

# Atlantic Strategic Plan Priorities

Coordination:



with collaboration of



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## **Presentation**

This document presents a contribution to the elaboration of the Atlantic Action Plan<sup>1</sup> within the Atlantic Strategy, it is the result of a collective work undertaken by a range of organizations from Atlantic regions connected to several maritime areas and to maritime clusters and similar organizations.

The preparation of this contribution is an initiative of a group of clusters from Atlantic Area: Oceano XXI, Plocan, CETMAR and Campus do Mar with the involvement of different partners associated such as universities, RDI Centers and companies.

The process, carried out from November 2012 to January 2013, followed a set of sessions/workshops, organized by Oceano XXI, that gathered several members of the clusters mentioned above. The present document is a synthesis of all the contributions got all along the process.

The document stresses for each one of the guidelines of the Atlantic Strategy the main key investments areas and some ideas of project to be launched within each one.

For each key investment area there was an organization responsible for the coordination of the process and integration of the contributions received from other partners. Some eventual formal asymmetries within the document may arise as the result of this collective approach.

This work has also produced a set of project sheets for all the key investment areas, which, despite not being included in this document, could be an added value for the future development of the economy of the sea. These project proposals are likely to be submitted to candidature within the Atlantic Action Plan or other instruments in next future.

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<sup>1</sup> MARE/C1 (21/11/2012)CALL FOR SUGGESTIONS FOR KEY INVESTMENT AND RESEARCH PRIORITIES

## Contributors

- Coordination:** Oceano XXI - Associação para o Conhecimento e Economia do Mar  
With collaboration of:  
Plocan – Plataforma Oceânica de Canarias;  
CETMAR – Centro Tecnológico del Mar; and  
Campus Mar
- Other participating institutions:** 3B’s Research Group;  
A4TEC Informática;  
CENTEC – IST – Centro de Engenharia e Tecnologia Naval – Instituto Superior Técnico;  
CESAM– Centro de Estudos do Ambiente e do Mar;  
CIIMAR - Interdisciplinary Centre of Marine and Environmental Research;  
Critical Software;  
EnergyIN – Pólo de Competitividade e Tecnologias da Energia  
ESB/UCP – Escola Superior de Biotecnologia da Universidade Católica do Porto;  
FEUP – Faculdade de Engenharia da Universidade do Porto;  
Foodintech – Food Systems Engineering;  
GIRM-IPL – Grupo de Investigação em Recursos Marinhos – Instituto Politécnico de Leiria;  
INEGI – Instituto de Engenharia Mecânica e Gestão Industrial;  
INESC Porto – Instituto de Engenharia de Sistemas e Computadores do Porto;  
IPVC – Instituto Politécnico de Viana do Castelo;  
ISCIA - Instituto Superior de Ciências da Informação e Administração;  
ISEP – Instituto Superior de Engenharia do Porto;  
MeteoGalicia;  
PwC – Pricewaterhouse Coopers;  
Qualimar Pescados;  
Simbiente - Environmental Engineering and Management.  
Soja Portugal;  
Universidade de Aveiro;  
Universidade do Porto;  
Vda – Vieira de Almeida, Advogados;  
WavEC – Wave Energy Centre.

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## 1. Introduction

The Atlantic Ocean, which marks the western boundary of the EU, is the second largest of the world's oceans and is the only one bathing Europe's shores. The Atlantic area deals with new economic realities and the EU shares responsibility for stewardship of the world's oceans<sup>2</sup>. The Atlantic Ocean's characteristics and dimensions establishes a set of specific challenges to science and marine technologies, including underwater robotics in the field of deep sea exploration due to the demanding operating conditions (applied to areas such as biotechnology and the exploitation of new deposits of oil, gas and other minerals in the sub-sea floor), offshore exploitation of renewable energies due to particular demanding environmental conditions, and biotechnology and marine bio-resources. Driving a current of innovation, supporting business growth and rise the contribution to EU 2020 – Smart Specialization, Sustainability, Economic Growth and Employment.

Addressing these challenges and opportunities, the goal of this contribution is to strengthen the potential of Atlantic Ocean Science and Technology research, innovation, knowledge transfer and business:

- Developing Strategic Partnerships with Outstanding Research Centers in Atlantic Area;
- Improving responses to Atlantic European Ocean stakeholders' needs and unlocking regional social-industrial development;
- Increasing the Atlantic Area Human Potential.

While improving the applicant's innovation potential in the referred areas, this strategy will act as an enabler of Atlantic economic and social development, as well as a builder of Atlantic Europe's improved capacity to respond to European Ocean stakeholders' needs and society concerns.

Unlocking Atlantic regions is one of the issues that the EU27 is presently facing. The existence of a macro-regional strategy for the Atlantic Area and its Action Plan (under construction), strongly marked by the ocean, reinforces our commitment which incorporates in its strategic directions the deep sea, the maritime security, biogeochemical technology, maritime highways, logistics, off-shore aquaculture, energy, mining and a number of areas particularly relevant to the development of Atlantic Region. The present strategy face the challenges and opportunities proposed by the Maritime Strategy for Atlantic Ocean Area<sup>3</sup>, and give some contributions towards the implementation of all the priorities and guidelines: implementing the ecosystem approach; reducing

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<sup>2</sup> COM(2007) 575

<sup>3</sup> COM(2011) 782

Europe's carbon footprint; ensuring a sustainable exploitation of the Atlantic seafloor's natural resources; responding to threats and emergencies; and seeking socially inclusive growth.

The proposed set of key investment areas within each strategic priorities followed, cumulatively, four main conditions:

- Contribution to the achievement of the guidelines under the Atlantic EU 2020 strategy;
- They have a transnational dimension;
- They are based on the action of a multilateral network of actors such as R&D, universities, companies associated to a set of Atlantic clusters and similar organizations;
- The stakeholders are clearly identified.



