

OCEAN LIDER: Ocean Renewable Energy Leaders

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Abstract

The CENIT-E OCEAN LIDER project (Ocean Renewable Energy Leaders) is an ambitious technology initiative promoted by a consortium of companies with a strong capacity in researching, which addresses the challenge of generating and creating the knowledge and technologies necessary for an efficient and sustainable renewable ocean energy generation.

OCEAN LIDER project's main target is to research and to generate knowledge for the development of breakthrough technologies necessary for the implementation of integrated facilities for the use of renewable ocean energy (wave energy, currents and hybrid systems: wave/wind energy and currents/wind energy).

If forecasts are met (up to 35 patents and 17 copyrights), the results of the OCEAN LIDER project will have a significant economic, social and environmental impact and enable Spain to remain the global renewable energy leader, helping generate skilled employment and combating climate change.

Keywords: Currents, Hybrid Systems, OCEAN LIDER, Wave.

1. Introduction

OCEAN LIDER is with another 17 projects one of the selected in the fifth call of the National Strategic Consortia for Technical Research (CENIT-E). The project has a budget of approximately 30M€ and has received a grant close to 15M€ (49.3%) from the Spanish Centre for the Development of Industrial Technology (CDTI) and the Spanish government's State Fund for Local Investment (the so-called Plan-E), along with the backing of the Ministry of Science and Innovation. OCEAN LIDER is the biggest of its kind worldwide.

The project main goals are:

- The sustainable use of renewable ocean energy.
- The full research on integrated generation of renewable energy sources, establishing a new market niche and using the knowledge of other

industries to re-focus their activities towards this brand new sector.

- Study possible combinations of wave, tidal and wind to decrease overall costs (structural, electrical and control, O&M, decommissioning) and to speed up the development process of large ocean energies power plants.

- Creation of new products, processes and services of strategic importance to the sectors involved.

- Promote a new economic growth model based on renewable energies and energy saving, contribute with renewable sources to energy supply, meeting the Spanish and European needs (20%, 2020) and offsetting the trade balance.

- Improving energy sustainability and combating climate change.

- Become a worldwide leader in the renewable energy sector, enhancing the ability to generate wealth and employment in the Spanish industry.

The project is led by Iberdrola Ingeniería y Construcción and coordinated by Innovamar and is structured in 6 different areas of development to meet all demands during ocean energies projects lifecycle. The activities that comprise the project are the followings:

- I. Technology and intelligent systems research for identification and characterization of suitable sites and optimum resource assessment and design of integrated power generation units.
- II. Technologies for ocean renewable energy generation.
- III. Technologies for distribution, transportation, transformation and quality of marine renewable energy.
- IV. Management, maintenance and intelligent communication systems for ocean farms.
- V. Research in technologies and systems for the operation and safety of ocean power generation units.
- VI. Technologies for the preservation of resources, environmental management and climate change.

Due to the multidisciplinary nature of the investigations to be carried out, the project comprises a total of 20 companies from different sectors such as energy, information and communication technologies, shipbuilding, marine, electrical systems, civil engineering, maintenance, security, environmental,

aviation, aerospace and monitoring presenting all of them an extensive knowledge and experience in various disciplines.

Furthermore, the consortium also involves a large number of research centres and universities, a total of 25, to provide support in the studies and research and its experience in the different sectors.

The participating companies in the consortium and a short description of them are listed in Table 1:

Companies	Companies description
Iberdrola Ingeniería y Construcción	Engineering and consulting services, construction, maintenance.
Iberdrola Renovables	Engineering, construction, energy distribution and control.
Acciona	Wind Farm development and construction.
GMV	Transport, remote control and satellite navigation applications.
Ibaia	Generation system design.
IDESA	Large steel equipment engineering and manufacturing.
Igeotest	Geotechnical characterization survey.
Ingeteam	Power electronics and control.
NEM	Systems maintenance.
Oceantec	Design, testing and manufacture of renewable ocean energy device.
PROES	Energy, maritime and environmental consultancy and engineering.
Prysmian	Manufacturing and installation of cables.
Seaplace	Engineering projects development in the navy field and offshore industry.
Sener	Engineering and consultancy services.
Vicinay Cadenas	Manufacturing and commercialization of mooring systems.
Norvento	Promotion, operation and maintenance of power plants.
Praesentis	Submarine systems development.
Tecnoambiente	Environmental consultancy.
AREVA	Transport and energy distribution.
TECMECA	Manufacture of welded structures.

