DG MARE

Research & Innovation and Atlantic Ports – Post Atlantic Forum workshop report (Cork, 4-5 March 2013)

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This report has been drafted by the Consortium, on behalf of DG MARE.

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Contents

Forward

The Directorate General for Maritime Affairs and Fisheries (DG MARE) and the Atlantic Forum have initiated a stakeholder consultation process to contribute towards the development of an action plan for the Atlantic Ocean region. To assist in the development of the action plan, five workshops have been planned. For each workshop, a thematic report is provided to inform the discussion and summarise the outcomes.

The purpose of the thematic report is to provide background information, including overview statistics and macro trends, on the broad workshop discussion topics. After the workshops, the thematic report provides a summary of conclusions and main themes discussed. After completion of the workshops, DG MARE will compile recommendations on priority research, investment and policy actions in the Atlantic Action Plan. The Atlantic Action Plan will address the five themes/challenges defined in the Atlantic Strategy (COM (2011) 782):

- Implementing the ecosystem approach
- Reducing Europe's carbon footprint
- Sustainable exploitation of the Atlantic seafloor's natural resources
- Responding to threats and emergencies
- Socially inclusive growth

Introduction & Context

Cork Atlantic forum workshop

The objective of this report was to inform and provide a starting point for discussion at the Atlantic Forum event in Cork to be held on 4-5 March 2013. There were two overall themes for discussion on the first day of workshop: Research & Innovation and Atlantic Ports. The purpose of the workshops was to identify the research and innovation priorities necessary to enable the implementation of an Atlantic strategy.

Accordingly, the event was organised into two parallel workshops:

- Research & Innovation across the five 'pillars' of the Atlantic strategy as laid out in the Commission's communication;
- Atlantic ports, including the future role of small and medium sized Atlantic ports, development of short sea shipping, port governance and innovative and eco-friendly ports.

Structure of the report

This report is divided into two sections covering (I) Research & Innovation and (II) Atlantic Ports. For each part, the report attempts to identify:

- **Context, baseline and trends:** an introduction to the workshop themes, including defining of important concepts, and discussion of the past and future trends
- **Challenges and gaps**: the challenges faced by coastal communities and suggestions of gaps that need to be addressed in a coordinated manner through collective action.
- **Potential areas for future action**: a non-exhaustive list of draft research and investment priorities, which can act as preliminary ideas for discussion regarding Atlantic cooperation. This section also proposes a number of questions that may be addressed during the sessions.
- **Workshop report**: summarising the key discussion themes raised during the workshops

The focus has been on the major trends, rather than local interests, as the Atlantic Action Plan is intended to be an overall plan for the entire region. However, inspiration may be found in local initiatives that have the potential to be implemented on a larger scale. **Mini-case studies looking at European initiatives, projects co-financed by the EU, as well as private or national projects are presented throughout the report in orange boxes.**

Research & Innovation

A cross-cutting theme

While the Atlantic region is undergoing difficult economic and social transitions, it is rich in science, technology and innovative knowledge, home to some 340 research institutes (in the wider Atlantic area including e.g. Germany and Norway), and enjoying a long history of cooperation in the field of research.

Research and innovation will play a central role in the Atlantic Action Plan, through strategic investment at each step of the innovation chain as innovative new *blue* products and services are brought to markets and begin to provide new, high value-added jobs for coastal communities.

Reflecting this context, the *Commission communication on developing a maritime strategy for the Atlantic area* identified research and innovation funding as a key tool for the implementation of the Atlantic Action Plan. Specifically, it will '*promote excellence, tackle societal challenges and boost competitiveness, creat[ing] sustainable growth opportunities that compensate for the relative decline of traditional maritime industries*'.

Furthermore, the ongoing SEAS-ERA project is in the process of delivering specific priorities for the Atlantic basin that can feed into the work programmes of the new Action Plan, and the region has a relatively strong track record in the field of research upon which to build.

Favourable policy context focusing on innovation and growth

The EU has launched Europe 2020, which is a growth strategy aimed at making European societies global leaders in terms of competitiveness and sustainability. The strategy emphasises three mutually reinforcing priorities: smart growth, sustainable growth and inclusive growth. To support the priorities, the Commission has put forward seven flagship initiatives, 3 of which are closely aligned to the area of research an innovation:

- *A resource-efficient Europe:* to support the shift towards a low-carbon economy that is efficient in the way it uses all resources, and increase certainty for investment and innovation.
- *An industrial policy for the globalisation era:* to guide and help industry prepare to meet these challenges by, inter alia, promoting technologies and production methods that reduce efforts on natural resource use
- *Horizon 2020:* the financial instrument to implement the Innovation Union in which all research and innovation funding of the current Framework Programmes will be bundled.

Multiple EU funding and support mechanisms

A number of different financing options are available to potentially support R&D, the demonstration of new technologies or the market uptake of new products and services in the field of marine and maritime research. In the past, the EU's research programmes have provided substantial marine research funding. Under the 6th Framework programme, the total EU contribution to marine and maritime research projects amounted to € 612 million. For FP7, a recent analysis conducted by the Commission showed that of 217 calls for proposals over 2007-2010, about 4.4% (3384 proposals) of all proposals submitted (77589), can be identified as marine-related proposals or bearing potential applications in the maritime sector. This amounts to over 1.4 billion Euro dedicated to 644 marine-related proposals and accounts for about 6.4% of the financial contribution awarded by the European Union to all proposals selected within FP7 in 2007-2010 and 5% in terms of the number of proposals.

Key sources include EU and national funding mechanisms, as well as the European Investment Bank and private sources. Looking forward to the 2014-2020 programming period, an overview of a sample of EU funding sources (COM proposal) is provided below.

Table 1: Possible financing instruments of the EU - COM proposal

Financing instrument	Budget (2014-2020)	Specific relation to research & innovation in maritime industries
European Regional Development Fund[1]	€183.3 Billion	Investments to contribute to creating and safeguarding sustainable jobs, through direct aid to investment in SMEs 40 billion is proposed to be allocated to Connecting Europe Facility for transport, energy and information and communication technologies
Horizon 2020[2]	€80 billion	Priority 3 on "Societal challenges" has a total budget of €31.7 billion. Four of the six societal challenges relate to the maritime sectors: Marine and Maritime Research & the bio-economy: 4.1 billion Secure, clean and efficient Energy: 5.8 billion Smart green and integrated transport: 6.8 billion Climate action, resource efficiency and raw materials: 3.1 billion
EMFF[3]	€6.7 billion	The EMFF aims at achieving the objectives of the reformed CFP and of the IMP, with a €6.7 billion budget. The budget earmarked for fisheries might even decrease slightly because of the envelope allocated to Maritime Affairs. However, it is not yet known how funding will be broken down between Fisheries and Maritime Affairs (Integrated Maritime Policy –IMP).
European Social Fund[4]	€84 billion	No specific relation to marine research, however greater emphasis on combating youth unemployment, promoting active and healthy ageing (which may indirectly impact coastal communities)
LIFE Programme	€3.2 Billion	The EC will ensure synergies between the LIFE Programme and other Union instruments and it may exploit research and innovation results produced by Horizon2020 and by previous Framework Programmes in the fields of research and innovation.

Strong foundation for cooperation in the region

A number of cooperation projects have been launched to address the fragmentation of marine and maritime research sectors, such as SEAS-ERA, MARCOM and EMAR2RES. As an illustrative example, SEAS-ERA is forging a shared vision for the European Atlantic sea basin and its varied geographical and environmental characteristics. One of the main work packages is the collaborative formulation of a European Atlantic Sea Basin Research Plan identifying marine research priorities relevant to the challenges and opportunities in the Atlantic region and local competencies. It seeks to improve understanding and protection of the European Atlantic area and its ecosystems, in order to generate a dynamic maritime economy in harmony with the environment.

In October 2011, a first document published, the *Draft Marine Research Plan for the European Atlantic Sea Basin*, which identified research priorities under 20 themes. Over the course of the following year, three Consultative Stakeholder Workshops were held (Science: Ostend, February; Governance: Lisbon, April; East-meets-West: at a number of regional meetings and workshops. This consultative process has led to an updated document that is currently in preparation. *Towards a Strategic Research Agenda / Marine Research Plan for the European Atlantic Sea Basin* hones down the original 20 themes to key research challenges and opportunities under eight themes and three support actions

[1] http://ec.europa.eu/regional_policy/sources/docoffic/official/regulation/pdf/2014/proposals/regulation/erdf/erdf_proposal_en.pdf

[2] http://ec.europa.eu/research/horizon2020/pdf/press/horizon_2020_budget_constant_2011.pdf#view=fit&pagemode=none

[3] http://www.crpm.org/pub/docs/329_tp_mff_en.pdf

[4] http://ec.europa.eu/esf/main.jsp?catId=62&langId=en

Table 2: SEAS-ERA objectives, themes and support actions

High-level objectives	
► Economic Recovery, Competitiveness and Sustainable Socio-Economic Development ► Environmental Protection & Climate Change ► Good Governance supported by evidence-based regulation and legislation	► Basic and Applied Knowledge ► Issues to be addressed at the appropriate regional or pan-European scale ► Regional and international co-operation

Basic Research & New Knowledge	Applied Research	Critical Support & Infrastructure Needs
► The Ocean Frontier: – Ecosystem Function – Biodiversity- Complexity and Linkages; ► Coping with Uncertainty and Change –the impacts of global climate change;	► Protecting the Marine Environment – Implementing the MSFD; ► Marine Renewable Energy - Powering Europe; ► The Greening of Maritime Transport - Safety, Surveillance and Logistics; ► Reclaiming Our Ocean Heritage - Marine/Maritime leisure and Tourism; ► Marine Bioeconomy: Fisheries, Aquaculture, Seafood; ► Harvesting the oceans non-living resources: Sustainable mineral, oil and gas extraction from coastal and offshore areas.	► A European Atlantic Ocean Observing and Forecasting Capability (including seabed mapping); ► An Atlantic Marine Socio-Economic Assessment Capability and Database; ► A European Atlantic Marine Science and Technology Foresight Platform (incl Biodiscovery & ICT and the Sea).

The Atlantic region has a strong foundation in the field of research and innovation, with all countries in the region having well-respected, highly active marine research institutes, universities with strong maritime programmes and clusters/competitiveness clusters that bring together maritime industry stakeholders. A European Directory of Marine Organisations (EDMO) has been produced in the context of SeaDataNet[5]. EDMO contains up-to-date addresses and activity profiles of research institutes, data holding centres, monitoring agencies, governmental and private organisations, that are in one way or another engaged in oceanographic and marine research activities, data & information management and/or data acquisition activities.

In terms of a definition, a "competitiveness cluster" brings together large and small firms, research laboratories and educational establishments, all working together in a specific region to develop synergies and cooperative efforts. It is essentially the French equivalent for what Michael E. Porter has called a "cluster", which are "geographic concentrations of interconnected companies, specialized suppliers, service providers, and associated institutions in a particular field that are present in a nation or region. Clusters arise because they increase the productivity with which companies can compete."[6]

The table below presents a sample selection of research and innovation organisations institutes and clusters with each Atlantic MS. This list below is based on the knowledge of the report writer through a desktop review and is only illustrative.

[5] http://www.seadatanet.org/Metadata/EDMO

[6] Porter, M.E "Location, Competition, and Economic Development: Local Clusters in a Global Economy", Economic Development Quarterly 2000; 14; 15

Highlights of Atlantic Research & Innovation

France

Ifremer (*Institut français de recherche pour l'exploitation de la mer*) is one of Franc's leading oceanographic institutes established in 1984 and currently employing over 1 500 employees. Its mission is to contribute to knowledge of the oceans and their resources, to monitoring of marine and coastal environments and to the sustainable development of marine activities. To this end, the institute operates tools for observation, experimentation and monitoring, and manage the oceanographic databases. Ifremer works with an extensive network, including the French scientific community, as well as partner organisations in numerous other countries.

Pôle Mer Bretagne is a maritime research and innovation cluster in the French region of Brittany. It is the heart of an extensive network that brings together large corporations, SMEs, research institutes and centres of higher education. The cluster's goal is to develop France's maritime economic potential, by identifying innovative projects and facilitating the mobilisation of resources and partners.

Ireland

The **Marine Institute** is the national agency responsible for Marine Research, Technology Development and Innovation. Founded in 1991, it seek to assess and realise the economic potential of Ireland's 220 million acre marine resource; promote the sustainable development of marine industry through strategic funding programmes and essential scientific services; and safeguard our marine environment through research and environmental monitoring.

IMERC (Irish Maritime and Energy Resource Cluster) has set out to harness and integrate diverse research and industry expertise through the development of an innovation cluster, with an initial focus on securing Ireland's position as a leader in the field of emerging ocean renewables such as tidal and wave. The Cluster was launched in 2010 by three public bodies, the University College Cork, the Cork Institute of Technology and the Irish Naval Service, with the goal of providing researchers, developers and investors with the tools to construct value-building relationships.