## 2. Atlantic Strategic Plans Priorities

This chapter underlines the main key investment areas proposed within the strategic priorities of the Atlantic Strategy. As you may see some of the key investment areas are transversal to more than one priority. The table below presents the relationship between each key investment area and one priority of the Atlantic strategy

Atlantic Strategy Axis	Key Investment Areas:
1. Implementing the ecosystem approach	Atlantic Ocean Observatory Responding to threats and emergencies in the maritime environment Integrated Coastal and Maritime Environment Management Offshore Aquaculture Valorization of marine biological resources
2. Reducing Europe's carbon footprint	Offshore Renewable Energy Ports and port activities
3. Sustainable exploitation of the Atlantic seafloor's natural resources	Marine resources and impact assessment, exploration and exploitation technologies Offshore multiuse floating platforms Valorization of marine biological resources
4. Responding to threats and emergencies	Responding to threats and emergencies in the maritime environment Integrated Coastal and Maritime Environment Management
5. Socially inclusive growth	New Skills and Employment Opportunities Socioeconomic Diversification: New sources of sustainable growth in the coastal regions of the Atlantic Arc

The following points explain for each key investment area a description of the objective and the presentation of the main action lines and project proposals. The potential imbalances between the presentation of each area is the result of the diversity of contributions got from the partners. Nevertheless the difference of approaches does not undermine the global relevance of the proposals.

### **3. Key Investment Areas**

#### ***1. Marine Resources and impact assessment, exploration and exploitation technologies.***

##### **Objective**

*Develop a R&D and Innovation strategy to raise EU knowledge and technology capacity for long term environment sustainable exploitation of deep sea mineral resources<sup>4</sup>.*

Marine mineral mining is increasingly growing and the global annual turnover of this activity can be expected to grow from virtually nothing to €5 billion in the next 10 years and up to €10 billion by 2030. To support this sustainable growth there is a need to promote a “breakthrough” and change how minerals are explored, extracted and processed. Materials, technologies developed for deep sea must be characterised by efforts to decrease size and increase autonomous operations under the most difficult environmental conditions that human-made equipment can be exposed to. We know that the seabed and sub-ocean floor natural processes are important to the world climate. But the knowledge of how important and in what ways leaves a lot to be desired. It is therefore essential that research adopting a holistic approach be done into how exploitation of seabed resources of any kind can take place without harmful environmental.

Potential impact of deep sea mining activities occurs in large areas with consequences in the economy and human life standards without frontiers limits. Only the collaborative work, multidimensional and transnational cooperation, enables the acquisition of knowledge, methodologies, and critical mass, and promotes the arch Atlantic regional, economic and social development, improving the capacity to respond to European needs and society concerns.

##### **Action lines/Potential projects**

1. Mining equipment. Develop downsized, intelligent mineral exploration, extraction and processing equipment and techniques being capable of operating autonomously in deep sea environments.
2. Deep sea and sub-sea environmental monitoring system. Develop technology and methodology for in-situ real-time monitoring impact assessment activity
3. Mapping Atlantic mineral resources.
4. Offshore Sand/Gravel and Mud/Clay Exploitation in Atlantic European Coastal Zones

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<sup>4</sup> COM(2011) 25

5. Assessment of Gas Hydrates occurrences, potential as a new energy resource and associated hazards in European Atlantic Margins

## ***2. Offshore multi-use floating Platforms***

### **Objective**

*Develop a R&D strategy, technology capacity, innovative solutions and business model for multi-use off-shore platforms*

In the next few years, the Atlantic Ocean will be exposed to a huge expansion of marine infrastructures. The most evident structures include offshore wind farms and exploitation of wave energy, cages for marine aquaculture and new constructions for applications such as transport and leisure. Innovation will be focused on aspect related with optimization of structural engineering, material and fabrication, but also by innovative multi-purpose design. They will contribute to improve the competitiveness of the European industry and generate higher-value knowledge for new applications at the crossroad between disciplines and technologies.

A focused research effort is being undertaken during the period 2007-2014 for ensuring that the environmental impacts of these activities on the oceans and marine ecosystems remain within acceptable limits with the use of marine space. Hence, offshore platforms that combine multiple functions within the same infrastructure offer significant economical and environmental benefits. The multi-use platforms developed from the concept designs will have the potential to provide Atlantic coastal regions with appropriate aquaculture systems, innovative transport services as well as leisure and offshore energy solutions.

### **Action lines/Potential projects**

1. Development of innovative solutions for a multi-use off-shore platform using new designs, materials with innovative properties with an optimal and sustainable use of the oceanic resources, looking for the integration with the marine environment and focus on provide breakthrough cost reduction.
2. Development working procedures for providing a cost reduction from building techniques to operational expenditures, commissioning and decommissioning, development intelligent management models and operational control for the platforms, decreasing time and simplifying requirements for installation, addressing ancillary issues in innovation as standardization and regulation, improving reliability, etc.
3. Demo-targeted pilot platforms construction, considering the future floating cities. A range

of demonstration activities is required to validate industrial viability, including technical, environmental and economical aspects. From computer simulation to full-scale development of prototypes at selected test site, including all kinds of testing and validation.

4. Maintenance and control: to preserve safety environment and platforms resources. Particularly, the project shall join forces to ensure safety operators that platform required.

### ***3. Atlantic Ocean Observatory***

#### **Objective**

*Develop, improve, complement and networking Atlantic Regional and Global Observatories.*

In the last decade major effort has been put to develop large-scale networks and e-infrastructures to share and distribute oceanographic data in the European space area. That is the case of EMODnet, MyOcean or EuroGOOS initiatives where observational and forecast data is acquired and shared using state-of-the-art technologies and standard formats. The success of these initiatives has been notable and most of the existing data available in Europe are now shared through the associated e-platforms.

At the same time several regional ocean observatories have been implemented with the aim to complement the already existing networks and to cover near-shore areas with higher spatial resolution observations and forecasts that can provide more detailed information and therefore provide better solutions to cope with the local needs. These local infrastructures can provide the link between the large-scale structures and the end-users located in each region making data more accessible and site-specific which allows to better address local problems.

