Blue Growth

Scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts

Final Report

Call for tenders No. MARE/2010/01

Client: European Commission, DG MARE

Rotterdam/Brussels, 13th August 2012

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ECORYS

About the Consortium

At Ecorys we aim to deliver real benefit to society through the work we do. We offer research, consultancy and project management, specialising in economic, social and spatial development. Focusing on complex market, policy and management issues we provide our clients in the public, private and not-for-profit sectors worldwide with a unique perspective and high-value solutions. Ecorys' remarkable history spans more than 80 years. Our expertise covers economy and competitiveness; regions, cities and real estate; energy and water; transport and mobility; social policy, education, health and governance. We value our independence, integrity and partnerships. Our staff is formed by dedicated experts from academia and consultancy, who share best practices both within our company and with our partners internationally.

Deltares is a leading, independent, research institute and specialist consultancy in matters relating to water, soil and the subsurface. We apply our advanced expertise worldwide to help people live safely and sustainably in delta areas, coastal zones and river basins. Deltares has the knowledge and resources to tackle water and subsurface issues worldwide in an integrated fashion. This means we never focus exclusively on technological issues. Our approach invariably takes account of ecological factors and administrative constraints such as spatial planning, with all the associated policy agendas, competing interests, and legal and economic processes. The integrated application of our various areas of sophisticated know-how, produces solutions that are more sustainable, optimally endorsed by the stakeholders and often, more economical.

Oceanic Développement was founded in 1992 at Concarneau - France, at the core of the European seafood industry, in one of the main fishing ports in France. The company expertise is focused on fisheries and the fishing industry. Since its establishment in 1992, the company gained experience and references on the following areas:

- Consulting: our consulting activity is covering all the fisheries and fishing activities, from the stock evaluation and catches to the marketing via processing, including Monitoring-Control-Surveillance and fishing port management;
- Technical assistance: Oceanic Développement manages scientific observers programs, catches control programs, MCS training programs;
- Expertise and know-how of the company are focused on fisheries sector only.

ECORYS Nederland BV
Watermanweg 44
3067 GG Rotterdam
P.O. Box 4175
NL-3006 AD Rotterdam
The Netherlands
T +31 (0)10 453 88 00
F +31 (0)10 453 07 68
E netherlands@ecorys.com
Registration no. 24316726
W www.ecorys.com

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Preface

More than 70 percent of Earth's surface is covered by water. This truly makes our planet the "Blue Planet". Not only is water a precondition to the existence of life but it also provides resources that directly contribute to our society, ranging from sea transport to the production of raw materials, fisheries, leisure activities etc. The sea is an integral part of the European identity and of the continent's economy. Among the 27 Member States of the European Union, 22 have a coast and two thirds of the European frontiers are set by the sea.

In light of this, it is essential that Europe recognises the true potential of its marine resources and develops an integrated policy that acknowledges the inter-linkages that exist between the different domains and functions of its seas, oceans and coastal areas. The Integrated Maritime Policy (IMP) that has been pursued by the European Commission since 2007 is an important step in realising Europe's future strategies and policies.

The Blue Growth project -"Scenarios and Drivers for Sustainable Growth from the Oceans, Seas and Coasts"- builds on earlier policy initiatives to recognise the potential of these marine resources and thus aids in realising the Europe 2020 strategy towards smart, sustainable and inclusive growth. It identifies areas of where this growth may be realised both on the short and longer term and addresses potential synergies between these functions to secure a blue future for Europe. At the same time it identifies bottlenecks and potential policy interventions to address these. As such is contributes to laying the foundations for a future European Blue growth strategy.

Throughout the project we have spoken to a large number of people from many different organisations and stakeholder representations. In addition we have received an extensive feedback from people and organisations on the subject in writing. We would like to express our gratitude to all people who have shared their valuable insight with us on the matter.
It should be noted that this report represents the views of the consultant, which do not necessarily coincide with those of the European Commission.

Rotterdam/Brussels/Delft/Concarneau, August 2012

The Blue Growth Consortium:

- Ecorys
- Deltares
- Océanic Développement

Executive Summary (short)

Introduction

The 'Blue Growth' initiative aims to elaborate the maritime dimension of the Europe 2020 strategy. Blue Growth is hence defined as "*smart, sustainable and inclusive economic and employment growth from the oceans, seas and coasts*". The starting point for the Blue Growth project is the grounded belief that seas, coasts and oceans can play a pivotal role in the solutions to many of the above challenges and tensions. In order to take advantage of their future potential, maritime economic activities need to be combined – smart combinations taking advantage of synergies and building critical mass. Innovation is key to this. Above all, maritime economic activities need to be sustainable – an integrated approach with a long-term focus and responding to the world's resource, climate and environmental challenges. It requires adequate support from local, national, EU and international policies. And maritime economic activities need to be inclusive – providing employment opportunities and promoting full participation – especially from local and coastal populations. The main aim of the Blue Growth project is to provide policy-makers at EU and sea-basin level with a comprehensive, robust and consistent analysis of possible future policy options to support such smart, sustainable and inclusive growth from the oceans, seas and coasts.

The Blue Growth project thereto:

- provides insight into the state of the art within maritime sectors;
- presents knowledge of innovation and technological developments that influence these sectors;
- creates an understanding of key external drivers that influence their potential;
- identifies key economic areas for the future sustainable growth of oceans, seas and coasts; and
- assesses the impacts of policy interventions that may contribute to reaping the existing potential.

The project was compiled by Ecorys in partnership with Océanique Développement and Deltares from December 2010 to August 2012.

Unexplored oceans and seas in the EU equates to underexplored economic potential

More than 70% of the earth's surface is covered by oceans and seas, much of which is either underexplored or unexplored. Oceans and seas also form an integral part of Europe's identity, with currently 22 (23 as of 01/2012 - Croatia) of the EU Member States having coastal territory and with two thirds of the European borders set by the sea. The Blue Growth premise is that oceans, seas and coasts are key contributors in tackling today's longer term challenges, such as globalisation and competitiveness, global warming and climate change. Moreover, the oceans and seas play a crucial role in terms of issues relating to poverty, mobility, and the increasing scarcity of natural resources and vulnerability of the planet. Blue Growth provides enormous potential for smart, sustainable and inclusive economic and employment growth – thus Blue Growth comprises the maritime pillar of the Europe 2020 strategy.

Belgian-sized European Blue Economy[1] shows impressive growth rates

In assessing the size of the Blue Economy, a functional approach is preferred over a sectoral approach. A functional approach is centred upon the socio-economic value derived from the major functions related to the oceans, seas and coasts. Many economic activities in Europe are related to the Blue Economy. The current size of maritime economic activities in Europe is estimated at a total Gross Value Added of € 485 billion. A total of 5.4 million people are employed as a result of these economic activities. Economic activities linked to the Blue Economy are not only found in coastal or sea areas, but also includes maritime economic activities located in landlocked Member States. Over the past 5-10 years, the demonstrated annual growth rates for a range of maritime economic activities have been truly impressive. According to Eurostat, some 88 million people work in coastal regions (NUTS III level) and 196 million people (43% of Europe's population) currently reside in such (statistical) regions.

With a large portfolio of varied maritime activities, the Blue Economy can generate further growth

A future-oriented study should not only focus on what is important today, but hone in on what can be expected tomorrow. Overall, the importance of maritime economic activities in Europe is expected to grow by 2020 to an estimated GVA of € 590 billion and to 7 million persons employed. Out of 27 total maritime economic activities, this study focuses on 11 activities which are anticipated to be essential for Europe's Blue Economy – now and into the future.[2] These maritime economic activities have been grouped according to their life cycle stage: mature, growth-stage or pre-development stage.

Mature economic activities – the bedrock of Blue Growth

These mature economic activities currently provide high amounts of added value economic activities and employ substantial numbers of people. The primary challenge of these activities relates to continued performance in the light of strong external pressures and fierce competition from global players. The future of these activities will depend on the strategies and business models implemented as well as the ability of this sector to adopt increasingly sustainable practices and to export to global markets.

Long-term annual growth for **shortsea shipping** is expected in the range of 3-4 % for the coming decade, while employment is expected to remain at the current level of approximately 700,000 people. Although limited funds for fleet replacement are anticipated, opportunities for suppliers related to environmental technologies are expected to be strong.

Offshore oil and gas is a large-scale activity where multinational players possess global reach. With half of all top 'oil majors' located in the EU, the export potential is substantial for both 'oil majors' and companies active in oil and gas technologies, shipping and ports. The challenges facing the offshore oil and gas industry will relate to increasing sustainable practices, improving security and ensuring public acceptance for offshore oil & gas exploration methods.

Coastal tourism alone employs over 2 million people in Europe and provides a mainstay to many local economies, particularly around the Mediterranean Sea. Yet, large portions of the sector will need to adjust their business models in order to address demographic changes and shifts in

[1] Blue Economy means economic activities linked to Blue Growth

[2] This excludes all military activities. Moreover, fisheries have not been specifically addressed in this study, as they have been covered by the Common Fisheries Policy (CFP). This study has sought, however, to identify complementarities and synergies with the CFP where appropriate and relevant.

purchasing power. The future success of coastal tourism is expected to be influenced by visions of (sustainable) value propositions – which may overcome the fragmentation of the industry.

The need for **coastal protection** is expected to expand due to climate change and rising sea-levels. Coastal protection activities, of which EU-players fulfil a crucial role, involve construction, dredging and shipbuilding. Global exports will be a major driver, as public budgets within the EU contract.

Growth-stage activities – creating new jobs right now

Growth-stage maritime economic activities have already attained critical mass, demonstrating growth over the past five years and promising future growth in the years to come. Growth-stage activities have the potential to create immediate employment opportunities in substantial numbers. However, there are important investments and preconditions required, e.g. sound legal framework and supporting infrastructures for the sectors in order to reach the full potential of these activities.

While overall trends indicate that global volumes of marine aquatic products are on the rise, EU-based **marine aquatic products** have fluctuated over the past 10 years. The prospects for marine aquatic products are expected to come from sustainable sources in general and organic aquaculture in particular. Additionally, growing algae shows significant long-term growth potential for a range of sectors including the health and cosmetic industry, the food and feed processing industry, and the green chemistry and energy industries.

Offshore wind is among the robust maritime employment generators, with an estimated 35,000 people employed as of 2010 and with the possibility of employment numbers increasing to 170,000 by 2020. These increases can not only be attributed to the growing share of offshore wind power capacity, but also to the labour-intensity of offshore installation, operation and maintenance. This potential, however, will only come to fruition if a long-term regulatory framework is put into place and the financing of large-scale infrastructure (notably grid connection) is secured.

Although US companies dominate the **cruise shipping** industry, the EU retains a strong global position in both the construction of cruise ships and in terms of attractive destinations and port infrastructures. Employment has grown in Europe from 200,000 in 2000 to 300,000 in 2010 and is expected to further expand to 400,000 in 2020. Much of this growth is dependent upon the sector's ability to develop sustainable business models, to invest in port infrastructure and to address a variety of security concerns.

With an increasing intensity and number of sea activities, **maritime monitoring and surveillance** is expected to play an expanding economic role (with 15-20% annual growth and 7% employment growth). This growth will be driven, above all else, by security, environmental and scientific factors. A dependence on public spending, mostly by Member States, makes such prospects less certain.

Pre-development stage – investing in jobs for tomorrow

The future appears to be bright for maritime economic activities in the (pre-) development stage. However, translating these opportunities into jobs requires concentrated investments in R&D, piloting and testing and is also dependent upon considerable technological breakthroughs. One lingering and critical question pertains to whether European companies and players have sufficient scale to compete with global players who may have spotted opportunities earlier or who have more room to manoeuvre to fund these activities.

Although **blue biotechnology** is currently more of a scientific than an economic sector, its future economic potential is limitless given its ability to generate a wide range of applications. Such applications include the development of new medical molecules, bio-plastics, enzymes and biocides.

The EU is well-placed to take advantage of these opportunities due to high level competencies in research and patenting activities as well as the presence of key commercial players from the cosmetic, pharmaceutical and chemical industries. In this respect, the strong linkages between these industries and the relevant fields of research cannot be understated. Accessing financing for development purposes, engaging companies and fostering a stable regulatory framework are crucial for the growth of blue biotechnology.

Europe has a strong position in **ocean renewable energy (blue energy)**, which is still in an early stage of development and has a strong focus on R&D. Prospects are most promising for the development of tidal current energy, directly followed by wave energy. The key to the future success of blue energy relies upon the rapid development of technological advancements and the successful completion of demonstration projects. Fluctuations in oil prices will have a significant impact on the future of this economic activity.

Although **marine minerals mining** are still in its infancy, economic activities in this area will be driven by expected supply shortages. New technological developments make prospects for sea-bed mining more feasible now than in previous years. By 2020, an expected 5% of the world's minerals located on the sea-bed, e.g. cobalt, copper, zinc and rare earth minerals, could be mined. Although mining companies and investors are often non-European, the EU is strong in dedicating ships, Remotely Operated Vehicles (ROV's), cutters and risers, and integrating all necessary competencies. Uncertainties and concerns linger in terms of the largely unknown environmental consequences and the outcome of current demonstration projects.

The materialisation of the Blue Economy will vary across Europe

The overall potential for the aforementioned maritime economic activities within the framework of the Europe 2020 is significant and genuine. Nonetheless, Blue Growth is expected to materialise in different forms and intensities across Europe's sea-basins. The pace at which development occurs is largely determined by context. For example, an environment conducive to sustainable growth will be most beneficial for Blue Growth. The face of the Blue Economy will also differ widely from place to place. Each of Europe's sea basins has its own economic, social, environmental, geographic, climatic and institutional characteristics that will contribute to a differentiated Blue Growth path.

Europe faces staunch competition in the growing Blue Economy

EU players need to come to grips with the increasing dominance of Asia in a range of maritime activities. Facilitating and supporting sustainable maritime innovations appear to be a classical European remedy - not only in emerging domains. Innovation is even more so the buzzword when it comes to the transformation of traditional maritime economic activities such as green shipping, sustainable tourism, organic aquaculture and even promoting more sustainable forms of business within oil and gas or marine mineral mining.

Acknowledging the knock-on effects for upstream and downstream suppliers

Europe's ability to compete and achieve future success in maritime economic activities, such as cruising, offshore drilling, offshore wind, marine mineral extraction and shortsea shipping, will have important knock-on effects for both upstream and downstream suppliers. Successfully rolling out tomorrow's maritime economic activities will, therefore, have a positive impact on an entire portfolio of other maritime economic activities, namely those of a cross-cutting nature such as shipbuilding, maritime monitoring and surveillance and blue biotechnology.

Commercial exploitation of technological capacity is crucial

The technological capacity of Europe is considered of critical importance in capturing the future growth potential of fast growing or emerging innovative economic activities. In terms of both scientific publications and patents, these activities show robust increases. An analysis of patents and scientific citations demonstrates that the EU possesses excellent academic and scientific capacities in most areas relevant to Blue Growth. However, the potential to commercially exploit these scientific competencies does not always keep pace with the science itself. In this respect, the key strengths of Europe are located in the fields of ocean renewables, offshore wind, aquaculture and oil and gas.

Synergies are crucial for an interdependent Blue Economy

Individual maritime economic activities do not always have the critical mass to prosper alone. Furthermore, conditions for growth are not always realised, particularly if they are located in sparsely populated or peripheral regions of Europe. The potential of Blue Growth can be reinforced by taking advantage of synergies. For example, this study distinguishes different types of synergies such as synergies between shared suppliers, enabling activities, shared (multipurpose) activities, common use of infrastructure, shared input factors, etc. The maximisation of such synergies can often be achieved through maritime clusters.

Maximising synergies through context specific coordination and planning

Synergies occur in situations where combining several maritime economic activities is likely to produce more growth and jobs than the sum of their parts. These kinds of synergies imply a form of orchestrated or spontaneous behaviour between key actors over forms of fragmented behaviour. In theory, an endless number of possible synergies exist; however, these interactions only tend to take place if maritime actors can work together in an intelligent and open manner. By analysing case studies from Ireland, the Gulf of Venice, Gdansk and Oostende, this report illustrates that identified synergies are not always as strong and impressive as expected. This underperformance can often be attributed to a pillarised and sectoral approach. Taking advantage of opportunities for synergies requires that the specifics of each location, area or coastal region will need to be reflected upon and adequately addressed. Making the most of potential synergies also requires support from the proper maritime spatial planning authorities and targeted local development strategies. Maritime spatial planning is essential in avoiding tensions or addressing specific bottlenecks which may occur at a specific location.

Priorities and the future of Blue Growth

The objective of the Blue Growth initiative – the maritime pillar of the Europe 2020 strategy – is to promote smart, sustainable and inclusive growth and employment opportunities in Europe's maritime economic activities in the short-, medium- and long-term time frames. The Blue Growth initiative specifically aims to promote synergies and foster framework conditions that support specific maritime economic activities and their value chains. Concretely, this translates into a particular emphasis on activities in the (pre-) development stage and targets the level of sea-basins, maritime clusters and localities.

Blue Growth requires a range of framework conditions to be fulfilled, most obviously: adequate infrastructure (including transport infrastructure, but also high-voltage and cross-border electricity grids) and highly skilled staff with access to low skilled workers. Other essential conditions include: public acceptance, a solid international legal framework regarding the international waters and good governance at local and regional levels. At the same time, it should be recognised that choices will need to be made in contexts where space is limited and the combination of all activities is not feasible. These realities require clear (maritime) spatial planning and spatial development initiatives.

CONCLUSION

The extensive review and analysis of Europe's Blue Growth potential has confirmed the potential of the Blue Economy as an untapped resource. The reader can find in the main report in-depth sector information on performance, value chains, main drivers and framework conditions for the sector developments. This is juxtaposed with a geographical approach, presenting the sea-basins and their idiosyncrasies with respect to Blue Growth. Of particular relevance for policy-makers is the section on synergies and tensions between maritime economic activities, since it puts Blue Growth in a wider economic development context. Finally, a thorough review of this report sheds light onto further areas for policy action. These include:

I) Promote maritime Research & Development – in particular for the pre-development maritime economic activities to bridge the gap between research and market uptake;
II) Boost access to finance – to foster maritime economic actors in the pre-development stage and to help overcoming the "valley of death";
III) Invest in smart infrastructure – for the mature maritime economic activities to flourish further;
IV) Provide maritime cluster support – to have more critical mass of actors, also across EU Member States;
V) Anticipate maritime skills needs – and attract skilled workers also in remote and peripheral places;
VI) Promote maritime spatial planning – to overcome the increasing complexity of maritime spatial use and to increase public acceptance for pre-development and growth-stage marine economic activities;
VII) Foster integrated local development – for a sustainable development of Blue Growth;
VIII) Stimulate public engagement – a vital ingredient to fully unleash the Blue Growth potential.

Some of these areas, such as accessing finances or integrating local development, are not necessarily specific to maritime economic activities. Still, it is important to bear in mind that the context for such policies needs to be tailored to the maritime environment which most typically includes remote, sparsely populated areas. These areas retain specific challenges for the development of maritime economic activities. The study confirms that Integrated Maritime Planning should continue developing further its overall direction towards Blue Growth objectives.

The detailed annexes provide more detailed information and are aligned to the main final report.

Executive Summary (long)

I. Blue Growth – a new pathway in Europe's future

1. More than 70% of the Earth's surface is covered by oceans. The sea is an integral part of Europe's identity, with 22 of the 27 Member States having a coast and two thirds of European frontiers being set by the sea. Oceans, seas and coasts can offer an essential contribution in tackling today's longer term challenges, such as globalisation and competitiveness, global warming and climate change, but also poverty and mobility, increasing scarcity of natural resources and vulnerability of the planet, urbanisation and concentration in coastal regions and demographic change. Keeping our seas healthy is a pre-condition for the long term sustainable exploitation of the possibilities it offers.

2. The starting point for the Blue Growth project is the grounded belief that seas, coasts and oceans can play a pivotal role in the solutions to many of the above challenges and tensions. In order to take advantage of their future potential, maritime economic activities need to be combined – smart combinations taking advantage of synergies and building critical mass. Innovation is key to this. Above all, maritime economic activities need to be sustainable – and be built on an integrated approach with a long-term focus and responding to the world's resource, climate and environmental challenges. It requires adequate support from local, national, EU and international policies. And maritime economic activities need to be inclusive – providing employment opportunities and promoting full participation – especially from local and coastal populations.

3. The main aim of the Blue Growth project is to provide policy-makers at EU and sea basin level with a comprehensive, robust and consistent analysis of possible future policy options to support such smart, sustainable and inclusive growth from the oceans, seas and coasts. The Blue Growth project thereto:
   - provides insight into the state of the art within maritime sectors;
   - presents knowledge of innovation and technological developments that influence these sectors;
   - creates an understanding of key external drivers that influence their potential;
   - identifies key economic areas for the future sustainable growth of oceans, seas and coasts; and
   - assesses the impacts of policy interventions that may contribute to reaping the existing potential.

   The project was executed by Ecorys in partnership with Deltares and Océanique Développement from December 2010 to August 2012.