Portugal

IMAR (*instituto du mar*) was established in 1991, as a non-profit, private organisation, bringing together the majority of universities in Portugal which undertake research in Marine Science and Technology. The objective of IMAR is the further development of Marine Science and Technology in Portugal, through integration of different disciplines and promotion of scientific cooperation. Through this, the institute hopes to advance scientific based policymaking, establish and promote key areas of scientific research on a multi-year scale and empower the Portuguese marine sciences community, making it more competitive on a European and international level. The human resources in IMAR include senior staff, post-doctoral fellows, postgraduate research students, undergraduates, and administrative and technical staff.

Oceano XXI (the Association for the Knowledge and Economy of the Sea) is the national maritime sector cluster of Portugal. The cluster's 'guiding vision' is founded on the promotion of the ocean as a source of wealth and knowledge and the sustainable exploration of its resources. The cluster promotes inter-company and inter-institutional coordination, as well as cooperation between public and private stakeholders who intervene in marine affairs, aims to modernize traditional oceanic activities and develop new, innovative activities, products and services aimed at exportation and reinforce research, technological development, innovation and training in marine matters.

Spain

The **Spanish Institute of Oceanography** (Instituto Espagnol de Oceanografia), created in 1914, is one of Spain's leading public research organisations, endowed with a budget of over 65 million Euros. The institute is tasked with carrying out applied research,

provides technical and scientific advice to the Spanish government and is a leader in the promotion of research cooperation.

The Galician ***Campus do Mar*** is a joint project by four universities, the Spanish Council of Scientific Research and the Spanish Institute of Oceanography. Its goal is to generate quality research and to provide the marine industry with knowledge and tools to compete on a global scale by training professionals and researchers in the field of Marine Science.

The **Clúster Marítimo Españo**, Spain's leading maritime cluster was created to promote the development and competitiveness of Spain's maritime industries through the facilitation of collaboration between businesses, academia and national authorities. The cluster also serves as the 'voice' of Spain's maritime industries vis-à-vis the Spanish government and on the international stage.

United Kingdom

With over 3 000 researchers, professors and staff and a student population of around 2 600, the **Plymouth University Marine Institute** is the largest such institute in the UK. The Institute supports a pool of world-leading experts and researchers organised primarily into research centres according to their areas of research, while also promoting the free flow of ideas and information between centres, allowing collaborative work, share equipment and facilities and the opportunities to seek out new researchers and graduates. The Institute works frequently collaborates with the business community on areas of breakthrough knowledge and innovation.

Marine South East is a business-led consortium developed to address the needs of the marine sector in the South East region. It was created to tackle the critical issues affecting marine businesses in the region and support the economic development of the marine sector in the South East. Specific goals of the consortium include increasing productivity through innovation, increasing market share by promoting business support services, clusters, networks and joint venturing, developing skills for the marine sector and workforce development initiatives and promoting cross sectoral collaboration to improve innovation, research and development.

Naturally, the European Atlantic Sea Basin cannot be seen from a European perspective alone – there is a need for co-operation in both governance and science with (i) the United States of America, Canada and Greenland, (ii) Central and South America and (iii) Western Africa. Examples of the need for a cross-Atlantic approach include in the areas of facilitation and co-ordination of deep-sea research.

Baseline situation and trends

For each of the five main challenges articulated in the Atlantic strategic (listed below), this section presents an introduction to the research and innovation as it applies to each theme, as well as an overview of the research trends.

- Implementing the ecosystem approach
- Reducing Europe's carbon footprint
- Sustainable exploitation of the Atlantic seafloor's natural resources
- Responding to threats and emergencies
- Socially inclusive growth

Implementing the Ecosystem Approach

Introduction

Maintaining a healthy marine ecosystem requires preserving the size and diversity of life within it,[7] including fish stocks as well as a number of different ecosystem indicators. While fishing is among the principal causes of the degradation of marine ecosystems, other factors include climate change, nutrient inputs, eutrophication, harmful algal blooms, contaminants (e.g. heavy metals), impacts of shipping, activities in the coastal zone and marine litter. Against this backdrop, there has been a growing realisation that fisheries management has focused too much on maximizing the catch of a single target species whilst neglecting other important variables such as, predators and other ecosystem components and interactions. The Ecosystem Approach provides the framework for a more effective and holistic management approach to fisheries management.

The Ecosystem approach can be difficult to define, however, the FAO definition provides a general explanation; 'the ecosystem approach strives to balance diverse social objectives, by taking into account knowledge and uncertainty about biotic, abiotic, and human components of ecosystems and their interactions and applying an integrated approach to fisheries with ecologically meaningful boundaries"[8]. In its practical application, this means applying a fisheries management that takes into account the various stakeholders and future generations, and that uses the goods and services provided by the marine ecosystem in a sustainable way. Implementation of the approach will not take effect with one piece of legislation. It is an evolution towards a different approach to managing natural resources that will take time and effort to put into action.

The ecosystem approach is at the heart of the Marine Strategy Framework Directive (MSFD), which adopts a results-based approach, encouraging regional cooperation, and leaving the Member States to decide how to reach the overall objective set at EU level. It is also expected to play a central role in the reform of the Common Fisheries Policy (CFP). Both the MSFD and the reformed CFD open up new imperatives and possibilities for cooperation in this domain. Beyond intergovernmental cooperation and coordination between research institutes, the ecosystem approach requires cooperation between all users of marine resources, working towards the sustainable use of the Atlantic area as a whole and not just targeted species. Scientific knowledge will need to encompass the broader ecosystem in a particular area rather than on a single fish stock. It also means gaining a better understanding of how our ecosystems work.

Research trends

The way in which we look at the ecosystem approach is fundamentally determined by the current state of knowledge, which is a result of past research projects. In view of these limitations, every 'definition' of the ecosystem approach, and particularly the indicators used, cannot be absolute. It is time-bound and needs to be adapted on the basis of new knowledge, but also according to policy choices. In other words, research will play a

[7] *CONNOLLY, Paul. 'Requirements for an ecosystem approach to fisheries management'. Report for the European Parliament, 2008*
[8] *FAO 2003, The Ecosystem Approach to Fisheries, FAO Technical Guidelines for Responsible Fisheries, No. 4, FAO*

fundamental role in both implementing and defining future evolution of the ecosystem approach.

The successful application of the ecosystems approach to fisheries management will also depend on the use of relevant indicators for measuring fish stocks and the effects of human activities, and on a sound policy for implementation in the Atlantic waters. Research will need to be undertaken on these issues as a successful implementation of the ecosystems approach offers strong potential for Atlantic fishers to market their catches as high-quality, sustainable products of high value to European consumers. Furthermore, while defining and validating indicators will be essential for the efficacy of the ecosystem approach, they will be of little use if there is no data to feed the indicators. Thus, a more holistic approach to ecosystem management will entail greater data needs from an entire spectrum of sources.

Finally, consideration needs to be given to the governance mechanism to implement the ecosystems approach, a definition/identification of thresholds on the descriptors of the MSFD, and the identification of environmental policies and/or legislative measures which need research support to be properly implemented.

Reducing Europe's Carbon Footprint

Introduction

Marine renewable energy (marine ocean energy sources such as tidal range, tidal current, wave energy and ocean thermal), as well as offshore wind present significant potential to respond sustainably to the future energy demand in Europe and contribute to Europe's political engagement to reduce its carbon footprint. The International Energy Agency estimates that tidal, wave, current, salinity gradient and ocean thermal technologies could represent more than 100 000 terawatt-hours of energy each year. To put that number into context, the EU's total energy consumption in 2008 was only 20 400 terawatt-hours.

Significant potential for offshore wind, wave and tidal energy has been identified on the open Atlantic seaboard, given its deep waters, strong winds and big differences between tides. A number of different technologies providing renewable energy are being tested, and some are on the market on a large scale (see table below for status of development). Given the potential of renewable energy sources, in recent years, marine energy has attracted large-scale utilities, energy agencies and industrial companies investing in the sector.

Table 3: Development prospects for ocean renewable energy technologies in the Atlantic region

	Technology	Technological Development	Commercial deployment	Potential MS	Challenges	2020 Prospects
Mature	**Tidal range**	Mature technology	Few existing operations	France, UK	Few commercially exploitable locations, high investment costs and concern over environmental impact	Very limited growth potential
Growth	**Offshore Wind**	Proven technology, but a quickly evolving sector as industry leaders search for cheaper, more efficient technologies	Large commercial wind farms have already been deployed in the Atlantic region and installed capacity is expected to grow considerably over the next decade	UK, France, Spain, Portugal, Ireland	Challenges in the offshore wind sector include the need for innovation to bring down costs while increasing in size and moving further offshore, as well as development of the necessary grid infrastructure	High growth potential

	Technology	Technological Development	Commercial deployment	Potential MS	Challenges	2020 Prospects
Demonstration	**Floating wind turbines**	Developing – many different designs and concepts, suited to a variety of site specificities and depth characteristics	Many projects are under way to develop and test technical innovations, but not yet commercialisation Nevertheless, there are two full scale grid-connected floating turbines	Portugal, France, UK	Competition is necessary to decrease costs	Strong potential for 2020
	Marine current (tidal energy)	Proliferating tech development – pilot plants in operation or planned	Market launch and commercial deployment as early as 2015	France, UK, Ireland	Prototypes being developed in context of proliferating technological development – however path to commercialisation is not yet known	Strong potential, but limited impact before 2020
	Wave energy	High development potential – technologies allowing operations in water are still in R&D stages	Some devices already being tested. Very promising source in long term.	France, Portugal , UK, Ireland	Some technologies allowing operations in shallow and deep-water zones are still in the research and development stages Diversity of concepts, difficult to assess their costs and market schedule	Strong potential, but limited impact before 2020
Research	**Ocean thermal energy**	Feasibility studies, onshore prototype	OTEC demands systems engineering competencies and industrial capacities that limit the number of players	Overseas territories of France	Prototypes only recently under way or being planned – commercialisation seems a long way off	Not viable before 2020
	Osmotic energy	Early stage R&D	World's first prototype osmotic power plant in Norway	N /A	The key to further development lies in optimizing membrane characteristics. Costs are high.	Not viable before 2020

From an Atlantic Member State viewpoint, these technologies are actively developing, as governments implement more stringent renewable targets and direct policy support. However there are challenges that need to be addressed to encourage the development of this sector.

- Firstly, there is a concern that the EU power grid will not cope with the added capacity as more projects near full-scale sea trials and supply electricity to the grid.
- Secondly, there are legislative and regulatory challenges, due to varied technology and regulatory standards, and the lack of a comprehensive policy framework.
- Thirdly, these emerging technologies face cost-competitiveness issues due to the initial state of development.
- Fourthly, offshore space is a limited resource, and therefore the expansion of offshore activities and the development of new uses of the sea will enhance the need to discuss maritime spatial use and conflicts.
- Finally, there is a need for better cooperation and coordination between sectors, public and private, and stages in the industry development lifecycle. There are opportunities for increased exchange between private and public sector actors, and other stakeholders, considering competing interests. Furthermore, the involvement of SMEs and entrepreneurs in the sector needs to be further encouraged, to make the most of their innovate contributions.

Research trends

The potential will only be realised through coordinated action, governance putting the right regulations and supports in place to facilitate the sustainable development of this new emerging industry, mobilising the significant economic, technical and scientific capabilities of the region and ensuring interconnectivity to move energy from where it is produced (Atlantic coast) to where it is needed (the urban and industrial centres of Europe).

In the area of marine renewables research and development, there are several European wide bodies. The **European Energy Research Alliance** (EERA) is a group of leading organizations in the field of energy research. EERA aims to strengthen, expand and optimize EU energy research capabilities through the sharing of national facilities in Europe and the joint realization of pan-European research programmes. Within EERA, there is an **Ocean Renewable Energy Group** (EERA-Ocean). This joint programme on Ocean Energy brings together the University of Edinburgh (UK), Technalia (ES), Wavec (PT), IFREMER (FR), ENEA (IT), HMRC (IE), SINTEF/MARNTEK (NO), and Fraunhofer (DE).

Many marine energy cooperation initiatives are also driven through the FP7 (7th Framework Programme for research and technological development). The "Regions of Knowledge" initiative aims to strengthen the research potential of European regions, in particular by encouraging and supporting the development of regional "research driven" clusters, associating universities, research centres, enterprises, and regional authorities. These calls for projects are also contributing to structure the sector by facilitating exchanges between players and fostering joint projects.