Currently existing Observatories partially funded by the EC, such as PLOCAN (Macaronesian archipelago), RAIA (Northern Atlantic area of the Iberian Peninsula), LOREA (Eastern part of the Gulf of Biscay) or Smart Bay (Galway, IE) among others, already provide a wide variety of services at a regional/local scale. However, almost none interaction between these networks and e-platforms has been produced during their foundations and the development of their services. Each local observatory, depending on its particular needs or resources, has focused in different topics offering a catalogue of operational services and products for end-users. A rationalization and capitalization of these previous efforts through networking and upgrading activities is needed so that a seamless access to the existing oceanographic data, products and services from these observatories is provided in a homogeneous and standardized way across the Atlantic Coast while serving as a link between the large-scale initiatives and the end-users.

These regional/local Observatories can give unique insights towards a deeper comprehension of the ocean and coastal dynamics at different spatial and temporal scales.

### **Action lines/Potential projects**

1. High resolution forecasts tailored to respond to each region peculiarities using large-scale models (e.g. MyOCean IBI) as boundary conditions. Nesting to biogeochemical models, sedimentary models, etc
2. Deployment of high spatial resolution observational networks that can cope with local phenomena including site-specific biological and physical parameters. New technologies like HF radars, gliders, AUVs, etc. should be incorporated routinely into the Observatories using standardized procedures.
3. Specific updates in the larger scale observatories in order to properly complement and address the needs of the local scale systems, in order to provide information for the rationalization, merging and analysis of the data stream from the coastal systems.
4. Homogeneous integrated access to data provided by the observational networks and local forecasting models for a wide variety of users complying with the OGC standards. Efforts should be done to implement a homogeneous catalogue of services through all the Observatories that could be easily accessed by different users and EMODnet.

## ***4. Responding to threats and emergencies in the maritime environment***

### **Objective**

Improve the response to threats and emergencies in the maritime environment in the following dimensions: (a)Prevention - Through regulations, implementation, enforcement and verification of good and faire practices, by raising standards through education and training; (b)Monitoring - Being able to observe and register data from maritime activities and share data and information, having the capability to generate knowledge;(c) Reaction - Means and technology to be able to fight causes and deal with consequences.

A safe environment is essential to the development of any sustainable human activity in harsh maritime conditions. Therefore, for the development of a truly European sea economy, a good use of the large maritime space under its jurisdiction is mandatory and the causes and consequences of the threats and emergencies in a more comprehensive and integrated way have to be properly addressed. Causes can be divided into: nature related (climate, tsunamis), accidents, or human intentional acts. When speaking about natural causes we refer to the maritime environment; when speaking about accidents we refer to maritime safety, and when human intentional acts are

involved, we speak about security. Consequences can also be divided into three inter-related areas which are the impact on human lives, on the economy, and on the environment.

Due to the complex nature of maritime activities conducted in spaces without natural frontiers and with the potential to impact in large sea spaces with huge consequences in the economy and human life standards, the only viable approach to deal with threats and emergencies is through an international cooperation and a multi-disciplinary approach. The enforcement of international regulating bodies, the multidimensional cooperation and collaborative work between public and private entities such as governmental agencies, research entities, universities, trade unions, companies, and the sharing of information, knowledge and expensive assets, is the only way to ensure an effective European response to threats and emergencies in the maritime environment.

**Action lines/Potential projects:**

1. Safety, Security and Survival training facility.
2. Towards an improved response to threats and emergencies (marine accidents, oil and HNS spills, natural events and illegal activities) in Atlantic coastal areas. The project/s will approach research and technological gaps on relevant areas linked to the response to threats and emergencies: observation, detection, monitoring, prediction, communication, data and information management, HNS behaviour at sea, oil and HNS response at shoreline and sea, waste management, mitigation, restoration, training and exercise.
3. Creation of a common Atlantic platform/network for maritime safety services, products and technology that unites public and private actors, broadens regional expertise and ensures market uptake.
4. On top and cross with Atlantic Ocean Observatories activities develop an early warning network.
5. Marine emergent toxins: hazards and risks - To map the occurrence of emergent marine toxins in Atlantic coastal waters and to highlight new potential vectors of these toxins and routes of exposure that may be important in terms of human health.
6. Invasive species in Atlantic Coastal Regions - Coordinating research to address and mitigate the impacts of introduced invasive alien species in marine ecosystems,

## ***5. Atlantic Integrated Coastal Zone Management common framework***

### **Objective**

#### *Macro-regional implementation of the North-East Atlantic Integrated Coastal Zone Management.*

Many European coastal zones face problems of deterioration of their natural, socio-economic and cultural resources. The impacts of climate change are expected to further increase the exposure of the coast to flooding and erosion. Yet, coastal planning activities or development decisions still take place in a sectoral way, hardly being linked to each other. This fragmented approach to planning and management leads to inefficient use of resources, conflicting claims on space and missed opportunities for more sustainable coastal development.

To improve this situation, the European Parliament and the Council adopted in 2002 a Recommendation on Integrated Coastal Zone Management<sup>5</sup> which defines the principles of sound coastal planning and management. These include the need to base planning on sound and shared knowledge, the need to take a long-term and cross-sector perspective, to pro-actively involve stakeholders and the need to take into account both the terrestrial and the marine components of the coastal zone. (sic, ec.europa.eu – Coastal Zone Policy)

In spite of the work carried out by the EU member states, reported on the national progress reports, and the lead provided by the OSPAR Commission for the cooperation on the protection of the marine environment of the North-East Atlantic, the Atlantic region countries still faces perturbing evidences of a clear lack of directives and policy enforcement that restrain local stakeholders from ineffective operationalization of limited subsets of the strategies and policies contained therein in response to individual motivations or political opportunity. It therefore remains clear that integration of the individual national strategies into a macro-regional ICZM for the North-East Atlantic, taking account of the complete range of stakeholder interests and fully articulating with the remaining operational programmes that stem from the Atlantic Strategy challenges and the EU's Marine Strategy Directive is utterly important.

The current proposal for the maritime strategy of the Atlantic Area within the EU 2020 agenda, defines the first of the five more pressing challenges as the implementation of the “Ecosystem approach” as the basis for marine management in both the Common Fisheries Policy and the Marine Strategy Framework Directive (MSFD)<sup>6</sup>. The latter pillar of EU's Integrated Maritime

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5 Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe (2002/413/EC)

6 DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 June 2008

Policy aims to achieve healthy marine waters by 2020. It applies an integrated approach to ecosystems and strives to contain the collective pressure of human activities within sustainable levels. It also establishes a clear regulatory framework for adaptation to climate change and allows for the regular update of environmental targets to take into account the variations caused by it.