4. The Blue Growth initiative forms an important contribution to the Europe 2020 strategy. Blue Growth is part of this strategy by offering the maritime elaboration of smart, sustainable and inclusive economic and employment growth from the oceans, seas and coasts. The project is also building and expanding on earlier policy initiatives. These include the Commission's Integrated Maritime Policy (2007), the Marine Strategy Framework Directive (2008) and the EU's programmes directed at promoting marine and maritime research and innovation, as well as a whole body of other initiatives.

II. The importance of the European Blue Economy

5. Many economic activities in Europe are related to the Blue Economy. Throughout Europe, according to Eurostat some 88 million people are working in (NUTS III) regions classified as coastal. And 196 million people (43% of Europe's population) are living in these regions. Furthermore, economic activities linked to the Blue Economy are not only found in coastal or sea areas, but may also include economic activities that are located in landlocked Member States, but are directly linked to marine and maritime economic activities. These facts make the measurement of the importance of the European Blue Economy a daunting challenge.

6. As a response, this project has assessed the Blue Economy through a functional approach – rather than a pillarised or sectoral one. Our functional approach is centred upon the socio-economic value derived from the major functions related to the oceans, seas and coasts. It allows for an inclusion of all economic activities in Europe related to the Blue Economy, also those beyond the coastal areas. It rightly excludes economic activities in coastal areas which are not maritime at all.

7. Our approach takes as a starting point the socio-economic value that is derived from the major functions that are related to the oceans, seas and coasts. Six major functions can be distinguished: maritime trade and transport; food, nutrition and health; energy and raw materials, living working and leisure in coastal regions and at sea; coastal protection and nature development and maritime monitoring and surveillance. In each of these functions, full account is taken of the value chains that are developed across a range of sectors, countries and regions. Particular attention has been paid to upstream and downstream activities, such as the construction of ships, which is important for several of the value chains identified.

8. Statistical data are not made to cover such a functional approach. Nevertheless, we have estimated that the Gross Value Added of maritime economic activities amounts to € 485 billion – exceeding the national income of a country such as Belgium. The employment related to these activities amounts to 5.4 million people. Annual growth rates for a range of maritime economic activities have been truly impressive over the last 5-10 years. These figures exclude military activities. Furthermore, fisheries are not specifically covered in this study either, as they are covered by the Common Fisheries Policy - an important complementary policy context. However the study has sought to identify complementarities with the CFP where appropriate and relevant, and tried to identify existing or new synergies with it.

9. The findings show a diverse mix of activities not only in size but also in their stages of development. Blue Growth applies to mature activities, such as shortsea shipping, offshore oil and gas, coastline tourism and coastal protection. It also applies to activities in their growth stage such as marine aquatic products, offshore wind, cruise shipping and maritime monitoring and surveillance. Finally, Blue Growth includes the newly emerging maritime economic activities in so-called pre-development areas. These are already present today, but are above all important as they are expected to hold an important promise towards Europe's future economy: blue biotechnology, ocean renewable energy and marine minerals mining are the one's that have been studied.

10. The importance of the European Blue Economy has also been assessed on the basis of the research and innovation performance, as these hold the key to creating a future Blue Growth potential and in establishing a strong competitive position of Europe. An analysis of patents and publications data in the above-mentioned maritime domains shows a strong increase in both patent and publication activities. Performance is especially strong in (pre)development and growth areas. Europe's strong knowledge base in these maritime areas is above all confirmed by its leading position in scientific citations. In terms of actual innovations or commercialisations, as indicated by the number of patents, Europe's position is clearly less dominant. Nevertheless, Europe still has a leading position in patent applications within wind energy and renewable ocean energy, as well as marine aquatic products and in the field of oil and gas.

III. The future potential

11. The main focus of the Blue Growth project has been to assess the future potential of Europe's Blue Economy. This future potential is determined by various factors which are both related to external drivers (such as climate change adaptation, ageing population, technology changes) as well as the internal response capacity and the competitive position of Europe's industry overall. For example Europe's position in oil and gas is very strong as a result of the solid global position of European companies in this field.

12. Overall, the importance of maritime economic activities in Europe is expected to grow by 2020 to an estimated GVA of € 590 billion and to a total of 7 million persons employed. Out of 27 total maritime economic activities, this study focuses on 11 activities which are anticipated to be essential for Europe's Blue Economy – now and into the future.[3] These maritime economic activities have been grouped according to their life cycle stage: mature, growth-stage or pre-development stage. The key conclusions per economic activity, including the challenges they face, are summarised below.

IV. Mature economic activities – the bedrock of Blue Growth

13. These mature economic activities currently provide high amounts of added value economic activities and employ substantial numbers of people. The primary challenge of these activities relates to continued performance in the light of strong external pressures and fierce competition from global players. The future of these activities will depend on the strategies and business models implemented as well as the ability of this sector to adopt increasingly sustainable practices and to export to global markets.

14. Long-term annual growth for **short-sea shipping** is expected in the range of 3-4 % for the coming decade, while employment is expected to remain at the current level of approximately 700,000 people. Although limited funds for fleet replacement are anticipated, opportunities for suppliers related to environmental technologies are expected to be strong.

15. **Offshore oil and gas** is a large-scale activity where multinational players possess global reach. With half of all top 'oil majors' located in the EU, the export potential is substantial for both 'oil majors' and companies active in oil and gas technologies, shipping and ports. The challenges facing the offshore oil and gas industry will relate to increasing sustainable

[3] As mentioned, this excludes all military activities and fishery activities.

practices, improving security and ensuring public acceptance for offshore oil & gas exploration methods.

16. **Coastal tourism** alone employs over 2 million people in Europe and provides a mainstay to many local economies, particularly around the Mediterranean Sea. Yet, large portions of the sector will need to adjust their business models in order to address demographic changes and shifts in purchasing power. The future success of coastal tourism is expected to be influenced by visions of (sustainable) value propositions – which may overcome the fragmentation of the industry.

17. The need for **coastal protection** is expected to expand due to climate change and rising sea-levels. Coastal protection activities, of which EU-players fulfil a crucial role, involve construction, dredging and shipbuilding. Global exports will be a major driver, as public budgets within the EU contract.

V. Growth-stage activities – creating new jobs right now

18. Growth-stage maritime economic activities have already attained critical mass, demonstrating growth over the past five years and promising future growth in the years to come. Growth-stage activities have the potential to create immediate employment opportunities in substantial numbers. However, there are important investments and preconditions required, e.g. sound legal framework and supporting infrastructures in order to reach the full potential of these activities.

19. While overall trends indicate that global volumes of marine aquatic products are on the rise, EU-based **marine aquatic products** have fluctuated over the past 10 years. The prospects for marine aquatic products are expected to come from sustainable sources in general and organic aquaculture in particular. Additionally, growing algae shows significant long-term growth potential for a range of sectors including the health and cosmetic industry, the food and feed processing industry, and the green chemistry and energy industries. In the latter segments, significant technological and growth breakthrough are expected around 2025-2030.

20. **Offshore wind** is among the robust maritime employment generators, with an estimated 35,000 people employed as of 2010 and with the possibility of employment numbers increasing to 170,000 by 2020. These increases can not only be attributed to the growing share of offshore wind power capacity, but also to the labour-intensity of offshore installation, operation and maintenance. This potential, however, will only come to fruition if a long-term regulatory framework is put into place and the financing of large-scale infrastructure (notably grid connection) is secured.

21. Although US companies dominate the **cruise shipping** industry, the EU retains a strong global position in both the construction of cruise ships and in terms of attractive destinations and port infrastructures. Employment has grown in Europe from 200,000 in 2000 to 300,000 in 2010 and is expected to further expand to 400,000 in 2020. Much of this growth is dependent upon the ability to develop sustainable business models, to invest in port infrastructure and to address a variety of security concerns.

22. With an increasing intensity and number of sea activities, **maritime monitoring and surveillance** is expected to play an expanding economic role (with 15-20% annual growth and 7% employment growth). This growth will be driven, above all else, by security, environmental

and scientific factors. A dependence on public spending, mostly by Member States, makes such prospects less certain.

VI. Pre-development stage – investing in jobs for tomorrow

23. The future appears to be bright for maritime economic activities in the (pre-) development stage. However, translating these opportunities into jobs requires concentrated investments in R&D, piloting and testing and is also dependent upon considerable technological breakthroughs. One lingering and critical question pertains to whether European companies and players have sufficient scale to compete with global players who may have spotted opportunities earlier or who have more room to manoeuvre to fund these activities.

24. Although **blue biotechnology** is currently more of a scientific than an economic activity, its future economic potential is limitless given its ability to generate a wide range of applications. Such applications include the development of new medical molecules, bio-plastics, enzymes and biocides. The EU is well-placed to take advantage of these opportunities due to high level competencies in research and patenting activities as well as the presence of key commercial players from the cosmetic, pharmaceutical and chemical industries. In this respect, the strong linkages between these industries and the relevant fields of research cannot be understated. Accessing financing for development purposes, engaging companies and fostering a stable regulatory framework are crucial for the growth of blue biotechnology.

25. Europe has a strong position in **ocean renewable energy (blue energy)**, which is still in an early stage of development and has a strong focus on R&D. Prospects are most promising for the development of tidal current energy, directly followed by wave energy. The key to the future success of blue energy relies upon the rapid development of technological advancements and the successful completion of demonstration projects. An increase (or less likely a decrease) of oil prices will have a significant impact on the future of this economic activity.

26. Although **marine minerals' mining is** still in its infancy, economic activities in this area will be driven by expected supply shortages. They include so-called critical raw materials, which are likely to be faced with geo-political or geological shortages, while vital for future (high-technology) commercial applications and products. New technological developments make prospects for sea-bed mining more feasible now than in previous years. By 2020, an expected 5% of the world's minerals located on the sea-bed, e.g. cobalt, copper, zinc and rare earth minerals, could be mined. Although mining companies and investors are often non-European, the EU is strong in developing and producing dedicated ships, Remotely Operated Vehicles (ROV's), cutters and risers, and integrating all necessary competencies. Uncertainties and concerns linger in terms of the largely unknown environmental consequences and the outcome of current demonstration projects.

VII. The Blue Economy will unfold in different ways across Europe

27. As the above overview points out, the overall potential for these maritime economic activities is clearly significant and genuine. Nonetheless, the pace at which developments materialise is strongly determined by the long term scenario in which these will be positioned. A sustainable growth scenario will be most conducive to Blue Growth, while fragile economic recovery in combination with limited global emphasis on sustainability would put a break on many of the above developments. Much will depend on the (long) time horizon of stakeholders and investors – especially for those activities in an early stage of development.

28. Also clear is that Europe will be far from alone when faring on the world's oceans and seas, and EU players need to come to grips with the rising dominance of Asia in a range of maritime areas. EU players need to come to grips with the increasing dominance of Asia in a range of maritime activities. Facilitating and supporting sustainable maritime innovations appears to be a classical European remedy - not only in emerging domains. Innovation is even more so the buzzword when it comes to the transformation of traditional maritime economic activities such as green shipping, sustainable tourism, organic aquaculture and even promoting more sustainable forms of business within oil and gas or marine mineral mining.

29. Furthermore, Blue Growth is expected to materialise in different forms and intensities, depending on the sea basins concerned. After all, each of the European sea basins has its own economic, social, environmental, geographic, climatic and institutional characteristics that need to be taken into full account.

30. The **Baltic Sea** region has experienced economic prosperity and the highest GDP growth in the EU since the late 1990s. However, there are large disparities within the sea basin with a clear east/west divide. Shortsea shipping, coastal tourism and cruise tourism are the most important activities. The sea basin faces a range of environmental pressures, including excess nutrients causing eutrophication and algal blooms. Cooperation between governments is relatively strong, and Baltic Member States also adopted an EU Strategy for the Baltic Sea Region.

31. The **North Sea** has long been a host to important European shipping lanes as well as a major fishery area. The sea is also a popular destination for recreation and tourism and has become a rich source for oil and gas, offshore wind and tidal power generation. Environmental concerns include the presence of hazardous substances as well as persistent organic pollutants. The North Sea is part of the OSPAR area – an intergovernmental body of 15 countries as well as the EU.

32. The **North-East Atlantic Ocean** provides economic value through a range of maritime activities. More than a third of the value of the maritime sector in the North-East Atlantic is generated by coastal tourism and shipping, with tourism and the fishing industry being the largest employers. Fishing is highly significant in certain parts. Norway's offshore oil and gas industry ranks among the largest in the world. The maritime transport and seafood sectors are important for Ireland, and in France, Portugal and Spain coastal tourism is the largest employer of the maritime industries. Across the area new industries are developing, with marine renewable energy (wind, wave and tidal energy production) being the fastest growing activity in coastal and offshore waters. Pressures on species and habitats are important in the Celtic Seas and the Wider Atlantic, while the Bay of Biscay and the Iberian coasts suffer from eutrophication and pollution from shipping. OSPAR is an important inter-governmental mechanism. The EU Maritime Strategy for the Atlantic Area proposes a coherent and balanced approach to this sea basin.

33. The **Mediterranean Sea** is the world's largest and deepest enclosed sea. Drawing upon its geographical location at the crossroads of three continents, the surrounding countries attract 30% of global international tourism arrivals – which makes coastal tourism and yachting hugely important. Shortsea shipping, oil and gas, cruise and port cities, aquaculture and fisheries are other important economic activities, while security and surveillance is an important cross-cutting activity. Pollution related to urbanisation and industrial activities, overexploitation of fisheries resources and threatened marine and coastal habitats are amongst the most

important environmental challenges. The sea basin is governed by several conventions, strategies and programmes, including the ENPI Partnership Instrument.

34. The **Black Sea** and the surrounding region have undergone major socio-economic changes over the past 20 years with mixed outcomes and partial successes. Important economic activities are shortsea shipping, offshore oil and gas exploration and coastal tourism. Additional sectors are fishing, land based industry, military uses and infrastructure. Aquaculture has become important in Turkey and Bulgaria. The Black Sea ecosystem has deteriorated severely since the 1960s, due to overexploitation coupled with adverse environmental conditions including the manipulation of hydrological regimes of out flowing rivers. The six neighbouring countries ratified the Convention on the Protection of the Black Sea against Pollution in 1992.

35. The **Arctic Sea basin** is characterised by strong future potential combined with exceptionally high environmental vulnerability. The projected climatic changes in the Arctic, particularly a decrease in sea-ice extent and thickness, will provide fresh opportunities for mineral resource development, oil and gas development, (cruise) tourism, and commercial fishing. But pollution related to these activities is a major environmental concern, as resilience of the Arctic ecosystem is low. The Arctic Council is the main intergovernmental body addressing these challenges.

36. The **Outermost Regions** add an exclusive economic zone which equals the combined area of the Mediterranean and Baltic Seas. Strategic activities for the Outermost Regions could be research facilities (on geology, oceanography, biodiversity, blue biotechnology, ocean renewable energy), and monitoring and surveillance (maritime traffic, pollution control, fisheries control and illegal immigration – specifically at the Canary Islands). The full-scale development of such activities will be subject to the improvement of accessibility of these regions, as well as the sustainable exploitation of coastal tourism, fisheries and aquaculture. In addition, due to their remote location and higher price levels for many goods and services (including energy and water) they form an ideal platform for piloting new technologies. Many of the Outermost Regions are vulnerable to natural and man-induced disasters. Climate change and sea level rise may affect them all. OSPAR covers the Azores, but not Madeira and the Canaries.

VIII. Synergies and tensions

37. Individual maritime economic activities do not always have the critical mass to prosper alone. Furthermore, conditions for growth are not always realised, particularly if they are located in sparsely populated or peripheral regions of Europe. The potential of Blue Growth can be reinforced by taking advantage of synergies. In the Blue Economy, synergies are therefore not a luxury but a pre-condition for future growth and development.

38. Important maritime economic activities which already have such critical mass are shortsea shipping, cruising, offshore drilling, offshore wind and coastal tourism. Such activities can have substantial knock-on effects for both upstream and downstream suppliers. Successfully rolling out tomorrow's maritime economic activities can, therefore, have a positive impact on an entire portfolio of other maritime economic activities, namely those of a cross-cutting nature such as shipbuilding, maritime monitoring and surveillance and blue biotechnology.

39. Different types of synergies have been identified in this study. They include:
    - Shared suppliers: several economic activities make use of similar inputs (e.g. shipbuilding as input to cruise shipping, shortsea shipping, coastal protection, offshore wind, offshore oil and gas, and marine mineral mining);

- Enabling activities: an activity which provides conditions for the development of another activity (e.g. blue biotechnology allows for bioremediation of oil and gas fields, which suffer from pollution and spills);
- Shared (multipurpose) activities: one activity serving several maritime functions (e.g. the use of exploration ships for oceanographic research, the search for active substances from marine creatures (blue biotechnology), oil and gas, as well as marine minerals);
- Common use of infrastructure, including ports but also offshore islands (e.g. offshore islands, which can host wind turbines, ocean renewable energy sources as well as algae growing, while simultaneously providing coastal protection);
- Shared input factors, including specialised workers such as maritime engineers (e.g. engineers in offshore oil are also servicing the offshore wind sector, and vice versa);
- Alignment of environmental impacts; common output-input relations contribute to increased sustainability – in the spirit of 'cradle-to-cradle' concepts.

40. Next to synergies, tensions may exist between different maritime economic activities directly, but also indirectly, for example if one activity puts pressure on the marine environment – thus compromising the potential of another activity. Most tensions are spatial in their nature. Hence a strong link exists with maritime spatial planning to address these tensions. An optimal strategy aims to avoid tensions and to optimise synergies.

IX. Maximising synergies through clusters

41. The maximisation of such synergies can often be achieved through promoting maritime clusters. By analysing case studies from Ireland, the Gulf of Venice, Gdansk and Oostende, this report illustrates that identified synergies are not always as strong and impressive as expected. This underperformance can often be attributed to a pillarised and sectoral approach. Taking advantage of opportunities for synergies requires that the specifics of each location, area or coastal region will need to be reflected upon and adequately addressed. The case studies point to a range of findings that can be of use to other maritime clusters and regions.

42. **Blue Growth is relevant both to traditional and new economic activities.** In Gdansk and Venice, the importance of traditional maritime sectors such as short-sea and deep sea shipping, a number of industrial complexes as well as cruise tourism are high and dominating over sectors that have developed more recently. In Italy the role of ‘new’ activities is particularly small compared to the other clusters, and one may question the need for a diversification strategy to increase resilience against future decline scenarios. In Galway and Oostende the role of traditional activities is much smaller (although a sector like coastal tourism is large everywhere) and developments are largely driven towards a further increasing development of new activities like ocean renewable energy and blue biotechnology.

43. **Periods of economic decline can enhance openness and willingness to embrace new maritime economic activities.** Several maritime regions have faced economic decline in the past, causing high levels of unemployment and forcing the regions to search for alternative job creating activities. But as all case studies have demonstrated, such decline can also lead to an openness and willingness to embrace new maritime economic activities. For example offshore wind and research institutes in Oostende, and manufacturing of luxury yachts and wind turbines in Gdansk.

44. **Cooperation can take place at various geographic levels**. In a country such as Ireland, a strong national guidance is found with national strategies in place, from which regions (e.g. Galway) can benefit. In Italy the regional governments are more important especially with regard to spatial planning issues, whereas in Oostende the developments are strongly locally steered. In Poland, an in-between situation is in place with Gdansk and Gdynia together with Sopot cooperating with the Voivodship and with gradually strengthening ties with the national policy makers. Furthermore the region is very actively participating in Baltic Sea cooperation partnerships and projects. In some regions strong intra-regional cooperation is found, as is the case in Poland where Gdansk and Gdynia ports are cooperating actively and each playing their role with regard to strength of the one port vis-à-vis the other. In Italy this is much less found with low levels of synergies between Venice and other regional ports like Triest or Koper.

45. **Policies focusing on maritime clusters can make a difference.** In both Oostende and Galway, the strategy to develop emerging sectors, driven through the establishment and support of research institutes 'pulling the wagon', has turned out to be successful by creating critical mass in the region. In the tri-city region of Gdansk, Sopot and Gdynia, an active Voivodship policy to develop a Pomeranian maritime cluster has been set-up. Furthermore there are plans to improve rail and inland waterway links with hinterland regions, notably the Warsaw area. In Oostende the cluster is rather well developed as is the case in Ireland.

46. **Addressing tensions – a vital part of managing Blue Growth.** Competition for space is an issue in all regions, and seems most problematic in the Gulf of Venice, where coastal tourism competes with all other activities on an intensively used coastline. The problem is most urgent on the Slovenian coast where on a stretch of only 47km all activities are to be accommodated. Furthermore, the coastline is vulnerable to erosion. Besides the provinces developing spatial plans – largely separating activities – the dedicated institutes of ISPRA (in Italy) and NMSPF (in Slovenia) coordinate and monitor developments. The MOSE project aiming to protect the Venice Lagoon is a specific addition to this.

47. **A call for Blue Growth leadership.** As a corollary, a need for leadership emerges, for Blue Growth to be advanced in practice. An obvious starting point when looking for such leadership is port authorities, which in many ways are well-suited to promote Blue Growth. However, the case studies point to the fact that leadership can come from various organisations, such as a research institute (Ireland), a region (Gdansk), or a port and city (Oostende). A good starting point for bringing Blue Growth to Europe would be to organise a specific communication campaign, stimulating Blue Growth platforms and initiatives, and accrediting already existing initiatives. These need to be part of a more comprehensive policy agenda, which will be elaborated in the next Chapter.