Table 4: Selection of the key recent FP7 funded European wide R&D initiatives

Name	Description	Funding	Timeline	Leader
MaRINET - Marine Renewables Infrastructure Network for Emerging Energy Technologies - www.fp7-marinet.eu	Access at no cost to 42 marine renewable energy testing facilities in Europe	FP7	Start: April 2011, 4 years.	UCC (Ireland)
WAVETRAIN 2 - Initial Training Network for Wave Energy Research Professionals - www.wavetrain2.eu	Marie Curie initial training network for Wave Energy	FP7	Start: October 2008, 45 months	WavEC (Portugal)
MARINA Platform – Marine Renewable Integrated Application Platform - www.marina-platform.info	Wind and Ocean Energy combination research.	FP7	Start: January 2010, 4,5 years	ACCIONA (Spain)
H2OCEAN – Development of a wind-wave power open-sea platform equipped for hydrogen generation with support for multiple users of energy - www.h2ocean-project.eu	Wind and wave power energy, H2 generation, multi-trophic aquaculture.	FP7	Start: Jan 2012, 3 years	AWS Truepower (Spain)

TROPOS - Modular Multi-use Deep Water Offshore Platform Harnessing and Servicing Mediterranean, Subtropical and Tropical Marine and Maritime Resources - www.plocan.eu	Design multiuse offshore platforms where ocean energy plays a key role	FP7	Start: February 2012, 3 years	PLOCAN (Spain)
ORECCA - Offshore renewable energy conversion platforms	Framework for knowledge sharing ; roadmap for research activities in the context of offshore renewable energy	FP7	March 2010 to August 2011	Fraunhofer IWES

Each of the technologies is at a very different stage of development. The most advanced is fixed-based offshore wind, which has reached the stage of full-scale industrial and commercial deployment. The total installed offshore wind capacity amounted to 3.8 GW in 2011, including a 31% growth rate in 2011[9]. The ocean energies on the other hand are less mature, despite acceleration in development over the past few years, and remain at the research, prototype or demonstration stage. At a global level, total installed capacity of ocean energy in 2011 is 519 MW, most of which related to tidal power plants.[10]

Apart from fixed-based offshore wind, there are good prospects for growth of floating offshore wind power, which could benefit from operational feedback from fixed-base wind turbines, as well as for marine current (tidal energy). Wave energy is less likely to reach the commercial stage for several years, and is positioned for medium- to long-term market development, along with OTEC, which is focused mainly on tropical areas.

The UK is currently the world's leading market for marine energy, with 300 MW of ocean energy projects in the pipeline to be installed over the next five years. Their strategy has a particular focus on developing and deploying wave and tidal energy, as well as offshore wind. Denmark is the number 2 offshore wind country with a current offshore capacity of 854 MW, 22,9% of the total wind capacity. Offshore wind turbines represented 62% of the capacity added in Denmark in 2010. France is continuing to support the development of marine energy technologies, and has only relatively recently pursued a focus towards offshore wind, after awarding a first round of offshore wind tenders in 2012. There are also strong plans for tidal energy (marine current), including an objective to install 2.5GW. Ireland has continued to focus on wave energy, including a full scale grid connected wave energy test facility. The average wave power in Europe is highest near the west of Ireland with an average wave power of 76kW occurring of the Irish coast. Spain has had late deployment of marine energy in comparison with other countries with a similar ocean power potential, such as UK or Portugal. It however possesses a number of test sites for prototypes in wave energy (growing since 2005) and floating wind turbines. Portugal is a world leader in wave energy technology, having developed since 2005, with a number of wave energy plants and prototypes in operation. Since 2010, Portugal has turned some of its attention to offshore wind.

Beyond renewables, the role of green shipping

Maritime shipping emits less greenhouse gas than road based transportation. One tonne of goods moved one kilometre causes an emission of approximately 110 g of CO_2 on road as compared to some 20 g on rail and 15 g on the sea.[11] Emission regulation and technological development in the land transport sector has driven pollution down. Modal shifts towards shipping is a causal element, but the same time SO_2 and NO_x from international shipping is on the rise and is forecast to surpass emissions from land and domestic shipping by the

[9] *Source: European Wind Energy Association*
[10] *Implementing Agreement on Ocean Energy Systems (OES), Annual Report 2010, International Energy Agency.*
[11] *European Environmental Agency: http://www.eea.europa.eu/data-and-maps/figures/specific-co2-emissions-per-tonne-1*

end of this decade.

Continuous efforts are being made in the direction of "green shipping". These efforts have various directions including:

- Emission reduction: exhaust scrubbers and alternative fuels (low sulphur fuels and liquid natural gas)
- Alternative energies: land supply of energy in ports (electrical power outlets), sails and solar panels
- Improved design: energy efficiency, improved design and recycling of materials.

Green shipping is integrated in the EU Framework for research and technological development (FP7). In 2012 for example, €24 million are set aside for ensuring safe, green and competitive waterborne transport.[12] Experts have assessed that natural gas in liquid form can become a viable fuel alternative in the next 5-10 years once the distribution infrastructure is in place.[13] Biofuels are relevant for shipping as for other energy dependent sectors. For instance, biofuels based on marine algae have undergone large scale tests[14], but marine algae applications are still development and their energy contribution over the next decade is likely to be modest.[15]

In spite of these efforts, the most likely near-future change in shipping fuels will be low sulphide potentially in combination with exhaust scrubbers[16]. Many of the other directions of efforts are still on the test and demonstration level and are therefore unlikely to become widespread in the short to medium run, but these technologies have all the same a growth potential due to the changes that lie ahead for maritime transport.

Coastal research and climate change

Climate change refers to a number of evolutions in the world's weather patterns, but has been particularly associated with higher incidence of weather-related natural disasters, including storms, flooding, wind and episodes of extreme heat or cold. It is widely recognized within the scientific community that the costs of weather-related natural disasters have been increasign and in large part due to climate change. Europe's coastal regions in particular could be highly affected.

The projected climate change effects that will impact for coastal areas include, *inter alia*, sea-level rise, changes in temperature, the direction and the power of waves, wind, precipitation and ice-cover, as well as an increase in extreme weather events. The European Environmental Agency also points to the potentially devastating effects of increased coastal flooding and erosion, saline intrusion, freshwater shortage and the loss of coastal ecosystems. A 2009 report on 'The Economies of Climate Change Adaptation in EU Coastal Areas' reported that the annual global adaptation cost to protect against coastal flooding due to sea-level rise lies somewhere between 5 billion and 15 billion USD and about 0,5 to 0,85 billion Euros a year for Europe.

This salient question has attracted an increasing amount of researchers and funding. On-going EU-funded projects include;

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[12] *European Commission: C(2011)5068*
[13] *DG MARE, "Blue Growth – scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts. Maritime Sub-Function Profile Report. Short Sea Shipping (1.2)" 2012*
[14] *For instance, algae fuels powered auxiliary engines Maersk Lines' 300 m long Maersk Kalmer en route between Germany and India (http://www.algaeindustrymagazine.com/maersk-and-navy-test-algae-fuel-on-container-shi/).*
[15] *Sustainable Energy Ireland: A Review of the Potential of Marine Algae as a Source of Biofuel in Ireland. 2009*
[16] *DG MARE, "Blue Growth – scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts. Maritime Sub-Function Profile Report. Short Sea Shipping (1.2)" 2012*

The Technical University of Delft in the Netherlands has secured nearly three million Euros of European funding for nearshore monitoring and modelling of coastal behaviour, in order to help develop a more informed coastal management strategies and mitigate adverse impacts of coastal change. State-of-the-art field monitoring methods will be deployed over a five year period along a 20 kilometre stretch of coast. The monitoring equipment will allow researcher to acquire unprecedented process information at different temporal and spatial scales.

The French Institute Marine Research and Exploitation (IFREMER) is currently leading JERICO, an ambitious project building a Pan European network for European coastal marine observatory. This network will integrate infrastructure and technologies such as moorings, drifters, ferrybox and gliders from different national observatories. The project hopes to lead to the definition of best practices for design, implementation, maintenance and distribution of data of coastal observing systems, as well as the definition of a quality standard.

Sustainable exploitation of seafloor natural resources

Introduction

Mineral and biological resources in the Atlantic Ocean - in the deep sea as well as in the coastal areas - are only used to a limited extent. The total activity in the EU concerning utilisation of resources for biotechnology, aggregates and minerals is also minor when measured in value added and number of employees. According to figures from the DG MARE *Blue Growth* report, only about 500 people are employed in the Blue Biotechnology sector in the EU and less than 5 000 in the marine mining sector, compared to 38 000 in the more mature offshore oil and gas sector.

Presently, there are no large-scale exploitation activities in the Atlantic Ocean. However, it is foreseen that the biotechnology and natural resource sectors will emerge in the coming years and have high potential future growth rates.[17] This is supported by a desire of the exploration and exploitation sectors to be first movers in the field; a wish that will nevertheless depend on their ability to combine the right skills and competencies with the ability to attract capital and ensure stakeholder involvement.

Biological resources

The biotechnology sector is characterised by few operators undertaking pioneer work. The companies have strong links to research societies in the Atlantic Member States and have mostly emerged from these. Activities are partly financed by public research funds and partly by private funds in the sector, and the necessary financing appears to be available for sector operations. The value added from these companies is still modest, but there is expectation that this will change in the near future.

The impact on the environment of sector operations is limited as the samples collected in the sea are analysed or further processed in laboratories, typically onshore. The companies in the sector have strong links to the research communities in the five countries, most of them having emerged from these communities. The impact from the operations of this sector on the marine environment is considered minor, since the volumes of collected samples are very small. Typically, analyses are conducted in laboratories, and large-scale production processes take place in dedicated onshore facilities.

Mineral resources

The minerals exploration and exploitation sector is more developed than the biotech sector, however, concerning deep-sea exploration and exploitation, there is a way to go before operations can be commercialised on a large scale, if they prove profitable. Presently, activities are on a small scale in the European Atlantic basin and the

[17] *Seas-era, A draft marine research plan for the European Atlantic sea basin, 2011*

technologies to exploit resources still need to be further developed to accommodate deep-sea operations and become cost effective. In addition, the presence of minerals needs to be determined more accurately. Today, some locations rich in resources are known, e.g. in areas with volcanic activity. The impact on the sea floor from exploiting the minerals can be severe, but the impact on, e.g. the ecosystem, is still unknown. The impact will naturally depend on the scale of exploitation and methods used.

In Europe, marine mineral resource exploitation is concentrated in the North Sea, where the offshore oil and gas industry has been operating since the early 1960s. Activities in the Atlantic, on the other hand, have so far been very limited. The potential for expanding these activities in a significant manner is very difficult to ascertain due to uncertainties in the availability, extent and accessibility of the resources.

Environmental conditions vary substantially between the different parts of the European Atlantic basin. Exploration technologies and research methodologies thus cannot be applied equally across the whole basin. This is reflected in the level of knowledge available from different parts of the basin, which is particularly the case in areas further offshore, where great depths make exploration complex. Here, the level of knowledge about the presence of resources remains very limited. This makes estimations of the exploitable potential difficult.

The overview below lists different types of deep-sea natural resources and their uses in different sectors.

Table 5: Deep-sea natural resources and uses

Resources/sector		Mining	Energy	Food	Pharmaceutical cosmetics	Other biotechnology	Construction	Manufacturing
Energy resources	Oil and gas		+			+	+	
Mineral resources	Polymetallic sulphides	+					+	+
	Cobalt-rich ferromanganese crusts	+					+	+
	Polymetallic nodules	+	(+)	(+)	(+)		+	+
	Superficial sediment types	+					+	+
	Sand and gravel	+					+	
Biological resources	Bacteria				+	+		
	Algae		+	+	+	+		
	Marine animals			+		+		

Research trends

Europe is a world-leader in research on marine biotechnology and marine mineral resources, including marine hydrocarbons. In all of these domains, European institutions lead over their American and Asian counterparts in terms of scientific output. However, non-European institutions are dominant in terms of number of patents and inventions, in particular from Japan and China in the field of marine biotechnology, and the US in marine minerals, suggesting greater involvement in research and uptake of its results by industry in these countries[18].

[18] *DG MARE, 2012: Blue Growth, sub-function 2.4: Blue Biotechnology*

There are multiple reasons for this, including potential bottlenecks in the European patent system.

Research on marine hydrocarbons is a mature field, and is largely driven and funded by private companies involved in commercial exploration and exploitation. In Europe, activities concentrate on the North Sea, with lesser expression in the Atlantic basin. Technologies from hydrocarbon exploration have been increasingly adapted to the exploration of other seabed minerals in the last three decades. Current technological developments focus on equipment for exploration and mining in the deep sea, usually involving private companies and public research centres.

Marine biotechnology research has progressed along three lines:

- Firstly, exploration of the marine environment for new organisms with potentially valuable molecules. This has concentrated primarily on coastal waters, due to ease of access, but is increasingly exploring remote environments in the deep-sea, in particular near hydrothermal vents.

- Secondly, identification and extraction of interesting molecules, aided by developments of molecular analysis technologies in the last 15 years.

- Finally, large-scale commercial production of molecules, either by culturing the organisms or by chemical synthesis. The latter in particular remains a bottleneck, and so far only a minute fraction of molecules of marine origin has reached commercial exploitation.[19]

There is still a huge potential for discovery in this sector, with approximately 8.7% of the total number of marine species is known, this figure being a mere 0,0001% of all species inhabiting the deep sea.[20] Current expectations are that deep-sea habitats contain a large number of species with greater genetic diversity and larger arrays of structurally and functionally unique molecules than marine species from shallower waters.

Additional, perhaps lesser know deep-sea research areas that could potentially be better addressed through regional collaboration include:

- Paleo-oceanography

- Offshore natural hazards or non-natural such as the sinking of the "Prestige" in Spain or the "Deep Water Horizon" disaster in the Gulf of Mexico

- Finding better predictive methods on how deep sea ecosystems respond to environmental changes,

- New techniques/technologies and methods to study the deep seas system.