The Directive presents a specific agenda, calling for the development of a marine strategy by each Member State with the provision by 2012 of a comprehensive assessment of the state of the environment, identifying the main pressures on their respective marine regions, and defining targets and monitoring indicators. "... By 2015, the Member States will have to develop coherent and coordinated programmes of measures. To reach the 2020 target, they will have to achieve efficient communication and close cooperation, notably through regional sea conventions...". The Directive also tackles the coastal areas challenges, by reinforcing the need to adopt the Integrated Coastal Zones Management (ICZM) approach as recommended to the EC in 2002 since then actively promoted as the cross-cutting instrument of the EU's Integrated Maritime Policy. ICZM integrates all policies, sectors and interests into the planning and management of human activities to achieve sustainable coastal development.

### **Action lines/Potential projects**

1. Designing model solutions and testing new methods within transnational partnerships to mitigate coastal change.
2. Representative and ecological coherent network of Marine Protected Areas in the NE Atlantic.

## **6. Offshore Aquaculture**

### **Objective**

*Support research, development, innovation and business in offshore aquaculture, considering the implementation of the ecosystem approach*

The growing human population combined with the rising in per capita consumption of seafood has increased the worldwide demand for marine products. Since world capture fisheries are in decline due to over-exploitation, aquaculture has played a fundamental role in the last decades to fill the gap between seafood supply and demand. However, at its current growth, aquaculture will not be able to keep pace with demand, and FAO estimates a deficit of 40 Mt in the supply by 2030<sup>7</sup>. In fact, environmental issues, urban pressure and competition for coastal land with other economic

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<sup>7</sup> AO, 2012. The State of World Fisheries and Aquaculture 2012. FAO Fisheries and Aquaculture Department. Rome. 209 pp.



activities have restricted the growth of the traditionally land-based and nearshore marine aquaculture industry. Therefore, aquaculture offshore has been recognized as a promising option for increased production. Offshore aquaculture provides important advantages such as higher production due to increased fish density capacity, optimal environmental conditions for a wide variety of species, animals are less prone to disease, etc. If offshore aquaculture expands too rapidly, however, it remains to be seen whether or not “dilution will remain the solution to its pollution”. Therefore, offshore aquaculture operations should include strategies to minimize the environmental impacts, since open-ocean aquaculture is prone to higher waste dispersion of excess feed, faecal matter and other wastes than inshore and inland aquaculture.

Implementing the ecosystem approach in the context of offshore aquaculture (EAA) should consider transnational and multilateral issues<sup>8</sup>. The success of offshore aquaculture entails evaluation of several common issues shared by neighbouring countries, including availability of agriculture and fisheries feedstocks for aquaculture feeds, regional impacts on marine ecosystems, economic and social impacts, spatial-planning and coastal zone management. There are some common regional ecosystem issues that demands transnational and multinational concerted action. For example, disease-spreading to wild populations and risks of escapees interbreeding with wild stocks causing a pathogen spreading and reduction in genetic variability of wild stock species. Projects in this domain should incorporate a multilateral approach with the involvement of Universities, R&D centers, National Maritime Authorities, Coastal Zone Management Authorities, industry and SMEs.

### **Action lines/Potential projects**

The offshore aquaculture brings specific challenges but also great opportunities such as:

1. Development of aquaculture offshore technology (i.e. cage design and construction materials), maintenance and operations (i.e. technology for remote fish husbandry, feeding control software, fish processing, real time monitoring of water quality);
2. Development of integrated multi-trophic offshore aquaculture (IMTA) systems such as finfish-seaweed-bivalves, as part of the solution for biomitigation of the nutrient excess in fed aquaculture, to minimize emission of biogenic matter from aquaculture and to minimize the potential impacts of the emissions;

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<sup>8</sup> Soto, D, et al. 2008. Applying an ecosystem-based approach to aquaculture: principles, scales, and some management measures. In D. Soto, J. Aguilar-Manjarrez and N. Hishamunda (eds). Building an ecosystem approach to aquaculture. FAO/Universitat de les Illes Balears Expert Workshop, 7-11 May 2007, Palma de Mallorca, Spain. FAO Fisheries and Aquaculture Proceedings. No. 14. Rome, FAO. pp. 15-35.

3. Studies on the potential of new high-valued species for offshore facilities towards supply diversification (especially for fish processing);
4. Studies on feeding formulation, fish nutrient budget and waste dispersion, to maintain high performance and reduce environmental impact;
5. Aquaculture Production Best Practices, logistic requirements and safer framework for workers in fish farms.

## ***7. Valorisation of marine biological resources***

### **Objective**

*Develop a R&D strategy for valorisation of marine origin products and compounds from undervalued, underutilized and unexploited marine species, by developing and optimizing extraction, formulations and processing technologies.*

Three overall action lines should be considered:

#### a) Valorisation of marine by-products

Characterization of by-products (potential use, presence of contaminants), development of new methods of collection and routing to processing plants, innovative methodologies of by-product processing that either improve quality, thus adding value, or reduce costs (energetic, environmental). Development of methodologies that result in added-value highly purified fractions for human consumption and other fractions of varying quality for the feed sector. The main applications in both human and animal nutrition of newly developed products should be established through thorough analysis of nutritional composition and biological properties (including in vitro evaluation of antioxidant, prebiotic and antimicrobial activities, among others). For feed applications, potential gains obtained from new products or new processing methodologies should be evaluated in vivo for different target-species (fish or crustaceans, pets, monogastric terrestrial animals), considering the organoleptic properties of the edible materials, as well as economic and environmental performances.

#### b) Valorisation of marine species for food uses

Optimizing innovation in the European sea industry through the integration of advanced technologies into traditional food production, tailored process technologies to preserve or to enhance the functionality, quality and nutritional value of food including organoleptic aspects in food production including new foodstuffs, new ingredients and development of eco-efficient processing and packaging systems, information and communication technologies for process

evaluation and control, and more efficient valorisation and management of by-products, wastes, water and energy, performing consumer and market studies and assessment of social and economic impact, including the development of sensors that can be used as a tool predicting the features of the final product.