X. Ways forward

48. The objective of the Blue Growth initiative – the maritime pillar of the Europe 2020 strategy – is to promote smart, sustainable and inclusive growth and employment opportunities in Europe's maritime economic activities in the short-, medium- and long-term time frames. The Blue Growth initiative specifically aims to promote synergies and foster framework conditions that support specific maritime economic activities and their value chains. Concretely, this translates into a particular emphasis on activities in the (pre-) development stage and targets the level of sea basins, maritime clusters and localities.

49. Blue Growth requires a range of framework conditions to be fulfilled, most obviously: adequate infrastructure (including transport infrastructure, but also high-voltage and cross-border electricity grids) and highly skilled staff with access to low skilled workers. Other essential conditions include: public acceptance, a solid international legal framework regarding the international waters and good governance at local and regional levels. At the same time, it should be recognised that choices will need to be made in contexts where space is limited and the combination of all activities is not feasible. These realities require clear (maritime) spatial planning and spatial development initiatives. Based on the analysis of the Blue Growth potential, a number of main areas for policy actions have been identified. These areas for policy action do not point to the needs of much additional regulation, but clearly express a need to offer the appropriate set of framework conditions to facilitate Blue Growth.

50. **Promote maritime Research & Development.** New sources of growth are triggered by continuous innovation. At the same time innovation activates labour productivity improvements which have a direct impact on economic growth. Hence research, development and innovation are at the heart of any Blue Growth strategic framework. In addition to existing policy initiatives, specific Blue Growth Policy Actions are suggested to focus on the development of a structural approach that could further promote maritime R&D but also enhance business innovation. These include:
    - Creation of critical mass in R&D funding by linking up EU, Member States and private funds in a better way and establishing appropriate collaboration of R&D networks;
    - Specifically address synergies already in the R&D stage (e.g. inventions that can benefit multiple economic sectors);
    - Strengthen the path from R&D to innovation and implementation;
    - Integrate the environmental sustainability aspect within R&D initiatives;
    - Data provision and specific RDI support in promising economic activities;
    - Exploration of a possible marine Knowledge Innovation Centre (KIC).

51. **Boost access to finance.** The future development potential of a Blue Growth strategy strongly depends on the ability of the economic actors to find a business model which fits the developmental stage and the global developments. Overcoming the “Valley of Death" [4] is critical. Specific additional Blue growth initiatives are:
    - Promote the use of the newly proposed EMFF for Blue Growth;
    - Promote the use of other and existing Structural Funds, notably through the ERDF and the ESF – taking full advantage of the Common Provisions;
    - Explore and promote the use of Horizon 2020 funds for pre-development stage activities, especially for demonstration projects;
    - Promote the use of existing EIB financial support mechanisms that promote access to finance towards Blue Growth activities.

52. **Invest in smart infrastructure.** A range of infrastructure elements are required for the growth and expansion of mature maritime economic activities. Additional investments will be needed particularly in Europe's energy infrastructure, but also accessible high quality port infrastructure is necessary. This may not only require investments in new infrastructure but also ongoing liberalisation and privatisation of port operations. The following activities are deemed to be important for Blue growth:
    - Support investments for an offshore energy grid;

[4] 'Valley of Death' is a phrase used in venture capital to refer to the period of time from when a startup firm receives an initial capital contribution to when it begins generating revenues. During the death valley curve, additional financing is usually scarce, leaving the firm vulnerable to cash flow requirements.

- Remove bottlenecks in existing operating practices that hamper synergies.
- Support investment schemes for port development.

53. **Provide cluster support.** Clusters are primarily market-driven and examples world-wide demonstrate that clusters can provide powerful engines of growth and jobs. Within Europe maritime clusters are seen to be suffering from market fragmentation and weak industry-research linkages. Building on the case studies executed within this project, specific Blue Growth initiatives than can be considered are:
    - Explore the use that can be made of the European Network of Maritime Clusters as well as its limitations;
    - Test the concept of 'maritime clusters' and their implementation in practice;
    - Strongly promote the awareness of Blue Growth to make regional and local stakeholders aware of its possibilities in stimulating new jobs and growth;
    - Promote transnational and transregional exchange of best practices and shining examples;
    - Promote the creation of multi stakeholder initiatives to overcome initial hurdles in creating cluster activities;
    - Support regional cluster analyses to define key strengths and main bottlenecks and define the appropriate cluster approach at a practical level.

54. **Anticipate maritime skills needs.** Shortage of skilled labour is an issue in many maritime sectors in Europe, although differences exist between countries and sectors. With an ageing population, this situation may even be aggravated in the future. Suggested policy initiatives are:
    - Use of the European Social Fund to promote initiatives aiming at the training and increasing awareness at schools and universities for the maritime economy;
    - Strengthen the links between universities and companies;
    - Ensure that the EU Skills Panorama is developed in such a way that it is most beneficial for the maritime sector;
    - Take part in the preparation of the policy initiative regarding the seafaring of workers of vessels in EU labour law bearing Blue Growth aims in mind;
    - Encourage job mobility between various maritime economic sectors at the local level of maritime clusters.

55. **Promote maritime spatial planning**. Expanded maritime economic activities – whether inside or outside the European waters – are likely to generate not only synergies but also tensions: on or around shipping routes and in and near congested ports, but also where renewable energy will be generated, where leisure activities take place, and where natural habitats are to be protected. In view of promoting Blue Growth the following additional suggestions are made:
    - Existing regulation and spatial planning should be assessed on its potentially adverse impacts on limiting new opportunities, but where possible stimulate new opportunities(e.g. design of wind farms);
    - Support a further standardisation of procedures across Europe;
    - Clearly address environmental sustainability in maritime spatial planning, also by internalising costs of economic activities (polluter pays principle);
    - Bundle national MSFD-plans to a EU vision on sustainability;
    - Further research on the relation between specific activities and their environment;
    - Address fisheries in spatial planning e.g. by introducing zoning, and low-impact fisheries;
    - Address the discharge of nutrients and pollutants from land-based sources as it is a primary stressor in many sea basins;

- Although formally not part of maritime spatial planning port planning is seen as an essential area for attention.

56. **Foster integrated local development**. Specific Blue Growth actions could include:
    - Optimise opportunities for promoting local development strategies under the new Structural Funds;
    - Promote best practice exchange of local development strategies across European actors, at the level of maritime clusters;
    - Develop a specific toolkit to bring 'Blue Growth' to maritime clusters, allowing them to take best advantage of Blue Growth opportunities and tailor these to local conditions.

57. **Stimulate public engagement.** Blue Growth should benefit large groups of citizens and stakeholders across Europe. But this is not likely to come by itself. Therefore, public engagement is vital in order to ensure that Blue Growth benefits all. In the Blue Growth project the following additional suggestions have been formulated:
    - Focus on transparency, early involvement, buy-in, added value of local knowledge;
    - Develop leadership and vision;
    - Support clear, feasible methodologies of stakeholder engagement (skills, costs, long term engagement);
    - Incorporate both a top-down and a bottom-up approach in the formulation of Blue Growth;
    - Extend and build on the large body of experience in public participation and engagement of local communities that was developed in the EU Water Framework Directive.

58. Some of the above policy areas, such as accessing finance or integrating local development, are not necessarily specific to Blue Growth. Nevertheless, it is important to bear in mind that such policies need to be always tailored to the maritime environment which typically includes remote, sparsely populated areas. Such areas always have their specific challenges. The study confirms that Integrated Maritime Planning – and particularly maritime spatial planning – can be a powerful tool towards meeting future Blue Growth objectives.

1 Introduction

1.1 Blue Growth – a new pathway in Europe's future?

Europe's long-term challenges are manifold

…Europe's long-term challenges are far from disappearing…

Within the current economic and financial crisis, it is difficult to focus on longer term challenges. Nevertheless, Europe's long term challenges are far from disappearing, even though economic and financial crises are imminent and recurrent. Amongst these longer term challenges are[5]:

- *Globalisation and competitiveness:* in 2025, nearly 2/3 of the world's population will be living in Asia, which is likely to become the first producer and exporter of the world and which catches up or even overtakes the US and Europe in the area of research as well as industrial production; overall, the economic and financial crisis has weakened Europe's competitive position vis-à-vis third countries, notably those in Asia;
- *Global warming and climate change:* climate change is expected to continue unabated and radical changes in production and consumption will be required to keep global warming to acceptable levels. The economic and financial crisis is not helpful in addressing these challenges, and progress in the decarbonisation of the economy has slowed down;
- *Poverty and mobility:* international migration flows will continue to exist and, without an important inflow of immigrants, the European population would start to decrease as from 2012; a third of the world population is undernourished;
- *Increasing scarcity of natural resources and vulnerability of the planet:* new geopolitics of energy are characterised by a relative balance of the strategic importance of the Middle East, Russia and the Caucasus; more than 50% of the major ore reserves are located in very poor countries; three billion people will be lacking water in 2025; and it is essential that Europe's efforts to slow down climate change are taken not only by Europe but especially by other powers;
- *Urbanisation and concentration in coastal regions:* today more than 41 % of the EU population lives in coastal regions[6]. For the coming decades a further concentration of people in these regions is expected. This will increase the pressure on land, fresh water and other resources available in these zones and thus increase the need for integrated policies;
- *Demographic change:* ageing of Europe's population in general and in coastal areas in particular may be a driver for specific maritime economic activities.

Tensions are likely to focus on food, health, energy, raw materials and water.

When these trends continue[7], they will lead to unprecedented tensions between the current methods of production, of consumption and the future availability of non-renewable resources. These tensions are likely to focus on food, health, energy, raw materials, and water. Additional challenges will arise in the areas of trade, investment and Europe's industrial competitiveness, but also in leisure and urbanisation. A continuous search will remain for new energy sources to reduce the dependency on third countries and world regions.

[5] EC DG Research (2009) "The World in 2025: Rising Asia and socio-ecological transition"
[6] Eurostat (2011), Regional yearbook 2011, Ch.13. Coastal regions are referred to as NUTS-3 regions along European coasts
[7] See for example ECORYS (2010) "Analysis of global long-term economic megatrends shaping Europe's future environment". Copenhagen: EEA.

Blue Growth: Oceans, seas and coasts as part of the solution

Blue Growth: smart, sustainable and inclusive growth from the oceans, seas and coasts

These long-term challenges are recognised by the European Union: the Europe 2020 strategy opts for smart, sustainable and inclusive growth as a response. However, the economic and financial crises have eroded our response capacity and our financial means. Hence, there is now a need to approach the Europe 2020 goals from unconventional, integrated and innovative perspectives.

The 'Blue Growth' initiative aims to elaborate the maritime dimension of the Europe 2020 strategy. Blue Growth is hence defined as "*smart, sustainable and inclusive economic and employment growth from the oceans, seas and coasts*". The maritime economy consists of all the sectoral and cross-sectoral economic activities related to the oceans, seas and coasts. While these activities are often geographically specific, this definition also includes the closest direct and indirect supporting activities necessary for the functioning of the maritime economic sectors. These activities can be located anywhere, also in landlocked countries. Hence maritime employment is all the employment resulting from the above activities related to the oceans, seas and coasts.

The starting point for the Blue Growth project is the grounded belief that seas, coasts and oceans can play a pivotal role in the solutions to many of the above challenges and tensions. After all, 70% of the world's surface is covered by oceans, and these vast spaces are yet largely unexplored. In order to take advantage of their future potential, maritime economic activities need to be combined – smart combinations taking advantage of synergies and building critical mass. Innovation is key to this. Above all, maritime economic activities need to be sustainable – an integrated approach with a long-term focus and responding to the world's resource, climate and environmental challenges. It requires adequate support from local, national, EU and international policies. And maritime economic activities need to be inclusive – providing employment opportunities and promoting full participation – especially from local and coastal populations. Blue Growth will not be realised by itself; it requires adequate support from local, regional, national, EU and international-level policies.

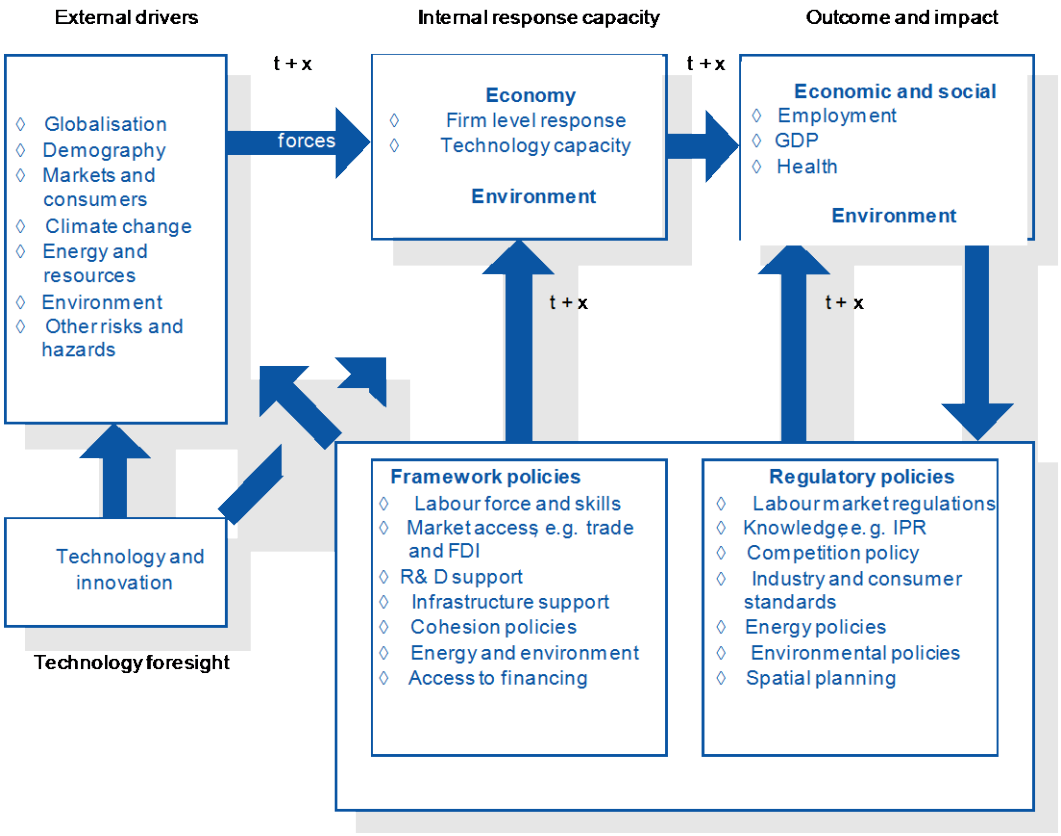
The main aim of the Blue Growth project is to provide policy-makers at EU and sea-basin level with a comprehensive, robust and consistent analysis of possible future policy options to support such smart, sustainable and inclusive growth from the oceans, seas and coasts. The Blue Growth project thereto:

- provides insight into the state of the art within maritime sectors;
- presents knowledge of innovation and technological developments that influence these sectors;
- creates an understanding of key external drivers that influence their potential;
- identifies key economic areas for the future sustainable growth of oceans, seas and coasts; and
- assesses the impacts of policy interventions that may contribute to reaping the existing potential.

1.2 Analytical framework applied

To answer these questions we have adopted an analytical approach which is based on a chain of causal links and takes the best insights from both socio-economic and environmental aspects of sectoral policies.

Figure 1.1 Analytical framework



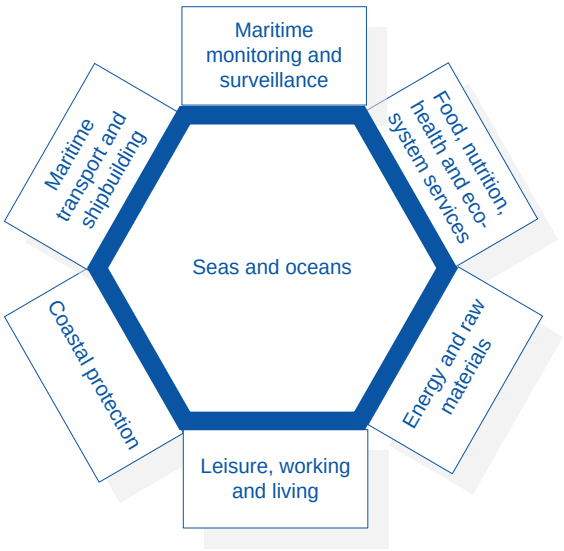
Note: t = time, t + x indicates that impacts may materialise later in time.

Based on this approach the study has been structured in such a way that it links specific tasks to match the analytical approach. Starting point are the maritime functions which are defined as the possible uses of seas and oceans by mankind. The external drivers and technological developments are identified and clustered into scenarios which have a direct influence on the potential of the different functions and the maritime economic activities that are part of them. At the same time policies may be developed which have an impact on realising potentials. The overall impact of both autonomous developments (under different scenarios) and policy interventions are eventually assessed to arrive at overall findings with respect to the Blue Growth potential.

The process of functions and maritime economic activities – going from wide to deep to wide

The Blue growth study has started from the perspective of six global maritime functions: Maritime transport and shipbuilding, Food, nutrition, health and eco-system services, Energy and raw materials, Leisure, working and living, Coastal protection, and Maritime monitoring and surveillance.

Figure 1.2 Maritime functions



These maritime functions have been elaborated and a set of 27 maritime economic activities or sub-functions has been defined. The economic importance of these maritime economic activities is summarized in chapter 2. The distinction of maritime economic activities was necessary as the level of analysis required asked for a more specific assessment than the six global functions did allow for. From these 27 maritime economic activities a selected set has been retained for further in-depth analysis based on their size, growth rate or potential they hold for the future.

As Europe's Blue Grow potential is diverse and differs per region a further analysis is presented of Blue growth activities per sea-basin. This is also related to the notion that synergies between the different economic activities are key in unlocking the full potential which exists. In looking at tensions and synergies the analysis is once a gain widened and looks at all maritime economic activities and not only for the selected ones.

1.3 Structure of the report

First, this report presents the importance of maritime economic activities to date. Based on an understanding of the dynamics, a selection of 11 activities is further assessed in the subsequent chapter. General scenarios are presented and the expectations of the maritime economic activities vis-à-vis these scenarios are elaborated.

In chapter 4, the seven Sea Basins are presented: their characteristics, economic use, environmental state as well as tensions in place and responses to these already taken at sea basin level. Specific attention is given to clusters across the sea basins. The chapter concludes with horizontal findings that feed into the subsequent chapters.

Chapter 5 provides an elaboration of synergies and tensions between the maritime economic activities, as well as geographic synergies and synergies between sea and land-based activities. To illustrate and clarify the interaction between functions and the potential for effective policy intervention for specific regional clusters have been elaborated in chapter 6.

Finally, the report concludes with an exploration of policy initiatives (Chapter 7).

In the Annexes of the report further details are provided on specific issues related to the overall analysis.

2 The importance of maritime economic activities

The potential of the European seas, coasts and oceans is manifold and complex. Economic sectors active on or near the seas are interacting with other sectors in complex value chains. The list of sectors relevant from a maritime perspective is very wide. For these reasons the Blue Growth study has adopted an approach that start from maritime functions. Economic activities in different sectors contribute to these functions in mutual interaction. As such a more complete picture of Blue Growth is presented taking due account of the interdependencies of individual economic activities.

This chapter elaborates the current economic importance of maritime economic activities that established the foundations for future Blue Growth. Is also looks at the current state of research and technology development in these economic activities based on an extensive patent and publication analysis. Finally it gives an indication of the growth potential and increasing relevance towards 2020.

2.1 The broadness of maritime economic activities

For each of the six maritime functions, profiles describing the key characteristics of the function and the main underlying maritime economic activities are drafted. A short summary of each function is provided below.

Function 1: Maritime transport and shipbuilding

This function concerns the transport of goods by sea and the services associated to this. Traditionally, the prime function of seas and oceans is **sea trade and sea transport**. More than 75% of the EU external freight trade is seaborne – and on-going globalisation has made this flow ever more important. Furthermore, short-sea shipping represents 37% of intra-EU exchange in terms of ton-kilometres[8]. This figure will be higher for countries with long coastlines. Sea transport is seen as a relatively sustainable mode of transport although the sector will face significant challenge to improve its environmental performance. The long tradition of sea navigation in many European countries has led to a relatively strong development of **maritime services** that support the sea trade and sea transport function (ranging from brokerage and insurance to classification and inspection, education and R&D). **Sea ports** are also part of the function as nodes of freight handling and concentrations of services as well as employment. Finally, the **shipbuilding industry** contributes to this function by providing the necessary equipment, which does not only cover ships but also the marine equipment in which European industries play an important role (Ecorys, 2009).

