The SEAS-ERA project

The FP7 SEAS ERA project (2010-2014) is a network of European marine research funding organisations (RFOs) consisting of 21 partners and two third parties from 18 Member and Associated Member States located along the European seaboard in the Atlantic, Mediterranean and Black Sea. The SEAS-ERA partnership maintains close contacts with the Baltic Sea RFOs through the EU BONUS project (www.bonusportal.org).

The principle aims of the SEAS-ERA network are to improve co-operation between national competitive marine research funding programmes, to facilitate better co-operation in addressing shared opportunities and challenges, to ensure better use of existing resources and capacities, to bridge identified gaps, to avoid duplication, to jointly fund strategic projects of mutual interest and in doing so, contribute to the sustainable development of the marine resource and progress the establishment of the marine component of the European Research Area (ERA).

The SEAS ERA project builds on the experience of the previous EU FP6 ERA-NETS: MarinERA (www.marinera.net) which involved 16 partners from 13 countries and organized a joint €5 million call for proposals; AMPERA (www.cid.csic.es/ampera) which involved 10 partners from 8 countries and organised a joint €2.25 million call for proposals; and MariFISH (www.marifish.net) which involved 18 partners from 16 countries and organised a joint €4.1 million call for proposals and common programming within five topics.

Summary of WP6 Atlantic Region Tasks

6.1. Developing a draft Strategic Marine Research Plan for the European Atlantic Basin (MI/EMB*)
6.2. Common Programmes (RANNIS)
6.3. Joint Calls (FCT)
6.4. Infrastructures (IFREMER*)
6.5. Capacity Building (FCT)
6.6. Coordination (RCN)

For further information on the FP7 SEAS-ERA Project see: www.seas-era.eu

*In the ‘Description of Work’, the beneficiaries are noted differently: EMB refers to MB-ESF, IFREMER refers to IFRPLLM and MINECO refers to MICINN.

Disclaimer:

SEAS-ERA Deliverable 6.1 was produced by the Marine Institute, Ireland (co-author: Geoffrey O’Sullivan) and the European Marine Board Secretariat (co-author: Nan-Chin Chu) for the FP7 SEAS-ERA consortium.

The information and views set out in this report are those of the SEAS-ERA Atlantic partnership and do not necessarily reflect the formal opinion of the SEAS-ERA partner parent organisations, the European Marine Board or its Member Organisations.
Towards a Strategic Research Agenda/ Marine Research Plan for the European Atlantic Sea Basin

Abstract

This document summarises the evolution of the SEAS-ERA Atlantic Sea Basin Marine Research Plan from the publication, in October 2011, of a draft Marine Research Plan to the present day. It describes the consultation process and modifications made as a result of stakeholder consultation and feedback.

It puts the evolution of an Atlantic Sea Basin Marine Research Plan in a temporal and policy context. The SEAS-ERA initiative on a Marine Research Plan for the European Atlantic Sea Basin was both opportune and timely given the parallel launch of the EU Strategy for the Atlantic (November, 2011) and the development of an EU Atlantic Action Plan 2014-2020 (May 2013). Neither of these very welcome initiatives had been anticipated when the original SEAS-ERA project was being prepared in 2009.

Accordingly, the SEAS-ERA Atlantic partners had an unprecedented opportunity to inform the preparation of the EU Atlantic Action Plan 2014-2020. This Action Plan is considered to be the appropriate framework for a Strategic Research Agenda for the European Atlantic Sea Basin. Hence the title of this Report is “Towards a Strategic Research Agenda / Marine Research Plan for the European Atlantic Sea Basin.”

Vision Statement

The European Atlantic Sea Basin Strategic Research Agenda / Marine Research Plan seeks to improve our understanding and protection of the European Atlantic, and its ecosystems, in order to catalyse a dynamic maritime economy, in harmony with the environment, and which has sustainable development at its core. This will be achieved through building on existing good practices and existing science and technology, harnessing new and emerging science, technology and innovation to add value and competitiveness to traditional sectors and create new and dynamic maritime sectors in a spirit of regional partnership and international co-operation.

“The greater danger for most of us lies not in setting our aim too high and falling short; but in setting our aim too low, and achieving our mark.”

Michelangelo (1474-1564)

This deliverable was compiled by the Marine Institute (Partner 9) and the European Marine Board (Partner 18) in collaboration with the SEAS-ERA Atlantic partners (Annex 1).

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Task 6.1: Strategic Analysis in the Atlantic Region

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Security: PU
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Figure 1.1. The European Atlantic Sea Basin [Source: SEAS-ERA (2011)]
1. Introduction

The objective of the discussion document, “A draft Marine Research Plan for the European Atlantic Sea Basin, published in October 2011, was to stimulate debate on the priority research topics that would inform a Strategic Research Agenda for the European Atlantic Sea Basin. The Discussion Document was drafted by the SEAS-ERA Atlantic Partnership (Annex 1), over the period 2010-2011, following a general structure agreed by the SEAS-ERA partners (e.g. A Shared Vision, Description of the Sea Basin, Geographic Boundaries, Basic Research, Applied Research, Research Support, Cross-cutting Issues, etc.) to be reflected in each of the three Sea Basin Reports e.g. Atlantic, Mediterranean and Black Sea).

The draft Atlantic Marine Research Plan was published in October 2011 and the stakeholder consultation extended formally from November 2011 to September 2012. However, in light of the important consultations taking place between September 2012 to March 2013 on the EU Strategy for the Atlantic (2011)\(^1\) and the development of an EU Atlantic Action Plan (2014-2020)\(^2\), publication of this report was delayed.

As a result of feedback received during the consultation process (Section 2), 20 of the 22 original themes identified in the discussion document (2011) were merged/revised to eight priority research themes and three critical supports (Table 1.1). Themes relating to Enabling Infrastructures and Building Research and Innovation Capacity are dealt with in other Reports (see Annex 4). This re-organisation was designed to:

- reduce the number of priority themes presented;
- reflect the priority areas identified in the EU Atlantic Action Plan (2014-2020) launched by the European Commission in May 2013;
- maximise the usefulness of the SEAS-ERA Atlantic Marine Research Plan in informing the EU Atlantic Action Plan and its implementation.

This is not a Strategic Research Agenda: This current Report is purposely titled “Towards a Strategic Research Agenda / Marine Research Plan for the European Atlantic Sea Basin”. It is not a Strategic Research Agenda, in the strictest sense, as it does not include all of the components normally associated with a Strategic Research Agenda (see Box). This fact was clearly stated in the original SEAS-ERA proposal.

“A Strategic Research Agenda is not a final document, but an on-going process”
A. Andrusaitis (BONUS)
SEAS-ERA Science Workshop 2012

“We live in interesting times”: The timing of the SEAS-ERA draft Marine Research Plan for the European Atlantic Sea Basin was both opportune and timely given the parallel launch of the EU Strategy for the Atlantic in 2011 and the development of an EU Atlantic Action Plan 2014-2020, published in May 2013 (Section 6). Neither of these very welcome initiatives had been anticipated when the original SEAS-ERA project was being prepared in 2009. The outcome was that the SEAS-ERA Atlantic partners had an unprecedented opportunity to inform the drafting of the EU Atlantic Action Plan 2014-2020.

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1. Introduction

**Quantification of Marine Resources.** The quantification and economic value of marine resources in the SEAS-ERA European Atlantic Sea-Basin has proved problematic, mainly because this area (i.e. the maritime territories of the 10 SEAS-ERA Atlantic partners) is not a standard unit for data collection. This issue is addressed in Section 5.2 of this report.

**Quo vadis?** The research landscape in which the SEAS-ERA project operates has radically changed over the period from 2007 to the present. During this period, the importance of the marine resource (the blue economy) and the role and essential contribution of marine research, technology and innovation, has experienced something of a "Renaissance."

This period has seen the launch of the Integrated Maritime Policy for the European Union (2007)\(^3\), its environmental pillar the Marine Strategy Framework Directive (2008)\(^4\), its research pillar the European Strategy for Marine and Maritime Research (2008)\(^5\), as well as a number of Sea Basin/Regional Strategies, including the European Union Strategy for the Atlantic (2011). The Blue Growth Strategy (2012)\(^6\) and associated studies and reports have emphasised the growth potential of the marine sector and identified key growth sectors, including blue energy, aquaculture, maritime, coastal and cruise tourism, marine mineral resources and blue biotechnology. Presentations at the 5 EU Atlantic Fora Meetings (see Section 2) and a series of consultancy reports contributing to the development of the Atlantic Action Plan have significantly added to our knowledge of the Atlantic Sea Basin environment and resource potential and have expanded on the very cursory overview presented in Section 3 of the 2011 Discussion Document. These presentations and reports are available on the EU Atlantic Forum website (http://ec.europa.eu/maritimeaffairs/policy/sea_basins/atlantic_ocean/index_en.htm).

Other important developments include:

- the addition of new marine ERA-NETS, such as the FP7 COFASP ERA-NET (2013-2016) [Cooperation in Fisheries, Aquaculture and Seafood Processing], FP7 OCEANERA-NET (2013-2017) for ocean energy and the preparatory action for an ERA-NET in Marine Biotechnology (www.marinebiotech.eu);
- the publication of sectoral marine-related Strategic Research Agendas, such as for example, that of the European Aquaculture Technology and Innovation Platform (EATiP) *The Future of European Aquaculture: A Strategic Agenda for Research and Innovation* (2012) and the WATERBORNE Technology Platform Strategic Research Agenda/ Vision 2025 (2011);
- the publication of the European Marine Board (2013) *Navigating the Future IV* Position Paper (June 2013)\(^7\);

![Figure 1.2. North Atlantic Ocean Circulation](http://ec.europa.eu/maritimeaffairs/policy/index_en.htm)

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\(^1\)http://ec.europa.eu/maritimeaffairs/policy/index_en.htm
\(^2\)http://ec.europa.eu/environment/water/marine/directive_en.htm
\(^3\)http://europa.eu/rapid/press-release_MEMO-08-553_en.htm
\(^4\)http://ec.europa.eu/maritimeaffairs/policy/blue_growth/index_en.htm
### A draft Marine Research Plan for the European Atlantic Sea Basin (2011)

#### Basic Research & New Knowledge:
1. Ecosystem functioning and processes;
2. Climate Change - mitigation & adaptation;
3. The Deep Ocean Frontier;
4. Conservation and Protection of Marine Biodiversity;
5. Transformative and enabling technologies.

#### Applied Research: Science supporting Society and Economy:
6. Marine Environmental Research;
7. Utilising the results/outputs of national marine environment and resource assessment programmes and nationally funded marine research programmes;
8. Marine Renewable Energy;
9. Shipping and Maritime Transport;
11. Marine Leisure & Tourism, including maritime culture & heritage;
13. High-tech Marine knowledge-based Products & Services;
14. Marine Biotechnology;
15. Oil and Gas Resources;

#### Research Support & Cross-Cutting Issues:
17. Marine Socio-Economic Assessment;
18. Data Management and Dissemination;
19. Seabed Mapping;
20. Management tools.

### Towards a Strategic Research Agenda / Marine Research Plan for the European Atlantic Sea Basin (2013)

#### Basic Research & New Knowledge:
1. The Ocean Frontier: Ecosystem Function – Biodiversity- Complexity and Connectivity;
2. Coping with Uncertainty and Change – the impacts of global climate change.

#### Applied Research - Science supporting Society and Economy:
3. Protecting the Marine Environment – Implementing the MSFD;
4. Marine Renewable Energy - Powering Europe;
5. The Greening of Maritime Transport - Safety, Surveillance and Logistics;
6. Reclaiming Our Ocean Heritage - Marine/Maritime Leisure and Tourism;
7. The Marine (Blue) Bioeconomy: Fisheries, Aquaculture, Seafood;
8. Harvesting the oceans non-living resources: Sustainable mineral, oil and gas extraction from coastal and offshore areas.

#### Critical Supports/Infrastructure needs:
9. A European Atlantic Ocean Observing and Forecasting Capability (including seabed mapping);
10. An Atlantic Marine Socio-Economic Assessment Capability and Database;

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Table 1.1. Comparison of the priority research topics included in the 2011 and 2013 SEAS-ERA Atlantic Research Plan Reports
2. The Consultative Process

Following the release of the draft Marine Research Plan Discussion Document in October 2011, the SEAS-ERA partnership initiated a consultative process with stakeholders. The Discussion Document was widely distributed (>1,500 copies), including at the Launch of the European Union Strategy for the Atlantic (Lisbon, November 2011), at Regional Atlantic Fora Workshops and at national Marine Research Seminars and Workshops.

Stakeholder Consultative Workshops

Three Stakeholder Consultative Workshops were held in 2012. Sixty-two invited experts participated in the Workshops resulting in 32 written responses. The Proceedings of these Workshops were published in September 2012 and are available on-line, along with the PowerPoint presentations at www.seas-era.eu/np4/34/. These Workshops included:

**Science Consultative Workshop, 28-29th February 2012 (Ostend, Belgium)** This Workshop attracted 36 invited experts (including 17 PowerPoint presentations). Issues such as basic versus applied research, the bottom-up versus top-down approach, prioritisation and implementation were discussed. Gaps identified included ecosystem complexity, feedbacks, linkages and interconnections, integrated coastal zone management and marine geology.

**Governance Consultative Workshop, 23-24th April 2012 (Lisbon, Portugal)** This Workshop was organised in co-operation with the Atlantic Arc Commission (AAC) of the Conference of Peripheral Maritime Regions (CPMR) to address the needs of governance (evidence-based policy making) and the peripheral regions. The Workshop attracted 26 invited experts (including 15 PowerPoint presentations). Key messages arising from the Workshop included that research should be “problem-focused and solution-oriented”, it should recognise the needs of the end-users, the research agenda should link science and management and involve stakeholders from the earliest stages such that the solutions/methodologies arrived at are within the capabilities of the end-user.