Table 1: Participating companies

In addition, the research centres and the universities that are participating in the project are listed too in the Table 2:

Universities and Research Centres	
CSIC	Univ. de Oviedo
Univ. Politécnica de Catalunya	Fundación Prodiotec
Univ. Politécnica de Madrid	Fundación ITMA
UPC-CIMNE	Fundación Euskoiker
Univ. de Cantabria	Canal de Experiencias Hidrodinámicas del Pardo (CEHIPAR)
IH Cantabria	CT INNOVA

Universities and Research Centres	
Fundación AZTI	Univ. de las Palmas de Gran Canaria
Univ. de Granada	Fundación General de la Univ. de Valladolid
Univ. Carlos III	Univ. Pública de Navarra
Fundación Robotiker	Univ. de Cádiz
Fundación Fatronik	Univ. Politécnica de Valencia
PLOCAN	Fundación Tekniker

Table 2: Universities and Research Centres

Is very important to note the interregional nature of the project, with companies and research centres from 12 different autonomous communities of which many of them are coastal communities that will encourage the development of this kind of energy in these areas.

The project has a total duration of 4 years, from 2009 to 2012.

2. Activities integrated in the project

2.1 Site characterization

This activity is led by Iberdrola Ingeniería y Construcción and consists of 3 tasks:

- Methodologies for site characterization.
- Research in prospecting devices and monitoring systems.
- Artificial intelligence technologies for the automatic evaluation of locations and the design of integrated units.

The main goals in this activity are the research on new methodologies and tools for identifying and characterizing suitable marine areas and sites with high renewable energies potential that enable the application and implementation of new technologies for their use and designing Integrated Ocean Energy Generation Units (UNIGEOs) suitable for different sites.

The companies that participated in this activity are: Acciona, Praesentis, GMV, Igeotest and PROES.

2.2 Generation

This activity is led by Iberdrola Renovables and consists of 4 tasks:

- Technologies for harnessing wave energy.
- Energy for marine currents.
- Wind power generation, systems coupled by waves and currents (Hybrid).
- Integration of renewables energies into existing marine environment structures and port facilities.

Research in this activity will be undertaken mainly on energy extracting systems, mechanical into electric energy conversion systems and foundation and anchoring systems.

The objectives for this activity are research on technologies and systems to obtain energy from ocean renewable sources such as wave energy, currents / tidal energy as well as integrated systems (hybrid) that can produce wind, waves and currents energy simultaneously and get a technological and significant leap in the marine energy converter devices development and efficiency and their integration in

large power plants to make ocean energies a profitable market.

The companies participating in this activity are: Iberdrola Ingeniería y Construcción, Acciona, Norvento, Oceantec, Seaplace, IDESA, Ingeteam, Vicinay Cadenas and TECMECA.

2.3 Energy Distribution, Transformation, Transportation and Grid Connection

This activity is led by Iberdrola Ingeniería y Construcción and consists of 2 tasks:

- Energy transport and distribution.
- Substations and marine transformation centre, networking and power quality.

The objectives are researching and designing innovative systems for efficient distribution, transformation and transmission of energy generated from offshore renewable energy sources and to ensure the quality of this energy delivered to the grid.

This general target will depend on achieving some specific objectives:

- Study and design innovative distribution and transport marine electric power systems obtained with the different systems developed by Activity II, including static and dynamic submarine cable and connection elements from the generating equipment.
- Research on systems for high efficiency power conversion at open sea, comprising transformation centers for low / medium voltage (submarine) as also HV substations to connect large ocean energies power plants.
- Submarine transformation centers encapsulation optimization.
- Statistical calculation and analysis of electrical faults on offshore equipments to optimize offshore electrical infrastructures and to make future ocean power plants more robust and profitable (SW Optimization Tool).
- FACTS and HVDC systems research with the aim to optimize the generated power quality.

