODnet are now producing publicly available data that will be used as background information for the analysis.

However, it should be noted that the process of generation of relevant information for site suitability identification will be a continuous process throughout the SafeWAVE project, and that the information sources that we have identified here should be considered as a starting point for the development of models and the production of the resulting WE development suitability maps. The information mentioned deals with potential environmental pressures that WECs could generate (electro-magnetic fields, underwater noise, habitat change, etc., derived from other sources (Galparsoro *et al.*, 2021).

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