**East-meets-West Consultative Workshop, 13th July 2012 (Dublin, Ireland)** The East-meets-West Workshop was organised in parallel with the 2012 European Science Open Forum Conference (ESOF 2012, Dublin: 11 – 15th July) facilitating participation of SEAS-ERA Atlantic partners in the ESOF Atlantic Summit (12th July). Participants [15] included SEAS-ERA partners, guest speakers (3) and representatives of the National Science Foundation (NSF-USA), Canada Foundation for Innovation (CFI) and Fisheries and Oceans Canada. The Workshop included eight PowerPoint presentations. Useful ideas were exchanged on potential areas for future co-operation, including the implementation of standard trans-Atlantic sampling transects and the use of the Belmont Forum Protocol for joint funding.

Presentation of the Discussion Document at relevant Fora

The SEAS-ERA Atlantic partners actively participated in a number of Atlantic Research Workshops including the EUSA Atlantic Forum Workshops 2012/2013. The SEAS-ERA Atlantic Discussion Document (2011) was referenced as background reading on the Atlantic Fora webpages.

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8 http://flagcr.org/index.php/belmont-forum
9 http://ec.europa.eu/maritimeaffairs/policy/sea_basins/atlantic_ocean/atlanticforum/events
The Atlantic Regional Fora Workshops included:

- **Horta**: Coastal and deep sea resources (21 September 2012);
- **Brest**: Innovation at the service of a low carbon economy (29-30 October 2012);
- **Bilbao**: Ocean services and climate change mitigation under the ecosystem approach (12 November 2012);
- **Cardiff**: Reducing carbon footprint and achieving socially inclusive economic growth (24 January 2013);
- **Cork**: Research and innovation, ports and overview of the Action Plan (4-5 March 2013).

SEAS-ERA made a formal presentation to the Horta (Azores) Forum on how the SEAS-ERA Atlantic Action Plan could contribute to the EUSA Atlantic Action Plan and to the Cork (Ireland) Forum on Atlantic Marine Research Infrastructures. SEAS-ERA partners also attended the Brest, Bilbao and Cardiff Atlantic Fora Workshops and distributed copies of the Atlantic Discussion Document.

The SEAS-ERA Atlantic Partnership made a formal written response to the EU public call for suggestions for key investment and research priorities to be included in the EUSA Atlantic Action Plan (2014-2020) (Annex 2) and prepared updates and briefing notes for various Conferences and Workshops (e.g. SEAS-ERA Strategic Forum, Brussels, 7th February 2013).

2012 SEAS-ERA Consultative Workshops on the draft Atlantic Research Plan

Left: Lisbon Consultative Workshop (April 2012), top-right: Dublin Trans-Atlantic Workshop (July 2012) and bottom-right: Ostend Science Workshop (February 2012).
3. Basic Research & New Knowledge

3.1. The Ocean Frontier: Ecosystem Function – Biodiversity – Complexity and Connectivity

To better understand Atlantic marine ecosystem functioning and processes, including complexity, linkage, inter-connectedness, feedback loops and the role of biodiversity, to improve ecosystem understanding and underpin the development of models and a prediction/scenario development capacity.

In the draft Atlantic Research Plan Discussion Document (2011), Ecosystem Functioning and Processes (5.2.1), the Deep Ocean Frontier (5.2.3) and the Conservation and Protection of Marine Biodiversity (5.2.4) were treated separately. Further to the various Stakeholder Workshops, and in particular to the Science Workshop held in Ostend in February 2012, it was decided to merge these three sections into a single section addressing ecosystems and ecosystem functioning as a single challenge, recognising the influential links between the deep ocean, shelf seas and coastal waters and between pelagic and benthic ecosystems. It was also recognised that understanding ecosystem dynamics (temporal and spatial variability), functions and interactions is basic to understanding the marine environment, and necessary to support the sustainable development of marine resources, modelling and forecasting and the implementation of an ecosystem approach. Understanding ecosystem functioning and processes is an essential ingredient of a balanced marine science portfolio and must include both “a hypothesis and an experimental approach”.

A considerable body of research has been conducted on ocean dynamics (e.g. thermohaline circulation in the North Atlantic), on seabed exploration and mapping and on marine ecosystem functioning and processes. Every new project reveals new knowledge and challenges existing concepts. Large-scale EU collaborative projects such as HERMES\(^1\), HERIMONE\(^1\), DS\(^3\)F\(^1\) and CORALFISH\(^1\) have greatly expanded our understanding of deep-sea ecosystems while projects such as Euro-BASIN\(^4\) have provided new insights into pelagic ecosystems. The advent and development of new exploration technologies (e.g. floating buoy systems, seabed observatories, ROV/AUVs and gliders), coupled with a better understanding of genetics and gene expression under different types of environmental pressures has greatly expanded our knowledge of ecosystem functioning and processes, though a lot remains to be discovered.

More recently, policymakers and stakeholders are demanding of science a better understanding of the ecosystem services and the integration of ecological and socio-economic sciences to better understand spatial and temporal trends and to better quantify the cumulative effect of multiple stressors, including human interactions, with ecological communities.


Some Key Sources of Information on Ocean Frontier Research Priorities
FP7 Euro-BASIN: Basin scale analysis, synthesis and integration: [www.euro-basin.eu];
FP6 MARBEF Project: Marine Biodiversity and Ecosystem Functioning (2009) [www.marbef.org].

\(^1\) [www.eu-hermes.net/]
\(^2\) [www.eu-hermione.net/]
\(^3\) [www.deep-sea-frontier.eu]
\(^4\) [www.eu-fp7-coralfish.net/]
\(^5\) [www.eu-hermes.net/]

6 | Towards a Strategic Research Agenda / Marine Research Plan for the European Atlantic Sea Basin
Some Indicative Ocean Frontier Research Priorities
The indicative research priorities under this heading are legion and summarised by the European Marine Board (2013) as:

1. Discover, describe and characterise marine biodiversity (from microbes to megafauna);
2. Characterise and understand human benefits derived from the seas and oceans [marine ecosystem goods and services] and the human and natural pressures that threaten them;
3. Investigate how species and populations adapt to changing marine environments;
4. Define the controls and limits of ecosystem resilience, including predictive capacities and regime shifts and adaptation in the context of global change;
5. Develop a functional and dynamic definition of ecosystem health which conforms to scientific understanding and principles and is usable in a policy context [via the EU Marine Strategy Framework Directive].

Other indicative priorities identified during the consultative process include:

- Research into ecosystem connectivity, with a view to understanding patterns of biodiversity, biogeography and deep-sea and pelagic ecology; this is relevant also to the design and implementation of ecologically meaningful MPA networks;
- Research on, and measurement of, rates of processes in the seas and ocean and mapping of where these processes occur;
- Better understanding of land-shelf-deep ocean interactions, including transfers of matter, energy, carbon and pollutants, and their implications [e.g. living resources, health of deep ecosystems, goods and services];
- Studying the morpho-dynamic evolution of the seafloor across time, space and scales; including their main anthropogenic and natural drivers [e.g. extreme events such as major storms, cascading events, seafloor eruptions, landslides, etc.], and the influence of these evolutions on deep-sea ecosystems;
- Research on tele-connections [e.g. ocean-atmosphere interface, atmospheric processes having effects over large geographical distances, etc.];
- Resolving the role of ecosystem structure on the efficiency of the biological carbon pump in shelf and open ocean systems;
- Defining the role of toxins and pollutants in modifying the functioning of marine ecosystems and their services;
- Assessing the response and adaptive abilities of key ecosystem engineers [keystone species] relative to changes in abiotic and biotic stressors;
- Research on existing and emerging activities and technologies, including [a] assessment of risks and environmental and health impacts; [b] economic feasibility studies, looking in particular at subsidies and alternatives; [c] research on mitigation techniques and precautionary approaches;
- Governance research: e.g. research into the adequacy of governance and management [incl. MPAs] and ex ante and ex post policy assessments.
3. Basic Research & New Knowledge

3.2. Coping with Uncertainty and Change - the Impacts of Global Climate Change

To provide an evidence-based understanding of marine climate change drivers, interactions and impacts in order to inform mitigation and adaptive strategies, improve modelling and predictive capacities at both the regional and local levels.

It is now widely accepted that human-induced climate change poses one of the greatest societal challenges in the coming decades. However continuing difficulties in accurate prediction and forecasting result in an unacceptable level of uncertainty which militates against focussed political action.

"......climate change is the greatest and widest-ranging market-failure ever seen,...... the benefits of strong, early action on climate change far outweigh the costs of not acting. Without action, the overall costs of climate change will be equivalent to losing at least 5% of global gross domestic product (GDP) each year, now and forever. Including a wider range of risks and impacts could increase this to 20% of GDP or more, also indefinitely. ......5–6 degrees of temperature increase is a real possibility". Stern Review on the Economics of Climate Change (2006)

Scientific research has contributed to an improved knowledge and understanding of the current and future potential impacts of climate change on the marine environment. Marine climate change impacts have been well documented at the Atlantic Sea-Basin level (e.g. OSPAR15 and ICES16) and at a more local level (MCCIP17).

European Union Framework Programmes (EU FP) have supported a broad-ranging and multidisciplinary research on how climate change affects marine systems at various spatio-temporal scales, ranging, for example, from thermohaline circulation [www.eu-thor.eu], ocean acidification [www.epoca-project.eu], to trans-boundary conditions between the Atlantic and Arctic Oceans18.

Although numerous attempts have been made to bridge the science-public understanding of global climate change issues [www.clamer.eu], communication beyond the scientific community has rarely been adequate and, as a result, issues relating to uncertainty, cause-and-effect, and impacts are not well appreciated or understood by politicians, policy makers or the general public.

In order to formulate better adaptive strategies to address the consequences of climate change, evidence-based understanding and quantitative assessments of the marine climate change impacts/potential impacts are essential. These are needed to:
• reduce the uncertainty of climate change projections;
• ensure the accuracy and coherence of measurements and predictions by means of an integrated monitoring and observation network;
• further improve the exchange of knowledge within the scientific community and between scientists, policy makers and the public at large.

Key Sources of Information on Marine Climate Change Research Priorities
• European Marine Board Special Report (2011) Climate Change and Marine Ecosystem Research: Synthesis of European Research on the Effects of Climate Change on Marine Environments. (www.clamer.eu);
• JPI Climate Strategic Research Agenda (2011) [www.jpi-climate.eu/publications/documents];
• The Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (AR5) (2013) [www.ipcc.ch/].

16 www.ices.dk/Searchcenter/Pages/default.aspx?k=Climate Change
17 www.mccip.org.uk
**Some Indicative Research Priorities**

- A better understanding of the role of the oceans as a regulator of climate, feedback mechanisms and atmospheric tele-connections;
- Improvement in the understanding of internal dynamics, temporal and spatial variability, steady state and boundary conditions in order to reduce uncertainty and develop more reliable regional and local models, forecasts and scenarios, including risk assessments;
- A better understanding of thermohaline circulation, ocean acidification, sea-level rise, multiple stressors, deoxygenation/hypoxia, alterations of food webs (productivity, physiology, reproduction, biogeography, etc.) and downstream effects on dependent communities to better understand the mechanics of climate/ocean interactions and shifts in the timing of critical biotic life cycles;
- Determine the mechanisms initiating climate induced hazardous events and identify indicators to improve the ability to forecast the spatial- and temporal occurrence of these events and the structures in place to protect citizens (e.g. public announcements and coastal protection);
- Understanding exchanges between sub-seafloor, seafloor and water column/atmosphere (e.g., CH$_4$ and CO$_2$ release, CH$_4$ natural sequestration, Carbon-sequestration, natural Carbon-capture via benthic-pelagic coupling) and prediction of how they might moderate climate change or vary because of it;
- Identification and quantification of the socio-economic impacts of climate change on the blue economy (e.g. sea-level rise, Greenland and Arctic ice cover melt, increased storminess and coastal inundation, biogeographic shifts in the distribution of species of commercial importance, biodiversity and ecosystem function and services, etc.).

**Enabling Actions**

- Development of a European Atlantic Ocean Observation and Forecasting Capability (See Section 5.1).
- Development / Co-ordination of an Annual European Atlantic Sea Basin Climate Change Report Card.
- Assessment of the degree to which the long-term monitoring of marine-related Essential Climate Variables (ECVs), as endorsed by the UNFCCC Global Climate Observing System (GCOS), are being implemented in the Atlantic Sea Basin.

4.1. Protecting the Marine Environment – Implementing the MSFD

Support the implementation of the Marine Strategy Framework Directive and the development and application of the agreed descriptors of “Good Environmental Status”.

In discussions following the publication of the SEAS-ERA Atlantic Discussion Document [2011], the issue of how to address the numerous and pressing issues related to the state of the Atlantic marine environment were discussed. Given the number of potential topics, a pragmatic approach was adopted, in line with European marine environmental policy (Marine Strategy Framework Directive, 2008), that the marine environmental research agenda should focus on supporting the implementation of the MSFD.

A central tenet of the MSFD is the achievement of Good Environmental Status (GES), defined as “the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive”. Good environmental status means that the different uses made of the marine resources are conducted at a sustainable level, ensuring their continuity for future generations. To help Member States interpret what GES means in practice, the Directive sets out eleven qualitative descriptors, which describe what the environment will look like when GES has been achieved.

A major challenge is to improve our scientific knowledge of the marine environment and apply and interpret the descriptors (and associated indicators) of GES under different geographical and environmental conditions in a changing world. Researchers from all disciplines are working together to better understand environmental processes, the impacts of human activities and climate change on marine environments, and the socio-economic aspects of marine life.