The companies that are participating in this activity are: Iberdrola Renovables, AREVA, Prysmian and Oceantec.

2.4 Operation and Maintenance

This activity is led by NEM and consists of 3 tasks:

- Conceptual and functional design of intelligent management and maintenance systems for UNIGEOs.
- Monitoring and communication in remote ocean locations.
- Research on intelligent and autonomous technologies for diagnosis with optimized maintenance marine farms.

For this activity the main goals are by using physical and empirical models for the devices diagnostics and characterization, devices, processing plants, equipment and systems for expert maintenance and monitoring and communication systems for remote locations in the ocean the research on systems and technologies that facilitate the management, maintenance and efficient

communication with ground control base ensuring the reliability and efficiency of generating systems.

The companies that participated in this area are: Iberdrola Ingeniería y Construcción, Iberdrola Renovables, Ibaia, GMV and Oceantec.

2.5 Marine Operations and Health Safety

The leader in this activity is PROES and it consists of 4 tasks:

- Marine Operations.
- Support facilities and installations means.
- Accessibility and emergency systems.
- Health and safety.

The main objectives for this area are thorough research in marine operations to perform, based on the specific generation system chosen and its lifecycle (installation, operation and decommissioning), installation means (ships, special platforms, installation equipment, etc.), port facilities and shipyards that meet the requirements for the installation of such generation and ancillary facilities systems, access systems (fast crew boats and personnel transfer system) and risk management programmes and emergency evacuation systems to generate breakthrough technologies and systems that facilitate the marine operations necessary in the shortest time & cost; and without any risk to security.

The companies involved in this activity are: Iberdrola Ingeniería y Construcción, Iberdrola Renovables, Acciona, Oceantec, Seaplace, Praesentis, GMV, Prysmian, Sener and IDESA.

2.6 Environmental

This activity is led by Acciona and consists of 4 tasks:

- Technologies and models for environmental impact assessment of ocean energy generation integrated units and its effect on climate change.
- Systems and technologies for minimizing the effects on climate change.
- Preservation of resources, intelligent system built into a GIS with new technologies for mitigation and compensation.
- Monitoring system and environmental management.

The main targets in this activity are the research on innovative technologies for the characterization, assessment and integrated environmental management of future marine renewable energy generation projects and the research on protocols, guidelines, methodologies, tools and technologies that enable a proper assessment of environmental impacts in the whole lifecycle of ocean renewable energy projects.

These objectives are structured in:

- Technologies and models to assess the impact of Climate Change.
- Systems and technologies for minimizing the effects of Climate Change.
- Preservation of the resource, intelligent system built into a GIS with mitigation and compensation new technologies.

– Monitoring and environmental management systems.

The companies involved in this area are Iberdrola Ingeniería y Construcción, GMV, PROES and Tecnambiente.

The budget percentage for each activity is provided in Fig. 1.

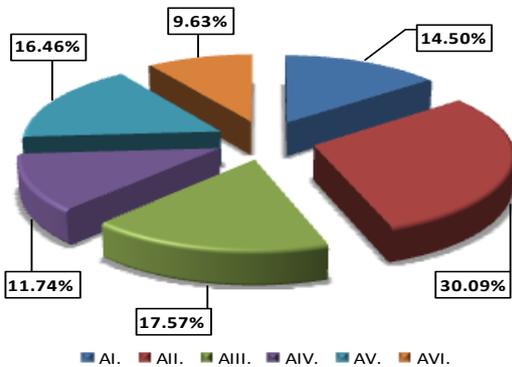


Figure 1: Budget for each activity.