Function 2: Food, nutrition, health and eco-system services

This function concerns the capacity of the maritime system to supply resources for direct consumption or for procession into food products or other consumer products. Historically, the **fishing industry** has been at the forefront of this function, providing the market with valuable proteins. Production and employment in this industry have declined over the last 15 years (Anderson and Guillen, 2009). **Marine aquatic products** have evolved from a traditional shellfish base (mussel, oyster) to modern fish operations (salmon, sea bass, sea bream, turbot, cod) which are more resource-intensive (animal feeding, medication, protection, sometimes heat). **Blue**

[8] Eurostat International Trade Statistics; EC, COM(2006)275, GREEN PAPER Towards a future Maritime Policy for the Union: A European vision for the oceans and seas, p8.

biotechnology (exploitation and aquaculture) are still at a very low scale in Europe although some algae products are widely used in the industry (e.g. agar, carrageenan and alginates). Start-up companies are working on the industrialisation of micro-algae growing facilities for producing oils destined to animal feeding, human nutrition (e.g. omega-3 and omega-6) and biofuel production. Other uses for marine resources are the **high value marine resources** for the cosmetics and pharmaceutical industries, which are already using algae components in several products but are also engaged in more R&D to exploit the potential of the marine biodiversity (e.g. research on some marine worms to produce artificial blood).

Function 3. Energy and raw materials

This function covers the exploration and production of energy and of raw materials on and from the seas. The seas and oceans are expected to play a (an even more) vital role in meeting the future energy demand. Substantial amounts of **oil and gas** are still to be explored and exploited from the sea, although drilling needs to take place at ever greater depths. **Offshore wind** power offers unprecedented potential, as it allows an up-scaling of the industry and the outputs, as it bypasses the opposition from residents and leaves landscapes untouched. Other offshore renewable energy sources include **wave, tidal, Ocean Thermal Energy Conversion (OTEC) and blue (osmotic) energy**.

Besides energy sources, the seas and oceans also contain huge stocks of other **raw materials** and minerals, including iron ore, tin, copper, manganese, gold, sulphides, phosphorites, diamonds, lime and aggregates including siliceous sand and gravel. These raw materials are vital for a wide range of manufacturing sectors, including high-tech manufacturing.

Last but not least, the oceans can be an abundant source of **drinking water** once desalination techniques have been put in place.

Function 4. Leisure, working and living

Coastal regions are important **living** locations for EU citizens. The landward part of the coastal zone plays an important role as a place for human settlement. In 2008, 205 million people or 41% of the inhabitants of the 22 EU Member States lived in EU coastal regions (Eurostat 2011, p.172). Associated to that, coastal regions offer many employment opportunities, particularly in the service sector. The component of **working** relates to an active population of approx. 89 million people in the coastal regions of EU Member States (Eurostat 2011)[9].

The **leisure** component is of particular importance and covers economic activities related to coastal tourism. Because of the presence of the oceans and seas and the attractive natural environment the coastal zone also has an important tourist function. Over the last decade the EU tourism industry has become a sector of major importance in the European economy. According to the European Commission, the EU tourism industry generated in 2006 in its most narrow definition more than 4% of the EU GDP representing almost 8 million jobs (EC 2006a, p.2). Marine tourism is estimated to represent 3 million jobs (EC 2008c, p4).

Function 5. Coastal protection

Coastal protection is different from other sectors as it is not an economic function in itself, but rather a *conditio sine qua non* for the use of coastal areas and for allowing other functions to flourish. Still its economic relevance might be substantial, and massive efforts in research and technological development are made to improve sustainable and safe coastal regions, which also

[9] Eurostat (2011), Regional yearbook 2011, p.180. Data of 2009, excluding data of Belgium, Bulgaria, Portugal and Finland.

contribute to coastal protection works and services as an EU export product. Because of its specific nature coastal protection has been defined as a separate maritime function.

Function 6. Maritime monitoring and surveillance

This function concerns the monitoring and surveillance of activities taking place at seas, as well as the monitoring of the environmental state and development of the seas and coastal areas in which these activities take place. Especially since the 9/11 terrorist attacks, the international political attention for **maritime surveillance** has increased extensively. With regard to international relations this mainly falls within the maritime transport function (think of ISPS code, port state control requirements, and container scans etc.). Furthermore international awareness for security on the high seas has risen, for example through coordinated actions against piracy. The Integrated Maritime Surveillance initiative was launched by the European Commission (EC 2009f), following the adoption of its IMP.

Whereas maritime surveillance is mostly focused on human related activities, **environmental monitoring** addresses the physical, biological, chemical etc. state of the seas and oceans. This is an increasingly important area in relation to marine observation, management of marine resources marine research and climate change issues.

2.1.1 Beyond sectors: towards value chains

As set out in recent Europe 2020 Flagship initiatives[10], a growing policy attention is being paid to value chains; they allow for an assessment of functions across sectors and world-wide, and point out where synergies and supply chain risks can occur. For the maritime functions studied, we have analysed the most important value chains. The core activities for each function or maritime economic activity will be surrounded by both upstream and downstream activities. Upstream of the value chain are suppliers of equipment and resources, who may also have their suppliers. Downstream are processing sectors and subsequently distribution and sales. For example, shipbuilding has not been treated as an independent sector, but depending on the type of ships incorporated as part of a range of value chains, notably those in short-sea shipping, offshore, cruise shipping, dredging and surveillance.

As demonstrated by the above example, maritime functions in the context of this study are not just economic sectors; they cover the relevant maritime value chains – including backward and forward linkages. This is important since large parts of the economic activities take place not in core sectors themselves, but in adjacent economic activities. Think of maritime transport where large parts of the added value is created in seaports and the hinterland services associated to this, as well as in the shipyards and other supply industry activities required for shipping. The same applies for each of the other functions.

For the analysis of the maritime functions and maritime economic activities, the global value chain has been reviewed. However certain downstream parts may not be directly linked to the sea anymore (e.g. road transport in Europe carrying containers with maritime cargoes) or is not identifiable as being maritime (car petrol sold at fuel stations which was refined in a seaport and extracted from sea wells). Without any clear limitation, virtually all economic activities will be considered ‘maritime’. Therefore it was necessary to limit the value chain at the point where a direct and substantial link to sea-based activities is no longer easily possible.

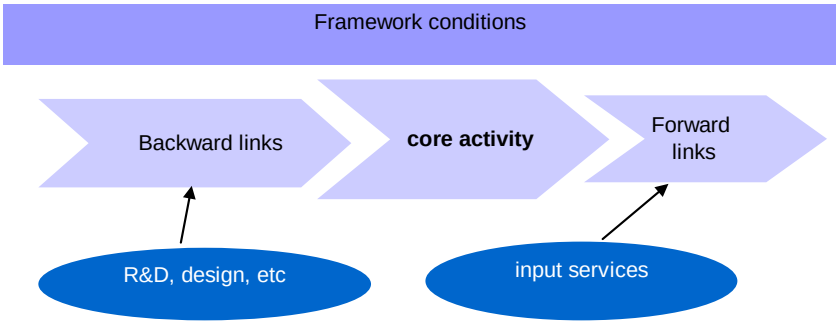
[10] See for instance the EC's Flagship on 'Integrated New Industrial Policy in the Globalisation era', COM 2010 (614)

Statistical data usually addresses economic sectors, hence to capture the economic importance of the functions, data from multiple sectors needed to be combined. This is complicated by the fact that many support sectors contribute to multiple maritime activities. For instance shipbuilding is relevant not just for trade and transport, but in fact for all six functions. The same applies for some other services. Hence, to estimate and rank the economic importance required assumptions to be made, which are described in annex 4.

Furthermore it is noted that for several maritime functions, available statistical data do not distinguish between underlying economic activities. For instance data on employment in shipping does not give figures for deep sea or short-sea shipping separately. Indicatively the relative importance of each maritime economic activity can be estimated using specific indicators, in this case for the example the volumes of cargo transported. In the underlying maritime economic activity reports (annex 3), these estimates are given.

Finally, in a number of cases assumptions had to be made because statistical data from public sources were not available or too crude. This was the case especially for economic activities that are still small in size or have a horizontal character (e.g. coastal protection, environmental monitoring, traceability and security of goods.

Figure 2.1 The approach of value chains, framework conditions and supporting services



As demonstrated in the example above, we also paid attention in the value chain analysis to the surrounding framework conditions, that provide the required conditions for the maritime economic activities to develop, and that can to larger or smaller extent be influenced by policy.

2.1.2 Twenty seven maritime economic activities

Within the 6 maritime functions, we have studied 27 specific maritime economic activities. The following table summarises all maritime economic activities that have been identified per function. For each maritime economic activity a very short description is included.

Table 2.1 Overview of functions and maritime economic activities

Function	Maritime economic activities	Short description
1. Maritime transport and shipbuilding	1.1 Deep sea shipping	International (freight) transport by sea with large vessels that often sail fixed routes (containers, major bulks) or tramp shipping.
	1.2 Short-sea shipping (incl. RoRo)	National and international freight transport within Europe and to/from neighbouring countries with medium sized ships. The same segments are found as under deep sea shipping.
	1.3 Passenger ferry services	Transporting passengers on fixed sea routes, national and international. Mainly intra-European. Sometimes this is combined with RoRo transport.
	1.4 Inland waterway transport.	Freight transport on inland waterways in Europe, consisting of both fixed link services and tramp services.
2. Food, nutrition, health and eco-system services	2.1 Catching fish for human consumption	Extracting wild natural resources (i.e. fish, crustaceans, molluscs, algae, etc.) for human consumption. The final product is either raw or processed fish.
	2.2 Catching fish for animal feeding	Extracting wild natural resources (essentially fish) for animal consumption. The final product is mainly fishmeal and fish oil, which can be used by agriculture and aquaculture.
	2.3 Marine aquatic products	Farming of aquatic organisms, mainly for human consumption (mainly fish and molluscs)
	2.4 Blue biotechnology	Using wild and farmed aquatic living resources as precursors of bio-molecules used for high value products (health, cosmetics, etc.). It is about unravelling the potential of the biodiversity of a specific earth compartment for the benefit of the rest of the economy.
	2.5 Agriculture on saline soils	Development of agriculture on saline soils, through improving existing crops or adapting salt tolerant plants.
3. Energy and raw materials	3.1 Oil and gas	Extraction of liquid fossil fuels from offshore sources
	3.2 Offshore wind	Construction of wind parks in marine waters, and exploitation of wind energy by generating electricity offshore
	3.3 Ocean renewable energy	Offshore development and exploitation of a variety of renewable energy sources excluding wind, including wave energy, tidal energy, Ocean Thermal Energy Conversion, Blue energy (osmosis) and biomass.
	3.4 Carbon capture and storage	Caption of CO2 at large emitters and ship these to empty offshore fields and other favourable geological formations for long term storage as a means to contribute to sustainability targets.
	3.5 Aggregates mining (sand, gravel, etc.)	Extraction of marine aggregates (sands and gravels) from the seabed.
	3.6 Marine minerals mining	Deep sea mining of raw materials other than aggregates., including critical materials which have a risk of supply shortage
	3.7 Securing fresh water supply (desalination)	Desalination of sea water for fresh water usage (agriculture irrigation, consumer & commercial use)
4. Leisure, working and living	4.1 Coastal tourism	Shore based sea related tourist and recreational activities.
	4.2 Yachting and marinas	Construction and servicing of seaworthy leisure boats and the required supporting infrastructure including marina ports.
	4.3 Cruise tourism	Tourism based on people travelling by cruise ship, having the

Function	Maritime economic activities	Short description
		ship itself as their home base of holidays and making visits to places passed during the trip.
	4.4 Working	Employment and economic activities taking place in coastal regions.
	4.5 Living	Residential functions and associated services in coastal regions.
5. Coastal protection	5.1 Protection against flooding and erosion	Monitoring, maintaining and improving the protection of coastal regions against flooding and erosion.
	5.2 Preventing salt water intrusion	Measures associated with coastal protection works aiming at the prevention of salt water intrusion as a measure to protect fresh water functions in coastal regions.
	5.3 Protection of habitats	Measures associated with coastal protection works aiming at protecting natural habitats.
6. Maritime monitoring and surveillance	6.1 Traceability and security of goods supply chains	Equipment and services used for security purposes in the field of maritime transportation.
	6.2 Prevent and protect against illegal movement of people and goods	Monitoring and surveillance of the EU coastal borders using a variety of services, technologies and dedicated equipment.
	6.3 Environmental monitoring	Marine environmental monitoring is not a clear-cut function. It may cover water quality, temperature, pollution, fisheries etc.

2.2 The current importance of maritime economic activities

…We estimate the GVA of these maritime economic activities to amount to € 485 billion…

Estimates on the economic importance of the maritime economy can never be precise for a range of methodological reasons that go beyond the scope of this document. The GVA produced in coastal regions ('working in coastal areas') overall amounts to no less than € 4.108 billion, and we estimate the GVA of maritime economic activities in the EU to amount to € 485 billion. The overall employment in maritime economic activities in the EU is estimated at 5.4 million (Figures 2.1 and Figures 2.2. and 2.3. with further visual illustrations). As explained to arrive at these data a number of assumptions was needed, which are reported upon in further detail in Annex 4.

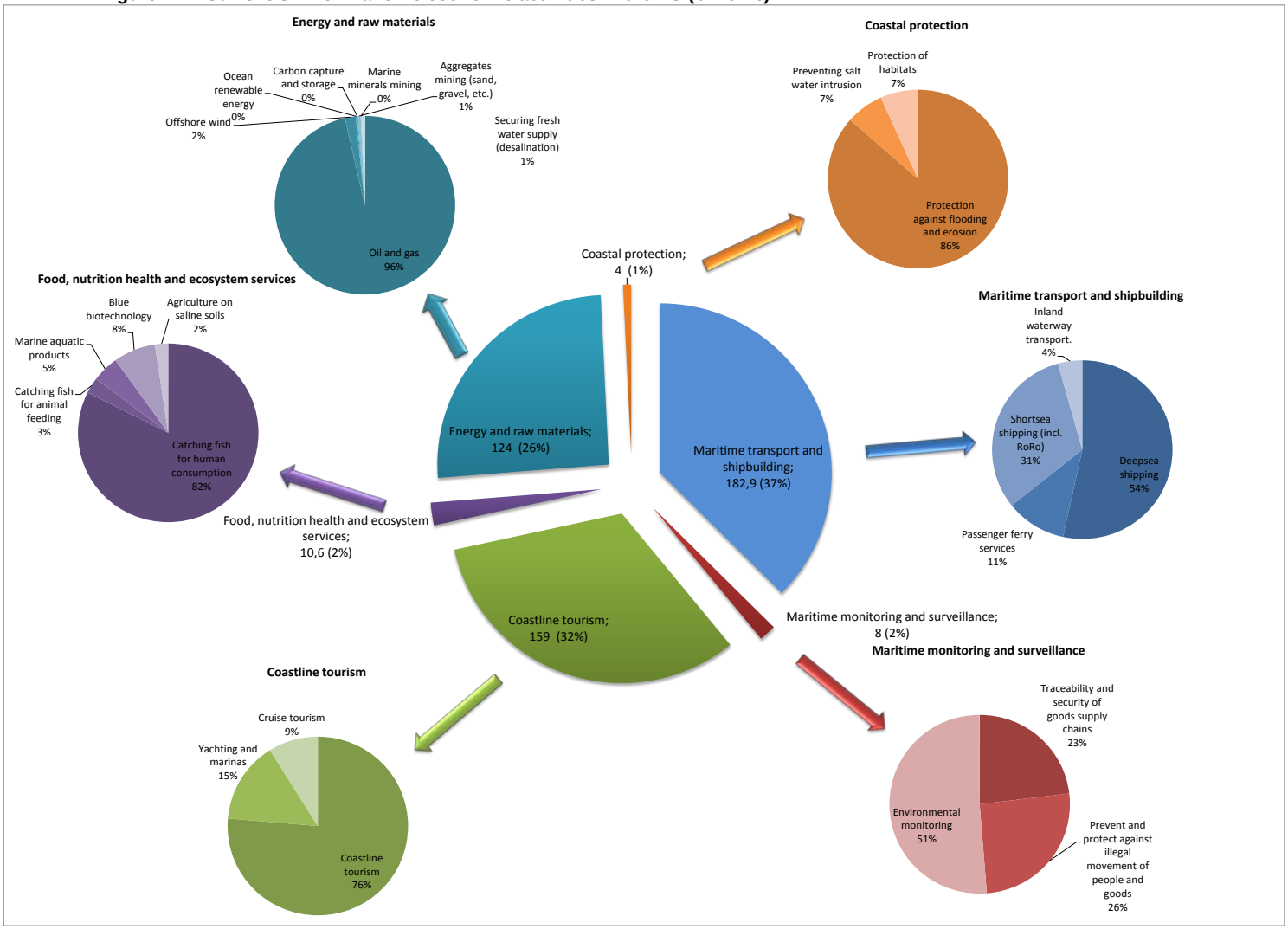
Table 2.2. Indicative size of maritime economic activities

Function / activities	Current size		Sources & Comments
	Value added (€ bn)	Employ-ment (in 1000)	
1. Maritime transport and shipbuilding			
1.1 Deepsea shipping	98	1,204	Eurostat database (2012); Data 2008; share in total shipping based on freight volumes
1.2 Shortsea shipping (incl. RoRo)	57	707	Eurostat database (2012); Idem
1.3 Passenger ferry services	20	200-300	Eurostat database (2011) (passenger statistics), Annual reports of operators (staff data); Data 2009; employment calculated based on staff/pax for several large operators. GVA share assumed relative to employment
1.4 Inland waterway transport	8	36	Eurostat database (2011); Data 2007
2. Food, nutrition, health and eco-system services			
2.1 Catching fish for human consumption	8.7	200-240	Anderson and Guillen 2009; Data 2007
2.2 Catching fish for animal feeding	0.3	6.0	Eurostat database (2011); Data 2007
2.3 Marine aquatic products	0.5	80	Eurostat database (2011); Framian 2007; Production data 2007, employment data 2005
2.4 Blue biotechnology	0.8	<0.5	Lloyds Evans (2005) (turnover), own estimate for employment; Assumed 1/3 of world production in EU
2.5 Agriculture on saline soils	<0.25	<0.5	no data, own estimate based on literature
3. Energy and raw materials			
3.1 Offshore oil and gas	107-133	25-50	Eurostat database (2011) + own estimate for offshore share; Data appear unreliable; probably much larger
3.2 Offshore wind	2.4	35	EWEA (2010), Eurobserver (2010), EWEA (2011); Share based on MW installed offshore compared to onshore; 2010 investment data as a proxy of GVA only
3.3 Ocean renewable energy (wave, tidal, OTEC, thermal, biofuels, etc.)	<0.25	1	Own estimate based on installed power. Data IEA (2011)
3.4 Carbon capture and storage	<0.25	<0.5	No data, own estimate based on literature
3.5 Aggregates mining (sand, gravel, etc.)	0.6	4.3	Eurostat database (2011); British Geological survey (2007); Offshore share estimated. Employment estimate based on UK data
3.6 Marine minerals mining	<0.25	<0.5	No data, own estimate based on literature
3.7 Securing fresh water supply (desalination)	0.7	7	Global Water Intelligence (2010); EU share estimated at 10% of global industry

Function / activities	Current size		Sources & Comments
	Value added (€ bn)	Employ-ment (in 1000)	
4. Leisure, working and living			
4.1 Coastline tourism	121	2,350	ECB (2011) (GVA), Eurostat database (2011) (employment); GVA calculated based on assumed share in EU total
4.2 Yachting and marinas	23.4	253	Ecotec (2006); Data for 2005.
4.3 Cruise tourism	14.1	143	European Cruise Council (2010); Based on expenditure data for 2009
4.4 Working	4,108	89,000	Eurostat database (2011); GVA in coastal regions (NUTS 3), 2008 data; employment data 2007
4.5 Living	n/a	205,000	Eurostat database (2011)
5. Coastal protection			
5.1 Protection against flooding and erosion	1.0-5.4	10-50	Eurosion (2004), IPCC (2009), EC (2004), Hinkel (2010) (GVA), own estimate (employment)
5.2 Preventing salt water intrusion	<0.25	<0.5	No data, own estimate based on literature
5.3 Protection of habitats	<0.25	<0.5	No data, own estimate based on literature
6. Maritime monitoring and surveillance			
6.1 Traceability and security of goods supply chains	0,6-3	5-10	Own estimate based on EC (2006)
6.2 Prevent and protect against illegal movement of people and goods	1-3	18	Own estimate based on EC (2006); Figures include only direct costs related to transport related activities, whereas the activity is wider than this. Figure calculated based on costs per port
6.3 Environmental monitoring	4	25	Ecorys (2011); Sub-function still in early stage of its development

For further visualisation of the performance of the maritime economic activities, please see also subsequent figures 2.2. and 2.3. beneath.