A number of organisations (e.g. ICES, JRC, EEA, European Marine Board, JPI Oceans, etc.) are currently contributing to the definition of this research agenda. In 2012, a co-ordinated FP7 Ocean of Tomorrow call funded a number of research projects related to the individual GES indicators. One of these projects, STAGES [2012-2014], has a co-ordinating role, and will:

1. Identify and synthesise the knowledge generated through EU and national research funded activities with relevance to MSFD objectives and make it widely accessible to policy and decision makers and to MSFD stakeholders;
2. Identify the needs for further research to improve the scientific underpinning for the implementation of the MSFD;
3. Provide concrete, pragmatic and ready-to-use recommendations on the development of an effective European science-policy platform to support implementation of the MSFD.

Accordingly, no further attempt was made to refine the suite of indicative Marine Environmental Research Priorities identified in the Discussion Document as these are being actively addressed in other fora [see above].

For a review of the state of the European Atlantic Marine Environment

The 2010 OSPAR Quality Status Report (QSR) provides an excellent and up-to-date description and assessment of the environmental quality and environmental issues pertinent to the European Atlantic. It includes a very comprehensive review of the current status regarding climate change, eutrophication, hazardous and radioactive substances, offshore oil and gas, fishing, human impacts and biodiversity and ecosystems. [http://qsr2010.ospar.org/en/index.html].

The overarching goal of the Marine Strategy Framework Directive [2008] is to achieve clean, healthy and productive European seas, and specifically, to achieve good environmental status (GES) of the EU’s marine waters by 2020.

Unsustainable use of our seas threatens the fragile balance of marine ecosystems. Human activities that depend on the sea, such as fishing and tourism, suffer when ecosystems become damaged. We can expect increasingly serious competition for marine resources.

Sea for Life (EU, 2011)
Some Indicative Research Priorities

Some Indicative Marine Environmental Research Priorities:

- Development of a toolbox and guidelines for the application of the 11 descriptors (and attendant indicators) of Good Environmental Status (GES);
- Demonstrate the efficacy of the GES descriptors/indicators in a variety of environmental conditions and geographic locations;
- Assess the feasibility of aggregation of MSFD indicators;
- Identification and assessment of the risks associated with new and emerging anthropogenic pollutants.

Enabling Actions

- Better use of data from national/Member State monitoring and resource assessment programmes to describe/understand both anthropogenic and natural impacts on the state of the marine environment;
- Better optimisation of MSFD indicators at a regional scale to reduce monitoring costs.

4.2. Marine Renewable Energy - Powering Europe

To underpin the sustainable development and competitiveness of Europe’s marine renewable energy sector, increase the contribution of marine renewable energy to Europe’s energy portfolio and maintain Europe’s leading role in the emerging ocean energy industry.

The oceans represent a large and relatively predictable resource for renewable energy. The main forms of marine renewable energy are offshore wind, waves, tides, marine currents, salinity and temperature gradients and marine biomass. Offshore wind, tidal energy and marine biomass are currently the most mature technologies.

The very significant potential value of the European/Atlantic seaboard marine renewable energy resource in terms of job creation and internationally traded products and services, and in terms of energy security, a reduction on the reliance on fossil fuels (i.e. energy supply) and a reduction in carbon dioxide emissions (by about 65 Mt CO₂ by 2020), is well recognised and is reflected in the significant investments by industry along the European Atlantic coast.

There are, however, many technical, economic, environmental and social challenges related to the development and growth of the marine renewable energy sector, not to mention an increased competition for marine space (with existing sectors: transport, fisheries, aquaculture, leisure & tourism). Nonetheless the potential benefits to the Atlantic Region of Europe are significant. For example:

- Europe’s offshore wind potential is enormous and estimated to be able to meet Europe’s electricity demand seven times over (European Environment Agency);
- The EU’s Blue Growth Strategy (2012) identifies blue energy as one of five major growth areas in the Union;
- Europe can expect to install up to 100GW ocean energy projects by 2025, with each MW having the potential to generate 10 to 12 jobs (EU-OEA, 2013).

Delivering new, offshore technologies is capital-intensive. The Ocean Energy sector is currently developing first and second generation prototypes with a final target retail value of €4-5m/MW.

Increasing the reliability of devices and driving down the cost of energy is a universal goal for all ocean energy developers.

Ocean Energy Association, 2013
The main barriers to expansion are two-fold: (a) **Infrastructural**: facilitating the transport of electricity from where it is produced to where it is needed (the pan-European Grid) and (b) **Competitiveness**: significant R&D is required to bring down manufacturing, production and maintenance costs.

A new Marine Renewable Energy ERA-NET (OCEANERA-NET: 2013-2017) is due to commence in December 2013. This ERA-NET is well placed to identify and co-ordinate research priorities related to marine renewable energy.

**Some Indicative Marine Renewable Energy Research Priorities:**
- Improve the cost competitiveness;
- Model testing, performance validation (e.g. *in-situ* testing of scale one prototypes), hydrodynamic modelling;
- Control systems, power take-off (PTO) technologies, floating structures and mooring design, wave forecasting, new and innovative Marine Renewable Energy devices;
- Energy transmission to shore, storage and grid infrastructures;
- Assess the energy options and technologies for Europe’s outermost regions and islands;
- Measurement and mitigation of the environmental impacts of marine renewable energy, including underwater noise;

**Enabling Actions**
- Further commitment to, and development of, the pan-European grid, facilitating the transport of electricity generated on Europe’s Atlantic seaboard to the main urban areas and industrial centres of central Europe;
- Contribution to the development of standards and testing protocols and strengthening the roles and co-ordination of Test Centres;
- A critical assessment / review of marine biofuels, including co-products (e.g. proteins from algae), production costs, appropriate business models, alternative uses and environmental impacts.

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**Useful Sources of Information on Marine Renewable Energy and Research Priorities**


4.3. The Greening of Maritime Transport - Safety, Surveillance and Logistics

To develop an environmentally friendly maritime transport sector while remaining cost competitive in the global market and/or adding competitive advantage.

In the 2011 Discussion Document, Shipping and Maritime Transport (5.3.4) and Maritime Safety, Security and Surveillance (5.3.5) were dealt with separately. Here they are combined into one section with an emphasis on safe, green, competitive and sustainable transport across the seas and oceans.

The maritime transport and ports sector is one of the most valuable resources in terms of revenue and employment in the European Atlantic Area, providing vital links for trade and commerce in the Atlantic Sea Basin, between European regions (e.g. the North Sea, Baltic and Mediterranean), North America and globally.

Regarding Maritime Safety, Surveillance and Logistics, at European and Member State levels, there is a need to improve co-ordination and inter-operability within Europe to guarantee safety and security of passage while at the same time exercising State sovereignty in European waters. In this regard, good progress has been made with cooperation in the area of maritime safety, security and surveillance, in particular in relation to: emergency at sea responses (including search and rescue); pollution response (including catastrophic events); environmental protection, fisheries enforcement; improved vessel traffic management and information; and maritime security and surveillance at sea (including border control, counter-narcotics, human trafficking, smuggling and other forms of organized crime). Work is underway to ensure a Common Information Sharing Environment (CISE)\(^{21}\) to facilitate interoperability and the exchange of maritime ship-to-ship and ship-to-shore data. Given the broad expanse covered by the European Atlantic Sea Basin, there are significant opportunities to improve the efficiency and effectiveness of co-operation in these areas, both between the agencies within each jurisdiction and across jurisdictions through greater information exchange (including e-communication) and shared analysis.

**Research, Development and Innovation:** The WATERBORNE Technology Platform\(^{22}\) argue that given the high-technology nature of the European shipping sector, and the high Europe-wide priority for safety and environmental quality, research, development and innovation (RDI), high global standards and effective international control are essential. E-maritime approaches may provide a solution, providing a means to improve the flow of information from ship-to-ship and ship-to-shore and to provide the backbone for new products and services. Improved safety and monitoring services are a high priority for minimising the impacts of shipping and maritime transport infrastructure on the environment.

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\(^{21}\)http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_en.htm
\(^{22}\)www.waterborne-tp.org

In 2011, the WATERBORNE™ replaced its VISION 2020 document, with a medium and long-term Vision 2025 document (called “Vision 2025”) along with an updated Waterborne Strategic Research Agenda (WSRA), a Waterborne Implementation Road Map (WIRM) and a Waterborne Declaration (2012). The VISION 2025, the WSRA and the WIRM are regarded as tools rather than position papers and will be updated regularly in response to the rapidly changing business environment.

The major challenges identified in achieving this Vision 2025 are:
- **Societal Challenges**: Developing a low carbon, low emission economy; Adapting to climate change; Harvesting natural resources; Assuring safe and secure supply of goods and services.
- **Economic Challenges**: Improving competitiveness; Improving innovation and technology transfer; Increasing the level of education and skills; Addressing new and developing routes and markets.

The WATERBORNE™ community proposes to address these challenges by means of both privately and publicly funded research and innovation. This work will support the delivery of the “Europe 2020” objectives and will focus on three main areas:

**Sustainable Waterborne Transport:**
- Assuring security of supply;
- Increasing the energy efficiency of ships and vessels;
- Minimising the environmental impact of ships and vessels;
- Building safer ships and vessels;
- Increasing competitiveness;
- Recruiting and retaining a skilled workforce;
- Developing advanced waterborne infrastructure including e-maritime solutions.

**Support for the harvesting of offshore resources:**
- Renewable energies: wind, wave and tidal energy;
- Fossil fuels and raw materials;
- Fisheries and aquaculture.

**Minimising impact on the oceans:**
- Developing a better understanding the oceans;
- Improving products and services for marine monitoring;
- Increasing direct collaboration with the marine sciences.

**Sources of Information on Maritime Transport, Safety, Surveillance and Logistics Research Priorities**
The Northern (Arctic) Passage – the Next Horizon for Maritime Transport

Cutting as much as ten days – 40 per cent – off the sea journey from western Europe to Japan has been made possible in the last couple of years, courtesy of global warming, by record sea-ice melt in the Arctic Ocean. With the result that in the first half of this year Russia has been able to approve the transit along its coast through its Northern Sea Route, previously the “Northeast Passage”, of some 204 ships, up from only 46 ships last year, and just four two years earlier.

It’ll be a few years yet before the Arctic routes are commercially viable, shipping sources say, not least because the latter route is limited to ships with a draft of 41 feet or less – a ship carrying 2,000 containers might make the voyage more efficiently, but the biggest ships will still have to rely for the 33-day Rotterdam-Kobe trip on the Suez Canal.

South Korea’s Maritime Institute estimates, however, that the Northern Sea Route, which is likely to be open for eight months of the year within the decade, could account for up to a quarter of Asia-Europe trade by 2030, saving hundreds of millions on shipping company fuel bills. The route also has the added attraction of taking shipping away from the pirate and politics-infested Middle East.

The surge in Arctic shipping is prompting concerns among environmentalists, already campaigning against the expansion of mineral exploration in the Arctic, over safety and accidents – there are few resources to track ships or mark safe routes in the far north.


Some Indicative Maritime Transport, Safety, Surveillance and Logistics Research Priorities

- Promotion of the research priorities identified by the Waterborne TP Strategic Research Agenda (2011);
- The green ship concept including the reduction of ship emissions and control of non-indigenous species introductions via ballast water, energy saving (efficiency), new materials, new design of multipurpose vessels;
- Environmentally friendly alternatives to anti-fouling hull coatings (e.g. nano-skins);
- Mapping and preparedness to reduce the risk of maritime accidents (collisions, fires, polluting incidences, etc.);
- Developing integrated ocean services for safe navigation, ship routing and risk assessment;
- Advanced Integrated Ship Control (ISC) Systems to improve competitiveness and safety of ship and port operations;
- Satellite-based maritime tracking, container-screening and monitoring systems and biometric ID port perimeter security.
4.4. Reclaiming Our Ocean Heritage - Marine/Maritime Leisure and Tourism

Putting our shared ocean heritage on the Marine Agenda, encouraging ocean knowledge (ocean literacy) amongst our citizens and recognising the potential for a broad range of marine/maritime leisure and tourism opportunities.

The EU Blue Growth Strategy (2012) identifies maritime, coastal and cruise tourism, as one of five areas that could deliver sustainable growth and jobs in the blue economy. The extraordinary beauty and diversity of Europe’s Atlantic coasts, as well as the wide range of facilities and activities on offer, make them the preferred holiday destination of 63% of European tourists. This sector has now become the largest single maritime economic activity, employing 2.35 million people; equivalent to 1.1% of total EU employment, and despite being a mature area is expected to grow by 2 to 3% by 2040. In some areas, tourism is an additional source of income for coastal communities, but in others it can dominate the local economy, with more than 90% of the enterprises involved employing less than 10 people (Note: these figures relate to the EU-27). Further data from the EU INTERREG-IV NEA2 project, covering Atlantic Europe, identifies 16,000 businesses (mainly SMEs) with an annual turnover of €9 billion and providing 85,000 jobs.

Key Sources of Statistical Information on the European/Atlantic Tourism Resource

Recreational Fishing (RF)
One of the emergent coastal/leisure activities is recreational fishing, defined as "the use of fish resources for personal consumption and/or leisure". Around 10% of the European population fish for recreation, but the contribution of RF to exploitation of coastal fisheries resources is largely unknown and is an issue raised in the reformulation of the Common Fisheries Policy. The economic valuation of RF is complex because the goods and services (e.g. the angling experience) are only partly traded on formal markets and up-scaling of the induced economic impact requires combining expertise from fisheries biology, economics and social science.

Specific challenges for the North-East Atlantic include:
- The need to develop “niche” markets, based on its natural and unique assets, such as through cultural events, eco and gastronomic tourism, historical heritage and sports events, etc.;
- Providing an alternative to “sun holidays”;
- A highly seasonal demand which has repercussions for the structure of the industry, including the labour market, the supply chain and on the environment;
- The jobs created are often precarious and there is a strong turnover given the highly seasonal nature of the activity.