Issues to overcome for the future development of marine minerals exploitation include the location of deposits; the determination of their type and abundance, and the assessment of commercial viability, in particular in view of resource uncertainties and current technological barriers. The uncertain future regulatory framework for deep-sea mining activities is another factor hampering development, as are concerns by the public and the scientific community as to the possible negative environmental impacts of deep-sea mining.[21] Furthermore, the rise of the BRIC countries and their increased cooperation in issues of climate change and sustainable development may pose opportunities for coordination. The environmental framework includes policies at different levels, including specific national legislation, which may be the implementation of an EU directive, or which may be the wish to

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19 ESF-Marine Board. Marine biotechnology: A new vision and strategy for Europe. Position Paper 15. Brussels; Anonymous: A new down for marine biotechnology in Europe. Biotechnological Advances 2011; 29: 453-456
20 Presentation of Ricardo Serrao Santos at the workshop in the Azores 20 and 21 September 2012
21 Pfannkuche O, Camerlenghi A et al. The deep-sea frontier: Sustainable use of Europe's deep-sea resources. Scientific needs and strategies. Foresight document. [www.deep-sea-frontier.eu]; DS3F. Infrastructure and synergies. Workshop report. Deep-Sea and Sub-Seafloor Frontier. [http://www.deep-sea-frontier.eu]

protect special national interests. Together with OSPAR, a voluntary cooperation between the countries bordering on the North Sea or the Atlantic Ocean, these legislative instruments provide the guidelines for the use of national waters. In international waters, the UN has launched a number of initiatives, such as conventions that guide the right to operate in those waters.

Responding to threats and emergencies

Introduction

The Atlantic region faces a number of common security and safety threats, meaning there is clear added-value in regional approaches to addressing these issues. Integrated Maritime Surveillance is one of the five pillars of the Integrated Maritime Policy, and is about providing authorities interested or active in maritime surveillance with ways to exchange information and data, thereby making surveillance cheaper and more effective. Currently, EU and national authorities responsible for different aspects of surveillance – e.g. border control, safety and security, fisheries control, customs, climate change environment or defence – collect data separately and do not necessarily share them, resulting in duplication of data collection activities. Therefore, at European and at national level there is a need to integrate the co-ordination and inter-operability of the Member States ability to exercise sovereignty in European waters. Good progress has been made with regards to coordination and cooperation on responses to emergencies at sea and pollution, management of vessels and improved, more integrated maritime surveillance.

Maritime safety is a multilevel topic involving the shipping industry, national and international policy initiatives in combination with regional and local involvement in enforcement, response etc. Furthermore, data needs to be generated, policies implemented and technologies developed. Successful action on all levels is needed to ensure safe maritime transport in the Atlantic. Much of the work on prevention and surveillance is carried out at the EU and IMO level, whereas coordination of search and rescue, emergency response and clean-up is organized at national, regional and local level. The Atlantic Action Plan may play an aligning and cooperation-enhancing role in maritime safety, especially on the latter aspects.

European Maritime Safety Agency

EMSA was established in 2003, following the fallout from the Erika (1999) and the Prestige (2002) accidents and their resulting oil spills. EMSA provides technical assistance and support to the European Commission and Member States in the development and implementation of EU legislation on maritime safety, pollution by ships and maritime security. It has also been given operational tasks in the field of oil pollution response, vessel monitoring and in long range identification and tracking of vessels.

EMSA was established by Regulation (EC) No 1406/2002 as a major source of support to the Commission and the Member States in the field of maritime safety and prevention of pollution from ships, and subsequent amendments have refined and enlarged its mandate.

In the domain of security as well, responsibility for surveillance of and response to security operations is dispersed and interoperability of systems and procedures low. The administrative structure of national authorities dealing with surveillance, monitoring, tracking and reporting actions are varied and particularly complex and there is a lack of wide-area maritime surveillance, using integrated satellite and sea-based technologies and networked sensors. In the open seas, there is only partial coverage, and a need for continuous and persistent surveillance. On the operational side, cross-border cooperation is not carried out at the same level in all sea areas around the EU. Cooperation can standard practice in some domains of offshore activity, while virtually absent in others.

Research trends

Research in the area of maritime safety has focused on developing operational and technological concepts capable of meeting the changing needs of the demand side while enhancing safety and the protection of the environment. Research can be divided into several categories:[22]

- Development of logistic concepts and systems;
- Introduction of innovative designs, technologies and working practices for safer ship operations;
- Development of efficient traffic management systems for sea and river operations;
- Education, human factors and improvements to the working environment; and
- Reduction in environmental risks and the promotion of environmentally friendly operations.

The EU is already involved in several projects to improve the monitoring of sea areas and vessel traffic in the Atlantic. An example of this is ARCOPOL +, an Interreg funded project that aims to further improve maritime safety and Atlantic regions coastal pollution preparedness and response against oil and Hazardous and Noxious Substance (HNS) spills through technology transfer, training and innovation.[23] Previously identified gaps in the HNS knowledge will be addressed and further incorporated into local and regional contingency planning to contribute to build a reasonable and efficient response. Innovative tracking, forecasting and decision support tools will be adapted to the needs of local and regional authorities that will be trained on their application.

Given the size of the Atlantic, there are significant opportunities to improve the efficiency and effectiveness of MS operations in these areas, both within the agencies within each jurisdiction and across jurisdictions through greater cooperation, information exchange and shared analysis. Future trends that will highlight the need for a coordinated approach include:

- Increased competition for space: this creates increased pressure for environmental protection
- Future shipping: keep dangerous ships away from protected areas (and other industries/activities– maritime spatial planning
- Incentives for quality: Good standard/record gives better routes (including the use of certificates, "above compliance" standards)
- Trend from compliance culture towards safety culture.

Following the implementation of the PASR Preparatory Action on Security Research in 2004-2006 by the European Commission, an EU Security Research Programme (ESRP) was included for the first time in the RTD Framework programme in FP7. The objectives of FP7 Security Research are to: make Europe more secure for its citizens, strengthen industrial competitiveness; promote research excellence and state-of-the-art; prevent the fragmentation of research efforts and to strengthen critical mass. FP7 SEC provides support for transnational collaborative research in a number of areas, including maritime security. Research topics relating to maritime security, such as secure container-screening, biometric ID port perimeter security, satellite-based tracking of maritime areas and blue border surveillance, have been addressed in a number of work programmes. This has enabled a number of maritime security research projects to be undertaken, including SOBCAH, SECCONDD, AMASS, OPERAMAR and UNCOSS.[24] Key research topics have included:

- container-screening systems
- biometric ID port perimeter security
- satellite-based maritime tracking
- blue border surveillance

[22] EXTRA consortium for DG Energy and Transport, (2001) "Maritime Safety: Results for the transport research programme"
[23] *ARCOPOL: The Atlantic Regions' Coastal Pollution Response, 15th February 2012*
[24] *Centre for Strategy and Evaluation Services, "Ex-post Evaluation of PASR Activities in the field of Security and Interim Evaluation of FP7 Security Research, Maritime Security and Surveillance - Case Study", January 2011*

Socially inclusive growth

Introduction

While there are considerable differences between many regions of the Atlantic area, many communities are currently dealing with a decline in traditional industries such as employment in fisheries and shipbuilding, the shift of mass tourism to sunnier climes and the tendency of elderly people to choose the coast for retirement. The on-going socio-economic changes in coastal regions can be characterized as a "double movement".[25]

On one hand, the fisheries sector is experiencing shrinking stocks, new technologies are increasing harvesting efficiency, and expanding national and international fisheries management systems are changing the face of fisheries management. Furthermore, there is a trend towards increased aquaculture production, and a focus on more local, environmentally friendly, small scale fisheries adjusted to local needs.

On the other hand, the tourism sector is expanding, leading to situations where communities previously dependent on fisheries are changing their focus towards an emerging recreational potential for coastal tourism. These opportunities are typically based on the specific qualities of the local coastal region. At the same time these disappearing fisheries communities are providing attractive settings for short terms visitors and retirees seeking coastal housing.

Whilst there is much variation along the Atlantic coast, aspects of this "double movement" can be widely seen. Many communities need to cope with a decline in employment in fisheries and ship-building, a shift of mass tourism to sunnier climates, and the growing tendency for the elderly people to retire to coastal regions.[26] These challenges must be met through measures to assist in the restructuring of the labour and employment market, as well as through innovation to add value to fish products, diversification activities and the development of culture marine heritage.

Potential measures to address the challenges include the creation of new high-added value jobs in coastal regions, and an associated workforce training and re-skilling programme to ensure that the population has the required competencies. In addition, there needs to be wider mutual recognition of training and professional qualifications, so that maritime expertise can be retained and attractiveness of maritime professions restored.[27] Furthermore, the skills and experience of retired maritime industry professionals needs to be exploited to attract younger generations to maritime careers.

Research trends

Diversifying local economic activity can help ease the pressures of the restructuring of traditional industries, by providing opportunities that ease economic and social transitions and generate employment for the next generation. Within this context, diversification can refer to two ideas; diversification within the fishing sector, including the development of new techniques, products, business models and markets and the broader diversification of coastal areas into sectors that are either not at all or loosely related to fishing. This spectrum can also include intermediary diversification outcomes, such as the development of complementary income streams from related or unrelated sectors for people remaining in the fishing sector (marketing fishing by-products, fishing tourism etc). Research and innovation will play a key role in helping communities to diversify their local economies and provide high-value jobs for groups hit hard by unemployment, such as the young and the elderly.

On the other side of the equation, policy makers must anticipate future labour force needs and make sure that the region has the necessary skills and can attract the right people. The education and training of seafarers is an important issue for the EU, in order to maintain and develop the level of knowledge and skills in the maritime

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[25] *Holm, Petter (2001). The Invisible Revolution. The Construction of Institutional Change in the Fisheries, Norwegian College of Fishery Science, University of Tromsø, Tromsø.*
[26] *COM(2011) 782 final, "Developing a Maritime Strategy for the Atlantic Ocean Area", November 2011.*
[27] *COM(2011) 782 final, "Developing a Maritime Strategy for the Atlantic Ocean Area", November 2011.*

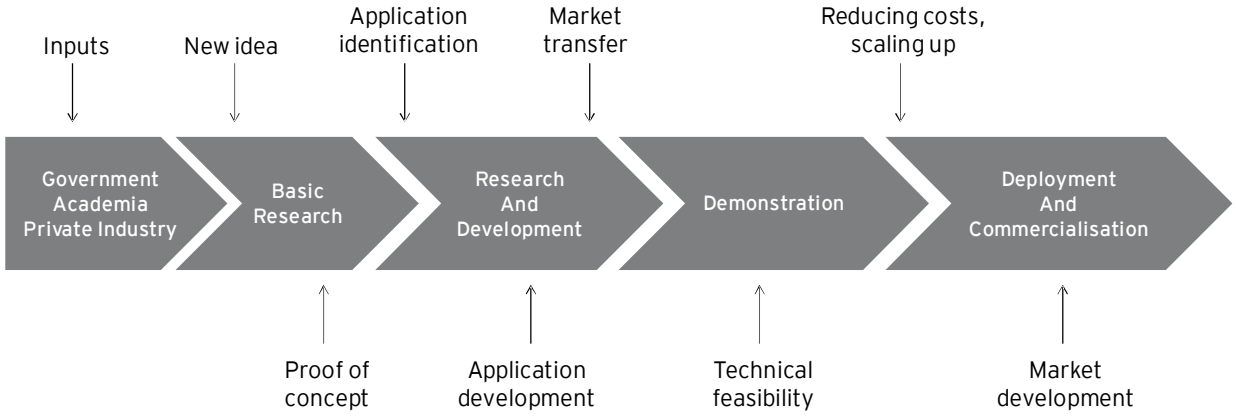
sector in the EU as well as in the interest of maritime safety. In addition to training and educational programmes, the encouragement of marine clusters can provide valuable centres of research and innovation.

Maritime clusters have a large labour mobility within their sectors. In the Netherlands almost 30% of maritime labour intake and outflow comes from or goes to other maritime sectors.[28] Key aspects and benefits of clustering include promotional activities that can enhance possibilities to cooperate efficiently, a focus on education, training and the labour market, and a focus on research, development and innovation.

Local Development Programmes such as LEADER and Axis 4 of the European Fisheries Fund (EFF) have helped to provide fragmented communities with an organisational platform, a voice and a channel of communication to those areas of government and policy that affect their future. Through particularly Axis 4 of the EFF, Member States have been able to design and implement projects that address demographic changes and the need to diversify activities and innovative through adding value to fisheries products, in order to create employment.

Challenges and gaps

This section presents a synthetic overview of the preliminary gaps identified relating to research and innovation specifically in the five themes touched upon the first section of this report. The innovation chain is a useful way of emphasizing and contextualising the research input necessary to maximize economic benefits from a particular sector at each stage of development of a product or service; from idea to market deployment. A number of other cross-cutting categories have also been identified, including knowledge development (e.g. advancement of scientific knowledge), reinforcing collaboration, research infrastructure development and data collection that do not neatly fit into one single point on the innovation chain or have inherent value outside of the context of the development of a product or service.