3. Economical and Managing Structure

The total budget for the OCEAN LIDER is 30 M€ and of them 15 M€ are grant. The Fig. 2 showed how the budget is distributed:

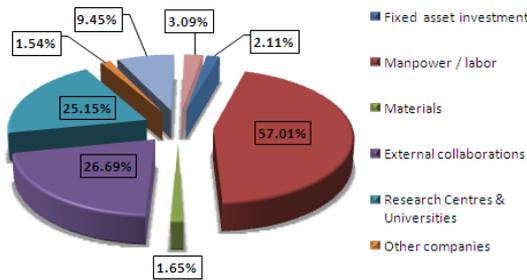


Figure 2: Economical structure (Items)

The project managing structure is constituted as follows:

Board Committee: consists of one representative from each company and is managed by a representative from Iberdrola Ingeniería y Construcción. Its main goal is monitoring and advice on coordination and project management.

Project Director: represented by a member from Iberdrola Ingeniería y Construcción, in this case is Juan Amate López and is supported by the Management Bureau. Project Director's goals are: project coordination faces the CDTI and the companies that participated in the project and he is designated by the Board Committee for monitoring the project process.

Advisory Committee: consists of the main research centres participating in the project and other agencies. Their functions are to advise the consortium about the project progress, issuing reports and recommendations.

Technical Committee: represented by the leader from each activity and coordinated by the Project Director with the support of the Management Bureau.

Its main goals are supervise the technical project and coordinate the Work Groups.

Work Groups: represented by the companies that are participating in each activity. It is coordinated by the activity leader and there is one Work Group for each activity.

Management Bureau: in this case it is represented by Innovamar and its main targets are the administrative and technical project management and ensure the correct budget, schedule and activities implementation.

The consortium managing structure is provided in Fig. 3.

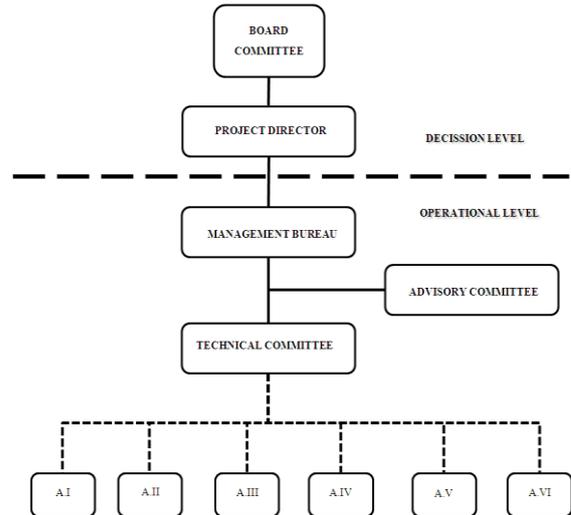


Figure 3: Consortium management structure.

4. Results

Finally it is expected that the global results have a major economic, social and environmental impact, permitting maintain the world leadership in renewable energy generation, promoting employment and enhancing the fight against climate change, issues that will drive the new economic growth model based on renewable energy and energy saving.

Moreover, the specific results expected for this project are:

- 35 patents expected:
 - 7 sites characterization and monitoring systems.
 - 9 new conversion devices.
 - 2 energy conversion systems.
 - 2 mooring systems.
 - 2 cables and connectors devices.
 - Surveillance and monitoring systems for O&M.
 - Ships, offshore operation systems and navigation systems.
 - Emergency and safety systems.
- 17 property records expected:
 - UNIGEOs sitting and designing evaluation models.
 - Structural, calculations and design models.
 - Electricity networks calculating and optimizing models.

- Management, operation and environmental UNIGEOs control models.
- Environmental assessment of ocean energy power plants models.

Acknowledgements

Finally acknowledge to all the companies, research centres, universities and people that are participating in this project and in the different work areas, for his collaboration and investigation that are carrying on.

The different companies, research centres and universities that are participating in OCEAN LIDER are shown in Fig. 4 and 5.



Figure 4: Companies that participated in OCEAN LIDER.



Figure 5: Research centres and Universities that participated in OCEAN LIDER.