The sheer variety of Europe’s tourism means that most growth-generating initiatives will inevitably be on a local or regional scale. Each of Europe’s sea-basins presents different challenges and opportunities, requiring tailor-made approaches. In the North-East Atlantic, more than a third of the value of the maritime sector is generated by coastal tourism and shipping, with tourism and the fishing industry being the largest employers. In France, Portugal and Spain, coastal tourism is the largest employer of the maritime industries. More recently, cruise tourism, and to a lesser extent eco and gastronomic tourism, are gaining popularity in the Atlantic region.
**Key Sources of Information on Marine/Maritime Leisure and Tourism Research Priorities**

**Marine Tourism** Discussion Document for Public consultation on the challenges and opportunities for maritime and coastal tourism in Europe. Blue Growth Report [2012].


**Oceans and Human Health** European Marine Board Position Paper [in press].

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**Some Indicative Marine/Maritime Leisure and Tourism Research Priorities**

- Methodologies to assess the economic value and environmental impact, including the carbon-footprint, of Marine/Maritime Leisure and Tourism activities;
- Methodologies to assess and quantify the willingness of the public to pay for marine ecosystem conservation and protection for tourism purposes, including maritime heritage;
- Methodologies and technical interventions to secure and preserve maritime heritage, including submerged artefacts;
- Research on social innovation to address the seasonality of tourism and tourism related employment;
- How to promote Ocean literacy.

**Indicative Enabling Actions**

- An inventory of European Atlantic maritime culture and heritage, including submerged artefacts and submarine landscapes.

4.5. The Marine (Blue) Bioeconomy: Fisheries, Aquaculture, Seafood Processing

To develop the Blue Bioeconomy, supporting sustainable and environmentally friendly fisheries and aquaculture, based on an ecosystem approach, and providing a range of quality, healthy and value-added seafood products to the consumer and a livelihood to dependent coastal communities.

The European seafood industry is economically and socially important, especially in coastal and peripheral regions. The EU fisheries and aquaculture sectors generate an annual harvest of circa 6.3 million tonnes (4.4% of world catch) of seafood, resulting in an overall value output of €33 billion and supporting approximately 400,000 jobs [EMB, 2013].

The EU seafood market currently imports 65% of its requirement from outside the EU, with the remaining 25% and 10% coming from fisheries and aquaculture respectively, with a total seafood consumption of 13.2 million tonnes [EC COM(2013) 229 final]. For non-EU countries such as Norway and Iceland, fisheries and aquaculture production are of even higher economic importance, with a total production of 3.3 and 1.3 million tonnes in 2008, respectively.

Advancing Europe’s bioeconomy is an important element of the Europe 2020 Strategy. This is reflected in the 2012 European Commission DG Research and Innovation Strategy, “Innovating for Sustainable Growth: a Bioeconomy for Europe” [EC COM(2012) 60 final]. The strategy encompasses renewable bio-resources from the land and sea and their conversion into food, bio-based non-food products including bioenergy. With respect to fisheries, aquaculture and seafood processing, the following high-level objectives are stated:

- Manage natural resources (e.g. fish stocks) sustainably;
- Promote sustainable and competitive aquaculture;
- Reduce the heavy EU dependency on seafood imports.

To achieve these objectives, the following actions were identified:

1. Enhance scientific knowledge and innovation, reinforcing advice on fisheries management, supporting decision-making and strengthening an ecosystem based fisheries management as a central principle of the revised Common Fisheries Policy;
3. Promote consumption of safe, nutritious and healthy European seafood and ensure traceability of seafood from net and cage to plate.

Eurostat Pocketbooks: Agriculture, Forestry and Fishery Statistics (2013)

Identification of Research Priorities and Strategic Research Agendas
While the SEAS-ERA partnership is a network of Marine Research Funding Organisations with a broad marine remit, there are other organisations/networks with a more specific and focused “marine bioeconomy” brief which are also well placed to advise on marine bioeconomy research requirements. These include ERA-NETs (e.g. COFASP, see below), Technology Platforms (e.g. EATiP) and advisory groups such as ICES and SCAR-FISH. These groups have or are in the process of defining Strategic Research Agendas/Marine Research Plans related to the Blue Bioeconomy and are referenced where appropriate.
MariFish ERA-NET (2006-2011): the FP6 MariFISH ERA-NET (2006-2011) was an FP6 ERA-NET bringing together the major European national funders of marine fisheries research to strengthen the links between marine fisheries science and fisheries management. See: [http://www.marifish.net](http://www.marifish.net)

COFASP ERA-NET (2012-2016): the FP7 COFASP ERA-NET was established in 2013 to strengthen cooperation in European research on the sustainable exploitation of marine resources in the seafood chain by bringing together a network of SeaFood Research Funding Agencies. In addition to continuing the co-ordination activities initiated by MariFISH, COFASP will undertake a foresight study to identify the research needs for fisheries, aquaculture and seafood processing together with stakeholders. This information will be used to develop a common strategy for the seafood sector. See [www.COFASP.eu](http://www.COFASP.eu).

**The Ecosystem Approach?**

The ecosystem approach is a way of making decisions in order to manage human activities sustainably. The ecosystem approach recognises that humans are part of the ecosystem, that human activities affect the ecosystem and are affected by it. The ecosystem approach requires:

- An integrated approach that considers all ecosystem components (e.g. human activities, habitats and species, and physical processes);
- Consideration of ecosystem functions and resulting ecosystem services;
- Strong participation of stakeholders.

**Definitions of the ecosystem approach**

The Convention on Biological Diversity (CBD) defines the ecosystem approach as “a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.”

In the marine environment, ICES defines it as “the comprehensive integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of the marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity.”

[ICES LIFE+: http://www.projectpisces.eu/guide/implementing_the_ecosystem_approach/what_is_the_ecosystem_approach/](http://www.projectpisces.eu/guide/implementing_the_ecosystem_approach/what_is_the_ecosystem_approach/)

4.5.1. Sea Fisheries

To support the sustainable development of the fisheries sector and sustainable fishing communities through evidence based fisheries management and the introduction of an ecosystem based approach to management.

The Atlantic is one of the richest ocean regions in the world, but also one of the most heavily exploited, with over 79% of EU-27 Member State catches (3.9 million tonnes – 2009 figures) taken there, of which over 50% was taken by Danish, Spanish, French and UK fleets. In the North-East Atlantic, fisheries peaked at 13 million tonnes in 1976 and have since fallen to around 10 million tonnes per annum (FAO). The exploitation of many stocks continues to be beyond sustainable levels. Of the stocks assessed, 19 stocks are considered to be overexploited and a further 10 to be outside Safe Biological Limits. In addition, the status of a large number of stocks still cannot be fully assessed due to lack of data. A large proportion of the catch is discarded or not used optimally and the cost of fishing continues to be relatively high due to overcapacity and rising fuel costs. Higher yields, more security of supply and lower environmental impacts would be expected to follow from reductions in fishing effort.

The primary instrument for fisheries management in the European Union is the Common Fisheries Policy (CFP) with its fundamental pillars being ecosystem based management (EBM) and the Precautionary Approach. The reform (2013) of the Common Fisheries Policy places increased importance on industry involvement, regional management, the allocation of fishing rights and reducing discards. The requirement for full catch accountability and the landing obligations in the reformed Common Fisheries Policy is likely to change incentives and induce a high demand for new approaches and appropriate technology from the fishing sector. These changes will require an appropriate response from the science community regarding research priorities for the coming decade.

“Ecosystem-based approach to fisheries management means an approach ensuring that benefits from living aquatic resources are high while the direct and indirect impacts of fishing operations on marine ecosystems are low and not detrimental to the future functioning, diversity and integrity of those ecosystems”.

The CFP’s (General Approach) Basic Regulation

Key Sources of Information on Sea Fisheries Research Priorities
EFARO (2012). An EFARO View: Strategic Science Priorities for the next decade in support of sustainable living marine resources and a healthy environment. [Online].

Some Indicative Sea Fisheries Research Priorities

- Defining fisheries and ecosystem interactions to support the Ecosystem Approach to Fisheries Management (EAFM) and developing appropriate management approaches;
- Science to support mixed fisheries advice and management (including multi-species models);
- Mitigation or elimination of discards, as well as better use (valorisation) of by-catches;
- Achieving Maximum Sustainable Yields (MSY) for European fisheries;
- Understanding and predicting climate change induced changes on the biogeography and physiology of commercially important species;
- Provision of a solid scientific basis for the implementation of the MSFD with particular reference to the fisheries related Indicators of Good Environmental Status (GES): Descriptor 1 (biological diversity), 3 (population of commercial fish/shellfish) and 4 (marine food webs) and the use/interpretation of these under different environmental conditions;
- Identification, evaluation and implementation of technical conservation measures (TCM) for example in NATURA sites;
- Socio-economic assessment and evaluation of management regulations, regional management plans, market development and technological advancements on dependent fishing and coastal communities.

4.5.2. Aquaculture

To increase the productivity and output of European Aquaculture production, reduce imports, harness new space (e.g. offshore aquaculture) and technologies (e.g. genomics) to produce quality food products in an environmentally sustainable way.

Globally aquaculture is a large and modern industry, with the EU and EEA Member States producing some 2.6 million tonnes (€7 billion) of produce per annum, and employing an estimated 100,000 people in production and an additional 90,000 in the service, processing and other linked activities, including research (EATIP, 2012). It is the fastest growing food production sector world-wide, already representing half of global seafood protein production.
In the European Atlantic region, circa 50% of the EU production of shellfish (mainly mussels and oysters) is concentrated in France (oysters), Spain, the Netherlands and the UK (mussels). 28% of EU production is marine fish, mainly salmon in the UK and Ireland, followed by sea bass and sea bream in France and Spain. The remaining 22% is freshwater fish.

Aquaculture presents significant potential for expansion in the European Union (EC COM(2009) 162 final). The value of EU aquaculture output in 2010 was €3.1 billion, corresponding to 1.26 billion tonnes of production (EC COM(2013) 229 final). The EU Strategy for the Sustainable Development of European Aquaculture (EC COM(2002) 511 final), and the more recent EC Communication on Aquaculture (EC COM(2009) 162 final), identify a number of challenges in building an economic and environmentally sustainable European aquaculture industry, including: limited access to space; lack of a coherent administrative framework for the issue of production permits and licensing; lack of national or regional plans for setting production targets, industry fragmentation; limited access to seed capital or loans for innovation in a risky context (particularly with constant changes in the economic situation and in trade patterns); pressure from imports and the insufficiency of medicines and vaccines.

The more recent EC Communication, Strategic Guidelines for the sustainable development of EU aquaculture (EC COM(2013) 229 final), estimates that each percentage point increase of current EU consumption produced internally through aquaculture could help to create 3,000-4,000 new full-time jobs in the sector. This also explains why aquaculture is one of the pillars of the EU Blue Growth strategy (EC COM(2012) 494 final). Research and innovation will continue to be at the core of EU efforts to provide a basis for sustainable expansion of the sector, but also to make EU aquaculture production the most technologically advanced in the world, producing the highest quality seafood products with the highest safety standards for premium markets (EMB, 2013).

The European Aquaculture Technology and Innovation Platform (www.eatip.eu) has produced a strategic vision to 2030 wherein European aquaculture would produce 4.5 million tonnes of sustainable food products (€14 billion) annually and support 150,000 direct jobs. EATiP identifies eight priority themes, each with its own targets, goals and research requirements. These include: product quality; consumer safety and health technology and systems; managing the biological cycle; sustainable food production; integration with the environment; knowledge management; aquatic animal health and welfare; socio-economic management and governance.

Key Sources of Information on Sea Fisheries Research Priorities
FP7 AQUAEXCEL Project Aquaculture infrastructures for excellence in European fish research (www.aquaexcel.eu).

Some Indicative Aquaculture Research Priorities
Productivity:
• Develop improved rearing system technologies and appropriate genetic tools and procedures to improve productivity, health and welfare;
• Improve food, feed and nutrition and conversion rates.
Containment and Escapees:
• Development of guidelines and standards to ensure optimization of containment of aquaculture species;
• Development and implementation of guidelines to mitigate effects of escapees on the environment and on wild stocks;
Disease control:
• Development of novel treatments, including vaccines for enhanced disease (pathogen) and pest (parasite) control;
• Development of best practice in integrated disease and pest management to ensure optimum use and efficacy of existing control measures;
Diversity:
• Identify new species for aquaculture, adding diversity to the number of species farmed.
• Explore new spatial opportunities for aquaculture including offshore/deepwater and on-shore aquaculture;

4.5.3 Seafood Processing

To ensure food safety, quality and traceability, to add value to seafood products, including the development of functional foods, better understand consumer preferences and diversify the range of consumer products.

The overall value of the output of the EU-27 seafood processing industry amounts to around €20 billion. Spain, the United Kingdom, France, Germany and Italy are the leading countries in terms of production. The sector consists of nearly 3,700 companies with total employment of around 120,000 persons. The mainstay of European production relates to fish, crustaceans and molluscs. No breakdown is available for the SEAS-ERA Atlantic Area (i.e. EU plus Iceland and Norway).

Fishery and aquaculture products play a significant role in human diet, both in Europe and worldwide, as a source of protein-rich healthy food. Worldwide, the consumption of these products represents 17.8 kg/person/year or 15.7% of animal protein intake. Within the European Union (EU-27), the average consumption of fish is 23.3 kg/person/year, ranging from 4.6 kg/person/year in Bulgaria to 61.6 kg/person/year in Portugal. Only six of the SEAS-ERA Atlantic partner countries (BE, ES, FR, IS, NO, PT) consume above the EU-27 average of 23.3 kg/person/year with Icelanders consuming 90.6 kg/person/year (2012 data).