Overview of gaps in research and innovation for each Atlantic challenge

The table below provides an overview of the gaps that have been identified for each of the Atlantic challenge areas. It is followed by a discussion of the specific identified gaps within each of these categories.

[28] *Ecorys (2006) – Monitor maritime labour market. More information concerning this labour mobility is included in Annex 12.*

Research & Innovation gaps	Ecosystem Approach	Reducing Carbon Footprint	Sustainable seabed exploitation	Responding to threats	Inclusive growth
Basic research & development	√	√	√	√	√
Demonstration		√	√		
Reducing costs		√	√		
Scaling up		√	√		
Market deployment		√	√		
Developing knowledge	√		√	√	
Reinforcing collaboration	√	√	√	√	√
Infrastructure investment	√	√	√	√	√
Data collection	√	√	√	√	√

Basic research & development

- Cutting edge ideas need critical funding to get off the ground (marine renewable energy)
- Understanding the potential of seabed natural resources requires exploratory research to identify what the Atlantic seabed has to offer in terms of biological diversity and minerals, including where these resources are and, then, understanding how to extract these resources in a cost-effective and sustainable way (minerals) and/or possible applications for these resources (biotechnology).
- There is a need for further investment to improve technologies for secure containers (e.g. equipped with Intrusion Detection Sensors, electronic seals and data device reading capabilities) (responding to threats)
- The success of the ecosystem approach will lie in the development of relevant indicators

Demonstration

- Encourage demonstration programmes of full-scale projects, coastal onshore prototype test sites and facilities (marine renewable energy)
- Insufficient understanding of the processes for overcoming the uncertainty associated with new commercial explorations of deep-sea biological and mineral resources, so that these sectors may become attractive to new businesses

Reducing costs & Scaling up

- Research into equipment or methods that assist in scaling-up technology into farms or arrays, such as specialist installation and maintenance vessels and electrical connection equipment (marine renewables)
- Develop new manufacturing processes to reach high volume productions (ocean renewables)
- Insufficient research focus on processes and technology for exploiting deep-sea resources in a manner that is simultaneously cost-effective and protective of the environment (seabed minerals)

Market deployment

- Ability of research to move closer to the market, including shortening product maturing time. To achieve this, the research community and businesses need to improve their ability to communicate together (renewables and seabed resources)
- Encourage collaboration between industry and research, through the development of marine clusters (renewables and seabed resources)
- Insufficient experience of appropriate business models for activities in these sectors, including public-private partnerships (seabed minerals)

Reinforcing Collaboration

- Strengthen industry-research collaborations across all domains of research
- In general, the lack of research is not just a lack of activity in general, but rather a lack of a common guiding objective for the research for the area of the European part of the Atlantic area combined with specific knowledge gaps. To allow for a sharing of results and assets, a close relationship between researchers would be beneficial. There are few cross-country initiatives and a clear tendency to work for national objectives and rather than for the sea basin of the Atlantic as a whole
- As new ways of exploiting ocean resources are brought to fruition, spatial planning will no doubt become a key issue and is already becoming a barrier to growth in some markets. A robust cooperation framework is needed domestically and between neighbouring Member States
- By its very nature, the ecosystem approach requires close cooperation between all neighbouring states in the Atlantic sea basin for effective implementation.
- Cross-border cooperation is not carried out at the same level in areas. It is standard practice in some domains of offshore activity, while barely present in others (responding to threats)
- Interlinking maritime surveillance systems presupposes thorough consideration of diverse legal issues related to the exchange of information collected for different purposes and from different sources (responding to threats)
- There is limited interoperability between sectoral stakeholders and systems (responding to threats)
- Very low number of research consortia combining experts from academia, businesses and policy institutions (seabed minerals)

Infrastructure development

- Investment in research infrastructure, particularly innovative new methods of data collection.
- Research into development of innovative new research to connect new sources of ocean energy to the existing grid.

Data collection

- Industries such as seabed mining and ocean renewables must invest in costly data collection for many activities. More publicly available data could help reduce these costs and, for example, better design and situate offshore structures.
- There is a lack of wide-area maritime surveillance, using integrated satellite and sea-based technologies and networked sensors. In the open seas, there is only partial coverage, and a need for continuous and persistent surveillance (responding to threats)
- The ecosystem approach is very 'data-hungry'. To implement it will necessitate a great deal of investment in data collection and integration of data sources.
- Data confidentiality and the protection of personal data are also key issues. Work towards an integrated maritime surveillance network needs to define at least the nature of the data involved, the purposes (and the methods) of the exchange and the potential recipients of the data, as well as incorporating the necessary safeguards with regard to the confidentiality and security of (certain) data and the protection of personal data, where this may be relevant.

Potential areas for future action

From the gap analysis, a number of initiatives might be proposed in order to provide the optimal framework for research and innovation across the five pillars of the Atlantic strategy. Other factors, such as the market prices of the resources cannot be affected from these, but are still very likely to have a major impact on the prospects of success of the utilisation of the resources, and indirectly on the success of these initiatives.

- Atlantic strategy can provide a framework for further developing innovative data sharing initiatives beyond the limits of current directives
- Cooperation on the development of a strategic research agenda for the Atlantic.
- Reducing administrative burden, streamlining support services and reducing regulatory uncertainty with regards to research activities in Member States, including increased cooperation through working groups covering public administrations and industry to address measures to overcome barriers

- Research investments complementary to spatial planning needs to identify optimal installation sites.
- Improve collaboration between industry and academia in order to speed up market take-up of new ideas.
- Develop new gear and to raise awareness of existing equipment to ensure that the fisheries sector minimises its environmental impact, e.g. minimising fish discards and disturbance of the seafloor.
- Reinforce cooperation between research institutes

Workshop report: summary of key discussion themes

Socially inclusive growth

The following table shows the key themes discussed during the main and short interventions. As a general remark, this session covered a wide range of subjects, and did focus on "socially inclusive growth" as defined in the Atlantic Strategy communication. For example, subjects such as addressing demographic changes in coastal communities, training and development of novel tourism concepts were not raised during this session.

Theme	Gap	Possible actions to address gaps	Examples of projects/ good practice
Value chain approach, clusters, networks	• Need research driven by demand • Need to know who the customers are • Need a process for stimulating business investment • Need to overcome the current silo approach	• Support and build on existing and emerging regional maritime clusters • Encourage cooperation and network building along value chain; bridge gap between research/innovation and private sector funders • Produce innovation road-maps • Encourage attractive and innovative approaches – e.g. better knowledge dissemination and up-take, research voucher and graduate industry placement schemes	European Clusters for Atlantic Strategy Implementation (E-CASI)... http://ec.europa.eu/maritimeaffairs/policy/sea_basins/atlantic_ocean/atlanticforum/call/contributions/e-casi_en.pdf
Importance of Marine Knowledge	• Fragmentation and duplication of marine knowledge and research • Barriers to knowledge transfer – e.g. no incentives, unclear responsibilities and ownership • Too much focus on knowledge production rather than dissemination and transfer	• Establish a dedicated knowledge transfer node within clusters and up-skill researchers • Develop a central marine research repository • Support clusters and knowledge innovation communities • Encourage broad and multidisciplinary stakeholder involvement in research • Foster the strength of pivot agencies (technology transfer offices) • Support the development of standard for data that will allow easier exchange of information	N/A
Importance of civil society	• Whilst the public has been engaged through Atlantic Forum, focus must be put on communicating Action Plan • All stakeholders need to be on board to achieve the strategy, particularly the public	• Need to highlight the vital role of the Atlantic to all of Europe • Promote education to build social awareness about oceans • Need to fully define social engagement and inclusion given that research and innovation are critical to empowering local communities • Essential to communicate the Atlantic Action Plan effectively to the public • Make strategy use of the stakeholders in the implementation process. Make sure they have a formulated role.	N/A
Harmonise infrastructure	• Infrastructure lag is posing a barrier to industry developments	• Multi-use platforms, e.g. Smart buoys • New aquaculture technologies • Ocean observation systems • Initiate dialog between the relevant stakeholders e.g. energy production and aquaculture	N/A

Reducing Europe's Carbon footprint

This session of interventions focused on accelerating the commercialisation of MRE and greening maritime transport. One key topic not emphasised heavily in the Atlantic Strategy Communication was the identified need to better measure the impacts of climate change in order to define strategies of how to act. One point that was not discussed heavily is how R&I funds, SMEs and large companies will work together towards the development of the marine renewable energies sector.

Theme	Gap	Possible actions to address gaps	Examples of projects/ good practice
Bringing MRE to market	• Barriers to commercialisation • Fragmented approaches • Negative stakeholder perceptions • Marine spatial planning	• Create a network of research centres • Pool and share resources, e.g. scientific vessels • Develop high resolution databases for MRE test sites • Introduce trans-regional fund to invest in MRE pilot farms • Develop multi-use floating platforms • Harness oil and gas industry technology to support emerging maritime sectors	N/A
Greening of maritime transport	• Ship design and port preparedness • Lack of policy / legislative drivers for greening of ships	• Develop LNG technology, SOx sensors, e-navigation systems • Promote short-sea shipping and Motorways of the Sea • Invest in sea ports as efficient multi-modal platforms • Create incentives for the shipping sector to green their ships	N/A

Measuring impacts of climate change	• No mention of carbon capture / sequestration in Atlantic Strategy
	• Need for climate change mitigation and adaptation strategies, requiring:
	  • Measurement of CC impacts
	  • CC forecast models
	  • Subset of long-term datasets
		• Develop an overall assessment of carbon footprint of the blue economy
		• Establish partnerships to identify/monitor the impacts of Climate Change
		• Develop better tools for forecasting climate changes and assess the risks
		• Develop/maintain/standardize a subset of long-term datasets for climate change analyses / modelling
			N/A

Sustainable exploitation of the Atlantic's seafloor natural resources

This session focused on identified research needs and priorities in the area of mineral mining and marine biotechnology, as well as the need to better share marine research infrastructures, harmonise standards and create incentives for sharing research results. There was little focus on newer innovative and not so well developed research areas, such as paleo-oceanography, offshore natural hazards, and deep sea viruses for biotechnology applications. Furthermore the subject of competition/cooperation with non-European actors, such as the BRICs was not raised.

Theme	Gap	Possible actions to address gaps	Examples of projects/ good practice
Industry research into sea-bed mineral mining	• Technically challenging and financially difficult • Proposed research on geo-science, mapping & developing extraction technologies is too limited in scope • Lack of coordinated international action (reach out to the other side of the Atlantic)	• Need to model and understand seafloor (validation of models required) • Understand ecosystem connectivity, including at ocean basin scale • Make best use of novel mapping and survey technologies (AUVs, swarm robotics) • Develop in-situ monitoring and modelling capability • Gather all results from mapping and modelling and combine them in an overview • Achieve co-ordinated actions with USA & Canada for basin scale assessment of deep-sea mining operations	N/A
Marine biotechnology research priorities	• Need to raise profile and awareness of EU marine biotechnology research • Misalignment at national, regional and pan-European levels • Technology transfer	• Create a strong identity and communication strategy for research • Stimulate development of research strategies and programmes for marine biotechnology and align at all levels • Significantly improve technology transfer pathways, through proactive, beneficial collaboration between academic research and industry in order to secure access to, and ensure fair and equitable benefit sharing of, marine genetic resources • Improve training and education	N/A
Marine research infrastructures	• Infrastructure needs modernisation / optimization • Sharing of findings	• Support and encourage coordination of observatories and monitoring • Harmonise data sharing/standards • Focus on infrastructure, monitoring and data to underpin MSFD reporting • Need for closer coordination between life sciences & marine mining sector • Need to create incentives to share findings and support their further development in the value chain	N/A

Implementing the Ecosystem Approach

This session focused on the ecosystem approach to manage maritime activities in a more sustainable way. The discussions focused predominantly on fisheries management, in line with the Atlantic Strategy Communication, and subjects such as Marine Spatial Planning were not raised at length.

Theme	Gap	Possible actions to address gaps	Examples of projects/ good practices
Marine Strategy Framework Directive	• Lack of data and inability to communicate issues • Complex web of actors • Connecting Science to Policy	• Develop operational guidelines, indicators and tools for GES assessment, coordinated at regional and sub-regional level, and integrated, cost efficient and optimized Monitoring Programmes • Promote technology and new broad scale methods to monitor the sea • Support coordinated management measures	STAGES Project
Coastal observatories	• Data accessibility • Coordination of observations	• Establish a smart(er) observation system & new ways of mapping the seas • Create new deep ocean observation platforms, providing real-time data • Comply with OGC standards providing free access to data • Develop local operational oceanographic models: nesting, data assimilation, coupling to biological models	N/A
Measurement of ecosystem impacts	• Understanding behaviour and impacts	• Understand how ecosystems work and their natural cycles • Measure/model the consequences of global change and multiple impacts • Improve knowledge of the connections between humans and the sea • Devise and compare options for sustainable use and conservation	N/A
Role of technology platforms	• Sustainable, competitive and efficient fish and seafood in the whole chain	• Focus on energy efficiency in fisheries, from the sea/farms to the shop • Develop future fishing Vessel Technologies • Tackle fishing discards from a research and innovation perspective	N/A

Responding to threats and emergencies

This session focused on maritime observation networks and the importance of cooperation and a common governance framework.