Figure 2.2 Current GVA of maritime economic activities in the EU (billion €)



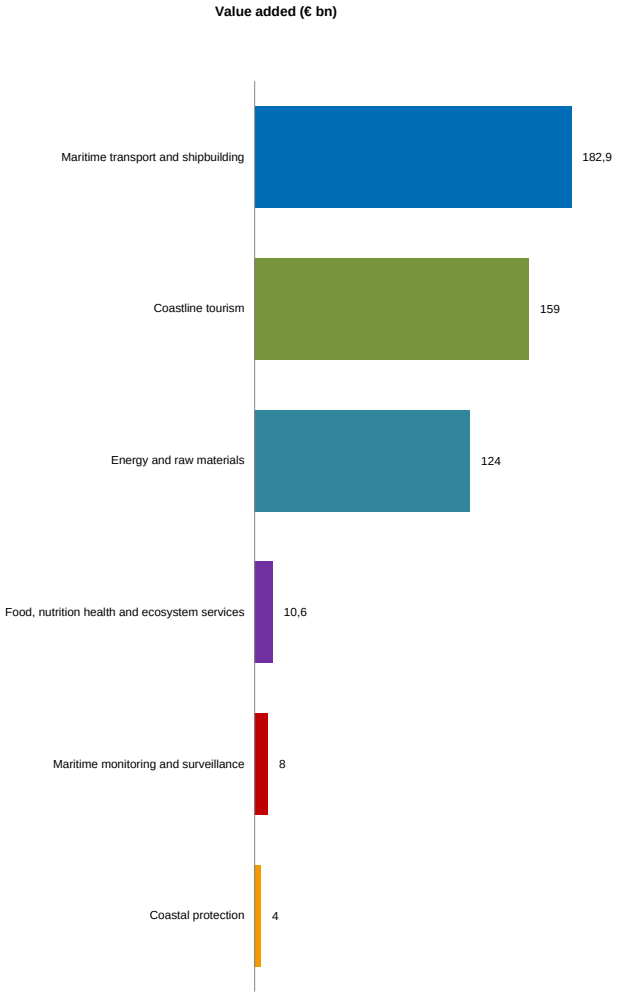
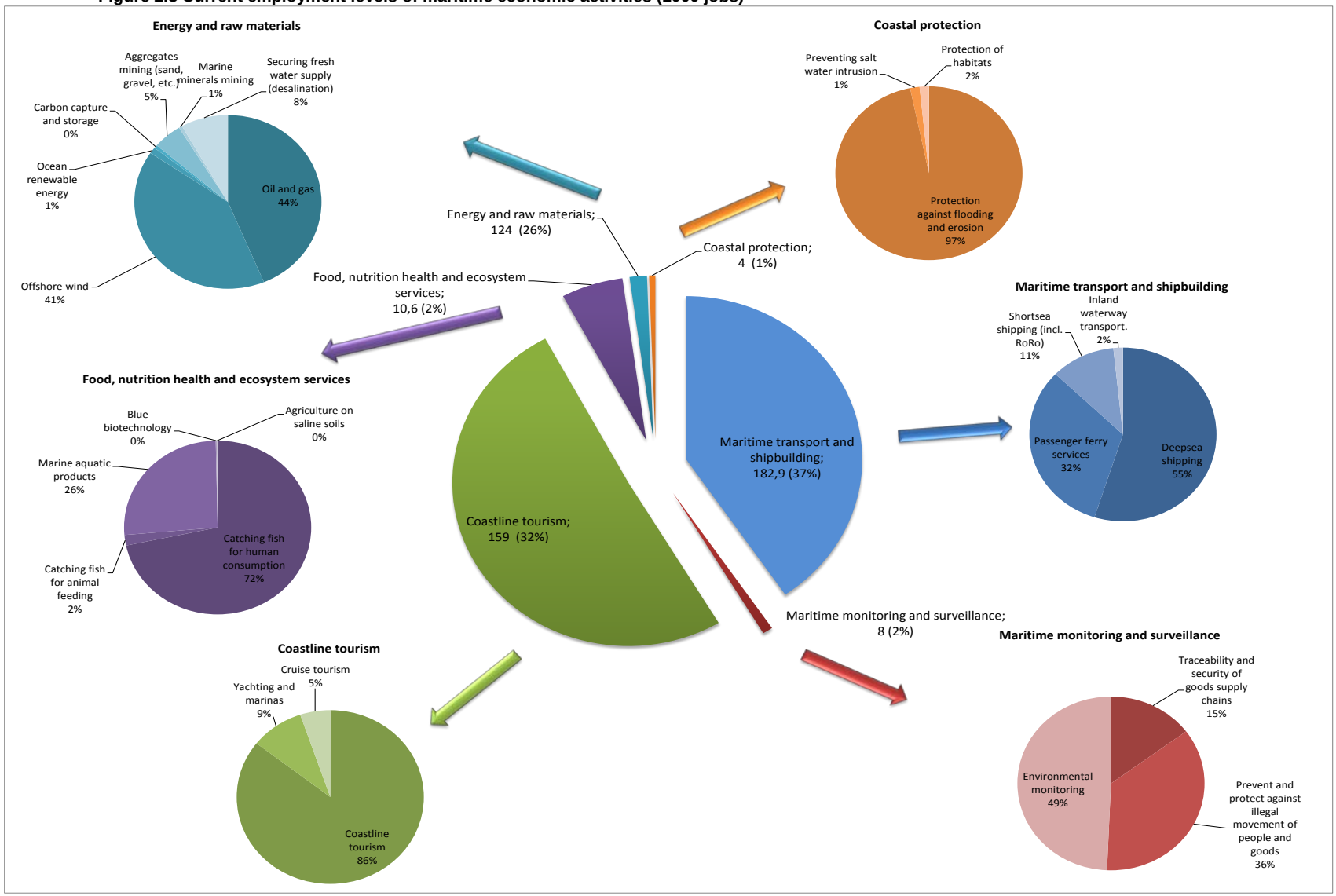


Figure 2.3 Current employment levels of maritime economic activities (1000 jobs)



Note: in the subsequent assessment in this and the next chapter, the three activities under 'Maritime monitoring and surveillance' have been addressed in combination. The same applies to the three activities under 'coastal protection', and the activities 'coastal tourism' and 'yachting and marinas'.

…the seven biggest maritime economic activities alone provide over 5 million jobs today…

The maritime economy is important in Europe. The seven *biggest* maritime economic activities alone today provide almost 5 million jobs[11]. Coastal tourism and deep sea shipping are the maritime activities which currently provide most employment, followed by short-sea shipping – all employing from almost 1 to over 2m jobs each. Oil and gas are above all important for their GVA contribution (€ 100-135 billion). Yachting and marinas, passenger ferry services and catching fish for human consumption each provide currently around 250,000 jobs. Clearly some activities are labour intensive (e.g. tourism); whereas others are capital intensive and have high GVA levels per employee (e.g. oil and gas).

…Truly impressive growth rates for a range of economic activities….

Based on the available time series data, compound annual growth rates have been truly impressive for a range of maritime economic activities. Double-digit annual *growth rates* have been recorded in offshore wind energy, cruise shipping and desalination. Deep sea shipping and short-sea shipping have seen strong GVA growth, but not accompanied by equal job growth.

2.3 A dynamic perspective: life cycles and growth outlook

…A future-oriented study should focus on what can be expected tomorrow…

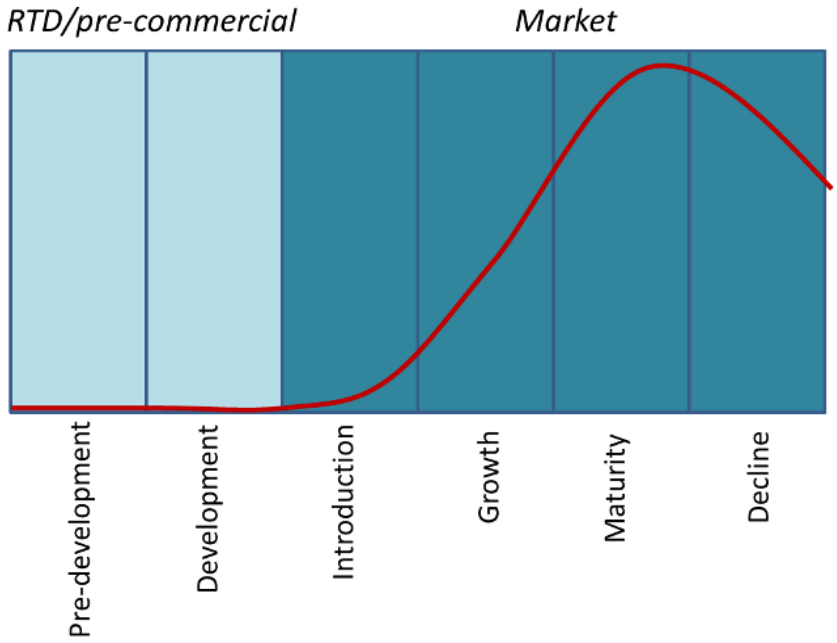
The product life cycle approach

A future-oriented study should not only focus on what is important today, but particularly on what can be expected tomorrow. We have thereto applied an extended life cycle approach to 27 specific maritime economic activities and have classified them according to their development stage, which we have grouped as follows:

- *(Pre-) development stage*: In the pre-development stage inventions have been made, but most promising outputs are still to be defined. Much R&D required. In the development stage, the possible outputs are clear, but commercial viability still needs to be proven;
- *Growth:* (strong) economic growth and/or employment growth. Smaller sized companies can enter the market, prices of technologies gradually go down;
- *Maturity:* economic activity remains stable at a big size. Market positions of main players are clear and competition is fierce;
- *Decline*: economic activities are declining, no major innovations are being made, and it is clear which players are dominating the market.

[11] For example, the resulting data on value added and employment are higher than those found in the study of Policy Research Corporation (2008), which is mainly due to the broader definition of maritime functions chosen here as compared to the 'areas' defined in their study, which were more concentrated on specific economic sectors. Secondly, some changes are related to development over time between the studies.

Figure 2.4 Product life cycle approach

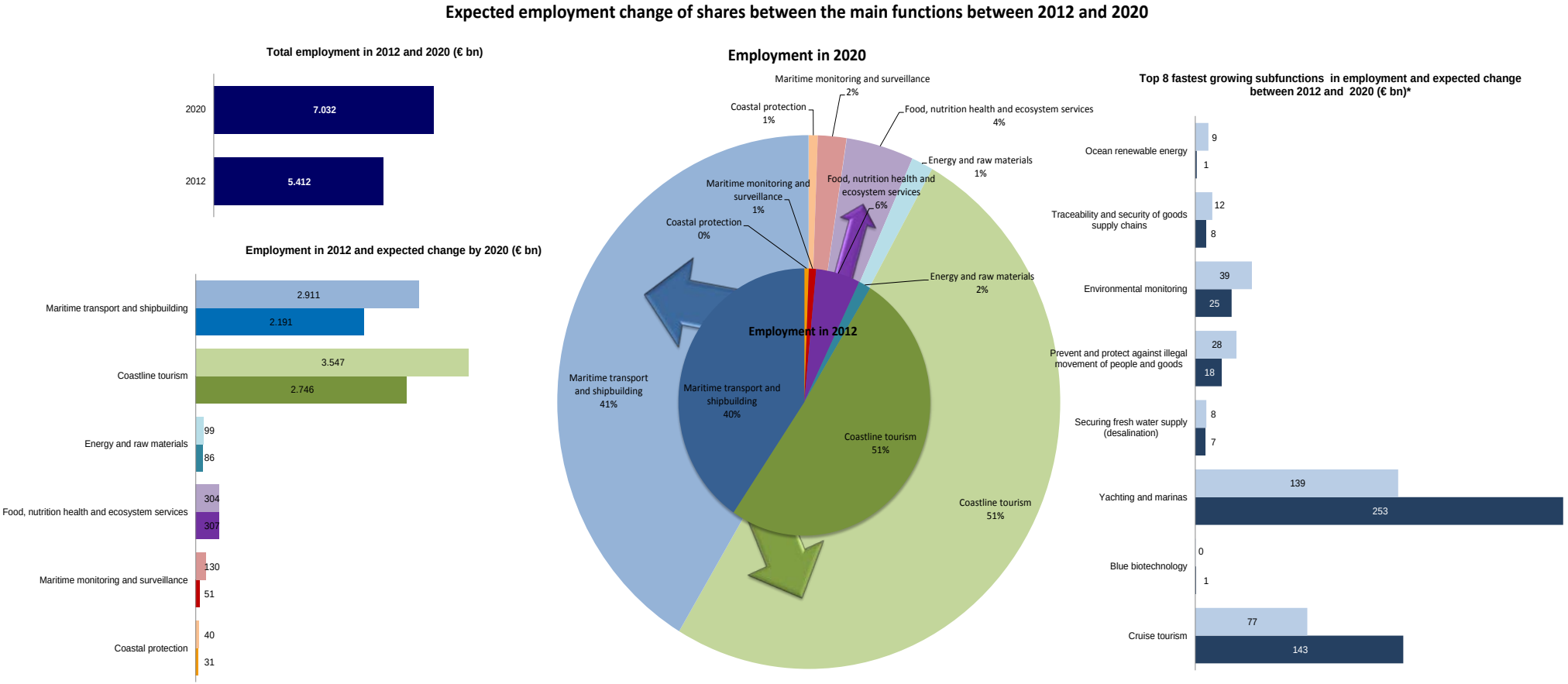


Outlook on future growth

No specific forecasts exist for the set of maritime economic activities as a whole. Hence, using available sector specific literature, views from industry stakeholders interviewed and workshop discussions, we have made a best guess estimate on the expected growth of the 27 economic activities for the coming decade. Assumptions on future annual growth[12] provide an indication that the Blue growth sectors will rise in economic importance from some € 488 billion in 2010 to about € 600 billion in 2020, and the number of jobs increasing from 5.4 million to 7.0 million. Clearly differences exist between the various maritime economic activities. Mature sectors generally have lower growth rates, but their sizes remain large and also in 2020 they will contribute the largest shares of GVA and employment. Growing and pre-development activities however will face much stronger growth rates – often double digit – resulting in a more than doubling between 2010 and 2020. Figure 2.4 below shows the expected growth between 2012 and 2020, and indicates the fastest growing activities.

[12] Assumptions are based on growth forecasts given in literature or extrapolation of historical growth rates. See annex 1 for underlying assumptions and sources.

Figure 2.5 Current size (employment) versus estimated future annual growth rate)



Selected maritime economic activities

…Future potential will depend on innovativeness, competitiveness, spill-over and commitment to sustainability

The 27 maritime economic activities have been ranked by current size (GVA and employment levels today), recent growth (average annual growth over the past 5 years in terms of GVA and employment) and expected future potential (scores on the six criteria innovativeness, competitiveness, employment, policy relevance, spill-over/synergies, and sustainability). See annex 1 for the data used, underlying sources and resulting rankings.

On the basis of the top-7 current size, top-7 recent growth and top-7 future potential rankings, we have selected the below 11 maritime economic activities as most essential for further analysis and potentially for policy-support within the context of Blue Growth. They are balanced in terms of their current importance, their short-term growth rates, and their longer term potential. An additional consideration has been to add value within this project, and therefore to prioritise maritime economic activities that have been less covered through existing studies, and which would have the most potential to benefit from support at an EU level over and above actions already underway. We will present the future outlook for each of these maritime economic activities in the subsequent chapter[13].

Table 2.3 Maritime economic activities by development stage – based on size (2008 or latest available year), recent growth (average annual GDP growth last 5 available years) and potential (ranking 1-6 with 6 highest)

Maritime economic activity	Size today (billion €)	Recent growth	Future potential
Mature stage			
1. Short-sea shipping	**57**	5.8%	2
2. Offshore oil and gas	**107-133**	-4.8%	1
3. Coastal tourism & yachting	**144**	3-5%	4
4. Coastal protection	**1.0-5.4**	4.0%	6
Growth stage			
5. Offshore wind	2.4	**21.7%**	6
6. Cruise tourism	14.1	**12.3%**	5
7. Marine aquatic products	0.5	**4.6%**	4
8. Maritime monitoring and surveillance	5.6-10	**+**	5
(Pre-)development stage			
9. Blue Biotechnology	0.8	4.6%	**5**
10. Ocean renewable energy	0.25	+	**5**
11. Marine minerals mining	0.25	0/+	**4**

See Annex 1 on methodology for detailed data.

Future potential: Score is based on an evaluation of six criteria: innovativeness, competitiveness, employment, policy relevance, spill-over/synergies, and sustainability.

2.4 Research and technology levels in selected activities

Note: This section is based on an analysis of patents and publications carried out on the basis of Thomson Reuters data, within the context of this project, in the period June-August 2011. The technical report including details and definitions is included as Annex 2 of this report.

[13] Fisheries are not specifically covered in this study, as they are covered by the Common Fisheries Policy - an important complementary policy context. However the study has sought to identify complementarities with the CFP where appropriate and relevant, and tried to identify existing or new synergies with it.

The technological capacity of Europe is considered of key importance to capture the growth potential identified, especially since many of the economic activities identified are based on intensive usage of technology and future trends and directions are driving the need for upgrading technical possibilities to overcome the challenges associated to these.

An assessment was made on the activity level of science and technology in 10 selected economic activities where we expected a reasonable or high amount of research and development. We have looked at patents filed (EU single country patents, intra-European and extra-European patents), scientific publications and citations. We have collected the relevant information from the Thomson Reuters service:

For Patents:

- List of leading European and Non-European institutions/actors (universities, companies etc.) in terms of numbers of patents;
- Citation analysis: ranking of institutes/actor by patent citation frequency; ranking of countries by patent citation frequency;
- Geographic analysis: number of EU single country patents, intra-European and extra-European patents.

For Scientific Articles:

- List of the top institutes/actors within the cluster in Essential Science Indicators in terms of citations, number of papers and citations per paper;
- List of the leading European institutions/actors in terms of numbers of citations, number of papers and citations per paper;
- Number of domestic, intra-European, extra-European co-publications by leading research institutions / actor;
- Number of EU single country publications, intra-European co-publications and extra-European co-publications;
- Number of citations, number of papers and citations per paper by country.

Below, we present the main conclusions of this analysis. Further details can be found in annex 2.

Strong increase of patent activity over time

Table 2.3 presents the growth of patents filed over the past decade.

Table 2.4 Overview of patent activity in the period 2001-2010

Patents				increase in %	increase in %	% of total	% of total
Year	*2001*	*2006*	*2010*	*2001 - 2010*	*2006 - 2010*	*2001*	*2011*
Offshore Wind	28	62	210	750%	339%	2%	6%
Ocean Renewable Energy	110	166	730	664%	440%	8%	20%
Maritime Security & Surveillance	51	160	186	365%	116%	4%	5%
Environmental Monitoring	127	195	382	301%	196%	10%	10%
Desalination	202	284	590	292%	208%	15%	16%
Algae Aquaculture	218	241	534	245%	222%	17%	14%
Blue Biotechnology	169	223	408	241%	183%	13%	11%
Oil & Gas	156	182	340	218%	187%	12%	9%
Marine Mineral	93	103	193	208%	187%	7%	5%
Protection against flooding	155	119	166	107%	139%	12%	4%
Total of the subfunctions analysed	1309	1735	3739	286%	216%	100%	100%

Source: Thomson Reuters, 2011

What becomes clear from the table above is the high amount of patents in pre-development activities: Ocean Renewable Energy (20% of total), Algae Aquaculture (14%) and in Desalination (16%); other high amounts can also be noticed in Blue Biotechnology (11%) and Oil & Gas extraction (9%). Also noticeable is the strong increase (286%) in patent activity for all maritime economic activities analysed in the period 2001-2010. Overall patent activity worldwide has roughly doubled in this period, but has almost quadrupled for these maritime activities. Spectacular increases are observed in patenting in Offshore wind, Ocean renewable energy, and to a lesser extent Maritime Security & Surveillance and Environmental Monitoring over this period. Overall, the amount of patents[14] filed demonstrates the high degree of innovation and research taking currently place in the maritime economic activities.

A boom in publications on maritime economic activities

The strong R&D activity in the maritime economic activities analysed is confirmed by a boom in publications: from an overall 1,300 publications in 2001 to almost 5,000 publications in the year 2010. This increase has been particularly strong in environmental monitoring, now responsible for more than 1/3 of all publications analysed. Other much publicised maritime economic activities are Algae Aquaculture, notably in growing aquatic products and Blue Biotechnology. Oil & gas is currently also a subject of strong academic interest.

Varying strength of EU patenting within the global context

The relative strength of the EU however varies strongly by activity. The EU is clearly leading in offshore wind and ocean renewable energy sources, where more than 1/3 of all global patents counted have been filed. An almost similar performance can be recorded in the sector of Ocean Renewable and Algae Aquaculture, where over 30% of patents are filed in the EU. The EU patent activity is less dominant in other areas, with still reasonable performance in Oil & Gas but less so in other economic activities analysed. The share of patents filed with the Patent Co-operation Treaty is rather stable across maritime activities (with the exception of Coastal protection)[15].

The EU's dominance is however much stronger in the area of publications, as measured through the number of citations. It has brought forward the authors of at least 4 out of 10 authors in a wide range of maritime economic activities, from those in the energy and raw materials to the living resources domains. Environmental monitoring is the only domain where the EU has generated less than 30% of global publications analysed.

These findings point to major discrepancies between the patent and publication patterns. An emerging conclusion is that the EU has excellent academic and scientific capacities in the maritime economic activities analysed, but considerably less commercial potential to commercially exploiting scientific research better in terms of patent output.