The valorisation of undervalued or underexploited marine species of animal origin and/or the utilization of their residues for food purposes not only generate value-added products, but it will also allow optimizing the use of the product as a whole and will drastically reduce the negative environmental impact contributing to its sustainability<sup>9</sup>.

Additionally, the utilization of algae for developing new products with high nutritional value and good alternatives to animal-derived high biological value proteins or increase the use of these compounds as natural additives for food formulation: follow “natural” trend currently observed in food product development<sup>10,11</sup>

#### c) New uses of marine bioactive compounds

Many marine organisms such as cyanobacteria, epiphytic marine bacteria's, fungi, algae, sponge, cnidaria and other invertebrates and vertebrates have developed a great variety of adaptation that allows them to live in contrasting environments and face predation and hostile conditions. Although marine biodiversity far exceed that of terrestrial habitats, only a small portion of organisms have been investigated for bioactive substances. A number of bioactive substances have already been isolated and are under test or already in the market, demonstrating the great potential that is still to be explored. Several fields of application have already been identified, such as cosmetics, medicine, food industry. Today, many well know anti-cancer compounds and secondary metabolites which act against infectious diseases and inflammation are in the market, but new biotechnological uses should also be explored such as antifouling agents<sup>12,13</sup>.

Exploration of seabed and common fisheries activities are issues shared by neighbouring countries, including availability of species, regional impacts on marine ecosystems, economic and social impacts, spatial-planning and coastal zone management, which demand transnational and multinational concerted actions.. Projects in this domain should incorporate a multilateral approach

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9 The State of World Fisheries and Aquaculture , FAO 2012; Arason et al, 2009

10 Chandini, S. K., Ganesan, P., Suresh, P. V. e Bhaskar, N. (2008); Seaweeds as a source of nutritionally beneficial compounds–A review; Journal of Food Science and Technology; .45(1), 1–13

11 Araújo, R., et al. (2009); Checklist of benthic marine algae and cyanobacteria of northern Portugal; 1ª edição; Botanica Marina 52, 24-46

12 Folmer, F, Houssen, WE, Scott, RH, Jaspars, M. 2007. Biomedical research tools from the seabed. Current Opinion in Drug Discovery and Development 10(2): 145-152.

13 Leão, PN, Engene, N, Antunes, A, Gerwick, WH, Vasconcelos, V. 2012. The chemical ecology of cyanobacteria. Natural Products Reports 29:372-391.

with the involvement of Universities, R&D centers, National Maritime Authorities, Coastal Zone Management Authorities, and industry.

**Action lines/Potential projects:**

1. Development of new biomedical uses for bioactive substances through the isolation, purification, structure elucidation and studies on the biomedical properties of a vast array of new bioactive substances obtained from marine organisms.
2. Development of sustainable technologies and processes (reactors, aquaculture including aquarium production, etc) for the production of high value bioactive molecules from marine origin.
3. Development of novel “green” antifouling coatings based on natural compounds produced by marine organisms.
4. Development of new food products from underutilised and underexploited fish species through characterization of residues and species, development of new food formulations, consumer and market studies and assessment of social and economic impact, pilot project development and implementation.
5. Development of new food products from Algae, by studying new technologies for the preservation of algae, the extraction of high value-added components from algae and their subsequent use as natural additives in foods.
6. Development of an information technology structure to support chain of custody of fish from the fishing vessel to the final consumer.
7. Development of technological solutions to use real time data from food processing operations in information management systems.

## ***8. New Skills and Employment Opportunities***

### **Objective**

*To foster the creation of new jobs and to develop education and vocational training proposals that respond to anticipating the needs of skills to be produced for the development marine and maritime activities*

Generation of new employments of quality is one of the priorities of EU2020 to enhance competitiveness and to promote social inclusion. High unemployment rates have shown drastic increases as a result of the economic crisis. In this context, youth unemployment and long term

unemployment are the most critical issues. The development of sea economy activities raises new employment challenges and the need of more skills to address the needs new jobs. Consequently, actions focused on the generation of new employment opportunities, education and vocational training and mobility schemes are of great relevance.

Including all economic activities that depend on the sea, the EU's blue economy represents 5.4 million jobs and a gross added value close to €500 billion per year. The EU, identifies in the communication “Blue Growth: Opportunities for marine and maritime sustainable growth”, five areas where additional effort at EU level could stimulate long-term growth and jobs in the blue economy, in line with the objectives of the Europe 2020 strategy. These areas are: renewable energy, aquaculture, maritime and coastal tourism, extracting minerals from the seafloor and blue biotechnology. All these areas are of very high potential in the European Atlantic Area.

Nevertheless, for this new horizon of employment opportunities to be successful in the Atlantic Area, an effective cooperation between education and training institutions, the R&D and innovation system and enterprises is clearly needed. The high density of marine-oriented Education and Training institutions, Research Centers and Enterprises in the European Atlantic Area places the EU in a potentially advanced position within the global scenario of knowledge generation, transfer and job creation in the marine and maritime domains and provides the basis for transnational opportunities of collaboration in these areas.

Development of effective information pathways and linkages between Universities and enterprises within the framework of the Atlantic Maritime Strategy will allow the development of joint platforms of marine and maritime job opportunities at the European Atlantic level, identification of entrepreneurial education and training demands and eventually the incorporation of these education and training needs into the university and other education and training institutions curricula. A number of projects might emerge from these strategic lines, which are likely to provide useful tools for the improvement of employment rates, mainly youth, in the Atlantic Europe.