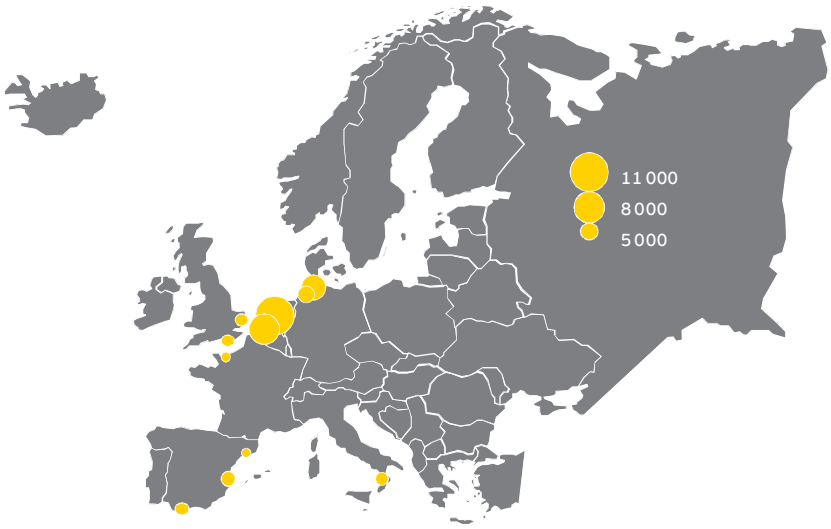
Theme	Gap	Possible actions to address gaps	Examples of projects/ good practices
Policy framework	• Institutional challenges • 3 and 4 D rights regimes, externalities	• CISE, surveillance and observations, safety risk prevention, pollution control, invasive species	N/A
Cooperation across levels and borders	• Unclear governance • Fragmentation of efforts	• Common governance framework, e.g. – collaboration for optimum distribution of response equipment and environmental protection • Involve all stakeholders • Promotion of innovation networking and clustering more focused political and social science research	N/A
Comprehensive maritime safety information system (decision support system)	• Transition from knowledge generation to decision support • Need real time data to identify suspicious patterns and raise alarms	• Framework for R&I on data fusion, knowledge generation, decision support • Cloud based (delivered over a network) • Understanding of vessel behaviour • Sharing of surveillance information with appropriate authorisation • Services catalogue • Assess risks of marine accidents	N/A
Enhancing observation networks and algorithms	• Multi-role patrol vessel coverage • Autonomous vessels for collision avoidance	• CCTV for fisheries monitoring • Use buoy networks in deep-seas • Maximising opportunities from GMES/Copernicus • Ship detection for small, wooden vessels • Improve Sat-AIS detection	N/A
Environmental knowledge and protection	• Knowledge of ecosystem impacts • Knowledge transfer and applications	• Recognition of biodiversity as critical infrastructure • Enhance ecosystem knowledge • Translating knowledge to practical applications • Common approach to invasive species	N/A

Atlantic Ports

Snapshot of Europe's ports

Europe's coastlines (over 100 000 km) are home to more than 1 200 merchant ports across 22 Member States, making it one of the most dense port regions worldwide[29]. These ports are key components of a broader transportation network that is vital to the functioning of Europe's economy, with almost 90% of the EU external freight trade being seaborne and 40% of intra-EU trade short sea shipping[30]. In 2010[31], over 3,6 billion tonnes of goods were handled in and over 400 passengers passed through European ports[32]. Europe's ports have historically developed in their own diverse ways due to the variety of geographic characteristics, type of traffic handled, markets served and long-standing local political and economic cultures. Today, the industry is remarkable for its vast array of organisational and legal models and approaches to port financing and port governance.

Figure 1: Europe's top ten ports by containers handled in TEU (twenty-foot equivalent units)



Source : Eurostat/Ernst & Young

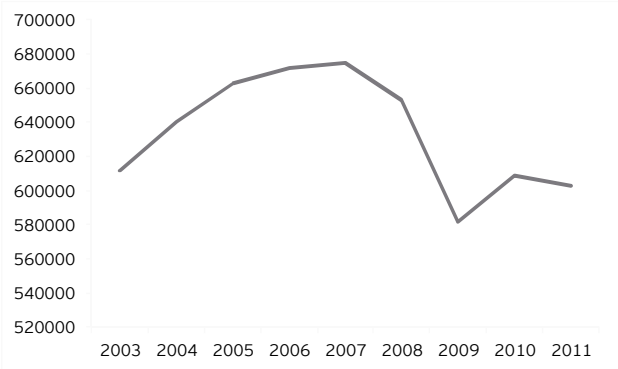
A large part of shipping activity is centralised in a small number of mega-ports due to their proximity to major European production and consumption markets in the North West of Europe. These mega-ports have grown exponentially over the past decade (Rotterdam, Hamburg, Antwerp…). In the first quarter of 2012, Europe's top five ports in terms of gross weight of all goods handled accounted for almost 25% of all goods handled in the EU that same quarter[33].

Atlantic ports

[29] *Commission communication on a European ports policy COM(2007) 616 final*
[30] *idem*
[31] *Most recent data as at January 2012*
[32] *Eurostat, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Maritime_ports_freight_and_passenger_statistics#Further_Eurostat_information*
[33] *Idem*

Northern European ports have historically limited the growth of Atlantic ports and today their proximity to key markets and integration into global supply chains gives them a huge competitive advantage. Nonetheless, Atlantic ports constitute an important part of goods handled in the EU, with 13,3% of short sea-shipping in 2010 passing through ports in the region and almost 17% of all goods handled in European ports[34]. The Atlantic region does not host any of Europe's mega-ports, but can rather be characterised by a number of significant smaller ports. Another notable characteristic is the diversity of ports, with fishing ports, trade, civil or military naval industry, and sites dedicated to recreational and leisure activities and innovating maritime technologies. These ports are an important source of employment, income and dynamism for local economies. On the EU level, ports are a direct and indirect source of over half a million jobs. The following graph shows the effects of the economic crisis on Atlantic ports, which plunged to pre-2003 levels over the span of just two years, putting further economic stress on the region's ports.

Figure 2: Total good loaded and unloaded in Atlantic region ports (thousands of tonnes)



Source: Eurostat/Ernst & Young

In this challenging economic environment, ports must better anticipate and adapt their services and infrastructures to a rapidly changing market and environmental conditions. However, the economic crisis has only made more apparent, difficulties that had been identified by the industry. A 2007 public consultation of stakeholders by DG MOVE found a number of obstacles, specifically capacity shortages in some areas, environmental concerns and the need for more efficient ports.

Addressing these challenges is essential for Europe and for the Atlantic region, because Europe's competitiveness and economic and social integration are increasingly dependent on the conditions of ports, with nearly 90% of EU external freight and 40% of freight exchanges between EU Member States being seaborne. Logistics such as transport and storage account for 10–15% of the cost of a finished product for European companies[35]. Furthermore, small and medium sized ports connect peripheral EU regions, relieve congestion, by reducing the burden on larger ports and are key for the future expansion of more environmentally modes of transport such short sea shipping.

EU Port Policy

The constitution of a European Port Policy has been a lengthy and often times difficult process. During the first decades of European integration the prevailing opinion was that ports, unlike other industries, could develop without being subject to supranational policy setting common rules and practices[36]. However, economic and

[34] *Idem*
[35] *COM(2006) 336 final, Freight Transport Logistics in Europe – the key to sustainable mobility, Brussels, 28.6.2006*
[36] *Pallis, A.A. and Verhoeven, P. (2009), Does the EU Port Policy strategy encompass 'proximity'?*

political developments have gradually pushed the boundaries of port policy making to include the EU level. Political evolutions include the gradual establishment of a true common market with the dismantling of tariff and nontariff barriers and mutual recognition of national standards, which greatly enhanced the freedom of movement of goods, services, people and capital. The 1987 Single European Act paved the way for stronger supranational cooperation, with all transport related decisions henceforth taken by qualified majority voting instead of unanimity. As European markets integrated and the EU became increasingly implicated in port policy making, interaction within the industry intensified and Europe saw the development of transnational industry associations to defend interests in the sector.

In the early 1990s Europe embarked on elaborating its first common transport policy, with the objective of developing a coherent European infrastructure network, notably through the idea of the Trans-European Transport Networks. Then, in 1997, the Commission adopted its first publication solely focused on ports, the Green Paper on Sea Ports and Maritime Infrastructure, which focused on port financing and charging, the integration of ports in the TEN-T and market access to port services. The next important milestone was the Commission's proposal for a port services directive that would open up market access to the provision of port services in all European ports with international traffic. This directive failed twice to secure necessary political support in the European Parliament and was officially withdrawn by the Commission in 2006.

Following the two successive setbacks for the port services directive, the Commission conducted an extensive stakeholder consultation process that led to the elaboration of a communication on European Ports Policy in 2007, which also figures in the Commission's integrated maritime policy. The policy seeks to facilitate the coherent and sustainable development of the European port system and ensure a level playing field.

Baseline situation and trends

Role of ports in the Atlantic region

Importance of small and medium sized ports in the Atlantic region

The table below lists the major Atlantic ports in comparison to their European counterparts. Three ports in the Atlantic Member States rank amongst the 20 largest cargo ports (short and deep sea freight), and they are relatively small in comparison to the largest maritime hub in Europe, Rotterdam. Other significant Atlantic ports include Southampton, Nantes Saint-Nazaire, Sines and Rouen. Marine transportation is dominated by few major ports and shipping companies and a host of smaller ports and SMEs.

Table 6: Atlantic ports amongst the largest European ports in 2011; the freight they handle, their size compared to the largest European port - Rotterdam - and their ranking in terms of size

Atlantic port	Gross weight of goods, thousand tonnes, 2011	Size compared to Rotterdam	European rank in 2011	European rank in 2002
Le Havre, FR	63,383	17%	7	6
Milford Haven, UK	48,699	13%	15	18
Dunkerque, FR	40,841	11%	20	12
Southampton, UK	37,878	10%	21	19
Nantes Sainte-Nazaire,	29,935	8%	28	22
Sines, PT	24,871	7%	34	36
Rouen, FR	23,275	6%	37	38

Source: Eurostat (mar_mg_am_pwhc)

View from a passenger perspective, Atlantic ports are also modest, unless the English Channel/Manche statistics are considered. In 2011, in terms of number of passengers embarking and disembarking, there were 3 Atlantic/Channel ports in the European top 20, as indicated below.

Table 7: Atlantic ports amongst the largest European passenger ports in 2011; number of passengers embarked and disembarked (in 1000)

Atlantic port	Passengers 1997	Passengers 2011	European rank in 2011
Dover, UK	21,236	12,918	1
Calais, FR	20,060	10,063	5
Santa Cruz de Tenerife, ES	3,980	4,305	19

Small and medium sized ports play a vital role in Europe's transport network and economy, on the regional level in particular. However, the increasing concentration of port activities in mega-ports and the economic crisis have put economic strains on smaller ports. While the Atlantic's ports have not been spared, they possess important assets that will help them develop and stay relevant in the coming years.

- Serve specific niche markets and have considerable expertise, such as fishing ports, trade, civil or military naval industry, recreational and leisure ports and site dedicated to innovative maritime technologies.
- In many cases, they are the sole source of commodities for isolated communities and provide crucial access to outside markets
- Help promote a balanced freight flow and provide congestion relief to major intermodal gateways and are the key to expanding the overall efficiency of Europe's marine motorways, and ultimately the entire transportation system.
- In the Atlantic region, ports are well placed to receive ships coming from the American and African continents and relieve the pressure on the cross-Channel and the North Sea maritime traffic.
- Provide redundancy and resiliency for emergencies situations and supply chain disruptions at larger ports and are important in order to be able to quickly respond to maritime security issues.
- Atlantic ports are important sources of development potential for local communities, providing income streams, not just from traditional port activities, but also new para-port activities, such as tourism and marine leisure, renewable industries, research, surveillance and security. Furthermore, while they are relatively underdeveloped compared to other regions in Europe, they have the 'space' to sustainably develop a set of diversified activities.

Regional cooperation

Cooperation in the region is more developed than many of Europe's other sea basins, through forums such as the Atlantic Arc Commission and its subsidiary Conference of Atlantic Arc Cities, however, there is room for improvement. Cooperation has the potential to deliver results in several key areas in particular.

- Cooperation in the development of strategic infrastructure, such as the region's proposal for an Atlantic freight corridor, 'continental gates', logistic and storage infrastructure and 'motorways of the sea'. This type of infrastructure requires a strategic vision for the region and deep cooperation among stakeholders
- Development of new blue industries, such as aquaculture (and expansion into offshore sites), renewable sea energies, seabed mining, etc require well orchestrated regional cooperation, particularly concerning spatial planning, in order to achieve a high level of efficient resource utilisation.