A specific role is played by China. Whereas in most countries the number of patents that is filed in a country reflects domestic applicants, in China, the share of foreign patentees has been growing compared to domestic applicants[16]. This points us to another important aspect in this analysis, i.e. there might be a difference between the country where the invention has emerged and where it is carried out (filed). Finally there may be different patenting cultures between countries. This not only

[14] The count of patent records refer to patent families or inventions, and not to individual patent documents, e.g. the European granted patent, and the US granted patent for a single invention family is counted as "1" in aggregate in all the analyses.
[15] Costs of filing a patent within the Patent Co-operation Treaty can differ from filing costs and documents required within the respective national / EU Patent Offices.
[16] Eve Y, Zhou, and Bob Stembridge (2011) "Patented in China: The present and future state of innovation in China. Thomson Reuters.

reflects the decision to patent an invention (e.g. the lack of a European unitary patent may have an influence in this respect), but may also regard the level at which patents are filed[17].

Table 2.5 Share of EU in global patents (priority country analysis) and global citations per maritime economic activity

Patents 2001-2010	Patents EU	Non-EU	PCT*	Citations EU	non-EU
Offshore Wind	37.5%	45.9%	16.5%	44%	56%
Ocean Renewable Energy	35.5%	49.2%	15.3%	44%	56%
Algae Aquaculture	31.2%	53.2%	15.6%	46%	54%
Oil & Gas	22.1%	58.2%	19.8%	47%	53%
Maritime Security & Surveillance	17.6%	64.5%	18.0%	35%	65%
Environment Monitoring	17.5%	67.9%	14.5%	28%	72%
Marine Mineral resources	16.0%	70.3%	13.7%	40%	60%
Desalination	15.0%	73.2%	11.7%	38%	62%
Blue Biotechnology	12.7%	70.8%	16.5%	46%	54%
Protection against flooding	10.5%	83.7%	5.8%	37%	63%

* PCT = Patent Co-operation Treaty (global patents)

Source: Thomson Reuters, 2011, calculations Ecorys

EU leading on a number of maritime economic activities in global patenting

The Table 2.6 below shows that in the activities analysed the EU is leading in terms of total patents carried out on EU-27 territory, with slightly more patents than in the US. Japan (19%) is ranking third, followed by China. However, this is not valid in all fields. In fact Europe's leadership is only shown in a number of maritime economic activities. In terms of global patent output, Algae Aquaculture has generated the most patents filed (5627 patents) in the last decade. Equally interesting for patenting seems to be Desalination (5364 patents), Oil & Gas (4820 patents) and Blue Biotechnology (4227).

In terms of global share of patenting, China is leading in Desalination (21%) and the US is strongest in Oil & Gas with nearly 1 in 3 patents carried out in the US, but also leading in Environment Monitoring (38%) and Maritime Security & Surveillance (35%) and Marine Minerals. The picture of Europe's strength in algae aquaculture, ocean renewable and offshore wind is also apparent.

Table 2.6 Priority countries of patents (absolute – upper table, relative – lower table) 2001-2011

Global patent concentration - EU vs. competitors	EU Member States + EU Patent Office	China	US	Japan	South-Korea	Worldwide
Algae Aquaculture	1755	756	1022	1416	261	5627
Desalination	792	1129	921	1069	301	5364
Oil & Gas	1063	371	1415	213	53	4820
Blue Biotechnology	537	570	563	1181	269	4227
Ocean Renewable Energy	1380	631	526	425	403	3886
Environment Monitoring	576	331	1241	669	237	3287
Maritime Security & Surveillance	404	153	800	325	80	2301
Marine Mineral	361	339	424	336	196	2254
Coastal Protection	209	109	185	842	374	1983
Offshore Wind	479	156	170	133	43	1276
Total	**7556**	**4545**	**7267**	**6609**	**2217**	**35025**

[17] For example Japan is generally regarded to patent innovation at a lower component level than European countries.

Global patent EU vs. competitors in % of global	EU Member States + EU Patent Office	China	US	Japan	South-Korea
Algae Aquaculture	31%	13%	18%	25%	5%
Desalination	15%	21%	17%	20%	6%
Oil & Gas	22%	8%	29%	4%	1%
Blue Biotechnology	13%	13%	13%	28%	6%
Ocean Renewable Energy	36%	16%	14%	11%	10%
Environment Monitoring	18%	10%	38%	20%	7%
Maritime Security & Surveillance	18%	7%	35%	14%	3%
Marine Mineral	16%	15%	19%	15%	9%
Coastal Protection	11%	5%	9%	42%	19%
Offshore Wind	38%	12%	13%	10%	3%
Total	**22%**	**13%**	**21%**	**19%**	**6%**

Source: Thomson Reuters, 2011, calculations Ecorys

EU leading on all domains in scientific citations

Regarding priority countries in terms of scientific citations, EU research institutes and scientists working for EU research institutes[18] are leading in all fields. They are even issuing over 40% of global publications in the Environment Monitoring (46%), Algae Aquaculture (44%), Oil & Gas (44%), and Ocean Renewable Energy (43%), followed by Blue Biotechnology (40%). Only in the case of Desalination (28%), it scores lower than one third of global publications.

Overall, it can be concluded, that the EU is accountable for twice as many publications as the US, both continents still far ahead its main competitors.

Asia has the strongest position in companies that are filing patents

When looking at leadership of the individual top 20- organisations in patenting (the assignees), Analysing all patents registered by the 20 most important organisations worldwide in each maritime economic activity makes clear that Asia is by far the most active companies in the marine activities analysed, with 60% of patents filed by all top-20 companies in all maritime economic activities together, followed by the EU with 19% and the US third place (18%). The US is only leading in environmental monitoring and also in maritime security & surveillance – due mostly to the strong military innovation capacity in these areas. This can be influenced by the size of the assignees and the distribution of patenting patterns (equally divided among a large group of a few top institutes).

Within the below context, the EU is clearly in a leading position in all energy related activities: it has generated around half of the reviewed patents in Oil & gas, Offshore wind, and Marine mineral resources, while 1/4 of the reviewed patents in Ocean renewable energy sources.

The EU's leadership position is much smaller in the remaining areas, and this is likely to be for two reasons: either EU players are not able to compete with the innovative strength of other global players (e.g. Desalination and Coastal protection – where all big innovators are Asian) or EU players are relatively small and fragmented, so that individual players are not able to compete with global players (e.g. Algae aquaculture, Blue biotechnology).

[18] Publications are counted regardless the citizenship of the scientist, but considering the location of the research institute/university

The US has a lead position in institutes that publish

Opposite to the strong position of Europe in scientific publications, the US represents the top publishing institutions. When linking publications for the marine activities to the geographical locations of respective research institute or university, where the scientist is located, the US is clearly in a leading position in all energy related activities. The US dominance can be concluded from the fact of being attributable of 52% of global publications for all economic activities analysed – based on the fact that at least 1 in 3 of the top-20 research institutes and universities are located in the US. Again this deviation may be linked to a more fragmented institutional structure in Europe where publications are distributed among more institutes and a few top institutes are lacking.

The only exceptions to this rule being Algae aquaculture, where EU research institutes account for 2/3 of publications, and marine mineral resources (45%) and Desalination (34%) in which Asia is leading compared to the US and the EU.

2.5 Conclusion

Maritime activities constitute an important component of Euro's economy. In total over 200 million of Europe's inhabitants are living in coastal areas and total employment in coastal areas amounts to almost 90 million. When the economic importance of maritime functions that make use of coastal, sea or ocean resources is further analysed 27 specific groupings of economic activities can be distinguished, which together represent an gross value added of 488 bn Euro and create employment for 5.4 million people in Europe.

When the maritime economic activities are analysed from a dynamic perspective they can be categorised in different stage of their life cycle. The distinction is made between mature economic activities, activities which are clearly in their growth phase and (pre)development maritime activities which are still in their infant stages but hold an enticing promise to the future European economy.

Research and innovation hold the key to creating a future Blue growth potential in establishing a strong competitive position of Europe. The analysis shows that there is a strong increase in patent and publication activities, in particular in (pre)development and growth areas, which confirms the growing importance of these domains towards the future. Europe's knowledge base is strong as being confirmed by Europe's leading position in citations. In terms of actual innovation or commercialisation, as indicated by the number of patents Europe's position is clearly less dominant, although Europe still has a leading position in the wind energy and renewable ocean energy, and algae aquaculture. Also in the field of oil & gas Europe holds a strong position.

In the next chapter the selected 11 promising economic activities are assessed with regard to their future potential, and challenges as well as framework conditions are addressed.

3 Blue Growth: the future potential

3.1 Introduction

The Blue Growth study is primarily oriented towards the future, and hence we have included an assessment of the most promising activities/markets in the future. Based on indicators such as innovativeness, potential for competitiveness of EU industry, employment creation, spill-over effects and sustainability considerations, we have identified blue biotechnology, offshore wind energy, protection against flooding and erosion (hereafter: coastal protection), ocean renewable energy, maritime surveillance and marine minerals mining (deep sea mining) as most promising activities.

The findings on these 11 activities will feed into the analysis of sea basins and synergies, where their interaction with all other economic activities will be addressed. This will provide the basis for exploring policy initiatives for blue growth across all 27 maritime economic activities identified.

Two types of scenarios for the future

The future cannot be predicted and therefore it is needed to develop different alternative scenarios as part of the foresight process. These not only refer to the technological developments that are shaping the future potential but also refer to the other forces and drivers that impact on these futures and should be taken into account in policy formulation, planning and decision-making.

The proposed approach to developing scenarios follows from the methodological framework as presented in our technical proposal and consists of the combination of two types of scenarios:

1. *General background scenarios*; from a top-down approach, four more or less realistic futures have been painted for a timeframe of 10 – 15 years.
2. *Micro-future Scenarios*; from a bottom-up approach, likely futures specific to maritime economic activities for a timeframe of 10 – 15 years. A 'micro-future' is a future which is specific to the maritime economic activity under investigation, and deemed desirable and ambitious, but at the same time realistic. Desirable in terms of Europe 2020 policy goals: smart, sustainable and inclusive. Ambitious and realistic in terms of aiming at above-average estimates, but always rooted in the best available information from literature and interviews.

These two types of scenarios will now be presented in the subsequent parts of this chapter. First the four general background scenarios are presented (Section 3.2), followed by an overview of the potential of the specific maritime economic activities (Section 3.4, 3.5 and 3.6). The four general background scenarios and the micro-futures will then be confronted in the remaining Section 3.7.

The following sections 3.3 – 3.5 describe the 'micro-future' of 11 promising maritime economic activities, ordered by their development phase (mature, growing and pre-development). In each of the descriptions we will highlight:

- Definition of the activity, its value chain, main characteristics and the competitive position of the EU;
- Potential development: assessment of how the economic activity could develop in terms of focus, size, and impact. Included are the external drivers and the response capacity of the actors;
- Uncertainties: if the potential development were to come true, what would be required from the relevant drivers in the outside world? Would they develop in all four background scenarios or is the micro-future specific to one outlook?

- Synergies and tensions: what are the potential environmental consequences? What other maritime economic activities are expected to benefit?
- Framework conditions that need to be fulfilled in order to materialise the future potential of this maritime economic activity.

3.2 Four general background scenarios

The general scenarios serve a twofold reason:

a. They will help to improve the micro-future scenarios by discussing their potential in the four different futures.

b. Findings will be used to improve the robustness of policy options, by examining and discussing their effects in the four general scenarios.

3.2.1 The scenario matrix

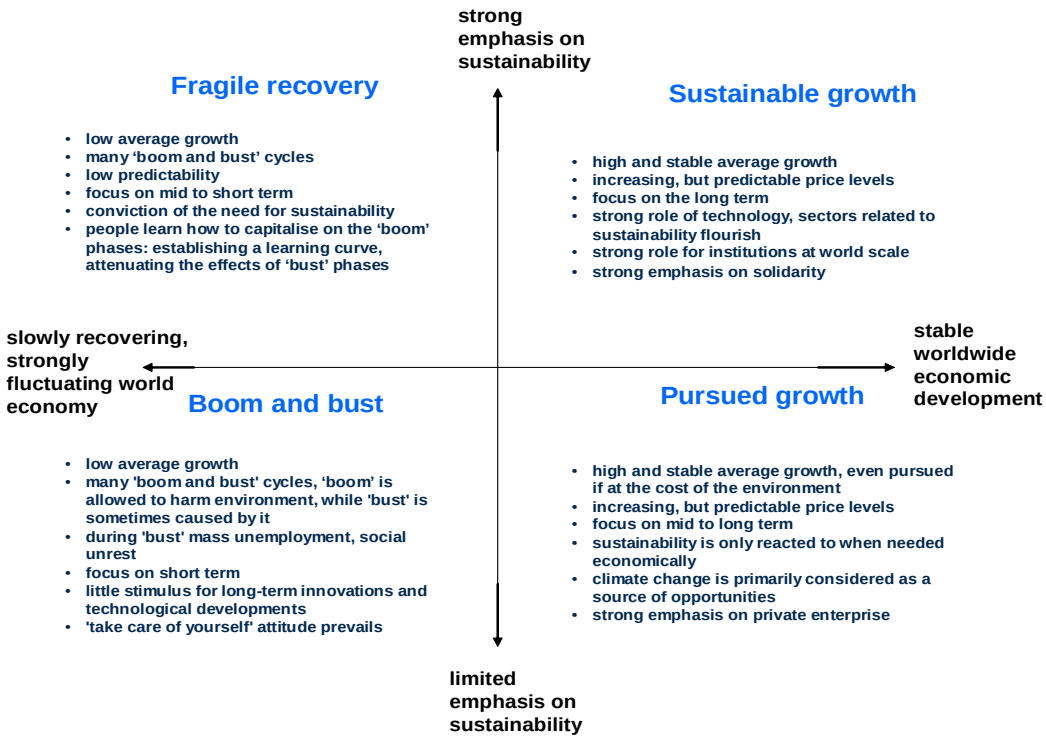
Note: The general background scenarios are described in full in Annex 3.

As a starting point, and based on an analysis of a wide range of trends and drivers (Annex 3), the two most relevant and uncertain trends identified are 'economic climate' and 'degree of sustainability'. These trends are used as the axis of the scenario matrix below.

…The future Blue Growth potential will much depend on essential variables that lie outside the maritime world itself.

The resulting four background scenarios are external scenarios, which means they are outside the direct control of policies – and representing possible futures. The scenarios can have a significant impact on the way in which Europe's Blue Growth develops, as the potential for Blue Growth maritime economic activities will vary depending on the background scenario that will materialise. Most essential variables are the importance of sustainability, the worldwide economic development, Europe's position within that, and above all the time horizon against which investments and initiatives need to be reviewed, returned and recouped. Each of the scenarios will therefore lead to a different use of the seas and the oceans.

Figure 3.1 Positioning of the four background scenarios.



Beneath the four general scenarios are described more in detail with an estimated development in the year 2025.

3.2.2 Short descriptions of the four scenarios: the world in 2025

Sustainable Growth

The world economy has shown and continues to show strong and stable growth. Growth rates differ throughout the world: the BRIC countries have maintained their relatively high pace and the world is now dominated by five power blocks, instead of the one or two at the beginning of the millennium. This puts extra stress on international coordination.

Sustainability, rooted in a worldwide public conviction, is a strong driver. It promotes a long-term view, anticipating future shortages and having alternatives timely in place. New industries have developed as a result of it, in energy efficiency, energy production, recycling technologies and food production.

Related to the economic stability, governments and private enterprise are confident enough to embark on long-term plans and investments. Funds for scientific research and technological development are amply available, which has lead to an innovative economy, in which the EU plays a strong role.

Globalisation and global competition have continued over the past decades. Overall the result is an efficient world economy, guarded by a host of organisations operating at world level. This also has its effects on climate change, which is now believed to be under control with binding international treaties.

Pursued Growth

The world economy has developed similar to the previous scenario, but under different circumstances. Economic growth has been pursued actively by national authorities, even if it came at the cost of the environment. The sparse objections that have been made have not been able to change the common belief that nature is, to a large extent, able to take care of itself; and if it is no longer, then technology will have progressed far enough to mitigate the adverse effects.

The economic model used has led to a fast depletion of natural resources. Until now, the world has not run into acute problems, and it has been slow to prepare for it, again acting on the belief that technology will help us out. Sustainability issues therefore play a role only in areas where economic damages result. So some know-how on sustainability is developed.

Science and technology receive ample resources, thanks to the flourishing economy. Successful innovations have been made in many fields and especially in extraction of resources from the earth, under ever more difficult conditions, both from land and the sea floor.

Competition for resources is strong, and though the economy has globalised, individual nations and power blocks show a tendency to pursue their own interests first - although balanced by the many parallel interdependencies. This trend results in a large number of bilateral agreements between (clusters of) nations.

Boom and Bust

The world economy is still recovering slowly from the economic crises of the 2010's. Recovery is hampered significantly by boom and bust cycles (short-lived, strong growth, meeting its limits and then resulting in shrinkage), which leads people and authorities alike to focus on the short term, on survival, on their own direct interests.

Long-term economic investments have shown a marked decline over the past decennia. Everything is focused on short term profitability. Some people, some nations are better in capitalising on the economic cycles, but solidarity is low and welfare differentiation increases - 'God helps those who help themselves'.

Science and technology are limited in size and scope. Fundamental research is cut down to almost zero, which has caused a significant brain drain to countries that perform better, most notably to Asia.

The environment is suffering from these developments; it has no priority in people's minds and is left to nature itself to recover.

Fragile Recovery

The world economy is still recovering slowly from the economic crises of the 2010's. As in the previous scenario, recovery is hampered significantly by boom and bust cycles, but even so, people strongly believe in the importance of sustainability. Although this may have hampered economic recovery even more, the future prospects are improving, because this slow path is sustainable and leads to a widely supported type of society.

The high value attributed to sustainability has also resulted in a stronger role of national authorities and of solidarity principles than in the previous scenario; national authorities have among others the task to attenuate as much as possible the ups and downs in the economy.

Long-term economic investments have shown a marked decline over the past decennia. Primary focus is on the short term survival of uncertain circumstances, but wherever possible, reservations are made for the longer term: sustainable developments are promoted whenever the economy allows, efforts are made to accumulate knowledge and build forth on previous boom stages.

Science and technology are limited in size and scope. As fundamental research is cut down to almost zero during bust phases, but increased during boom phases, a vagrant community of researchers has developed, who follow the economic fluctuations over the world, eventually disseminating the results world-wide.

The environment does receive a lot of attention, though probably not as much as it should due to the limited resources.

Four futures in 2025				
	A. Sustainable Growth	**B. Pursued Growth**	**C. Boom and Bust**	**D. Fragile Recovery**
Economy	Stable growth, increasing but predictable price levels, confidence in the future, long-term planning and investments, increasing globalisation, increasing global competition, relatively weakening position 'overall' of EU due to faster growing BRIC.	Stable growth is pursued, even if it is at the cost of the environment - 'nature will take care of itself'. The rate of depletion of natural resources is highest here, which is bound to cause setbacks, but not yet in 2025, and believed to be solved by technology. Increasing but predictable price levels, confidence in the future, long-term planning and investments, increasing globalisation, increasing global competition, relatively weakening position 'overall' of EU due to faster growing BRIC.	Slow recovery from the economic crisis, while the recovery is hampered even more by strong fluctuations in growth and in price levels. Planning aims at the short term and long-term investments show a sharp decline. During 'boom' phases, much is possible, while 'bust' phases result in mass unemployment and social unrest.	Slow recovery from the economic crisis, while the recovery is hampered even more by strong fluctuations in growth and in price levels. Rooted in public opinion, economic recovery is not allowed to harm the environment. This slows down the short-term economic recovery, but in the longer term offers new opportunities, while somewhat levelling the peaks and valleys of the boom and bust cycles.
Science and technology	Are considered important drivers, receive sufficient resources, support among others the development of sustainable production methods	Are considered important drivers, receive sufficient resources. Technology is trusted upon as the solution to future problems, to be developed when the need arises.	Science and technology aim at the short term, at readily implementable research and innovations. Limited funding. Fundamental research is cut down to almost zero, causing a brain drain to Asia. Capitalising on boom phases is key here.	Science and technology aim at the short to mid term, trying to establish a learning curve from boom phase to boom phase, preserving knowledge gained. Funding is limited. Fundamental research is cut down and shifts internationally, resulting in a 'vagrant' research community.
Environment and climate	Strong commitments to environment, rooted in public conviction of its importance; gradual shift towards sustainable production processes and renewable energies will prevent acute shortages of energy, raw materials and food.	Limited commitments to environment, which only becomes urgent when it causes economic losses. Climate change is primarily seen as an opportunity for private enterprise. Strong belief in resilience of natural systems.	Environment and climate change are of secondary importance, receiving attention only for the most acute problems during 'boom' phases.	Environment and climate receive much attention, though not as much as desired because of limited resources. Policy aims at guaranteeing a learning curve from 'boom' to 'boom' phase, thereby applying a longer time horizon than in C.
International relations	Strongly developed and aimed at long-term coordination and cooperation. World governance is the lubricant of development.	Strongly developed and aimed at long-term coordination and cooperation, but only if related to direct national interests. More bilateral agreements than in A.	Of opportunistic nature, aimed at serving short-term national interests, thereby adding to the overall volatile character of the economy.	Opportunistic and guided by available funding, but rooted in a shared vision on future desired state.
Role of public authorities	Play a strong role in the fields of planning, national and international coordination and in presiding over conflicts. Strong position of global organisations.	Play a strong role in the fields of planning, national and international coordination and in presiding over conflicts. Strong position of national authorities.	Weak and unreliable, due to limited resources and capacity to anticipate. Unrest during 'bust' phases causes frequent government changes.	Considered instrumental in preventing the worst excesses of boom and bust, trying to keep course in difficult circumstances. Hampered by limited resources.

