

# The Biscay Marine Energy Platform (bimep), environmental impacts and monitoring plan

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## Abstract

**On the first of June 2009, the General Council on Environmental Quality Assessment of the Ministry of Rural, Marine and Natural Environment of the Spanish Government, on the light of the Environmental Impact Assessment (EIS) of the bimep project carried out by AZTI-Tecnalia, decided that the bimep project did not require to carry out the whole Environmental Impact Assessment (EIA) process. In any case, the Environmental Impact Statement (EIS<sub>t</sub>) of the Ministry, taking into account the great uncertainties about some predicted environmental impacts, underlined the need to implement the proposed Environmental Monitoring Program (EMP) of the EIS. Funded by the Basque Entity of Energy (or Ente Vasco de la Energía (EVE), [www.eve.es](http://www.eve.es)) and carried out by the Marine Research Division of AZTI-Tecnalia ([www.azti.es](http://www.azti.es)), the EMP in its preoperational phase started its activities in August 2011. This work review the expected environmental impacts of the bimep project and the methodology of the EMP for the monitoring of hydrodynamics, landscape, benthic communities, ichthyofauna, marine mammals, fishing activity and submarine archaeological and cultural resources.**

**Keywords:** Environmental Monitoring Program, wave energy, bimep, ichthyofauna, benthic communities, marine acoustics, mammals, hydrodynamics.

## 1. Introduction

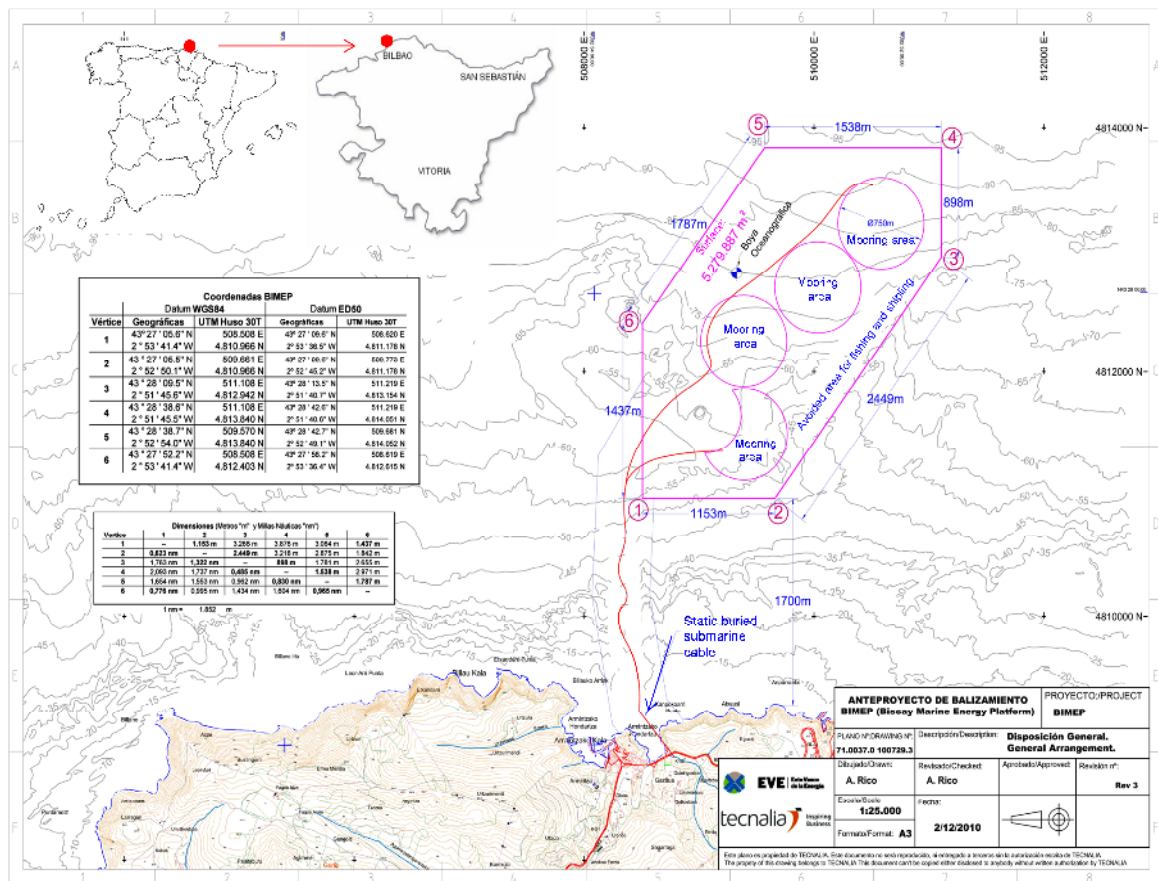
The Biscay Marine Energy Platform (bimep) is an offshore infrastructure for research, test, demonstration and validation of wave energy generation device. The establishment of the bimep requires the closure of a sea area of 5,3 km<sup>2</sup>, ranging between 50 m and 90 m depth. Within this area, four static submarine cables are to be placed, which will operate at 13 kV and 5 MW (Figure 1). Wave energy generation devices will be