Atlantic Gateway project

The Atlantic Gateway (originally known as the Ocean Gateway) is an ambitious and controversial private sector led redevelopment strategy for the North-West of England (Merseyside through to north Cheshire, Chester, Halton and Warrington into Greater Manchester), the UK's second most important economic area after London. The project has 50 billion pounds of financial backing, making it one of the largest redevelopment plans in the UK's history. The intention is also to create, on the back of these developments, a new strategic focus for promoting regional growth. As such, the concept is being promoted by NWDA and GONW regional development offices. Major infrastructure investments will include extensive redevelopments of Liverpool's port and the Manchester Ship Canal, led by a leading private real estate, transport and infrastructure company. Further capital investments will be focus on the strand between Liverpool and Manchester and the construction of two new ports. The project hopes to rebalance the economy by attracting investment and talent to the area, relieve road congestion from goods being transported from the south and promote sustainable growth through investment in emerging local industries and renewable energy projects. Promotional material for the project reckons that by 2030, there is the potential for some 250,000 new jobs to be created in the Atlantic Gateway area and around 140,000 of these jobs will be associated with Atlantic Gateway priority projects, involving 14 billion GBP of new investment.

However, the project has attracted some scepticism, particularly from the Manchester City Council, which has called into question the idea of linking the Liverpool and Manchester's economic futures, as two politically, economically and socially distinct cities. Furthermore, council documents have pointed to a wider lack of evidence to support the concept of the Atlantic Gateway and a lack of analysis of the costs and benefits, nor of the scale of any public intervention which is likely to be required.

Connecting ports with the hinterland...

Role of Atlantic ports in the TEN-T network

Transport is a strategic sector, fundamental to all economic activity and itself an important component of the European economy. According to the Commission, freight traffic is expected to increase almost 80% and passenger traffic by more than 50% before the year 2050 and, at the same time, Europe has set ambitious objectives to reduce its carbon footprint substantial, reducing greenhouse gas emissions by 20 – 30% by 2020. Constructing a more coherent and sustainable transport system can contribute substantially to the sustainable development of transport in Europe and reducing environmental costs through efficiency gains and promoting and facilitating the use of alternate transport means, particularly for freight. Port related traffic alone constitutes a significant portion of European traffic, estimated that some 603 billion inland tonne kilometres generated annually within the EU territory from seaborne freight[37].

Together, the Member States of the EU comprise some 5 000 000 kilometres of paved roads, 212 800 kilometres of rail lines and 42 709 kilometres of navigable inland waterways[38]. Much of this infrastructure was developed by national policy makers and often with little regard for intra-European interconnection. In order to establish a single, multimodal network integrating land, sea and air transportation throughout the entire EU, policymakers established the trans-European transport network (TEN-T) in the 1990s, with the goal of eliminating barriers to uninterrupted network access

Initially TEN-T policy did not include ports, because of the indecisiveness of European policy makers to become involved in the sector and staunch industry opposition. However, since 2001[39], after a compromise with industry

[37] *Ports and their connections within the TEN-T, 2010*
[38] *DG MOVE*
[39] *Decision No. 1346/2001/EC*

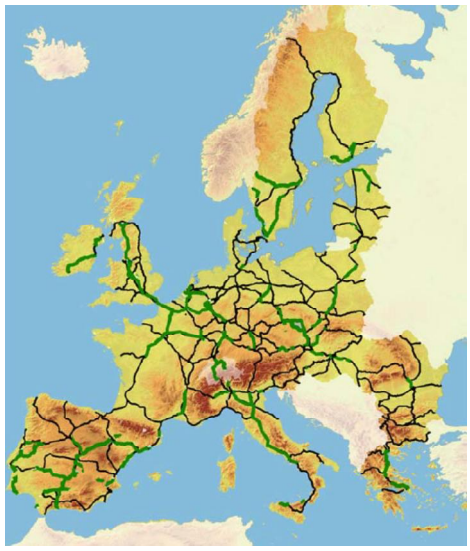
leaders, TEN-T policy has reflected the importance of the ports sector within the development of the trans-European transport infrastructure, as a driver of economic growth, economic cohesion and the alleviation of inland congestion, with almost all commercially significant included in the TEN-T network. However, very little funding has been allocated to port infrastructure projects, although some ports have benefited from TEN-T support through major railway investments.

Increased focus on ports for 2030

In 2011, a Commission proposal put forth a new set of guidelines for determining the infrastructure of the TEN-T within which projects are identified. The new policy sets out a much more restrained 'core' transport network for Europe to be completed by 2030 and a comprehensive network to be completed by 2050. This dual approach aims to focus spending on a smaller number of projects where real EU added value can be realised. Seaports feature prominently in the new TEN-T framework. 83 ports and port clusters were selected as part of the core network including around 20 in the Atlantic region.

The map illustrates the prioritised land corridors and port infrastructure in the Atlantic area. It is clear that major investments along the Atlantic can be expected towards 2030 and pre-identified core projects comprise both a port/rail upgrades between Lisbon (Sines port) and Strasbourg and between Dublin via the Channel to Paris and Brussels[40].

Figure 3: TEN-T core network in 2030 (bold lines indicate projects completed in 2011), *Source: DG MOVE: Connecting Europe: Putting Europe's economy on the move. 2011*



Today, bottlenecks, missing links and inefficient capacity management continue to act as an obstacle to the smooth flow of traffic in Europe. Technical barriers, such as railway gauges, electrification and traffic management systems persist. Imbalances in infrastructure endowment are also impeding economic and social cohesion by limiting access to markets. Ports in particular will need to take a central position in the integration of Europe's transport system. Currently, only 35 ports are considered to be well connected to the land network.

[40] DG MOVE: List of pre-identified projects on the core network in the field of transport, 2011 (http://ec.europa.eu/transport/themes/infrastructure/connecting/doc/revision/list-of-projects-cef.pdf)

TEN-T extends beyond ports…

Short-sea shipping and motorways of the seas

With forecasts showing that transport demand will continue to grow, policymakers in Europe have recognised that the optimum use should be made of all forms of transport and maritime transport figures importantly in that equation. The Atlantic region in particular, with its dense network of smaller ports and the remoteness of some parts of the region is well placed to capitalise on the development of short sea shipping (SSS). SSS is the maritime transport of goods over relatively short distances, as opposed to the intercontinental cross-ocean shipping or traditional land-based modes. Currently, Atlantic ports only feature once among the top 20 European SSS ports, in terms of gross weight of goods in Mio tonnes in 2010. Le Havre features in the 8th spot, accounting for 38.3 mio tonnes in 2010, however experiencing a 5.6% decrease from 2009.[41]

This form of transport has garnered increasing attention on the European level, because it is highly efficient in terms of environmental performance and energy efficiency. Developing SSS in Europe has the potential to solve, or at least considerable reduce, road congestion problems that affect many parts of the European continent. Since the 1990s, policymakers have been active in identifying and trying to remove barriers to growth in this industry.

In its Transport White Paper of September 2001, the Commission proposed the development of "Motorways of the Sea" as a "real competitive alternative to land transport." To help these lines develop, the White Paper states that European funds should be made available. These "motorways of the sea" should be part of the Trans-European network (TEN-T). A 2003 programme for the promotion of short sea shipping identified important barriers to growth including better integration in door-to-door supply chains, reduction of administrative complexity and promoting port efficiency and laid out 14 actions aimed at improving the efficiency of this mode of transport and overcoming obstacles to its development and . A year later, in 2004, "Motorways of the Sea" were linked to the greater project of the Trans-European Transport Networks (TEN-T). Article 12a of the TEN-T regulation sets out three main objectives for SSS: freight flow concentration on sea-based logistical routes, increasing cohesion and reducing road congestion through modal shift. Motorways of the Sea project can benefit from TEN-T funding and are also one of the new types of actions eligible for EU funding under the second Marco Polo Programme, a market-oriented support programme financing innovative actions to promote short sea shipping and intermodal services which shift freight off the road

Figure 4: Motorways of the Sea of Western Europe

[41] Eurostat (http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:EU-27_Top_20_SSS_ports_in_2010_(gross_weight_of_goods_in_Mio_tonnes).PNG&filetimestamp=20120410155043)

Four corridors have been designated for the setting up of projects of European interest

- Motorway of the Baltic Sea (linking the Baltic Sea Member States with Member States in Central and Western Europe, including the route through the North Sea/Baltic Sea canal) (by 2010);
- Motorway of the Sea of western Europe (leading from Portugal and Spain via the Atlantic Arc to the North Sea and the Irish Sea) (by 2010);
- Motorway of the Sea of south-east Europe (connecting the Adriatic Sea to the Ionian Sea and the Eastern Mediterranean, including Cyprus) (by 2010);
- Motorway of the Sea of south-west Europe (western Mediterranean, connecting Spain, France, Italy and including Malta and linking with the Motorway of the Sea of south-east Europe and including links to the Black Sea) (by 2010).

For short sea shipping to be competitive, the preservation of a larger number of smaller but well equipped ports is essential and the Atlantic region provides the ideal underlying infrastructure for the development of the sector.

Blue belt project

Because customs cannot be certain that a ship entering an EU port has not visited a non-EU port during its voyage, short sea shipping is in principle subject to the same controls as deep sea shipping upon arrival in the port of call, although these procedures are simplified to a certain extent in many cases. Blue belt is a pilot project being implemented by the European Maritime Safety Agency that aims to explore new ways of promoting and facilitating short sea shipping through helping customs officials better assess risk when short sea shipping vessels arrive in their port of call.

Around 250 'blue ships' were selected to participate in the pilot project on a voluntary basis. The movement of the ships is then monitored using the SafeSeaNet system, the EU's vessel traffic monitoring and information system, and customs officials in ports of call will receive a timely notification of the vessels arrival in port, allowing them to benefit from an added degree of certainty with regards to the participating ships voyage, as well as information on previous voyages and ship owners will benefit from faster processing of good through customs.

Port governance in transition...

Ports developed very differently across Europe, depending on the type of traffic they handled, geographical location, markets served and local economic and political traditions. Researchers often refer to governance traditions such as the 'Hanseatic' tradition of local municipal governance dominant around the Baltic and North Sea, the 'Latin' tradition of state governance, common in France and Mediterranean countries and the 'Anglo-Saxon' tradition of independent governance[42]. While the development of the common market and an embryonic ports policy on the European level have ironed out some of the diversity, strong regional distinctions still remain and the industry is a patchwork of different management approaches. Furthermore, as the environment in which ports operate changes, port authorities are having to make existential decisions about the roles they will play in developing their ports in the future.

Approaches to governance

A number of different management models have been developed over the years for ports. A 2007 World Bank

[42] *European Port Governance, ESPO fact finding report*

report laid out four general categories into which management approaches can be classified. Each model has its own set of characteristics concerning, ownership of port land, provision of port services, infrastructure, superstructure and equipment and other characteristics such as labour policies.

The quickly evolving environment in which ports function has put strong pressure on the traditional role of port authorities, which has subsequently changed significantly over the past two decades. The broad trend has seen a shift from purely public to more private roles, although, responses have been conditioned by cultural inclinations as to whether the role of port authorities ought to be restricted to relevant enforcing regulation or should be to more actively participate as a market player. The landlord model is now the most common paradigm throughout Europe.

As approaches to port governance have evolved, so have the roles played by port authorities. Researchers have identified four 'roles' played by authorities (Verhoeven 2010).

- Landlord
- Regulator
- Operator
- Community Manager

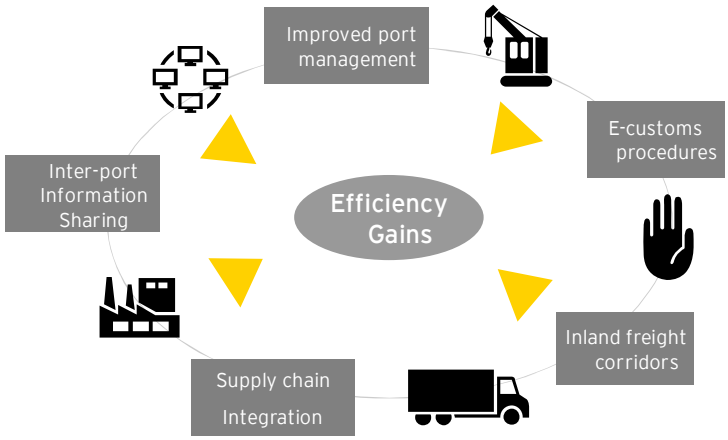
This fourth role very much stems from the changing nature of port communities and stakeholders. Ports are increasingly major nodes in a complex web of transport and product supply chains. As they integrate into wider hinterlands, ports are becoming clusters of a wide array of different actors from logistical service providers to transporters. It is now more important than ever that authorities focus on facilitation of the port community, problem solving and maintaining good relations with external stakeholders. Heightened competition between ports is pushing authorities well beyond the confines of their ports in order to develop and maintain good transport links between the port area and the hinterland.