Five specific opportunities are identified, some of which overlap with the marine biotechnology sector:

1. **Product development** - Much of the seafood produced in Europe lacks differentiation, thus limiting the value-added from wild and farmed sources. Developing new products, to meet the needs of an environmentally aware, health conscious and/or convenience-oriented consumer is essential. Access to premium, high-value (global and local) niche markets is vital for securing the growth and competitiveness of Europe’s seafood industry;

2. **Functional Foods** - The use of marine origin materials as ingredients for functional food, pharmaceuticals, nutraceuticals and biomaterials requires increased research in bioprospecting/biodiscovery to identify and extract ingredients from fish, marine invertebrates, algae, marine plants and marine microorganisms. Building competitiveness in exploiting these novel sources requires research on bio-technology processes to target, collect, identify, classify, extract, store, etc., in order to fully explore the potential for novel uses for marine derived compounds;

3. **Consumer health** - Health aspects are important both from a consumer preference perspective and a public health perspective. The production of safe food is an essential pre-requisite for all European seafood. From a public health perspective, a strategy for low-cost, healthy nutritious products to meet the demand among poor consumers for sources of protein is required. Health claims attached to food need to be supported by solid research;

4. **Traceability** - Traceability is important for several purposes: (1) to assure consumers on quality; (2) to document sustainable harvesting; (3) to document origin; (4) to document different aspects of quality; (5) to confirm source species and (6) to document all sources of input, e.g. days since catch, treatment, additives, etc.;

5. **Certification and branding (labelling)** - With a plethora of labels already used for food, knowledge is needed on what consumers need and want of information, on what to label, at which level to label and to meet national and EU requirements for food labelling, e.g. health claims.

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**Environmental interactions:**
- Better understand aquaculture interactions with EU Habitats Directive/Natura 2000 sites;
- Reduce organic and chemical waste production/by-products;
- Develop easy to use quantitative indicators of environmental impact to advise and allay public concerns.

**Regulation:**
- Research to support/inform the development of a coherent and streamlined regulatory process, including operations in and around Natura 2000 areas, to facilitate the development and growth of the aquaculture sector.
Some Indicative Seafood Processing Research Priorities:

**Product Development**
- Assess consumer values, attitudes and behaviour to identify new products from an expanded marine foods source, including processing waste streams;
- Develop new processes for the reutilization of discards, by-catch biomass and fish processing waste (e.g. as animal feeds, cosmetics, etc.);
- Assessment of current status of fish processing waste recovery and utilisation.

**Functional Foods**
- Explore the use of fish and aquaculture products (including seaweed) as marine ingredients for functional foods, and nutraceuticals.

**Pharmaceuticals and biomaterials**
- Explore the use of fish and aquaculture products and by-products (including seaweed) as marine ingredients for pharmaceuticals, biomaterials and bioenergy.

**Certification and branding (labelling)**
- Develop effective labelling systems and standards, including consumer friendly information on health, fish welfare, origin and treatment.

4.6. Harvesting the oceans non-living resources: sustainable mineral, oil and gas extraction from coastal and offshore areas

By 2020, 5% of the world’s minerals, including cobalt, copper, and zinc could come from the ocean floor, This could rise to 10% by 2023. Global annual turnover of marine mineral mining can be expected to grow from virtually nothing to € billion in the next 10 years and up to €10 billion by 2030.

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**Key Sources of Information on Sea Food Processing Research Priorities**


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23**SEAMOUNT MINERAL DEPOSITS A SOURCE OF RARE METALS FOR HIGH-TECHNOLOGY INDUSTRIES, OCEANOGRAPHY, Volume: 23 Issue: 1 Special Issue: SI, 184-189 [MAR 2010].**

While the jury is still out as to the future/desirable balance between traditional energy sources (e.g. oil and gas) and new renewable energy technologies, the European oil and gas sector must react to (a) the decline of North Sea oil and gas reserves and the need for enhanced techniques to facilitate recovery from marginal fields and (b) the potential for new reserves in the Barents Sea, the Gulf of Cadiz/Algarve and the Arctic. Regarding a viable supply of natural gas from methane hydrates, the necessary technology to deliver this is still in its infancy.

Notwithstanding the scientific challenges related to the exploitation of marine mineral, oil and gas resources, the key societal challenges/concerns to be addressed include: environmental impacts, risk assessment, use of marine space, appropriate governance and dealing with safety and hazards.

Key Sources of Information on Non-Renewable Marine Mineral and Oil and Gas Research Priorities


Some Indicative Non-Renewable Marine Mineral and Oil and Gas Research Priorities

• Understanding the geological, geochemical and biological processes leading to the formation of mineral, including oil and gas resources;
• Basic research on deep geology, geo-biological properties of the shallow seabed environments and seafloor processes;
• High resolution seabed mapping, habitat mapping to characterise the existing ecosystem and provide an ecological reference, prior to exploitation;
• Critical assessment of carbon capture and storage in the oceans and its potential environmental impacts and its long-term monitoring and management requirements.

Mineral Exploration

• Resource assessment techniques, novel 2D/3D seismic imaging techniques, risk analysis particularly for deep sea environments;
• Mapping the mineral resources of the European Atlantic Sea-Basin and evaluating their industrial potential, including an Assessment / Re-Analysis of existing mineral resources in the Atlantic Sea Basin;
• Assessment of the environmental impacts of deep-sea mining and mitigation techniques;
• Impacts of increased off-shore sand and gravel extraction for beach nourishment and to counteract sea level rise impacts;
• New monitoring technologies.

Oil & Gas Exploration

• Improved resource assessment techniques, novel 2D/3D seismic imaging techniques, risk analysis particularly for small and marginal fields;
• Improving methods for enhanced oil recovery (EOR) by polymer injection and a better understanding of its environmental impacts;
• Improve exploration techniques for identifying and quantifying marine gas hydrates fields and assessing their economic potential;
• Developing innovative techniques for the exploration and production of natural gas from hydrate-bearing sediments (CO$_2$ injection, thermal activation or depressurisation), accompanied by an economic evaluation and risk assessment of each method identified;
• Developing associated carbon capture and storage (CCS) techniques; e.g. CO$_2$ injection to enhance oil recovery and to store carbon in depleted offshore fields or saline aquifers accompanied, by an economic evaluation and risk assessment of each technology identified.
5. Critical Support/ Infrastructure Needs

5.1. A European Atlantic Ocean Observing and Forecasting Capability, including Seabed Mapping

Establish a European Atlantic Ocean Observing and Predictive Capability, based on existing structures, platforms and mechanisms, to support the implementation of EU policies, reduce costs to industry, public authorities and research institutions, stimulate innovation and reduce uncertainty in our understanding of the behaviour of the Atlantic Ocean and the impacts of climate change.

The seas and oceans have a profound effect on the Earth’s weather and climate. This relationship has long been recognised by marine scientists who have sought a better understanding of ocean heating and circulation and its implications for weather, climate and productivity, not only in the oceans but also on land. Key to the understanding of these relationships is ocean observation and monitoring at appropriate spatial and temporal scales using a range of physical, chemical and biological sensors and supported by state-of-the-art data management, processing and visualisation techniques. This activity demands a truly inter-disciplinary and multi-disciplinary approach.

The importance of coordinated and networked ocean observations has long been recognised as an important pre-requisite to our understanding of the oceans. This has been consistently advocated by the marine science community (e.g. the EurOCEAN 2004, 2007 and 2010 Conferences and their attendant Galway (2004), Aberdeen (2007) Ostend (2010) Declarations), in the report of the DG MARE Marine Research Infrastructures Working Group Towards a European Integrated Ocean Observation (2013), in strategic EU communications (e.g. the European Strategy for Marine and Maritime Research (2008), Marine Knowledge 2020 (2012) and initiatives (e.g. European Marine Observation and Data Network – EMODNet) and more recently, the European Marine Board Navigating the Future-IV Report (June 2013) chapter on “An integrated and sustained European Ocean Observation System (EOOS).”

In July 2013, the European Commission published a consultancy report on the Marine Knowledge 2020 Strategy which highlights how the availability of and better access to marine data can stimulate innovation and reduce the costs of uncertainty in working in the marine environment. The report provides valuable economic estimates of the reduced costs to governments and operators related, for example, to offshore engineering, marine design, coastal erosion, operations at sea, ocean energy and safety of navigation24.

MARE Marine Research Infrastructures Working Group Towards a European Integrated Ocean Observation (2013), in strategic EU communications (e.g. the European Strategy for Marine and Maritime Research (2008), Marine Knowledge 2020 (2012) and initiatives (e.g. European Marine Observation and Data Network – EMODNet) and more recently, the European Marine Board Navigating the Future-IV Report (June 2013) chapter on “An integrated and sustained European Ocean Observation System (EOOS).”

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Key Sources of Information relating to the establishment of a European/Atlantic Ocean Observing System


At a Trans-Atlantic Workshop hosted in Galway (Ireland) in May 2013\textsuperscript{25}, inspired by the European Union Strategy for the Atlantic (EUSA, 2011) Action Plan, a joint statement on Atlantic Ocean Co-operation was agreed between Canadian, European and United States of America participants (Annex 3).

Galway Trans-Atlantic Vision Statement (2013)

Through seamlessly integrating science and technology and improved collaboration between Canada, the European Union and the United States of America, our common objectives are to have by 2020:

- An enhanced predictive capacity for the major risks and changes in the dynamics of the North Atlantic Ocean, its ecology, circulation system, interactions between the Atlantic and Arctic as well as ocean-atmosphere connections;
- Based on existing and new capability, to have implemented a fit for purpose North Atlantic multi-platform ocean observing and forecasting system driven by science and societal needs and providing real time data and long term time series;
- Mapped the Atlantic to underpin the accuracy of predictive models and forecasts and identified key tectonic / volcanic sites, as well as ecologically and economically important (and potentially undiscovered) seafloor and water column habitats;
- Enabled the safest operational and risk management environment for operation at sea as well as for offshore and coastal users;
- Forged greatly strengthened collaborative operational and scientific undertakings of mutual benefit and integrated these activates seamlessly across the North Atlantic between Europe and the North Americas;
- Supported the development, through public, academic and private sector partnerships (e.g. clusters of innovation), of a range of new and innovative knowledge based and globally traded products and services, including novel observing technologies and innovation to promote new opportunities for sustainable socio-economic growth;
- Revolutionised our understanding of the role of the North Atlantic in earth system dynamics, especially with respect to interactions with coastal zones and with the Arctic, Central Atlantic, the Baltic Sea and the Mediterranean;
- Promoted ocean literacy, engaged with societal stakeholders (including citizen participation) and inspired and educated the next generation of trans-disciplinary scientists and engineers.

Seabed mapping

The EU Green Paper Marine Knowledge 2020: from seabed mapping to ocean forecasting (2012)\textsuperscript{26} proposes the development of a seabed map of European waters by 2020. This new seamless multi-resolution digital seabed map of European waters will:

- be of the highest resolution possible, covering topography, geology, habitats and ecosystems for the benefit of industry, public authorities, researchers and society;
- provide the knowledge base to facilitate the growth of a sustainable, job-creating ‘blue economy’ in marine and maritime sectors by improving the competitiveness and efficiency of industry, public authorities and researchers;
- stimulate innovation and reduce uncertainty in the behaviour of the sea.

After a first pilot phase on a limited scale, the EU has now embarked on a second phase that aims to deliver low resolution mapping (one eighth of a minute for bathymetry, 1:250,000 for sediments) of European waters by 2014.

This is based on existing surveys although at the same time there are several on-going national surveying efforts such as the MAREANO programme in Norway, the INFOMAR programme in Ireland, the M@arbis and INFORMAR projects in Portugal and the litto-3D LIDAR-based coastal mapping in France.

These efforts will contribute to the aim of producing a seamless mapping of European waters by 2020. One of the outstanding marine research priorities to reach this target is to agree a standard methodology and classification system for recording seabed habitats.

\textsuperscript{25} www.marine.ie/atlanticasharedresource
\textsuperscript{26} http://ec.europa.eu/maritimeaffairs/policy/marine_knowledge_2020/index_en.htm
Some Key Challenges, Indicative Research Priorities and Enabling Actions

Challenges
• Using existing systems and mechanisms, develop and maintain a sustainable and integrated programme for surveying and observing the coasts, seabed and water column, covering the waters of EU Member States, Outermost Regions and Overseas Countries and Territories from the coasts to the deep ocean;
• Develop a network of coastal oceanographic forecasting systems across the North Atlantic that build on the Copernicus (GMES) marine service;
• Standardise sampling and observation techniques, integrate new technologies and common data standards to facilitate open data access and the use and reuse of data;
• Develop a harmonised seabed habitat classification system to facilitate seabed mapping;
• Build an industry, academia and government cross sector vision of a shared data collection, management and information infrastructure;
• Contribute to a more effective stewardship, cataloguing and distribution of interoperable marine data and a multi-resolution seabed map through contributions to the European Marine Observation and Data Network;
• Develop and maintain the capacity for rapid response to unanticipated and episodic events that require immediate scientific investigation to advance knowledge;
• Engage with existing international networks (e.g. GEO – Blue Planet Initiative) to set the Atlantic in a global context;

Research
• Develop new instruments and platforms for ocean observation and ecosystem monitoring (including seabed mapping) that increase the number of parameters that can be measured automatically, lower the costs of observation and accelerate the dissemination of data to users;
• Integrate historical and palaeo data, ocean observing and forecasting systems to provide better indicators of past, current and future environmental status;
• Advance existing technologies (including approaches emerging from other disciplines), ecosystem and biogeochemical models, as well as developing empirical and modelling approaches to enable the quantification of evolutionary change in ocean systems;
• Quantify the effects of multiple stressors on biogeochemistry, organisms and ecosystems;
• Proactively translate knowledge, based on an ecosystem approach, to improve the stewardship of natural resources;
• Develop cost effective chemical and biological (including genomic/meta-genomic) sensors as well as autonomous fixed and mobile platforms (sea-floor stations, oceanic floorings, deep ocean profilers, gliders, drifters, etc.) systems for ocean observation;
• Evaluate the role of biodiversity in the health and functioning of ecosystems and the maintenance of ecosystem services;
• Determine the mechanisms initiating hazardous events and identify indicators to improve the forecast of the spatial-temporal occurrence of these events;

Enabling Actions
• Establish a trans-Atlantic Science Forum (Canada - European Union - USA) to identify and elaborate a suite of marine science challenges that would best be addressed on a co-operative basis;
• Undertake a detailed review of existing North Atlantic ocean observation capacities, identify temporal-spatial gaps in coverage, critical parameters to be measured and the challenges to deliver the required predictive capacity by 2020;
• Assess the potential of utilising existing trans-Atlantic cables to host an array of marine sensors;
• Undertake a detailed review and make recommendations on the optimum approach to seabed and seabed habitat mapping such that [a] mapping initiatives, carried out separately or jointly, can be seamlessly merged and [b] a standard methodology and classification system for recording seabed habitats is available.
5. Critical Support/ Infrastructure Needs

5.2 An Atlantic Marine Socio-Economic Assessment Capability and Database

Establish an Atlantic Marine Socio-Economic Assessment Capability and Database to facilitate the compilation and disaggregation of North Atlantic marine social and economic data for the European Atlantic Sea Basin to assist investment and regional analysis, including investment in research and research infrastructures.