connected to these cables through dynamic submarine cables. On land, the bimep will provide a research centre in Armintza (Bizkaia, Basque Country, Northern Spain) where developers will be able to control the behaviour and performance of the wave energy converters (WECs).

According to the Royal Decree 1/2008 of Environmental Impact Assessment (EIA), the bimep project falls into the 4.c category of projects of Annex II of this Decree. Such classification involves that the competent authority for environmental issues, that is, the General Directory for Quality and Environmental Evaluation of the Spanish Ministry of Environment, Rural and Marine Environment, has to decide whether or not the project needs to undergo the complete procedure of an EIA.

In January 2009, the General Directory for Quality and Environmental Evaluation opened the bimep project to public consultation, during which more than 30 different stakeholders were consulted. Based on the outcomes of the public consultation, the project analysis and the Environmental Impact Study (EIS) carried out by AZTI-Tecnalia ([www.azti.es](http://www.azti.es)) in December 2008, the General Directory for Quality and Environmental Evaluation decided in June 2009 that the bimep project did not require to carry out the whole EIA process, arguing that the expected environmental impacts will not be significant. The EIS considered that main actions associated with the project that could cause impacts were related to the installation process and the physical presence of structures (i.e. submarine cables, moorings and WECs), which could generate conflicts between different users of the area, as well as underwater noise, electromagnetic fields, reduction of marine energy, etc.

Considering the uncertainties of the impacts associated with WECs, due to the early development stage of wave energy harnessing devices and the lack of referenced data accounting for environmental surveillance of specific projects, the Environmental Statement recommended the implementation of an Environmental Monitoring Plan (EMP), which had already been suggested by the EIS of the bimep project.



**Figure 1:** bimep project. Red lines indicate the location of submarine cables. The pink line delimits the area closed to other users.

Funded by the Basque Entity of Energy (or Ente Vasco de la Energía (EVE), [www.eve.es](http://www.eve.es)) and carried out by the Marine Research Division of AZTI-Tecnalia ([www.azti.es](http://www.azti.es)), the EMP started its activities in August 2011, with the start of the pre-operational phase. Based on the EIS, the main environmental factors that could be affected by the project, and therefore where the EMP should focus its attention are: the hydrodynamics, landscape, benthic communities, ichthyofauna, marine mammals, fishing activity and submarine archaeological and cultural resources. Due to the early stage of the EMP and therefore, the limited data availability, data have not yet been analyzed. Thus, this work present the methodology followed by the EMP. It is expected that a report with all the results of the EMP will be presented at the end of 2012.