As an example of port coordination, in France, there is an Atlantic Region Inter-Port Coordination Board, whose role is to harmonize and to promote the development of the Ports of Bordeaux, La Rochelle and Nantes – Saint Nazaire.

Promoting innovative ports...

Intelligent, eco-friendly ports

The management of ports is challenging due to the complexity of operations in ports with multiple actors and processes. Environmental concerns and under-capacity in some ports are forcing port authorities to take innovative approaches to making ports more 'eco-friendly' and finding efficiency gains. The future competitiveness of Europe's maritime industries and their ability to address these environmental and productivity concerns will be influenced to a high degree by research and innovation in the sector. New investments have the potential to lead to innovative types of vessels, safer vessels, advanced propulsion systems, higher energy efficiency and more environmental protection. Furthermore, integrating advanced 'intelligent' information technologies systems can enhance the functioning of ports, sharing of information between ports and more effectively integrate the maritime transport industry into the logistic chain. Enhanced management and control also extend beyond port authorities to customs procedures and beyond the port itself to traffic management inland.



Inter-port information sharing

Major ports and port actors, such as logistics supply companies very often employ advanced information systems in the daily conduct of operation, but these systems are usually not interoperable, which prevents economies of scale, and smaller ports and companies are often not equipped at all with these systems. Generally, at each port call, the same data must be entered several times, often manually, which raises the potential of errors and delays. In order to improve the information exchange of the port-related supply chains, many ports around the world have begun developing port community systems, platforms for information exchange for the port community. Once these systems have been put in place, there is theoretically no more need for bilateral communications, because each port-related actor sends its information to the central system, which can be accessed by other actors to get the information they need.

Improved port management

Port traffic management systems reduce the transit time of goods in ports, lowering costs for transporters and increasing profits for port authorities. As ports have grown and the economy has become ever more globalised, management of ports has taken on a new dimension of complexity. The number of actors has proliferated and ports themselves, as crucial intermodal gateways, are now highly integrated into global supply chains.

E-customs procedures

The Customs Union is one of the fundamental pillars of the Europe, at the heart of the Internal Market. EU Customs services handle nearly 20% of total world imports. Current practices in customs procedures and processes are generally complicated and based on paper declarations. The Commission has adopted an electronic customs initiative[43] that aims to establish a secure, interoperable electronic customs system for the exchange of the data. E-Customs means using information technology systems to collect and store customs information and duties and the use of technology to control the flow of goods and persons in and out of Member States. This initiative, and the employment of integrated technologies in Europe's ports that can efficiently handle the flow of goods while securing Europe's borders, have the potential to reduce costs for transporters, industry and consumers.

Inland freight corridors

Some active port authorities are beginning to take proactive action outside of their own ports, including addressing hinterland bottlenecks and investments in hinterland networks. On the European level, freight corridors, particularly rail, are priority investments and will help to relieve congestion on roads and reduce the environmental costs associated with inland transport. The Atlantic Arc Commission is currently promoting an Atlantic region freight corridor its hopes will contribute to the sustainability of freight transport in the region and the creation of a more competitive logistics offering for regional companies. Advanced information technology systems can also help reduce congestion and environmental costs in the hinterland through better management of freight corridors. In this domain, promoting the use of alternative inland transport, such as short sea shipping and rail, can play an important role in relieving congestion on Europe's motorways and reducing environmental costs.

Supply chain integration

Information sharing is essential for effective supply chain management providing the basis for the control of upstream and downstream logistics-related operations and for seamless integration of the supply chain as a whole. Good information sharing systems prevent uncertainty related to lead times, capacity availability and product quality, improves coordination, decreases supply chain costs, and makes it possible to respond to changing customer needs more quickly.

[43] *Decision 70/2008/EC*

Europe promoting innovative ports

The European Commission supports innovation and technological development in maritime transport sector through its multi-annual framework programmes and RTD platforms, such as the Waterborne Technology Platform and specific initiatives such as Marco Polo.

Maritime transport administrative procedures can be complex, time-consuming and are still often done on paper, particularly in smaller ports. The EU e-Maritime initiative has been implemented with the goal of fostering the use of advanced information technologies in the maritime transport sector. Ports in particular stand to gain considerably in efficiency through implementation of innovative technologies for port management, inter-port communication and integrated management of supply chains and freight corridors. Major European ports already have advanced information systems that can deliver considerable quality and efficiency gains, however, the interoperability between port information systems is practically non-existent and small ports might not be equipped with electronic data transmission at all.

E-navigation in the Baltic Sea

Over the past decade, growing economic activity in the region has led to increased traffic in the Baltic Sea. EfficienSea, a project financed by the ERDF's Baltic Sea Programme and managed by the Danish Maritime Safety Administration, aims to improve maritime safety and environmental sustainability as traffic increases in the Baltic Sea through accident prevention, mitigation and development of best practices.

One of the major themes of the EfficienSea project is e-Navigation, the harmonised collection, integration, exchange, presentation and analysis of maritime information onboard and ashore by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment.

Work Package 4 of the project aimed to provide the Baltic Sea countries and the European community with a comprehensive best practice demonstration of the e-Navigation concept in order to facilitate the further development and full scale implementation of the concept. This encompassed establishing e-Navigation trial zones where service providers could deploy and test trial versions of their products and services, and where these can be assessed by real users. The demonstration is expected to help prepare and mature as many stakeholders as possible for undertaking their roles in the future full scale deployment of e-Navigation systems.

Work Package 5 involved the evaluation of existing vessel traffic data and the development of new tools, facilitating efficient coastal zone management. The aim was to improve data bases and prediction tools on maritime traffic (including AIS management, numeric traffic simulation and environmental effects) and to establish spatially corresponding geographical, biological and coastal zone user data in order to provide the basis for further enhanced efficiency of maritime traffic while adhering to principles of safety and environmental sustainability.

Challenges and gaps

The Atlantic region's ports present an enormous opportunity for the region. They are the region's gateway to the rest of the world, are strategically placed to take play a role in the development of a number of new blue industries and provide the infrastructure needed for the expansion of short sea shipping in the region. Ports are have also been undergoing a period of fundamental change and are facing a number of new challenges that require innovative solutions. For example, how can ports adapt the way they operate to more effectively manage activity and how can ports respond to environmental concerns and contribute to Europe's engagement concerning the reduction of greenhouse gases?

The following points summarize a number of gaps that have been identified across the issues that were discussed in this report.

- While TEN-T policy has reflected the fundamental position that ports occupy in Europe's transport system as major intermodal gateways, investment in hinterland linkages has been underdeveloped, creating bottlenecks in the inland transport system and leading to inefficient capacity utilisation.
- Short sea shipping (SSS) has long been recognised as having the potential to reduce congestion in Europe's main ports and motorways, and providing an efficient and environmentally friendly alternative to traditional transport modes. However, the mode remains underdeveloped, due to a number of obstacles, including integration in the supply chain, administrative complexity and lack of investment in port infrastructure and management systems necessary to handle large amounts of short sea traffic.
- Historically, the Atlantic region's ports have been small compared to Northern European ports, which have long attracted the majority of the continents shipping traffic. While the region's ports may be smaller, they are incredibly diverse and possess many strategic advantages for alternative marine industries, which have yet to be fully exploited. There is a strong tradition of cooperation, however, the ambitions of the Atlantic strategy have outgrown that cooperation and new efforts are needed.
- The European port landscape has historically been diverse, in terms of modes of financing and management. While the political and economic upheavals of European integration have brought port 'proximity' to a never experienced level, approaches to port management remain quite variable across the EU. This diversity is an advantage, but it also complicates the emergence of a strong European ports policy, which could provide considerable value-added. Port authorities' approaches to governance are also radically changing as they seek to deal with increased competition and evolutions in the industry. More than ever, stakeholders can benefit from this heterogeneity of experience in order to identify best practices and innovative new approaches and cooperate on issues of industry-wide concern.

Potential areas for future action

Investments in transport linkages with the hinterland are needed...

Now that ports have taken a more prominent place in the TEN-T policy emerging for the next multiannual financial framework, the financing opportunities need to be translated into concrete projects and collaboration. The Atlantic region port in particular could benefit from better hinterland linkages, ensuring cost-efficient transport options for local business.

Short sea shipping can reduce congestion and lower environmental costs....

It is clear what needs to be done to unlock the growth potential in the short sea shipping sector. Administrative procedures are burdensome and the 'motorways of the sea' concept is not sufficiently integrated into supply chains. However, substantial investment has not been made in bringing this concept to fruition. The Atlantic region has to port infrastructure to benefit from an expansion of this sector. Concerted regional investment and strategic planning could send the necessary signals to industry that policymakers are serious about promoting and facilitating short sea shipping.

Ports are important elements of regional development

Ports offer a multitude of economic potential, particularly the Atlantic's ports, which have the capacity to sustainably develop, are rich in their diversity and individual expertise and well placed to capitalise on the development of new blue industries. The approach must be comprehensive, bringing all stakeholders, including local government, port authorities and other industry actors and cover the entire spectrum of development possibilities in order to ensure diverse and sustainable growth prospects. Building on the strong foundation of cooperation that already exists in the region is also essential to the future success of the Atlantic's ports. In turn, ports are a unique opportunity for the region as a whole, not just localities with substantially sized ports. They are the gateway to the outside world, particularly well placed to tap into traffic from the Americas.

The role of port authorities is changing....

Local port authorities must adapt to changing circumstances and reach beyond their 'comfort zone'. More and more, authorities are acting a 'community managers', going beyond the classic roles of regulator/landlord and actively addressing bottlenecks, lobbying and investing in hinterland transport infrastructure. In order to do this, local regulatory and political conditions need to be in place to allow local authorities to take a proactive role in the development of ports.

Innovation is needed to improve efficiency and capacity utilisation...

Innovation will be crucial in providing the efficiency gains needed to sustainably develop capacity and reduce the

carbon footprint of ports and the wider supply chain. Responsibility to act lies in a number of different hands. European policymakers must leverage EU added-value to the maximum, investing in infrastructure projects that will make a significant difference. Hinterland networks, despite being on the agenda for over a decade, remain underdeveloped. Secondly, the EU and Member States should continue laudable effort to incorporate advanced technologies into customs procedures in ports, helping reduce down time and more effectively secure Europe's maritime borders. Finally, port authorities themselves must integrate new technology and cooperate through information sharing initiatives. This will increase the efficiency of the entire system and better integrate the process into the supply chain.

The table below presents a number of financing instruments identified for ports in the period 2014-2020.

Table 8: Possible financing instruments of the EU - COM proposal

Financing instrument	Budget (2014-2020)	Specific relation to Atlantic ports
Connecting Europe Facility (CEF)[44]	€50 billion	€31.7 billion to upgrade Europe's transport infrastructure, build missing links and remove bottlenecks. 80% of this money will be used to support: 1) Core network projects priority projects along the 10 implementing corridors on the core network. Funding will also be available for a limited number of other sections projects of high European added value on the core network. 2) Funding for horizontal projects – all of which are these are IT related The remaining funding can be made available for ad hoc projects, including for projects on the comprehensive network. €9.1 billion for trans-European infrastructure, helping to meet the EU 2020 energy and climate objectives.
Private funding	N/A	Diversified sources of finance both from public and private sources are required to support the growth and efficiency of ports. What are the key elements for unlocking the potential of public and private finances for ports? What about of strategic planning & sound economic assessment of port projects? There is a very strong leverage effect from TEN-T funding. Experience in recent years shows that every 1 million euros spent at European level will generate 5 million from Member State governments and 20 million from the private sector.

[44] http://europa.eu/rapid/press-release_IP-11-1200_en.htm?locale=FR

Workshop report: summary of key discussion themes

This session focused particularly on repositioning Atlantic smaller ports in order to provide opportunities for growth and investment. Ports governance and electronic ports management systems were also highlighted as key ingredients to render Atlantic ports attractive to operators.

Theme	Gap	Objectives / possible actions to address gaps	Examples of projects/ good practices
Ports governance	• Different governance models within same jurisdiction – barrier to modernisation	• Promote new models, such as Portuguese model of merging port authorities (Lisboa and Setubal in 2013), to better serve clients	New port governance model in Portugal – Public owned but operated by a Port Authority – Landlord model
Key positioning of Atlantic ports	• Container traffic is lagging behind • Need to attract traffic through infrastructure investments	• Develop integrated transport approach – rail, road and overland transporters • Establish new transport networks, railways, to link with hinterland • Relieve congested road traffic • Develop short sea shipping terminal infrastructure • Introduce specific pricing policy and promotion • Drive cooperation with dry ports and other ports • Develop transatlantic trade – US, Canada – and 'round the world' shipping services • Reinforce the important role of smaller ports in the region	e-puerto bilbao – single electronic window, simplified operating processes ICCS – Intermodal Corridor Community System
Port Management system	• Lack of interoperability between port systems – series of different systems being used, including unstructured info	• Establish platform to connect the value chain • Develop integrated system from port to customer in hinterland • Promote e-hubs – port one stop shop • Promote logistics single window – avoid using manual processes	Portuguese e-hub brings info on ships, including loading/unloading and declarations, train loading/unloading announcements, transit declarations, customs clearance