**Action lines/Potential projects:**

1. Creation of a virtual platform to match job supply and demand in the marine and maritime economic sectors including, also, the education and training virtual sites with the supply of different levels of education and training programs
2. Creation of new cooperation training and education programs of higher education in the marine and maritime domains within the Atlantic Area
3. Creation of mobility vocational training and education schemes addressed to students,

workers, and trainers within the Atlantic Area in the marine and maritime productive sector

## ***9. Offshore Renewable Energy.***

### **Objective**

*Research and Development of Technology for harnessing wave, tidal and wind energy and the development of infrastructures and public policies to ensure the continuity of development of such technologies*

The potential of the North Atlantic's powerful waves and of the strong coastal tidal amplitudes needs to be exploited as well. The predictable nature of energy from tides can complement the less predictable energy from wind.

The development of offshore renewable energy requires a detailed characterization of the resource (waves, wind and currents) and parameters such as temperature and salinity. The wave energy resource is relatively well known (and it can be improved with very little investment), however, such is not the case of wind and there is a very urgent need for a better characterization. The incorrect characterization of the wind resource has a very significant impact on the economic viability of offshore wind farms. Moreover, temperature and salinity affect the development of technological solutions and understanding their variations is also important.

Islands can receive a large proportion of their energy from the sea. However, successful deployment of large scale offshore renewable energy will only happen if grid connections are ensured to link the main production centres to the end-users. In December 2010, ten European countries agreed to develop an offshore electricity grid in the adjacent North Sea. In its new guidelines for implementing Europe's energy infrastructures, the Commission will propose that the Irish Sea be included along with the North Sea and the Baltic in a "Northern Seas offshore grid" that will be considered as an "energy infrastructure priority". This will speed up the process for granting of permits.

The Commission intends to implement the Council request to explore synergies between the European Energy Policy and the integrated maritime policy, in order to promote more energy generation from the sea, in particular wave, tide, currents and thermal gradient sources, including from the Atlantic.

The "European Ocean Energy Roadmap 2010 - 2050" report, published by The European Ocean Energy Association, states that the development of this sector can contribute to decrease the greenhouse gas emissions, to generate important economical and social benefits, and to consolidate the independence of the power supply. According to the latest forecasts, marine energy will fulfil

1% of the power demand of the EU in 2020 and 15% in 2050.

In this context, offshore renewable energy is becoming a field of great interest not only because it offers sustainable electricity generation but also because of the emergence of a new industry sector.

**Action lines/Potential projects:**

1. Further development of hybrid offshore energy technology for harnessing energy from the sea, with the application of new materials and innovative techniques for power generation;
2. Understanding the Environment: Detailed characterization of the offshore energy resources (wave, tidal, wind, solar, etc.) on the continental shelf of the countries that represent the Atlantic area for the identification, characterization and evaluation of possible areas to install offshore renewable energy technologies.
3. Develop an offshore electricity grid study examining the synergies, the technological difficulties, costs and the opportunity to build an offshore electricity grid between Countries of the Atlantic Area, hoping that might contribute to enable a single smart European electricity grid able to accommodate the massive integration of renewable and decentralized energy sources
4. Prototype Testing Centre (offshore wind, waves, currents and others) to verify the performance and reliability of wind turbines, wave energy converters and others.
5. Deployment of 10 demonstration farms in the range of 5 to 25 MW using wave, tidal currents and/or deep water offshore wind energy to enhance industrialization in the Atlantic Arch Countries.

***10. Socioeconomic Diversification: New sources of sustainable growth in the coastal regions of the Atlantic Area***

**Objective**

*To Identify new sources of sustainable growth in the Atlantic Area and to encourage entrepreneurship and new ways of business to foster processes of socially inclusive growth in the coastal zones highly dependent on fisheries*

The socioeconomic diversification of coastal regions highly dependent on fisheries calls for a global and integrated approach of the development process with a strong involvement of the local communities. The experiences reached by “Coastal Action Groups” under EFP is a very interesting experience that should be enhanced and enlarged in the future by the reinforcement of cooperation and exchange of experiences within the Atlantic Area. Themes such as the formulation of local



development strategies, education and vocational training, local animation processes, the development of entrepreneurship abilities are very important to support the development of new activities in the fields of maritime tourism, nautical activities, valorisation of new products, etc...

The specific and common characteristics of Atlantic coastal areas, weather, environment, natural landscape, the common culture, the seafood industry potential –as well as the fisheries problems-, made the Atlantic area a perfect arena for a transnational cooperation. The enhancement of these resources and the overcome of some constraints such as seasonality of tourism, dependence of fisheries, high unemployment rates, can be partially overcome by sharing or exchanging experiences and best practices. International cooperation is needed to put in common solutions through a multidisciplinary approach with the involvement of the community.

#### **Action lines/Potential projects:**

1. Creation of an Atlantic training program addressed to specific targets of the communities to generate the skills to start up diversification activities, and to increase the development of entrepreneurship abilities;
2. Creation of new products and activities for the Atlantic Area in the fields of maritime culture, gastronomy, nautical activities, cruise tourism, local products, the creation of an Atlantic trade mark and its promotion;
3. Networking and clustering between networks and local action groups: FARNET, FLAGs, LAGs, to improve the exchange of experiences, cross fertilization in favour of socioeconomic diversification and an integrated approach for territorial development to maximize the Community Support Framework funds (ERDF, ESF, CF, EAFRD and EMFF).

## ***11. Ports and Port Activities***

### **Objective**

*(a) To make use of recent scientific and technological advances in engineering, materials science, robotics, optics, acoustics and telecommunications, to optimize the efficiency of port activities, management, security and services; (b) To make use of multidisciplinary innovative solutions, with extensive use of autonomous vehicles, combining hydrographical, geological, geophysical, chemical, ecotoxicological, remote sensing and high resolution imaging observations, with numerical modelling, to monitor and mitigate the impacts of port facilities and activities; (c) To develop European integrated initiatives on education and specialized training for human resources on ports and port activities.*

Europe has more than 1200 merchant and fishery ports playing an important role in the European



socio-economic sustainable development and in the implementation of the European Maritime Strategy for the Atlantic. They are key points of modal transfer and of vital interest to handle 90% of Europe's international trade and 40% of the intra-Community trade. Ports contribute towards European cohesion and are direct and indirect sources of more than half a million jobs, ensuring dynamism and the development of whole regions including the most peripheral, in line with the Lisbon strategy. Ports have a key role on the reduction of the European carbon footprint, by providing services and infrastructures for the progressive replacement of road transport by waterborne transport – the new marine highways. The foreseen increase in offshore wind farming and wave/tidal energy plants, the future exploration of the Atlantic seafloor's natural resources and the increase in waterborne leisure activities will trigger the expansion and innovation of port services and technologies. Due to their responsibility on maritime traffic control and coastal navigation, port authorities play a key role on risk analysis, prevention and management of shipping accidents and pollution hazards. A modern network of seaports and inland ports must constantly evolve to provide for the forecast activity increases in the order of 10% per year, growing at twice the rate of global Gross Domestic Product.