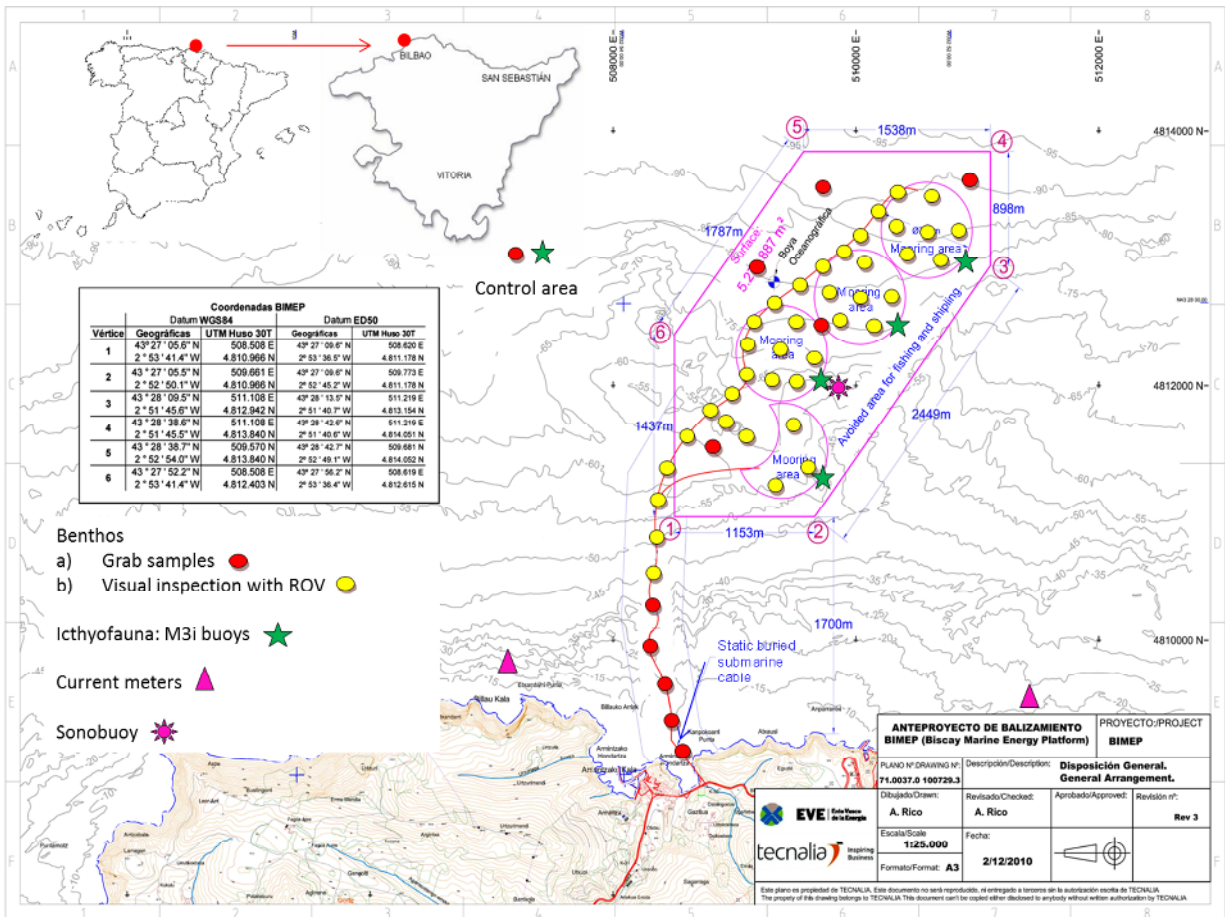
## 2. Hydrodynamics

A wavescan buoy is moored in the center of the bimep test site since *March* 2009. This buoy archives detailed directional wave parameters together with meteorological and surface current data *and is* also equipped with an Acoustic Doppler Current Profiler (ADCP) in order to monitor the full water column, up to 80 m depth. An exhaustive analysis of the buoy data, together with numerical tools (WAM and ROMS models), are also being implemented and will be the

source of data for the preoperational description of the hydrodynamics in the area.

In this context, two specific actions have been done to complete the preoperational description of the main hydrodynamic factors that are expected to be somehow modified. The first one is to simultaneously measure the wave conditions in two points with similar exposition and depth (around 30 m) but one within the area with the higher expected wave shadowing effect due to the presence of the devices and the other one out of this effect (Figure 2). Both instruments were the same (Nortek AWAC 1MHz) and identically configured. Both were deployed during the same period (January 18th to February 25th 2012) over 1 month and in winter, which is the most representative period in terms of wave energy in the area.

The second action is focused in the quantification of the natural spatial variability of the currents in the area. For this purpose a specific campaign with a vessel mounted ADCP has been designed. This data compared and corrected with those that have been simultaneously obtained in the buoy mooring mounted instrument, together with numerical results will lead to a better estimation and understanding of the 3D current field along the area. Also an estimation of the representativeness of the single point measurements inside all the bimep test site area, will be performed.



**Figure 2:** Sampling stations for benthic communities (both grab and visual inspection with ROV), ichthyofauna monitoring buoys, sonobuoy and current meters situation.

### 3. Landscape

The characterisation process of marine landscape was carried out in 4 stages [1]: (i) defining each Landscape unit's area; (ii) defining each landscape unit's characteristics; (iii) defining activities, visibility and views (Figure 3) and; (iv) presentation of landscape characterisation and base visual analysis (Figure 3).

Once base information is compiled and marine landscape characterisation and visual analysis completed, next step is establishing quality values and landscape fragility based upon the described marine landscape nature.