Various statistics and sectoral valuations are available on the marine economy of the European Union-27 and the North-East Atlantic. To-date, however, comparisons between the marine economies of the European Atlantic Sea Basin States (SEAS-ERA partners) have proved extremely difficult as (a) the ‘marine/ocean’ sector does not formally exist in many national accounts and (b) data collected are not comparable.

What is needed, to support a Strategic Research Agenda/Marine Plan for the European Atlantic Sea Basin, is renewed efforts to develop appropriate methodologies, marine socio-economic indicators and routine data collection procedures that will support regular and comparative economic assessments of the contribution of the marine/maritime sector to National, Regional (Sea-Basin) and European GDP.

This identified critical support/infrastructure is similar to and could input to and complement the Bioeconomy Observatory announced by the European Commission (EU Press Release (IP/13/113) February 2013) which will establish an observatory to map progress and measure the impact of the development of the EU’s Bioeconomy Strategy. The observatory will gather data to follow the evolution of markets, to map EU, national and regional bioeconomy policies, research and innovation capacities, and the scale of related public and private investments. The observatory will be coordinated by the Joint Research Centre, the Commission’s in-house science service.

Key Sources of Statistical Information on Marine Socio-Economics in the North-East Atlantic Area
- Maritime Facts and Figures (EU 2007)
- Blue Growth: Scenarios and Drivers for Sustainable Growth from the Oceans, Seas and Coasts (EU 2010)

Currently, a number of European Atlantic countries (e.g. France, UK) regularly produce marine socio-economic statistics, while others (e.g. Ireland and Portugal) are beginning to do so. The recently established EU MARNET Project will hopefully go some way to establishing a framework for a more comprehensive marine socio-economic network and capability for marine-socio-economic reporting, analysis and forecasting for the European Atlantic Sea-Basin.

The EU MARNET Project (2012-2014): A Marine Atlantic Regions Network (www.marnetproject.eu) is a pilot EU transnational (INTERREG-IV) co-operation project involving eight partners from the five Member States of the Atlantic Area (ES, FR, IE, PT, UK). The aim of the project is to create an EU Atlantic marine socio economic network that will develop a methodology to create and collate comparable marine socio-economic data across the Atlantic region, develop easy to compile and use marine socio-economic indicators, share data and to use this data to support regional marine socio economic development initiatives and assessments.

Some Indicative Marine Socio-Economic Research Priorities
- The development of a suite of appropriate, usable and comparable marine socio-economic indicators;
- The development of marine socio-economic modelling, scenario development and forecasting tools;
- Measuring the non-market marine values of marine ecosystem goods and services.

Enabling Action
- SEAS-ERA Atlantic partners to explore opportunities to establish an Atlantic Marine Socio-Economic Assessment Capability and Database with in the context of the EU Atlantic Action Plan and building on existing co-operative initiatives (e.g. INTERREG-IV MARNET Project).
5.3. A European Atlantic Marine Science and Technology Foresight Platform

Establish a European Atlantic Marine Science and Technology Foresight Platform to provide a forum to review and assess new developments in marine science and technology as well as new and emerging technologies that could be applied in the marine field.

In the original Atlantic Marine Research Plan Discussion Document (2011), Transformative and Enabling Technologies were included in Section 5.2.5. This topic sought to address the issue of the new ideas, innovations, methodologies, and in general new ways of looking at or doing things which continually come on the market from the laboratory bench. Some are immediately taken up and transform industrial sectors sometimes beyond recognition. Others languish for a time and are then rediscovered. There is no way of planning for such development, they happen, often as an offshoot of research and in particular from curiosity-driven or basic research, but their impacts can be immense. The original Discussion Document also had a Section 5.3.9 on Marine Biotechnology.

Further to consultation on the Discussion Document and the identification of a myriad of new technologies which could not be handled individually, it was decided to combine these two Sections and treat all new technologies (e.g. marine biotechnology, genomics, information and communications technology, nano-sciences, new materials, space, etc.) together. Further reasoning is that development in these areas is so rapid that research priorities are continually changing, and that specialist groups (including practioners and end-users) are better placed to advise on what is needed and what is worth adapting (e.g. marine biotechnology => blue biotechnology, genomics => marine genomics, sensors/robotics => marine sensors/robotics, etc.). In the area of marine biotechnology and genomics, a new ERA-NET partnership (www.marinebiotech.eu) is in preparation and has already had a number of preparatory meetings. This group, once formalised, is better placed to advise on marine biotechnology research needs and to up-date the highly informative and influential Marine Board Report “Marine Biotechnology: A Vision and Strategy for Europe” (2010).

Transformative (disruptive) technologies are defined as new knowledge, technologies and/or methodologies that do more than just change industrial processes. They change entire infrastructures, including governance and regulation. They may do this in uneven ways, leaving some sectors unchanged, while completely destroying and replacing others.

Enabling technologies are defined as knowledge, technologies and/or methodologies that, alone or in combination with associated knowledge/technologies, provide the means to generate giant leaps in performance and capabilities of the user. For example, the coming together of telecommunication technologies, internet, and groupware has levelled the field so that even smaller firms are able to compete in areas where they otherwise could not.

Navigating the Future-IV. Marine Board (2013) Chapter 10 “Blue technologies: Innovation hotspots for the European marine Sector” contains an excellent review of a number of emerging blue technologies that are helping to unlock potential in the marine environment. Such technologies include: robotics and autonomous systems, miniaturised solutions to marine monitoring, nature-inspired design, acoustics, nano-biotechnology, new concepts on harvesting ocean energy, ICT and the Sea.
5. Critical Support/ Infrastructure Needs

**European Marine Board Fora / Position Papers: A model for a European Atlantic Marine Science and Technology Foresight Platform**

The European Marine Board Open Forum ([www.marineboard.eu/fora](http://www.marineboard.eu/fora)) provides a potential model for a European Atlantic Marine Science and Technology Foresight Platform at a Regional Sea/Sea-Basin level. The Marine Board organises a Biennial Open Forum to bring together a wide range of marine science stakeholders (scientists, European and national policymakers, pan-European and regional networks, industry, NGOs, etc.,) to discuss and develop a common position on marine science topics of common interest. *Marine Board Fora have included: New Technologies for a Blue Future* (Brussels: April 2012); *Towards a European Network of Marine Observatories for Monitoring and Research* (Brussels: September 2010); *Marine Data Challenges: From Observation to Information* (Ostend: May 2008).

The Board also organises Specialist Expert Groups to prepare Position Papers reviewing priority/topical issues in marine science (e.g. Marine Protected Areas (2013); Marine Microbial Diversity (2012); Marine Biotechnology (2010); Remote Sensing in Shelf Seas (2008); Climate Change Impacts (2007)). These Position Papers review the state of the science and make recommendations on future actions and research priorities.

These Fora and Position Papers bridge the gap between the scientific community, policymakers and enterprise, and seek to provide an agreed vision and recommendations to address/advance the issue at hand.

Such a Platform, established to serve the European Atlantic Sea-Basin and associated countries, could act as a focal point for liaison with more specialised regional organisations (e.g. ICES/EFARO-Fisheries, OSPAR-Marine Pollution; EuroGOOS – Oceanography), provide a bridge between research funders and policy makers on the one hand and the wider marine science community (research institutes, public and private enterprises, NGOs and the citizen) and to the implementation of the European Atlantic Action Plan (2013) and contiguous Action Plans.

**Enabling Action**

- Establish a European Atlantic Marine Science and Technology Foresight Platform to provide a forum to review and assess new developments in marine science and technology, and new and emerging technologies, that could be applied in the marine field, to include marine biotechnology/bioprospecting, genomics and metagenomics, marine renewable energy, integrated sensor systems for sea-surface, water column, seabed and sub-seabed exploration, new composite materials for use in the marine environment.

The European Union Strategy for the Atlantic (2011) was launched in Lisbon in November 2011 as one of a number of EU Sea-Basin Strategies, supported under the Integrated Maritime Policy for the European Union (2007), to address regional development taking into account regional differences. A supporting Atlantic Action Plan was developed over the following 17 months through: Atlantic Member State (France, Ireland, Portugal, Spain and UK) inputs; an online stakeholder consultation and a series of five Regional Atlantic Fora Workshops (See Section 2). In May 2013, the EU published its Action Plan for a Maritime Strategy in the Atlantic Area: delivering smart, sustainable and inclusive growth (COM (2013)279 final).

The Atlantic Action Plan identifies marine investment and research priorities that could be considered for EU-Member State co-financing in the financial programming period 2014-2020 (including Structural/Cohesion Funding, Horizon 2020, Life+, Member State Research Funding Programmes, etc.) in order to stimulate blue growth, support job creation and sustainable growth.

Contribution of the SEAS-ERA Atlantic draft Marine Research Plan:
The timing of the SEAS-ERA project (2010-2014), and the compilation of a draft Marine Research Plan for the European Atlantic Sea Basin, could not have been more opportune. The preparation and publication of the draft Marine Research Plan for the European Atlantic Sea Basin Discussion Document (2011) paralleled discussions on the Atlantic Action Plan:

- The compilation of the Discussion Document influenced Member State inputs to the Action Plan, particularly in the case of Ireland where those preparing the SEAS-ERA Atlantic Plan and the national input to the EU Atlantic Action Plan were one and the same;
- The SEAS-ERA draft Marine Research Plan for the Atlantic was presented to the 1st Atlantic Forum Meeting in Horta (September 2012);
- Copies of the SEAS-ERA Marine Research Plan for the Atlantic were provided as background documentation (downloadable from the Atlantic Forum website) to the subsequent Atlantic Fora Workshops (Brest: October 2012; Bilbao: November 2012; Cardiff: January 2013 and Cork: March 2013);
- The SEAS-ERA Atlantic partnership made a formal submission to the Atlantic Forum on-line stakeholder consultation in February 2013 (Annex 2).

The EUSA Atlantic Action Plan (2014-2020)
The Atlantic Action Plan (2013) aims to revitalise the marine and maritime economy in the Atlantic Ocean area. It shows how the EU’s Atlantic Member States, their regions and the Commission can help create sustainable growth in coastal regions and drive forward the “blue economy” while preserving the environmental and ecological stability of the Atlantic Ocean.

1. Promote entrepreneurship and innovation
   - Improving educational and training measures for sea-related careers, including the creation of cross-border programmes and mutual recognition of national education and training programmes;
   - Innovate through research and technology, including research to improve the growth, productivity, competitiveness and environmental sustainability of fisheries and aquaculture (including offshore aquaculture) and the industry’s ability to respond to market needs.

2. Protect, secure and enhance the marine and coastal environment
   - Supporting initiatives to reinforce marine safety and security, including risk assessments and coordinated response mechanisms as well as investments in state-of-the-art research and equipment to respond to natural disasters or marine accidents;
Towards a Strategic Research Agenda / Marine Research Plan for the European Atlantic Sea Basin


- Developing a European Atlantic ocean observing and predictive capability, supporting the development of new instruments and platforms for ocean observation and ecosystem monitoring (including seabed mapping) to lower the costs and accelerate the dissemination of data to users;

- Encouraging cooperation between Member States on joint actions to restore ecosystems and achieve good environmental status, to assess the social and economic value and functioning of the Atlantic’s ecosystems and biodiversity and implement Maritime Spatial Planning and Integrated Coastal Management;

- Developing a better understanding of the technical feasibility, economic viability and environmental impact of mining for minerals in the Atlantic Ocean, and develop and test innovative mining technologies;

- Strengthening links between research and industry in order to develop biobanks and identify markets for innovative marine bioproducts (biomedicine, tissue engineering, pharmaceuticals, industrial enzymes) and focusing research into delivering industrial processes for manufacturing them;

- Promoting research, development and demonstration of technologies for the construction and maintenance of renewable energy installations for offshore wind, wave, tidal and biomass energies.

3. Improve accessibility and connectivity

- Facilitating the upgrade of infrastructure, such as ports, to improve connectivity with the hinterland, diversify activities such as maintenance of offshore renewable energy installations or tourism, enhance intermodality and promote fast turnaround of ships through measures such as provision of shore side electricity, equipping ports with liquefied natural gas refuelling capacity and tackling administrative bottlenecks.

4. Create a socially inclusive and sustainable model of regional development

- Identify and promote cultural and natural attractions such as the artisanal fishing, gastronomy and maritime heritage of the Atlantic coast.