3.3 Mature economic activities – the bedrock of Blue Growth

Note: A full description of the below activities (sub-functions) can be found in Annex 4 of this report.

These activities currently provide high amounts of value added and employ substantial numbers of staff. Main challenge for these activities is to continue to perform in the light of strong external pressures and fierce competition from global players. Much will depend on the strategies and business models implemented and on the ability to adopt increasingly sustainable practices, and to export to global markets.

3.3.1 Short-sea shipping: reaching out to Europe's neighbourhood [19]

…GDP growth will increase – but employment is expected to remain stable

The short-sea shipping value chain consists of the shipbuilding industry providing ships (including the marine equipment manufacturers), ship operators, handling services, port infrastructure provision and services, logistics and maritime infrastructure provisioning. The latter is usually a public task.

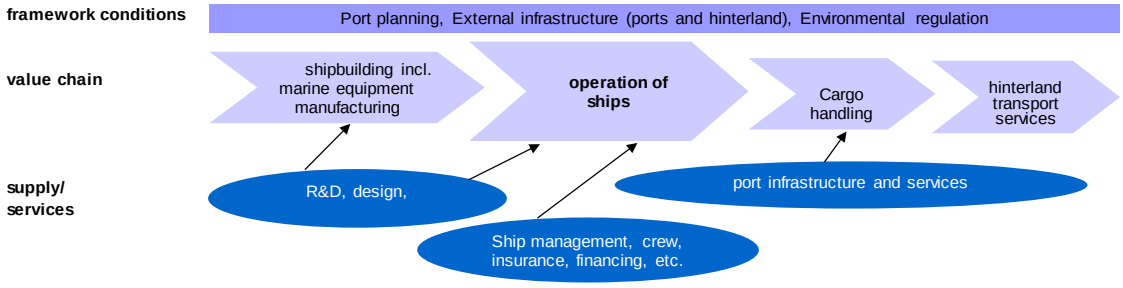
Shipbuilding and marine supply industry

Growth is expected in the supply industry, related to technologies addressing the environmental impacts of shipping (leading manufacturers in the area of propulsion systems and exhaust gas treatment are based in Europe – including companies like MAN, Wärtsilä and Rolls Royce). Additional growth of volume may be realised by stimulating modal shift, provided that the additional costs of complying with emission regulations do not form too much of a constraint. The emission of sulphur emissions (SO_2) of the sector will drastically reduce, due to the strict regulations in ECAs in particular and in general due to IMO regulations. This will be realised through a mix of measures: using low sulphur content fuel, scrubbers and LNG as a marine fuel. LNG will become an alternative source of fuel for a substantial share of the short-sea vessels once a suitable distribution infrastructure is set up. Experts estimate that this may take at least 5 to 10 years. In addition to the regulatory drivers pressing for these developments, the current market of high fuel prices also drives ship owners and operators to seek for energy efficiency gains, including the development of new ship designs, slow steaming and the use of more integrated and more efficient power systems.

Shipping and ship owners

Main players in ship operations are difficult to assign. In the bulk segment (liquid and dry bulk cargoes account for about 70% of the volume), the market is quite fragmented. In the RoRo/ferry segment companies like Grimaldi, Finnlines, P&O Ferries, Stena Line, Cobelfret, DFDS Seaways and Grandi Navi Veloci are worth mentioning. In the container segment mainline carriers like Maersk, MSC and CMA CGM are active as well as smaller players like Unifeeder, Seago. European manufacturers are leading in the development of new propulsion methods. EU supported R&D programs contribute to maintaining this lead position.

[19] Literature references used for drafting this section can be found in section 8.2.1 under the specific heading for this economic activity.



The transported volumes by short-sea shipping account for almost 1.7 billion tons per year, of which about 600 million tons concerned neighbouring states and 1 billion intra-EU shipping (37% of all intra-EU transport)[20]. Although the crisis causes a short term decline of these volumes, for the long term annual growth is expected in the range of 3-4 % for the coming decade. Employment is estimated at some 700,000 and this number is considered to remain relatively stable due to efficiency increases taking place along the value chain. Added value is estimated at €57 billion. The current crisis has brought some operators in trouble, especially in the segment of RoRo and ferry services, where also in periods of economic growth, competition is fierce and margins are low, which has resulted in an aged fleet in several parts of the market and limited funds for modernisation or replacement. Other parts of the short-sea segment may be affected by the overcapacity that is being created in deep sea markets caused by the large newbuilding activity over the past years. Overall however port related activity has recovered largely from the growth losses of 2009/10.

…Trade with Neighbourhood countries and congestion on the road will drive future growth.

The European Single Market will contribute to further exports and demand for short-sea shipping. Trade with Neighbourhood countries will increase – as growth in Turkey, Russia, Ukraine and North Africa will spur the demand for short-sea shipping. A similar development might be seen in the northern Mediterranean countries once these return to political stability (in the short term the effect of the Arab Spring will be a reduction of trade volumes, due to civil unrests). Congestion of road transport will lead to reduced competitiveness of this alternative, while expectations for rail and inland waterways remain modest. Price competition drives increasing ship size, and there will be diversity in the actor's potential (including terminal operators) to reach economies of scale – big players will be able to invest and adjust faster than small operators.

Uncertainty for short-sea shipping comes from the (limited) harmonisation of cross-border operations. Pricing and external costs are crucial determinants, and the correct incentives need to be provided.

The major impacts of short-sea shipping on the environment currently are chemical pollution due to oil spills, discharge of oil and ballast waters – the latter also risking the introduction of invasive species –, under water noise, and pollution by anti-fouling agents such as tributyltin (TBT). Other impacts include emissions of NO_x, particulate matter and sulphide to the atmosphere. These impacts tend to grow with increasing shipping activities whereas technology developments contribute to lowering them. The number of shipping accidents in European seas due to sinking, grounding, collision, fire/explosion and other accidents remains significant. Increasingly strict measures and a raising enforcement effort – also supported by improving monitoring devices – contribute to further reducing these impacts. Finally port construction works and dredging may give additional pressures on the environment.

[20] Eurostat database (data of 2009)

…A full recognition of the role of ports as key nodal points is required.

Short-sea shipping is an important element of the EU's maritime shipping and transport business. This is also made tangible through operational programs such as Motorways of the Seas targeting intra-European transport by sea, or the Blue Belt project aiming at reducing administrative burdens. There are strong synergies with deep sea shipping, which not only provides the overseas cargo, but also shapes the main ports. Passenger ferries provide synergies as well (e.g. RoRo), while inland shipping is another essential component of the chain. A full recognition of the role of ports as key nodal points is required. Port planning needs to be addressed in a wider sense – by identifying the main functionalities of ports and by building whole value chains around them – important synergies emerge here in terms of supply industry as well as tourism. Surveillance as a tool to improve the security of cargo as well as passengers also provides growth potential. Within this context, the Blue Belt Pilot Project aims to explore new ways to promote short-sea shipping in the EU by reducing the administrative burden for intra-Community trade[21].

The PROPS project, funded through the FP7 programme (Transport) is a sound example of how a mature transport industry can grow further through targeted promotion activities, better linkages to the value other modes of transport (intermodal).

PROPS

Promotional Platform for short- sea shipping and intermodality[22]

(2008 – 2011)

Project description:

The PROPS partners worked closely with the Short Sea Promotion Centres (SPCs) to develop a workable and replicable methodology that enhanced their practical promotion activities in the fields of legislative, technical, and operational actions and to extend their operations to encompass inter-modal and co-modal transport.

Project results:

- Identification of best practices towards improving the integration of short-sea shipping with relevant inland logistics chains. Particular attention was paid to the linkages of key supply chain stakeholders and the removal of bottlenecks.

- An ex-post analysis of the core processes - how short-sea promotion centres located in EU tourist destinations utilised their business networks to attract more tourists.

- A set of performance indicators and benchmarks, linked to self-assessment tools and training programmes for the Short sea promotion centres. Other tools to assist the SPCs improve their performance and their overall integration into European logistics business networks were developed, e.g. an e-booking system integrator to improve the access to commercial freight booking systems.

- A simultaneously running media campaign tested the campaign and the perception by business of the need to increase the amount of freight transport by short-sea shipping as an integral part of logistics supply chains.

Key data:

Funding programme: FP7 - TRANSPORT
Project duration: 36 Months
Total project volume: € 2,460,115
EU funding received: € 2,309,054

Assumptions about framework conditions

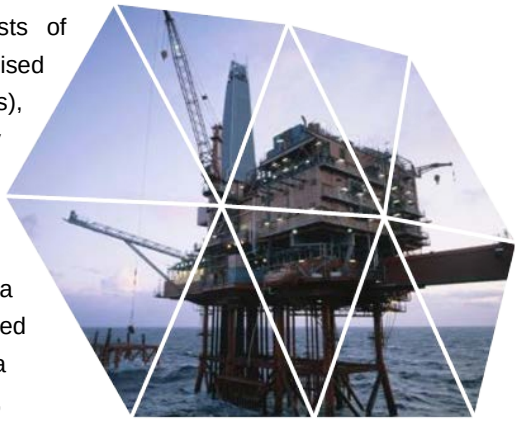
- Lack of capacity in and around secondary ports and their hinterland connections will be addressed;
- Strong enhancements in external infrastructure (ports and hinterland);

[21] See http://www.emsa.europa.eu/news-a-press-centre/external-news/item/684-emsa-5-year-strategy.html
[22] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=10502097

- Environmental regulation will be increased gradually, allowing the sector to acquire funds and invest in the necessary adaptation costs.

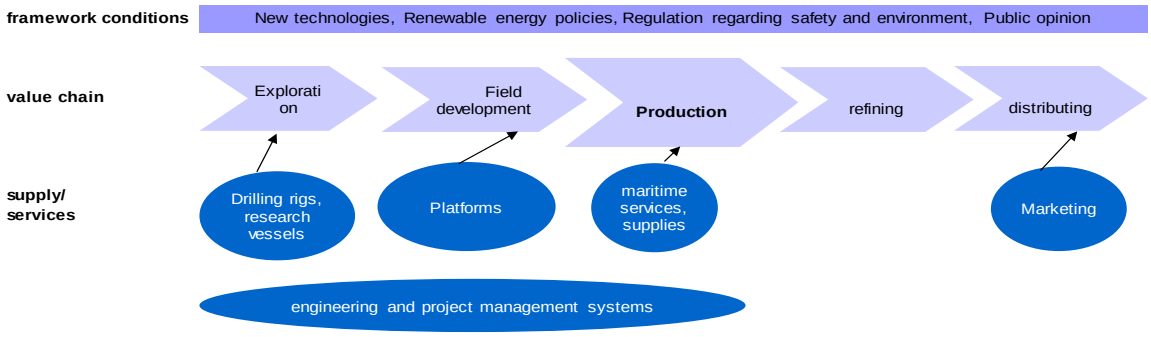
3.3.2 Offshore oil and gas: deeper and farther away[23]

…Despite all, global offshore oil & gas exploitation will still increase and Europe's larger actors are well-positioned to play an important role around the globe.



The upstream offshore oil and gas value chain consists of exploration (involving drilling rigs and research & specialised support ships), field development (building of platforms), production and exploitation. The latter two involve supply ships and related maritime services. Downstream activities are refining and distribution to the consumer markets.

This is a large-scale activity with multinational players having a global reach. Half of the top-6 so called oil majors are EU based and they include Shell, BP and Total. The export potential of a range of players in the value chain is strong, including drillers, surveyors, etc. Future efficiency gains in production are expected, as currently fields are being exploited for only about 50-60%.



The global demand for fossil fuels is still growing. More than 80% of Europe's oil and gas extraction takes place offshore, and concentrations of activity are found in the North Sea, the Adriatic Sea, as well as locations in the central and eastern Mediterranean and in the Black Sea. Its importance will reduce in the years to come due to the exhaustion of existing oil fields. Offshore gas exploration will stabilise still in the next 15-20 years, with methane hydrates extraction providing new opportunities, including those within or adjacent to the European waters. Also the opportunity of shale gas is being explored, and vast resources of some 1,000 trillion cubic feet are reported in UK offshore territory, equivalent to about 300 times the current UK gas consumption[24]. Others however question this estimate[25]. Also in other Member States interests into exploring the segment (onshore) are seen. However exploiting this faces a number of environmental concerns, and is also causing tensions with, or causing the slow down of the development of other offshore energy activities[26]. France[27] and Bulgaria[28] have banned the fractioning process.

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[23] Literature references used for drafting this section can be found in section 8.2.1 under the specific heading for this economic activity.

[24] UK has vast shale gas reserves, geologists say, 18 April 2012, http://www.euractiv.com/climate-environment/uk-vast-shale-gas-reserves-geolo-news-512236

[25] The Carbon Brief, 19 April 2012, 1,000 trillion cubic feet of offshore shale gas? "Don't believe the figures," says geologist, http://www.carbonbrief.org/blog/2012/04/1,000-trillion-cubic-feet-of-shale-gas, accessed 11 July 2012

[26] See for instance WindPower monthly (2012), Polish offshore plans suffer shale gas setback, 16 April 2012, http://www.windpowermonthly.com/go/europe/news/1126980/Polish-offshore-plans-suffer-shale-gas-setback/

[27] France24, 5 November 2011, French lawmakers ban controversial shale gas drilling, http://www.france24.com/en/20110511-france-votes-ban-shale-gas-drilling-fracking-ump-sarkozy, accessed 11 July 2012

[28] The Guardian, 14 February 2012, Bulgaria becomes second state to impose ban on shale-gas exploration, http://www.guardian.co.uk/world/2012/feb/14/bulgaria-bans-shale-gas-exploration, accessed 11 July 2012

More important still will be the export potential of European energy players and their suppliers in the exploration of oil, gas and methane worldwide, in ever deeper waters (e.g. in BRIC countries, Arctic). Major oil discoveries in other parts of the world, increased fuel prices and the EU's continued desire to become less dependent on oil imports will further drive this activity. Recent discoveries of the coast of Norway have indicated also European waters might still provide unknown resources. R&D activities are focused on these trends and include cost saving measures (cheaper materials, onshore control units, the use of monitoring devices, mobile platforms), exploration techniques (3-D and 4-D seismic imaging, measurement while drilling), Enhanced Oil Recovery (EOR) and Enhanced Gas Recovery (EGR), and deep water techniques (to deal with high pressures, corrosion or frozen surfaces). Norway is a key player in Europe. While Carbon Capture and Storage (CCS) could become a promising activity in the longer term, most experts do not expect this to be turned into economic activity within the next 10 years.

Uncertainties stem from financing – as the horizon of financial markets is shorter than payback periods. A major challenge lies in the need to make offshore more sustainable. Currently, environmental impacts tend to be adverse, and disasters not only spoil the environment but also the public acceptance of offshore oil and gas exploration. Particularly pristine territories – such as the Arctic – provide high risks. A continued boost in environmental impact reduction techniques is therefore expected.

Most operational installations reported air emissions and discharges to the sea as a result of oil and gas extraction. Routine operation of production platforms leads to the release of oil (and produced water) and chemicals to the sea, especially through discharges of produced water and partly from drill cuttings. Accidental oil spills can arise from different sources during operation and cause disastrous effects especially in semi-closed areas. Recent examples like the March 2012 North Sea leakage indicate no clear and ready to use responses are available that fit all events. Other pressures from oil and gas activities include emissions of volatile organic compounds, methane, sulphur dioxide, nitrogen oxides and carbon dioxide to the atmosphere. Construction of offshore installations, drilling and seismic surveys during exploration are sources of underwater noise. Installations at sea have a disturbing effect on bird life through light pollution. For that reason some offshore platforms nowadays carry green lights.

Oil & gas technology is an important driver for other offshore activities (e.g. deep sea technology). A strong synergy exists with offshore wind as well as with other renewables through the sharing of platforms and other infrastructures. Oil & gas provides also synergies with shipping and ports (imports, oil & gas terminal development).

The Chaintest project provides an interesting case for joint research, funded through the EU’s FP6.stream, of how new exploitation processes (floating platforms) can be maintained in a manner that is much better taking into account environmental aspects and the security of the offshore workforce.

Chaintest

Autonomous Robotic System for the Inspection of Mooring Chains that Tether Offshore Oil and Gas structure to the Ocean Floor[29]

(2005 –2008)

Due to the gradual depletion of the oil & gas exploitation close to the shores, floating structures platforms will have a considerable advantage over those fixed on the seabed. However, these offshore floating platforms used for oil and gas extraction, are moored to the seabed by enormous metal chains. Current practice involves bringing the chain on deck for visual inspection, taking it ashore for non-destructive testing (NDT) or inspecting it on site using remotely operated vehicles. However, these techniques have proven unreliable and subject to human error.

Project description:

The Chaintest project provided the solution by building a robot that can crawl along chains resting both above and below water for routine safety inspections. The device can test for cracks, corrosion and bent and elongated chain links.

Project results:

The robot removed rust and marine growth to conduct NDT using alternating current field measurement (ACFM) and ultrasonic guided wave (UGW) testing or low-frequency resonance techniques. Field trials were conducted at an indoor seawater facility at Brest in France.An autonomous robot system will make a significant contribution towards environmental protection and worker safety by improving the inspection of mooring chains used for tethering offshore floating production platforms[30].

Key data:

Funding programme: SME-FP6
Project duration: 30 Months
Total project volume: € 1 918 784
EU funding received: € 994 184

Assumptions about framework conditions being fulfilled:

- New technologies will allow further exploitation of offshore oil fields that are currently considered almost depleted;
- Renewable energy policies will provide room still for oil & gas;
- Regulations regarding the safety and the protection of the environment will be introduced gradually;
- Public acceptance;
- No radical changes in the public opinion with regard to this activity (oil spills, climate change impact, etc.).

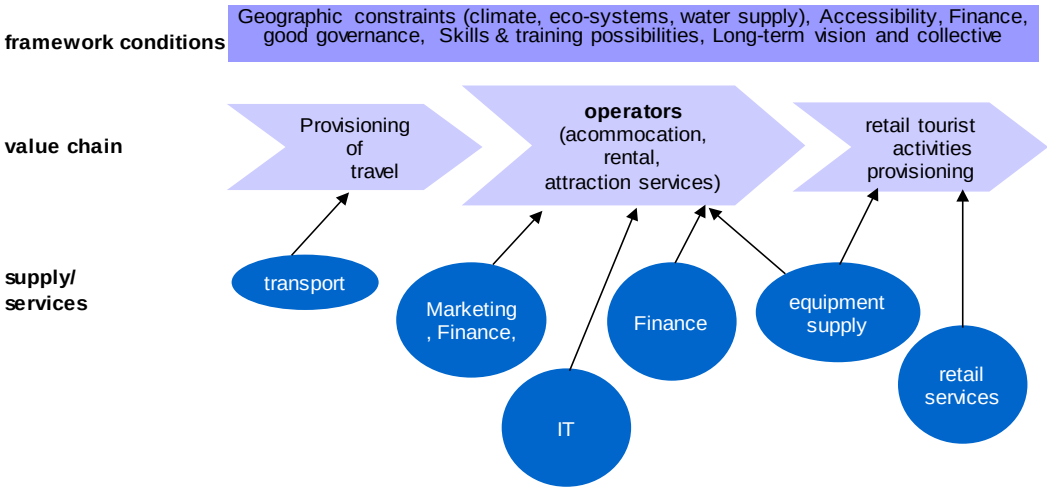
3.3.3 Coastal tourism and yachting: polarisation between places[31]

Coastal tourism is an activity involving a wide variety of stakeholders, but also policy measures at various levels. It is a broad industry as it contains attractions and transport, travel organisers and local tourist offices. Moreover, different target groups (e.g. business travellers, leisure tourists) are served.

Coastal tourism includes a) beach-based recreation and tourism, b) tourist activities in proximity to the sea, and c) nautical boating including yachting and marinas[32].

[29] http://www.chaintest.com/chain_objectives.html#
[30] http://cordis.europa.eu/fetch?ACTION=D&SESSION=&DOC=1&TBL=EN_OFFR&RCN=6959&CALLER=OFFR_TM_EN
[31] Literature references used for drafting this section can be found in annex 1 under the specific heading for this economic activity.

With more than 2 million European citizens being employed, it is by far the largest single maritime economic activity. The gross average economic growth is expected to be 2-3 percent in the years to come. As labour intensity is rather high the growth of employment is expected to be similar to this rate, with limited productivity growth as a consequence. While coastal tourism is a supplementary activity for some regions, it is the main source of employment and income for a large number of coastal communities across Europe.



Increased pressure for CO_2 cuts and fuel costs are expected to reshape the sector, as it is likely that in the long term distant short trips will decrease and local areas will become again more attractive tourism destinations, particularly for those who can no longer afford distant journeys. A strategic need for sustainable means of transport will surface. The need will grow for strategic thinking and acting in terms of sustainable transport solutions and ways to connect coastal regions throughout Europe - as fierce competition amongst regions and places within and outside the EU is expected.