The Atlantic Ocean, joining Europe, America and Africa, encompasses a huge potential area for economic growth and development in the deep-sea, continental shelves and coastal zones. To explore this potential, a wide network of interests, investments and technology must be created through international cooperation, intra-European policy and coordination. The exploration of this huge potential must be supported by sustainable development, safety and security policies able to protect the environment, investments, and human lives at sea. Ports are essential infrastructures to achieve these goals. The development of efficient codes of best practices, monitoring techniques and adequate procedures, at an European level, to minimize the inherent impacts on ecosystems from port-related facilities and activities is essential. Due to the open nature of the sea spaces and the players involved, a multi-level, multidisciplinary and transnational European cooperation, with links towards other relevant players, is needed.

**Action lines/Potential projects:**

1. Assessment of impacts and monitoring of port engineering works and activities, combining bathymetric, geological, geophysical and high resolution imaging, with bottom habitat mapping and characterization, resorting to innovative and efficient methods, with extensive use of robotic vehicles;
2. Development of integrated multidisciplinary approaches, combining observations with numerical models, to evaluate and monitor the sedimentary budget in navigation channels

and assess their navigability under different scenarios.

3. Improvement of existing geological and geophysical imaging techniques and processing algorithms, to better characterize the nature and thickness of bottom sediments, for a more efficient planning of dredging operations and minimization of associated costs.
4. Development of Environmental Sensitivity Index Maps, at an European level, to assist oil spill management in Port jurisdiction areas;
5. Development of integrated multidisciplinary characterization of planktonic and benthonic ecosystems to assess pollution effects, through ecotoxicological and chemical studies, combined with online monitoring, passive samplers and detailed habitat mapping, to better understand their vulnerability and design efficient measures for their recovery and mitigation of hazards;
6. Development of new standards and techniques for the evaluation of dredged sediments' quality to accurately define their final destination;
7. Development of integrated European programs for Education and Training on Port Administration and Business, safety and security, and technical/scientific issues.

## 4. Synoptic Table

Key Investment Areas:	Axis	Action Lines:
Marine resources and impact assessment, exploration and exploitation technologies	3	<p>1. Mining equipment. Develop downsized, intelligent mineral exploration, extraction and processing equipment and techniques being capable of operating autonomously in deep sea environments.</p> <p>2. Deep sea and sub-sea environmental monitoring system. Develop technology and methodology for in-situ real-time monitoring impact assessment activity</p> <p>3. Mapping Atlantic mineral resources.</p> <p>4. Offshore Sand/Gravel and Mud/Clay Exploitation in Atlantic European Coastal Zones</p> <p>5. Assessment of Gas Hydrates occurrences, potential as a new energy resource and associated hazards in European Atlantic Margins</p>
Offshore multiuse floating platforms	3	<p>1. Development of innovative solutions for a multi-use off-shore platform using new designs, materials with innovative properties with an optimal and sustainable use of the oceanic resources, looking for the integration with the marine environment and focus on provide breakthrough cost reduction.</p> <p>2. Development working procedures for providing a cost reduction from building techniques to operational expenditures, commissioning and decommissioning, development intelligent management models and operational control for the platforms, decreasing time and simplifying requirements for installation, addressing ancillary issues in innovation as standardization and regulation, improving reliability, etc.</p> <p>3. Demo-targeted pilot platforms construction. A range of demonstration activities is required to validate industrial viability, including technical, environmental and economical aspects. From computer simulation to full-scale development of prototypes at selected test site, including all kinds of testing and validation.</p> <p>4. Maintenance and control: to preserve safety environment and platforms resources. Particularly, the project shall join forces to ensure safety operators that platform requires.</p>
Atlantic ocean observatory	1	<p>1. High resolution forecasts tailored to respond to each region peculiarities using large-scale models (e.g. MyOCean IBI) as boundary conditions. Nesting to biogeochemical models, sedimentary models, etc</p> <p>2. Deployment of high spatial resolution observational networks that can cope with local phenomena including site-specific biological and physical parameters. New technologies like HF radars, gliders, AUVs, etc. should be incorporated routinely into the Observatories using standardized procedures.</p> <p>3. Specific updates in the larger scale observatories in order to properly complement and address the needs of the local scale systems, in order to provide information for the rationalization, merging and analysis of the data stream from the costal systems.</p> <p>4. Homogeneous integrated access to data provided by the observational networks and local forecasting models for a wide variety of users complying with the OGC standards. Efforts should be done to implement a homogeneous catalogue of services through all the Observatories that could be easily accessed by different users and EMODnet.</p>
Responding to threats and emergencies in the maritime environment	4	<p>2. Towards an improved response to threats and emergencies (marine accidents, oil and HNS spills, natural events and illegal activities) in Atlantic coastal areas. The project/s will approach research and technological gaps on relevant areas linked to the response to threats and emergencies: observation, detection, monitoring, prediction, communication, data and information management, HNS behaviour at sea,</p>