For further information see:
7. Trans-Atlantic Co-operation

In defining a European Atlantic Sea Basin Marine Research Plan, the SEAS-ERA Atlantic partnership has recognised, from the outset, that the implementation of such a plan needs co-operation, not only between EU and EEA Atlantic Member States, but also with (a) Non-EU eastern Atlantic seaboard countries (e.g. Faeroe Islands). Note: Norway and Iceland are members of the SEAS-ERA Project, and (b) western Atlantic Ocean seaboard states (USA, Canada, and Greenland).

This issue was further emphasised by the SEAS-ERA Atlantic partnership in its submission (Annex 3) to the on-line consultation on the EU Atlantic Action Plan (2012-2013): “an Atlantic Action Plan cannot be achieved by the five EU Atlantic Member States (France, Spain, Portugal, Ireland and the UK) acting alone, but will require active co-operation with our other European North Atlantic partners (i.e. Iceland, and Norway) and with our neighbours on the American Atlantic seaboard”.

Building bridges across the Atlantic: From the outset of the SEAS-ERA project, the Atlantic partnership started to explore linkages with similar organisations on the North American continent. This included:

- **Brussels, 14th September 2011**: Joint meeting between FP7 Euro-BASIN and SEAS-ERA Atlantic partners with DG RESEARCH (International Cooperation and Research Programmes), DG MARE (Atlantic Strategy), DG Environment (MSFD) and Brussels-based representatives of the US National Science Foundation (NSF), the US National Oceanic and Atmospheric Administration (NOAA) and the National Research Council of Canada.

- **Dublin, 13th July 2012**: The SEAS-ERA “East-meets-West” Workshop hosted a special meeting of Atlantic Research Funding Organisations from both sides of the Atlantic including SEAS-ERA partners, the US National Science Foundation (NSF), Fisheries and Oceans, Canada and the Canada Foundation for Innovation.

- **Brussels, 20th March 2013**: This Stakeholder Workshop on Transatlantic Marine and Arctic Cooperation was organised by DG RESEARCH to bring together some of the main actors (including the SEAS-ERA Atlantic partnership) already active in the area of marine and arctic research at European level. The Workshop addressed five (interlinked) areas: Observing Systems; Ecosystem Approach / Ocean Acidification / other Stressors; Marine Microbial Ecology; Arctic Research Infrastructure; Ocean Literacy. This Workshop was a precursor to the Irish-EU Presidency Conference (The Atlantic – A Shared Resource) held in Galway on 23rd and 24th May 2013.

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While only five EU countries (France, Spain, Portugal, Ireland and the UK) are involved in defining the EU Atlantic Action Plan (2014–2020), the SEAS-ERA partnership also includes other north-eastern Atlantic countries including: Belgium, Germany, Netherlands as well as Iceland and Norway.
The Irish-EU Presidency Conference "The Atlantic: A Shared Resource” May 2013: The Irish-EU Presidency Conference "The Atlantic: A Shared Resource", jointly organised by the European Commission (DG Research / DG MARE) and the Marine Institute (Ireland) on 23rd and 24th May 2013, was not a SEAS-ERA Conference as such, but was strongly influenced by SEAS-ERA and drew on ideas and contacts made through the SEAS-ERA project. The relevant outputs of the Galway Conference included:

- **A Scientific Workshop (23rd May) Report**, prepared by researchers from Europe, Canada and the United States of America, identifying the key scientific and societal challenges that need to be addressed in order to deliver (by 2020) a predictive capacity (both short term predictions and long term forecasts) for the major risks and changes in the dynamics of the North Atlantic. The Workshop also emphasised the need to explore cross-Atlantic processes as well as boundary process with the Arctic and South Atlantic and with the linked EU Regional Seas (i.e. the Baltic and the Mediterranean).

- **The Galway Statement on Atlantic Ocean Cooperation** [Annex 4] signed by representatives of the European Union, the United States and Canada who have agreed to join forces on Atlantic Ocean Research in order to better understand the Atlantic Ocean and promote the sustainable management of its resources. The Statement aims in particular to connect the ocean observation efforts of the three partners and is fully consistent with the SEAS-ERA objective of establishing a European Atlantic Ocean Observing and Predictive Capability (Section 5.1).

Full details of the Atlantic Conference and Galway Statement are available at: www.marine.ie/atlanticasharedresource.
8. Summary & Conclusions

Following the publication of the SEAS-ERA Atlantic Discussion Document (October, 2011), three Stakeholder Workshops were held to facilitate user feedback. These Workshops provided a unique opportunity to refine and consolidate the identification of research priorities. The original draft Marine Research Plan, nonetheless, proved extremely robust and comprehensive. The structure and layout of this Report was determined by these consultations and the parallel discussions on the development of the EU Atlantic Action Plan.

SEAS-ERA Consultative Workshops (2012): The Proceedings of the Consultative Workshops, which are summarised here, were published and can be downloaded, along with their associated PowerPoint presentations, from http://www.seas-era.eu/np4/34/ (see also Section 2).

8.1. Stakeholder Workshops

Science Workshop (Ostend: February 2012)
The Science Workshop identified four key issues which required comment and clarification. These included:

- Complexity, feedbacks, linkages and interconnections;
- Status of the draft Marine Research Plan for the European Atlantic Sea Basin;
- The top-down versus the bottom-up approach;
- Research Prioritisation.

Complexity, feedbacks, linkages and interconnections: Many of the Science Workshop participants expressed concern that the complexities of the marine ecosystem, important feedback loops and linkages were not adequately addressed or their importance sufficiently emphasised in the draft Marine Research Plan. Critical linkages and synergies between thematic priorities (e.g. aquaculture and marine renewable energy) and interconnections between adjoining sea areas (the Arctic and Southern Atlantic and the Baltic and Mediterranean Sea Basins) were weak and needed to be addressed. Accordingly in revising the draft Work Plan, this was taken into account and a revised section “The Ocean Frontier: Ecosystem Function – Biodiversity- Complexity and Linkages” introduced.

Status of the draft Marine Research Plan for the European Atlantic Sea Basin: Further to queries on the status of the SEAS-ERA draft Marine Research Plan for the European Atlantic Sea Basin: Discussion Document (2011), the SEAS-ERA Atlantic partners confirmed it is exactly what it says on the cover: a draft (i.e. a first attempt at identifying key marine research priorities for the European Atlantic Sea Basin) and a Discussion Document. It was presented as such by the SEAS-ERA Consortium to the wider marine science, governance, policy and other stakeholder communities to comment such that a broader consensus of the research needs in the European Atlantic Sea Basin can be identified. The impression that it is a “final”, polished document is wholly incorrect.

The top-down versus the bottom up approach: In the Introduction, the SEAS-ERA partnership state that it had decided to adopt a top-down rather than a bottom-up approach in preparing the Discussion Document. This was considered appropriate as la) the Marine Research Plan presented is a draft and a basis for further discussion, and [b] the SEAS-ERA Atlantic partners represent Research Funding Organisations (RFOs) which, in the main, have already identified Atlantic marine research priorities which needed to be reflected. Further, it is not wholly correct to say that the draft is top-down as the participating RFOs have their own National Scientific Advisory Groups, made up of national experts from the public (including academic) and private sectors, and these advisory mechanisms represent a very considerable bottom-up input. In addition, the draft drew heavily on other expert groups who are referenced in the Discussion Document.

A Strategic Research Agenda is not a final document, but an on-going process.

A major part of successful living lies in the ability to put first things first. Indeed, the reason most major goals are not achieved is that we spend our time doing second things first.

Robert J. McKain
8. Summary & Conclusions

**Research Prioritisation:** While it was agreed that prioritisation is essential, it was also agreed that prioritisation is neither easy nor totally objective – it is subjective, sector-specific and dictated by time and finance. A catastrophic storm or disease outbreak in aquaculture can, for example, result in a public and governance demand for responsive research to which the RFO is obliged to respond. In recessionary times, there is pressure to direct research to respond to the needs of the productive sector in terms of research supporting greater cost efficiencies, competitiveness, etc. Basic research and grand challenges benefit in times of plenty, but suffer during recessions. The EATiP gave an example of different Working Groups ranking a suite of priorities differently.

**Governance Workshop (Lisbon: April 2012)**
The Governance Workshop brought together the SEAS-ERA Atlantic partners, local and regional stakeholders and representatives of the Conference of Peripheral Maritime Regions (CPMR) with whom the Workshop was jointly organised. A clear message coming from the Governance Workshop was the need to better integrate the views and needs of the various stakeholder groups from the very beginning of the process and the need for science to deliver solutions to problems. These and other recommendations of the Governance Workshop are outlined below.

**Some key points arising at the SEAS-ERA Governance Workshop (Lisbon: April 2012)**
- Overall there was very good support for the draft Marine Research Plan (October 2011) and participants welcomed the opportunity to input;
- Participants welcomed the approach adopted by the SEAS-ERA partnership in preparing a Discussion Document around which discussion could take place, rather than starting with a “blank canvas”;
- As at the Ostend Workshop, there were differing views as to the classification system used (i.e. Basic Research, Applied Research, and Research Support) and what topics should be included in each category. However it was agreed that:
  - the classification system was of necessity artificial as nature is a continuum;
  - considerable opportunities exist at the interfaces of sectors (e.g. aquaculture and marine renewable energy) – this demands a multidisciplinary approach;
  - no adequate solutions or alternative classifications were obvious, though they would be most welcome;
- Geographical gaps in the current document include the importance of Macronesia and interactions between adjoining Sea Basins;
- A clear and effective strategy for knowledge dissemination and technology transfer is a critically important element of a Strategic Research Agenda;
- Concerns were expressed regarding the very broad nature and spread of the topics covered – however it was agreed that an inclusive agenda is essential as a starting point;
- Prioritisation reflects individual sectoral/stakeholder interests;
- From a governance and economic perspective, it is vital that research be problem-focused and solution-oriented;
- The research agenda must link science and management and involve stakeholders from the earliest stages such that the solution/methodologies arrived at are within the capabilities of the end-user;
- The science community needs to be challenged to come up with usable solutions and not focusing all the time on “complexity”, though the complexity of the ecosystem is acknowledged.

**East-meets-West Workshop (Dublin, July 2012)**
Questions posed to the East-meets-West Workshop, following formal presentations, included:
- How do we work together to promote/foster trans-Atlantic cooperation?
- Is there potential for a trans-Atlantic common programming initiative?
- Is there potential for a joint trans-Atlantic call?

During the roundtable discussions a number of contributors emphasised the critical importance of regular face-to-face meetings and the exchange of information on current and planned programmes of mutual interest. This leads not only to a better understanding of each other’s priorities and concerns, but builds confidence and trust, which are essential components of cooperation. In this context, it was suggested that we should look to major Ocean Events in the Atlantic Area as a venue for future trans-Atlantic dialogue. The European Maritime Day Conference (May, 2013, Malta) and the planned EurOCEAN Conference 2014 (although neither is planned for the Atlantic) were mentioned. Other possibilities included the American Association for the Advancement of Science (AAAS) and the European Science Open Forum 2014 (Copenhagen).
In the Euro-BASIN presentation, attention was drawn to a number of planned trans-Atlantic transects in 2013/2014, including between Europe and Canada and ongoing co-operation regarding biotelemetry and ocean tracking. These topics had already been discussed by the European partners at the SEAS-ERA Reykjavik Common Programming Workshop in May, 2012.

The difficulties in joint funding, and in particular joint funding across the Atlantic, were discussed. The fact that procedures and funding cycles/schedules differed and that this posed a barrier to co-operation was a recurring theme. However, it was also argued that the problem of joint funding between different European Funding Organisations has, to a degree, been solved as most European countries now adopt the EU Framework Model and that joint projects (virtual pot) are being successfully carried out under various ERA-NETS, including SEAS-ERA.

In this context, NSF identified the Belmont Forum model as being an appropriate and tested model for international co-operation. The Belmont Forum, initiated in 2009 by NSF (USA) and NERC (UK), now includes thirteen countries: Australia, Austria, Brazil, Canada, China, France, Germany, India, Japan, Norway, South Africa, United Kingdom, and the United States, along with the European Commission, the International Council for Science (ICSU) and the International Social Sciences Council (ISSC). A brief comparison of the rules and procedures used by the Belmont Forum and the current SEAS ERA Joint Call Agreement/MoU suggested considerable complementarity, such that both may be broadly interchangeable.

8.2. Summary of Conclusions

1. The SEAS-ERA project has made a major contribution to the elaboration of the European Atlantic Action Plan 2014–2020 published in May 2013 (Sections 2, 3 and 4);

2. The EU Atlantic Action Plan (2013) represents an agreed framework for future research priorities and related marine actions to be undertaken jointly in the European Atlantic Sea Basin (Section 6);

3. International co-operation, between all North Atlantic seaboard countries (Section 7), is essential to address many of the identified research priorities and, in particular, those related to basic research (The Ocean Frontier and Climate Change);

4. A number of critical supports and infrastructure needs are identified (Section 5) which would greatly contribute to sustainable economic growth in the European Atlantic Sea-Basin;

5. The SEAS-ERA Atlantic partnership is just one of a number of important networks involved in contributing to the definition of research priorities in the European Atlantic Sea-Basin. Other relevant groups include: ICES, OSPAR, European Marine Board, JPI OCEANS, EFARO, etc.; sectoral ERA-NETS (e.g. COFASP, Marine Biotech, Climate, etc.), as well as existing Technology Platforms (e.g. EATiP, WATERBORNE, etc.) and large scale co-operative projects (e.g. Euro-BASIN, THOR, etc.). Where possible these networks/projects have been identified as sources of further information.

“The real act of discovery consists not in finding new lands, but in seeing with new eyes.”