**Figure 3.** Landscape characterization and views in the bimep area.

### 4. Benthic communities

The characterization of benthic communities was done by means of: (i) *in situ* sampling with a Shipeck grab sampler soft bottom sediments in five locations (4

samples inside the bimep area and one far beyond in order to act as control area) and by divers in five locations near the landing point of the submarine cable (Figure 2) and (ii) visual inspection with a submarine camera in 36 points distributed all along the submarine



cable route and the mooring areas and two points in a submarine mountain, known as “Isla de las Lubinas” or “Punta Zuri” (Figure 2). This mountain goes approximately from 20m down to 60 m depth and it is known to host many fish species. In the Figure 4 a detail of both sampling campaigns can be observed.



**Figure 4:** Shipeck grab sampler (up) and underwater video camera (bottom).

Samples obtained, both in hard and soft substratum and in subtidal and intertidal stations, shall go through a sieve with a maximum 1 mm mesh size, which is enough to retain practically all species [2-5]. In the laboratory, benthic organisms will be separated for their identification (down to species level if possible) and counting of individuals. The main structural parameters of the community will be calculated from data extracted from counts, i.e., total abundance, specific abundance, specific richness and specific diversity by means of Shannon-Weaver index (1963), estimated from numeric and biomass data [6]. With the result from benthic communities’ analysis in soft substratum, a classification of stations according to the AZTI biotic index should follow [7-13].

Data from visual inspections with underwater video camera will be processed by means of specific software for species identification, counting and mapping.

## 5. Ichthyofauna

### 5.1 Visual census

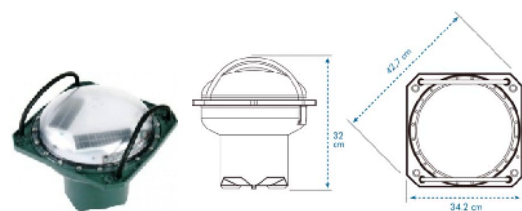
Of the existing methodologies used for carrying out in visual surveys, line transects and stationary methods were selected for the EMP.

a) Line transects: five 200 m (surveyed 2.5 m each sided of the transect line) transect lines were placed along the tip of a “Isla de las lubinas” submarine mountain. Through this technique, estimates on diversity (species richness and abundance), density and biomass of fish is obtained. Width and longitude of the transect line depends on the species to be studied (e.g. large, small, cryptic, etc.) [14-15].

b) Stationary methods: according to Tuya (2002), this technique is advisable in highly heterogeneous areas; it generates relative frequency and abundance estimates. Four sampling points at a 15 m depth were selected for visual inspection, one in the center of each of the four mooring areas of bimep (Figure 2). Only one sampling campaign was foreseen and it was conducted on the 26 of June of 2012. At each sampling point, divers recorded the observed species, number of individuals and size (length) of individuals within their visual field (an imaginary cylinder of radius “r” centred in the observer) for a period of time “t”, after which, caves and hollows where species with cryptic habits are checked in detail.

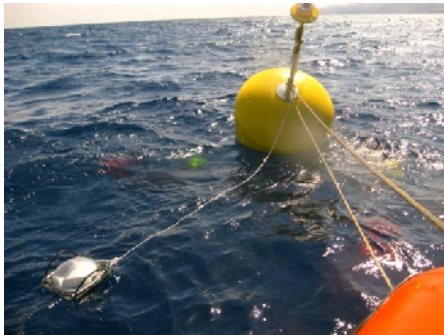
### 5.2 Active acoustic methods

For the bimep project, five M3i buoys were placed on the 6 of June 2012 in the area, one in each of the four mooring areas and one far enough from BIMEP area to act as control site (Figure 2). M3i buoys, developed by Marine Instruments ([www.marineinstruments.es](http://www.marineinstruments.es)), are specially designed for tuna fishing as they are associated to fish aggregating devices (FADs) (Figure 5). The M3i buoys are equipped with a GPS and echosounder (50 kHz and 500 W) and solar electric panels as their energy source. While the GPS of the buoy allows tracking the position of the buoy itself, the echosounder allows measuring the relative biomass below the FAD.