Key Investment Areas:	Axis	Action Lines:
		<p>oil and HNS response at shoreline and sea, waste management, mitigation, restoration, training and exercise.</p> <p>3. Creation of a common Atlantic platform/network for maritime safety services, products and technology that unites public and private actors, broadens regional expertise and ensures market uptake.</p> <p>4. On top and cross with Atlantic Ocean Observatories activities develop an early warning network.</p> <p>5. Marine emergent toxins: hazards and risks - To map the occurrence of emergent marine toxins in Atlantic coastal waters and to highlight new potential vectors of these toxins and routes of exposure that may be important in terms of human health.</p> <p>6. Invasive species in Atlantic Coastal Regions - Coordinating research to address and mitigate the impacts of introduced invasive alien species in marine ecosystems, Atlantic network for maritime safety, products and technology</p>
Integrated Coastal and Maritime Environment Management	4/1	<p>1. Designing model solutions and testing new methods within transnational partnerships to mitigate coastal change.</p> <p>2. Representative and ecological coherent network of Marine Protected Areas in the NE Atlantic.</p>
<i>Aquaculture offshore</i>		<p>1. Development of aquaculture offshore technology (i.e. cage design and construction materials), maintenance and operations (i.e. technology for remote fish husbandry, feeding control software, fish processing, real time monitoring of water quality);</p> <p>2. Development of integrated multi-trophic offshore aquaculture (IMTA) systems such as finfish-seaweed-bivalves, as part of the solution for biomitigation of the nutrient excess in fed aquaculture, to minimize emission of biogenic matter from aquaculture and to minimize the potential impacts of the emissions;</p> <p>3. Studies on the potential of new high-valued species for offshore facilities towards supply diversification (especially for fish processing);</p> <p>4. Studies on feeding formulation, fish nutrient budget and waste dispersion, to maintain high performance and reduce environmental impact;</p> <p>5. Aquaculture Production Best Practices, logistic requirements and safer framework for workers in fish farms.</p>
Valorisation of marine biological resource	1 and 3	<p>1. Development of new biomedical uses for bioactive substances through the isolation, purification, structure elucidation and studies on the biomedical properties of a vast array of new bioactive substances obtained from marine organisms.</p> <p>2. Development of sustainable technologies and processes (reactors, aquaculture including aquarium production, etc) for the production of high value bioactive molecules from marine origin.</p> <p>3. Development of novel “green” antifouling coatings based on natural compounds produced by marine organisms.</p> <p>4. Development of new food products from underutilised and underexploited fish species through characterization of residues and species, development of new food formulations, consumer and market studies and assessment of social and economic impact, pilot project development and implementation.</p> <p>5. Development of new food products from Algae, by studying new technologies for the preservation of algae, the extraction of high value-added components from algae and their subsequent use as natural additives in foods.</p> <p>6. Development of an information technology structure to support chain of custody of fish from the fishing vessel to the final consumer.</p>

Key Investment Areas:	Axis	Action Lines:
		7.1. Development of technological solutions to use real time data from food processing operations in information management systems.
New Skills and Employment Opportunities	5	<p>1. Creation of a virtual platform to match job supply and demand in the marine and maritime economic sectors including, also, the education and training virtual sites with the supply of different levels of education and training programs</p> <p>2. Creation of new cooperation training and education programs of higher education in the marine and maritime domains within the Atlantic Area</p> <p>3. Creation of mobility vocational training and education schemes addressed to students, workers, and trainers within the Atlantic Area in the marine and maritime productive sector</p>
Offshore Energy	2	<p>1. Further development of hybrid offshore energy technology for harnessing energy from the sea, with the application of new materials and innovative techniques for power generation;</p> <p>2. Understanding the Environment: Detailed characterization of the offshore energy resources (wave, tidal, wind, solar, etc.) on the continental shelf of the countries that represent the Atlantic area for the identification, characterization and evaluation of possible areas to install offshore renewable energy technologies.</p> <p>3. Develop an offshore electricity grid study examining the synergies, the technological difficulties, costs and the opportunity to build an offshore electricity grid between Countries of the Atlantic Area, hoping that might contribute to enable a single smart European electricity grid able to accommodate the massive integration of renewable and decentralized energy sources</p> <p>4. Prototype Testing Centre (offshore wind, waves, currents and others) to verify the performance and reliability of wind turbines, wave energy converters and others.</p> <p>5. Deployment of 10 demonstration farms in the range of 5 to 25 MW using wave, tidal currents and/or deep water offshore wind energy to enhance industrialization in the Atlantic Arch Countries.</p>
Socioeconomic Diversification: New sources of sustainable growth in the coastal regions of the Atlantic Arc	5	<p>1. Creation of an Atlantic training program addressed to specific targets of the communities to generate the skills to start up diversification activities, and to increase the development of entrepreneurship abilities;</p> <p>2. Creation of new products and activities for the Atlantic Area in the fields of maritime culture, gastronomy, nautical activities, cruise tourism, local products, the creation of an Atlantic trade mark and its promotion;</p> <p>3. Networking and clustering between networks and local action groups: FARNET, FLAGs, LAGs, to improve the exchange of experiences, cross fertilization in favour of socioeconomic diversification and an integrated approach for territorial development to maximize the Community Support Framework funds (ERDF, ESF, CF, EAFRD and EMFF).</p>
Ports and port activities	2	<p>1. Assessment of impacts and monitoring of port engineering works and activities, combining bathymetric, geological, geophysical and high resolution imaging, with bottom habitat mapping and characterization, resorting to innovative and efficient methods, with extensive use of robotic vehicles;</p> <p>2. Development of integrated multidisciplinary approaches, combining observations with numerical models, to evaluate and monitor the sedimentary budget in navigation channels and assess their navigability under different scenarios.</p> <p>3. Improvement of existing geological and geophysical imaging techniques and processing algorithms, to better characterize the nature and thickness of bottom sediments, for a more efficient planning of dredging operations and minimization of associated costs.</p> <p>4. Development of Environmental Sensitivity Index Maps, at an European</p>

<b>Key Investment Areas:</b>	<b>Axis</b>	<b>Action Lines:</b>
		<p>level, to assist oil spill management in Port jurisdiction areas;</p> <p>5. Development of integrated multidisciplinary characterization of planktonic and benthonic ecosystems to assess pollution effects, through ecotoxicological and chemical studies, combined with online monitoring, passive samplers and detailed habitat mapping, to better understand their vulnerability and design efficient measures for their recovery and mitigation of hazards;</p> <p>6. Development of new standards and techniques for the evaluation of dredged sediments' quality to accurately define their final destination;</p> <p>7. Development of integrated European programs for Education and Training on Port Administration and Business, safety and security, and technical/scientific issues.</p>