Marcel Proust, 1871-1922.
### Annex 1: SEAS-ERA Partnership

<table>
<thead>
<tr>
<th>Partner</th>
<th>Organisation</th>
<th>Country</th>
<th>WP6 Atlantic</th>
<th>WP7 Med</th>
<th>WP8 Black Sea</th>
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<td>1*</td>
<td>Ministerio de Economía e Innovación (MINECO) Project Coordinator</td>
<td>Spain</td>
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<td>4*</td>
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<td>Jülich Research Centre GmbH (JÜLICH)</td>
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<td>8*</td>
<td>The Icelandic Centre for Research (RANNIS)</td>
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<td>9*</td>
<td>Marine Institute (MI)</td>
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<td>European Marine Board (EMB)</td>
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<td>19*</td>
<td>The Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI)</td>
<td>Romania</td>
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<td>20*</td>
<td>The Centre for Scientific and Technical Information and Innovation Promotion of Ukrainie (UKRTECHINFORM)</td>
<td>Ukraine</td>
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<td>22</td>
<td>Institut Français de Recherche pour l’Exploitation de la Mer (IFREMER)</td>
<td>France</td>
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</table>

**Third Parties**

- Consiglio Nazionale delle Ricerche (CNR) | Italy | ●
- European Centre for Information on Marine Science & Technology (EuroOcean) | Pan-European | ● | ● | ●

* Denotes a Marine Research Funding Organisation (RFOs).

1 Due to national restructuring, the Danish partner (Danish Food Industry Agency, DFIA), had to withdraw from the SEAS-ERA project.

Public call for suggestions for key investment and research priorities: stakeholders invited to input suggestions on the key research and investment priorities of the Atlantic coastal areas focused on the five challenges of the Atlantic Strategy. Submission deadline: 15th February 2013).


Response by the FP7 SEAS-ERA Atlantic Network

The SEAS-ERA Atlantic Network:
1. Acknowledges the Commission’s invitation of 21st November 2012 to interested parties to contribute to the identification of key research and investment priorities to be addressed in the European Union Atlantic Action Plan (2014-2020);

2. Welcomes the overall trust of the EUSA in addressing the jobs and growth agenda as outlined in the Blue Growth Strategy and the recognition that marine research, development and innovation have a critical role to play in support of the SMART Blue Economy;


4. Endorses the five identified EUSA Challenges, i.e. (1) Implementing the Ecosystem Approach, (2) Reducing Europe’s Carbon Footprint, (3) Sustainable Exploitation of the Atlantic’s Seafloor Natural Resources, (4) Responding to Threats and Emergencies and (5) Socially Inclusive Growth, as being a useful framework to identify governance, research and investment priorities;

5. Welcomes the establishment of Maritime Clusters, as an engine of blue growth, bringing together local research centres, SMEs and public planning and development authorities, including representative bodies such as the Conference of Peripheral Maritime Regions (CPMR) with whom we have collaborated in identifying research and investment priorities.

What we miss in the current documentation is:

• A recognition that implementation of an Atlantic Action Plan cannot be achieved by the five EU Atlantic Member States (France, Spain, Portugal, Ireland and the UK) acting alone, but will require active co-operation with our other European North Atlantic partners (i.e. Iceland, and Norway) and with our neighbours on the American Atlantic seaboard;

• A reference to the importance of Basic Research. While welcoming the emphasis on applied research and innovation in the EUSA documentation, basic research is critical to our understanding of marine ecosystem functioning and the factors which influence long term sustainability;

• Stronger reference to the potential impacts of global climate change on Atlantic circulation and ecosystems as an issue of great mutual concern and one which demands a co-operative approach. The impacts of global climate change on Atlantic coastal communities, for example, as expressed by extreme weather events and changes in the biogeography of commercial species, could in the absence of policies and measures to prepare for and accommodate these changes, have catastrophic consequences for these dependent coastal communities.
With regard to the 68 indicative priorities included in the document “Indicative list of key investment and research priorities made by Member States”, provided as background information to this invitation, many of these have also been identified in our October 2011 Report “A draft Marine Research Plan for the European Atlantic Sea Basin” which was presented at the 1st Atlantic Forum Meeting in Horta, Azores, on 21st September 2012.

Regarding Critical Research Supports, we can identify three such supports which should be included in any subsequent Atlantic Action Plan. These are:

- **A European Atlantic Ocean Observation and Forecasting Capability** (including seabed mapping). This is consistent with recommendations made in relation to the recent EU Green Paper “Marine Knowledge 2020: from seabed mapping to ocean observation”, is a critical support to a better understanding and an ability to forecast and predict changes and should be implemented, if possible, as a trans-Atlantic initiative;

- **An Atlantic Marine Socio- Economic Assessment Capability and Database** – in this context, we welcome the recent INTERREG-IV funded pilot project MARNET: Atlantic Marine Socio-Economic Network (2012-2014), in which a number of our member organisations are involved;

- **A European Atlantic Marine Science and Technology Foresight Platform** to bring forward new ideas, promote technology transfer, access to and rapid up-take of new emerging technologies in, for example, marine biotechnology, ICT, nano-materials, etc. This could be developed as a standalone initiative or as component of a Atlantic Maritime Cluster project.

Submitted on behalf of the SEAS-ERA Atlantic partnership by:

Dr Beatriz Morales - Nin (SEAS-ERA Project Coordinator)

The **EU FP7 SEAS-ERA Atlantic Project (2010-2014)** is Network of Marine Research Funding Organisations (RFOs) consisting of 21 partners and two third parties from 18 EU Member and Associated States located along the European seaboard in the Atlantic, and in the Mediterranean and Black Seas [www.seas-era.eu](http://www.seas-era.eu). The Atlantic Network consists of 14 partners (11 of which are National Research Funding Organisations - RFOs) representing 10 of the 11 European Atlantic seaboard countries.
Launching a European Union – Canadian, United States of America Research Alliance  
(24th May 2013)

The Signatories of this Statement meeting on the occasion of the high level event  
The Atlantic – a Shared Resource, held on 23 and 24 May 2013-10-21 at the Marine Institute, Galway, Ireland

− Recognizing the importance of the Atlantic Ocean to our citizens, prosperity, human health and well-being, adaptation to climate and other environmental change, and security,
− Cognizant of our reliance upon the best available science and knowledge to inform decisions affecting the Atlantic Ocean,
− Realizing that our countries face similar challenges in promoting a healthy and well-understood Atlantic Ocean,
− Acknowledging the critical interlink between the Atlantic Ocean and the portion of the Arctic region that border the Atlantic,
− Appreciation the value of our on-going cooperation on the ocean science and observation in the Atlantic Ocean, and
− Valuing the essential role of international partnership to achieve our shared objectives and the potential of greater cooperation to advance our knowledge of the Atlantic Ocean,

Intend to advance our shared vision of an Atlantic Ocean that is healthy, resilient, safe, productive, understood and treasured so as to promote the well-being, prosperity, and security of the present and future generations.

This cooperation is intended to increase our knowledge of the Atlantic Ocean and its dynamic systems – including interlinks with the portion of the Arctic region that borders the Atlantic – by aligning our ocean observation efforts to improve ocean health and stewardship and promote the sustainable management of its resources. Observation is fundamental to understanding the ocean and forecasting its future. Activities may include efforts to better coordinate data sharing, interoperability and coordination of observing infrastructures and seabed and benthic habitat mapping.

This cooperation may result in mutual benefits including better ecosystem assessments and forecasts and deeper understanding of the vulnerabilities and risk, including those relating to the global climate system and climate change impacts. It can also help to generate new tools to increase resilience, conserve rich biodiversity, manage risk and determine social, environmental and economic priorities.

We further intend to promote our citizens’ understanding of the value of the Atlantic by promoting oceans literacy. We intend to show how results of ocean science and observation address pressing issues facing our citizens, the environment and the world and to foster public understanding of the value of the Atlantic Ocean.

We intend to advance this agenda by:

• Taking stock of and utilizing existing bilateral science and technology Joint Consultative Group (e.g. the U.S – European Union Science and Technology Joint Consultative Group and the Canada European Union Science and Technology Joint coordinating Committee) and multilateral cooperation frameworks including those related to ocean observation, and ocean literacy initiatives;
• Recommending priorities for the future cooperation and, where possible;
• Coordinating the planning and programming of relevant activities in these areas, including promoting researcher mobility.

This cooperation could potentially involve national partners and European Commission representatives, the private sector, and the scientific community to further our efforts by harnessing the value of public-private partnerships. This initiative is also expected to reinforce existing international efforts to advance our knowledge of the ocean, including the World Ocean Assessment.

For the European Union
Máire GÉOHEGAN-QUINN  
Commissioner for Research, Innovation and Science

Maria DAMANAKI  
Commissioner for Maritime Affairs and Fisheries

For the Government of the United States of America
Dr Kerri-Ann JONES  
Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs

For the Government of Canada
Edward FAST  
Minister of International Trade and Minister for the Asia-Pacific Gateway
Annex 4: SEAS-ERA Publications

**SEAS-ERA Atlantic Publications**


**SEAS-ERA Interim and Forum Reports**


**SEAS-ERA Mediterranean and Black Sea Strategies**


**Other SEAS-ERA Reports**


SEAS-ERA (2013) Inventory of Research, Monitoring and Technological programs and identification of the commonalities and gaps (March 2013) 16pp.


SEAS-ERA Publications and Workshop powerpoint presentations can be downloaded from: http://www.seas-era.eu/np4/34/
Annex 5: Glossary of Acronyms

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<thead>
<tr>
<th>Acronym</th>
<th>Title</th>
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<tbody>
<tr>
<td>AAAS</td>
<td>American Association for the Advancement of Science</td>
</tr>
<tr>
<td>AAC-CPMR</td>
<td>Atlantic Arc Commission-Conference of Peripheral Maritime Regions</td>
</tr>
<tr>
<td>CBD</td>
<td>Convention of Biological Diversity</td>
</tr>
<tr>
<td>CCS</td>
<td>Carbon Capture and Storage</td>
</tr>
<tr>
<td>CFI</td>
<td>Canada Foundation for Innovation</td>
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<tr>
<td>CFP</td>
<td>Common Fisheries Policy</td>
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<tr>
<td>CISE</td>
<td>Common Information Sharing Environment</td>
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<tr>
<td>COFASP</td>
<td>Cooperation in Fisheries, Aquaculture and Seafood Processing</td>
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<tr>
<td>CZM</td>
<td>Coastal Zone Management</td>
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<tr>
<td>DG MARE</td>
<td>Directorate General for Maritime Affairs and Fisheries (EU)</td>
</tr>
<tr>
<td>DG RESEARCH</td>
<td>Directorate General for Research, Innovation and Science (EU)</td>
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<tr>
<td>EAFM</td>
<td>Ecosystem Approach to Fisheries Management</td>
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<td>EATIP</td>
<td>European Aquaculture Technology and Innovation Platform</td>
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<tr>
<td>EBM</td>
<td>Ecosystem Based Management</td>
</tr>
<tr>
<td>ECVs</td>
<td>Essential Climate Variables</td>
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<tr>
<td>EEA</td>
<td>European Environment Agency</td>
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<td>EEA</td>
<td>European Economic Area</td>
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<tr>
<td>EFARO</td>
<td>European Fisheries and Aquaculture Research Organisation</td>
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<td>EMODNet</td>
<td>European Marine Observation and Data Network</td>
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<td>EEO5</td>
<td>European Ocean Observation System</td>
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<td>ESOF</td>
<td>European Science Open Forum Conference</td>
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<td>EU</td>
<td>European Union</td>
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<td>EU FP</td>
<td>European Union Framework Programme</td>
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<td>EUSA</td>
<td>European Union Strategy for the Atlantic</td>
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<td>FAO</td>
<td>UN Food and Agriculture Organization of the United Nations</td>
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<td>GCOS</td>
<td>Global Climate Observing System</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GEO/ IOOS</td>
<td>Group on Earth Observations/ Integrated Ocean Observing System</td>
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<tr>
<td>GES</td>
<td>Good Environmental Status</td>
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<tr>
<td>GMES</td>
<td>Global Monitoring for Environment and Security, now Copernicus- The European Earth Observation Programme</td>
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<td>ICES</td>
<td>International Council for the Exploration of the Sea</td>
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<td>ICSU</td>
<td>International Council for Science</td>
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<td>ICT</td>
<td>Information and Communication Technologies</td>
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<td>INFOMAR</td>
<td>Integrated Mapping for the Sustainable Development of Ireland’s Marine Resource</td>
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<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<td>ISC</td>
<td>Integrated Ship Control</td>
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<td>ISSC</td>
<td>International Social Science Council</td>
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<tr>
<td>JPI Oceans</td>
<td>Joint Programming Initiative Healthy and Productive Seas and Oceans</td>
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<tr>
<td>JRC</td>
<td>Joint Research Council</td>
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<tr>
<td>LIDAR</td>
<td>Light and radar, a remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected light.</td>
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<tr>
<td>MAREANO</td>
<td>Marine Area Database for Norwegian waters</td>
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<td>MCCIP</td>
<td>Marine Climate Change Impacts Partnership</td>
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<td>MoU</td>
<td>Memorandum of Understanding</td>
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<td>Marine Protected Area</td>
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<td>Marine Strategic Framework Directive</td>
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<td>MSY</td>
<td>Maximum Sustainable Yields</td>
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<td>Non-Governmental Organization</td>
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<td>National Science Foundation</td>
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<td>OSPAR Commission</td>
<td>Oslo and Paris Conventions for the protection of the marine environment of the North-East Atlantic</td>
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<td>Power Take-Off</td>
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<td>Quality Status Report</td>
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<td>Research, Development and Innovation</td>
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<td>Research Funding Organisation</td>
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<td>Remotely Operated Vehicle/ Autonomous Underwater Vehicle</td>
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<td>Technical Conservation Measures</td>
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<td>ThermoHaline Overturning-at Risk</td>
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