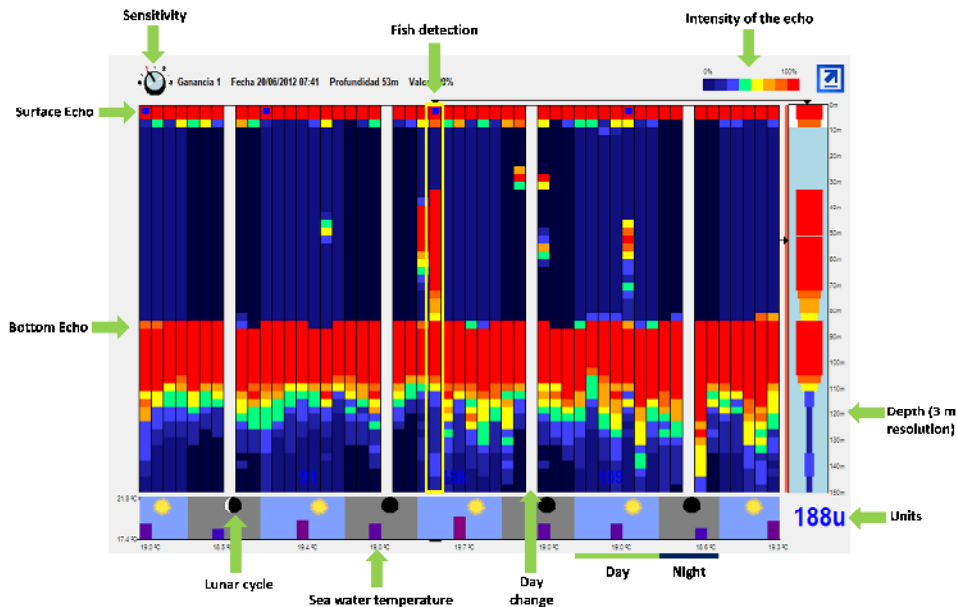
**Figure 5:** M3i buoy, as designed by Marine Instruments.

Figure 6 shows the deployment of a M3i buoy in the bimep area. Each M3i buoy was tied to a signalling buoy for marine safety purpose. The last one was moored in the places showed in the Figure 2.



**Figure 6:** Mooring works of the M3i buoys for fish monitoring.

Once activated, M3i buoys transmit messages via satellite with sounder information, GPS position, sea water temperature and battery level. Sounder information shows fish presence at 6 -150 m depth, with a 3 m resolution. It records data every two hours, both during day and night (12 measurements each day). Data can be viewed as it is shown in the Figure 7 and they can be downloaded to an Excel worksheet in order to extract information and carry out the appropriate statistical analysis.



**Figure 7:** Data display format provided by the control M3i buoy between 18/06/2012 at 11:54 (GMT) and 22/06/2012 at 12:33 (GMT).

## 6. Marine mammals and underwater noise

The presence of marine mammals and underwater ambient noise will be carried out by means of passive acoustic methods. For this, a sonobuoy was moored at 40 m depth on the 6 of June 2012 in the bimep area (Figure 2). This sonobuoy was developed by the Laboratory of Bioacoustics Applications of the Polytechnic University of Cataluña (<http://www.lab.upc.edu/>) (Figure 8).

Based on the technology and methodology developed by [16] the sonobuoy is able to detect and classify automatically all the acoustic events above the ambient noise (presence of cetaceans and noise) and store the information. It was moored on the 6 of June 2012 and during 3 months it will monitor the presence of marine mammals and underwater ambient noise. After these three months, another version of the sonobuoy able to send the information to a terrestrial station via Wimax connection will be moored.

The sonobuoy divides the recording bandwidth in frequency bands that cover the acoustic niche of most

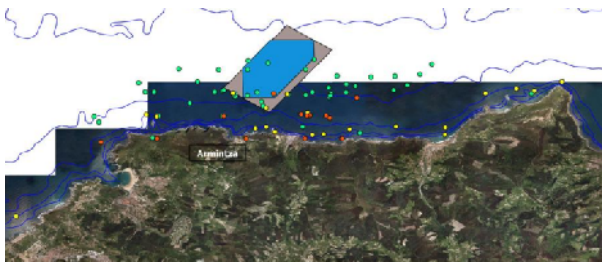
species and applies a series of detectors and classifiers. The information from the detection and classification modules is then used by localization and tracking algorithms in order to monitor the presence and activity of cetacean species. This allows assessment of the short-, medium, and long-term contributions of noise sources in these acoustic niches [17-19].



**Figure 8:** Sonobuoy for marine mammals and underwater noise monitoring.

## 7. Fishing activity

A study of the commercial fisheries was carried out based on fish landing statistics, fisheries surveillance data, academic studies, previous fisheries reports and consultation with local fishermen. A total number of 19 boardings were done in several small traditional fishing vessels that use to do their activity in the bimep area. Figure 9 shows locations where fishing hauls were carried out by the small fishing float near bimep area during 2010.



**Figure 9:** Fishing hauls of small artisanal fishing vessels in the bimep area between August and November 2010.

## 8. Submarine archaeological and cultural resources

A characterisation of possible archaeological remains was carried out during the visual inspection with submarine video camera and divers. No one element of interest was observed.

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