…Competition will affect areas without specific unique selling points that are poorly connected.

A growing demand for unique experience and value-for-money will shape parts of the sector. The mix of increased air transport prices and stagnant average income of EU citizens might reshape the current EU tourism demand towards higher value for money. Competition will come from both EU and worldwide destinations, which have greater quality of the local environment, infrastructures and services, and/or lower labour costs. They will adversely impact areas without specific unique selling points that are poorly connected to the main urban centres.

An important niche is represented by nautical sports. For example, 10 million people in the world travel each year to wind and wave surfing destinations and the trend is growing, and 500 thousand more people every year practice this sport[33]. Although no precise data are available for the EU the phenomenon is becoming increasingly relevant, particularly for Portugal, Spain, France and the UK[34]. Diving is another growing nautical sport activity, with 800,000 Europeans each year making one trip for diving experiences - with 10 night-out on average and including 'diving cruises' as a specialised segment - and spending more than €1.4 billion annually[35]. Main diving destinations are Spain, Malta, Cyprus, as well as Turkey and Croatia, in which diving has allowed extending the touristic season beyond summertime. One example is that of the Medes Islands (Spain), visited

[32] The cruise sector will be treated separately in the section below.
[33] Global Surfers Surf Atlas (www.globalsurfers.com)
[34] Global Surfers Surf Atlas (www.globalsurfers.com)
[35] *European Underwater Federation (EUF),*

each year by about 20.000 scuba divers, where divers represent 9.3% of the tourist population[36]. Furthermore, as divers expect variety of underwater landscapes (ex: shipwreck), several European countries (i.e. like Italy, Finland, or Greece) have taken advantage of there natural and cultural wealth setting up underwater archaeological park.

The growing demand for nautical sports has prompted interesting public-private initiatives, such as the Nautical Resorts in Spain and France - legal entities grouping nautical/water sport operators, local hotels, restaurants, shops, etc. to promote coordinated touristic strategies, including marketing, training and innovation activities - federated in the European Federation of Nautical Resorts[37]. A debated role is that of the about 1,600 marinas existing in Europe. Although possibly a relevant catalyst for economic growth, the lack of substantive scientific evidence across EU sea-basins is currently challenging any rigorous analysis of marinas' true potential. Any initiative promoting additional understanding and evidence on these focal points of coastal tourism is therefore welcomed by the practitioner community.

…Winners will be those places with strong innovation and marketing capabilities.

Europe overall will remain the first global player in tourism, but the Mediterranean predominance is expected to be challenged as the economic crisis affecting Europe also causes a trend towards more 'local' holidays. On the other hand, Mediterranean destinations are fighting back mostly by reducing prices and offering attractive packages. Winners will be those regions and places where tourists obtain 'value for money'. However, value is often captured by big players with limited spill-over effects to local and regional players.

The potential for marinas including yachting as drivers for long-term growth will remain important – with growth of approximately 2 – 3 percent on average per year. Other nautical sports on the other hand, are expected to stabilize over time, also due to demographic changes in Europe.

The future of coastal tourism will be shaped by the income potential of certain EU client groups - e.g. 35% of European tourists have changed behaviour due to the crisis. An ageing population and a larger share of educated citizens will lead to more demand for 'customised experiences'. Climate change makes many coastal regions exposed to sea-level rise and/or changing weather conditions. Increasing fuel prices will challenge existing transport models (e.g. low-cost airlines). Potential tensions might emerge with other relevant maritime economic activities for Blue Growth. On the one hand the growth in tourism also increases the pressure on natural areas and fragile ecosystems.

Tourism can contribute to pollution, marine litter and coastal erosion. These impacts tend to be aggravated by seasonal concentration and spatial concentration. In this respect, it is increasingly important to recognise the economic value of marine protected areas. On the other hand, activities related to aquaculture and mineral extraction might have a negative impact on tourism development as they could affect the quality of the marine environment and bathing water. Potential tensions need therefore to be carefully identified and possibly solved, or at least managed and mitigated. The growth of tourism has also increased pressure on natural areas and fragile ecosystems, such as dunes, cliffs and wetlands. Tourism also contributes to pollution, marine litter and coastal erosion. Beach tourism and recreational boating have direct effects on marine species and habitats. Other recreational activities that can put pressure on the marine environment include (kite-) surfing, scuba-diving, angling and whale-watching. A particular concern is habitat fragmentation caused by tourism-related development (including over-frequentation). Another concern is the disturbance of beach-dwelling species by tourists during the breeding season. The growing attraction of remote areas as tourist destinations puts these relatively pristine areas under pressure. Diving activities

[36] *Recreational Scuba Training Council (RSTC)*
[37] www.nautical-tourism.eu

without control can alter underwater ecosystems, especially when coupled with illegal gathering of coral, shells or fishing. Tourists also add synthetics to the marine environment, by using oils, crèmes, self tanning etc. to block out or fully use the sun; most of these end up in the sea.

But tourism has also the potential to create beneficial effects on the environment by contributing to environmental protection and conservation. The NEA-2 project is an example of regional efforts in this field (see box below). It is also a way to raise awareness of environmental values and it can serve as a tool to finance protection of natural areas, as Marine Protected Areas (MPAs), and increase their overall economic importance. Yacht harbours can have serious negative impacts on the environment due to the consumption of land, degradation of surrounding shallow waters, disturbance of the dynamics of coastal currents and chemical pollution. Marinas may constitute barriers for littoral drift. They also retain the sediments upstream, which may induce local erosion downstream. Dredging activities may result in the unintended extraction of species. Damage can be done in a variety of other ways (e.g. anchor impacts on sea-grasses).

Important for creating synergies will be the ability of key actors to develop an overall vision on value propositions – currently hampered by the large fragmentation of the sector. This fragmentation across sea-basins and proliferation of micro companies also limits innovation (Baltics and North Sea being well-placed). Adjustment and mitigation capacity varies across sea-basins, depending on the capacity of local institutions and actors to develop common mid- to long-term strategies[38]. In the end, coastal tourism will remain an important source of income for local communities, creating jobs due to the important amounts of money that coastal tourism attracts. Coastal tourism can also provide opportunities for coastal protection, e.g. marina infrastructure contributing to coastal protection of land and property from erosion by the ocean.

Assumptions about framework conditions

- Geographical constraints: climate and quality of the built and the natural environment;
- Lack of skills and training possibilities coincide with limited attractiveness/poor image on the labour market;
- Accessibility by sustainable transport modes;
- Access to finance;
- A need for good governance at all levels;
- Long-term vision and collective action;
- Better regulation (i.e. Blue Flags) in ensuring good quality of environment, bathing water, etc.

NEA 2[39]

Sustainable development of marine leisure and water sports in the Atlantic area

(2009 – 2012)

NEA 2 focussed on innovation and exchange activity between the partner regions, an analysis of the skills gaps and training needs. Besides, the project aims at creating an Atlantic Area Nautical Observatory. Finally, the project entailed also communication activities around to market the tourism potential of the area better and to promote traditional boats. All of this was done in the context of concrete development of environmental credentials in the industry and attention to social exclusion needs.

Project description:

NEA 2 was a project involving 23 partners in 8 regions on the European Atlantic coast. Together, they engaged in actions designed to ensure the sustainable development of marine leisure in the Atlantic Area. All water

[38] Interesting strategies can be found in Europe (i.e. Scotland and the Baltic) and internationally (i.e. New Zealand).

[39] http://www.nea2.eu/en/600/00/

sports including sailing were included in the project and the regions engaged focussed on their strongest or emerging sports.

Project results:
Economic Coordination – 4 generic actions - Developing research and innovation in the marine-leisure sector; Establishing observatories to understand the reality, trends, and economic impact of the marine-leisure sector in the Atlantic Area; Develop the economy of traditional boats; Develop marine-leisure products based on the discovery of the coastal, aquatic and marine environment.

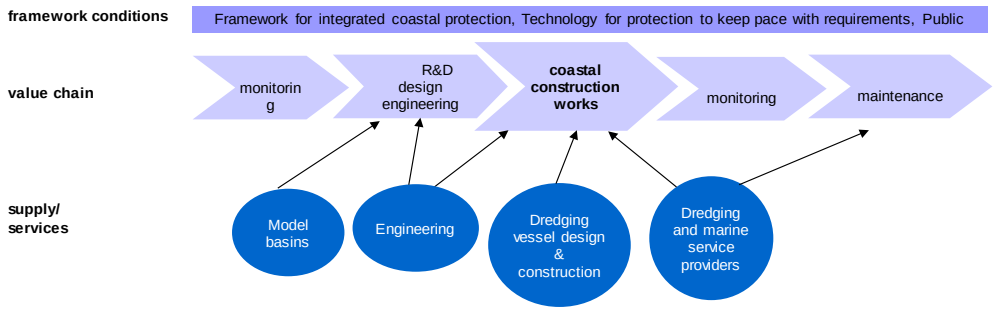
Environment Coordination: 4 generic actions - Improve the environmental credentials of marine leisure buildings (Water sports centres/clubs, marinas, marine-leisure industries etc.); Develop good environmental practice in the marine-leisure sector of the Atlantic Area; Develop the environmental awareness of marine-leisure users in the Atlantic Area; Publicise and foster the organisation of events aimed at promoting and improving the environmental qualities of the marine-leisure sector).

Social coordination: 3 generic actions – Develop and deliver pre-professional and professional marine-leisure training in the regions; Development of equipment and staff training to promote marine-leisure activities for disabled people in the Atlantic Area; Organisation of water sports events accessible to socially excluded populations; developing access to water sports for disabled people.

Key data:
Funding programme: INTERREG IVb Atlantic Area (ERDF)
Project duration: 38 Months
Total project volume: €4,721,137
EU funding received: €3,068,739

3.3.4 *Coastal protection: steadily reinforcing Europe and the world*[40]

Coastal protection in itself is a mature activity with experienced players dominating the field. However gradual innovations such as the sand motor, and 'Building with Nature' remain vital. They will increase enthusiasm and support for coastal protection. The research focus lies on the use of natural processes and as such integrating coastal protection in the available eco-systems (including projects like EUROSION and CONSCIENCE). Much of the R&D work takes place in joint projects with industry and government institutions. New ways of Public-Private Partnerships will increase the efficiency of funds spent. A technological adaptation will be the increased size of dredging vessels, reacting to larger distances-to-shore.



Experience and know-how of coastal protection is largely concentrated in Europe, with a limited number of large players operating internationally. Scientific research however takes place across the globe and as shown in section 2.4, in terms of patent registration Europe is not leading. Growth

[40] Literature references used for drafting this section can be found in annex 1 under the specific heading for this economic activity.

is expected at a moderate but steady pace, making coastal protection a strong export product to low-lying coastal regions all over the world. Because of its market leadership, the four main EU marine contractors will therefore continue to export their services and capture a substantial part of the growth in the rest of the world.

Climate change, resulting in sea-level rise and more extreme weather events, will continue for decades and even centuries to come. This is now a widely accepted view. Urbanisation, population and economic activities concentrated in deltas and coastal regions continue to grow. This leads to high and increased values to be protected. Coastal protection will therefore be a slowly but steadily growing economic activity over the coming decades. The functions that are part of the value chain are monitoring, design, construction, monitoring again, and maintenance. Whereas in the monitoring and design, both government agencies and engineering firms are the main players, construction is lead by the four large dredging and marine contractor firms (Boskalis, DEME, Jan de Nul and Van Oord). On the supplier industry side, IHC is the leading shipbuilder in this field. At the research side, leading bodies are research institutes like Deltares, Hydraulic Research Wallingford and Danish Hydraulic Institute, along with a number of universities. Annual turnover of coastal protection activities is estimated at € 1 to 5 bn per year[41] and is concentrated in the North Sea and Mediterranean.

…Important uncertainty is the dependence on public finance

An important uncertainty is the economic situation – as dependence on public finances is strong. In this respect, the roles, responsibilities and commitments of central vis-à-vis local government need to be further clarified. Short-term and erratic behaviour of local authorities is another uncertainty, and so are slow procedures and administrative burdens for market players. An equally important uncertainty is the attitude of local communities, and their awareness of the long-term risks and benefits related to coastal protection. The main adverse environmental impacts of coastal protection are related to dredging: CO2-emissions, disturbance of the soil causing harm to geomorphology and fish.

The conversion of coastal into artificial areas (e.g. harbours, dykes, groyne fields, seawalls, marinas, artificial beaches and other artificial constructions such as dams or sea walls) is high in certain coastal areas, such as the Belgian and Dutch North Sea coast. Due to the irreversible nature of land cover change from natural to urban and infrastructure development, these changes are seen as one of the main threats to the sustainability of coastal zones. Artificial coastal constructions may also cause loss or direct damage to natural habitats, form barriers to migrating species, and changes to the wave exposure. This may alter the physical nature of the seabed, which in turn may cause erosion, sedimentation and physical and chemical disturbance of ecosystems. While the structures are under development there may be more underwater noise, water pollution (e.g. higher turbidity), and air pollution. There may be a loss of space for human activities, such as coastal fishing. Soft-engineering coastal structures, such as dunes and salt marshes, are increasingly being employed to act as natural buffers against rising tides. These structures use the coastal sediment balance to ensure coastal stability. Beach nourishment means more marine sand and gravel extraction and significantly disturbs the biology at extraction and deposition sites. Several research projects have taken place in this domain (see the ENVICOP project in the box below as an example).

[41] Based on EUROSION (2004).

Coastal protection activities provide important synergies with ocean renewable energies, e.g. wave energy converters may help to attenuate wave attack and generate electricity. Dredging can facilitate coastal aquaculture, through intelligent design of coastal protection works. The potential for coastal protection activities is therefore strongest when based on long-term visions and when synergies are exploited already at the level of master plans.

ENVICOP

Environmentally Friendly Coastal Protection in a Changing Climate

(2012 – 2015)

The aim of this project is to raise public awareness on the risks of sea-level rise and to foster knowledge exchange on the importance of coastal protection.

Project description:

The project is an extended collaboration of three 3 EU and 2 non-EU research organizations, experienced in the area of research on environmentally friendly coastal protection methods. EnviCOP aims at strengthening research partnerships, primarily through staff exchanges of experienced researchers. These activities will focus on the improvement and coordination of advanced tools (numerical simulation and physical models) to better forecast short and long term phenomena with respect to coastal protection in a changing climate.

Project results:

The project is expected to provide an improved understanding of the forecast processes, new and improved numerical and physical model tools, resulting in introducing new and improved environmentally friendly coastal protection structures. The output should finally serve decision-makers in strengthening emergency planning arrangements, improving co-ordination of coastal erosion and surface water flood risk; managing the investment of significant levels of public funding, and helping coastal communities adapt to climate change.

Key data:

Funding programme: FP7 - PEOPLE
Project duration: 36 months
Total project volume: € 227,200
EU funding received € 193,200

Growth of the activity will largely depend on coastal protection needs on the one hand – which will rise with increasing erosion, climate change, and growing economic activity in coastal regions – and available public budgets. A recent FP7 funded research ClimateCost has indicated adaptation costs would rise from about € bn per year to about €1.5 bn in the next decade.

Assumptions about framework conditions being fulfilled:

- The most determining framework condition is that EU and national authorities put a firm framework for integrated coastal protection in place. Coastal protection is a maritime economic activity that, due to the slow progress of sea level rise, can be neglected for some time without being punished. An important role for authorities at national and EU level is to make sure that this activity receives sufficient attention and funding;
- Technology keeps in pace with requirements caused by sea level rise;
- Public awareness of the risks of sea-level rise.

3.4 Growth-stage: creating new jobs right now

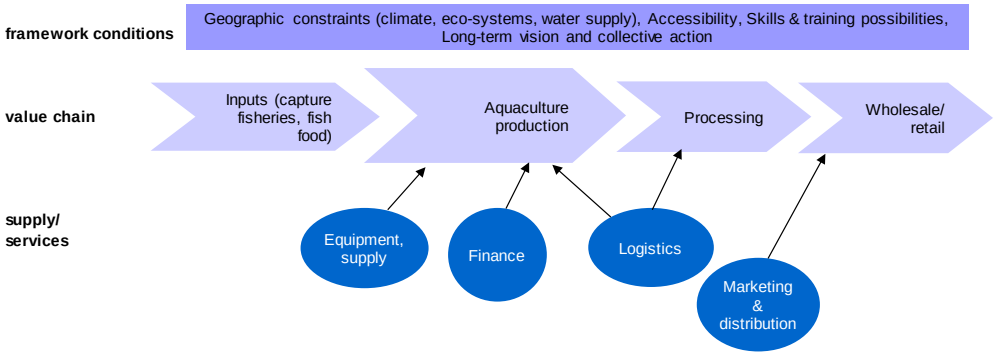
Note: A full description of the below activities (sub-functions) can be found in Annex 4 of this report.

These are the maritime economic activities which already have critical mass, which have already grown during the last five years and which can further grow in the years to come. These are the marine economic activities which will create immediate employment opportunities and that also in substantial numbers. However, there are important investments and preconditions required in order to reach the full potential of these activities.

3.4.1 Marine aquatic products: potential for growth [42]

Aquaculture means the rearing or cultivation of aquatic organisms using techniques designed to increase the production of the organisms in question beyond the natural capacity of the environment; the organisms remain the property of a natural or legal person throughout the rearing or culture stage, up to and including harvesting[43] [44]. Under this definition, algae can be differentiated in macro-, and micro algae: **Micro algae** are unicellular organisms of a comparably small size that are not suitable for open waters cultivation due to limited options for containment. Consequently, micro algae are produced on land either in open ponds or in closed system called bioreactors. Micro algae need nutrients to grow, such as nitrogen, phosphorus, sometimes silicon (for diatoms algae), but also micro-nutrients, e.g. iron and others. **Macro algae** (seaweed), on the contrary, are macroscopic multicellular organisms growing from photosynthesis, harvesting sunlight energy and fixating CO_2. They can be farmed (aquaculture) or exploited by extraction from natural populations in coastal areas (algae extraction). According to qualitative analysis, macro algae are mainly farmed at sea in Europe.

Farming of aquatic animals is mainly composed of three major sub-sectors: marine shellfish farming (e.g. oysters and mussels, shrimps, other crustaceans), marine finfish farming (salmon, sea bass and sea bream being the most important) and freshwater finfish farming (trout, carp, eel, etc.).



[42] The section on traditional aquaculture is based on desk-research mostly; interviews have been held for the part dealing with algae and seaweed. Literature references used for drafting this section can be found in annex under the specific heading for this economic activity.

[43] Council Regulation (EC) 1198/2006

[44] EC (2009) Building a sustainable future for aquaculture, Impact assessment, SEC (2009) 453, p.9

The value chain depicts the seafood value chain, and focuses on fish rather than the cultivation of aquatic plants including algae – which is yet less documented. Rising EU demand for fish has so far been largely met by rising of fish imports. Today, these make up roughly 60-65% of total fish supply to the EU. Taking into account the limits of capture fisheries, aquaculture appears therefore an appealing alternative. Indeed, global growth in aquaculture has been strong, with 40 million tons in 2002 to 53 million tons in 2009[45]. But so far, this growth has not been witnessed in Europe, with the exception of Norway. In 2010, total aquaculture production in the EU was just less than 1.3 million tonnes, worth some € 3.2 billion. The total number of employed in the sector is estimated at about 80,000. Of these, the strongest concentrations of employment can be found in France, Spain, Greece, Italy and Germany, where about 75% of all jobs can be found[46].

Since 1998, the overall production in marine and brackish water is slightly declining in volume but growing in value at the European level: Total production is estimated to reach €2.3 billion for just 0.98 million tonnes in 2010 compared to €1.6 billion for 1.05 million tonnes in 1998[47]. Over the period of 12 years, this evolution of value was however not steady: the value produced increased in the period from 1998 to 2001 (when it reached €2.2 billion), but then decreased from 2002 to 2004 (€1.9 billion). Fluctuations continued in more recent years, with an increase of value (to € 2.5 billion in 2007), followed by a slight decreased since.

Of the three sub-sectors in aquaculture, shellfish farming and marine finfish farming can be considered maritime. [48] Within the sub-sector of shellfish, oyster farming is concentrated in the west of France, where the sector faced a crisis in 2008 following very high mortalities of juvenile oysters. Spain and Italy are focusing on mussel farming, and so do the Netherlands, Ireland and the UK. With regard to the second sub-sector, the production volume of marine fish farming has been growing for a longer period of time. Over the last 30 years, the expansion in output from Atlantic salmon farming has been strong, with a focus on the UK and Ireland. The development of sea bass and sea breams aquaculture has been successful in Greece – but peaked in the years 2001-2002 after which prices collapsed due to overcapacity and lack of market demand/marketing. Tuna farming started in the early 1990s in the Mediterranean, but significant research and technological progress are still needed for upscaling.

The future of Europe's marine aquatic products is expected to depend on its ability to make the sector **sustainable,** in particular through pursuing **organic aquaculture**. Europe is relatively well-placed to pursue this strategy, as it cannot compete on costs and as it caters increasingly to the wish of European consumers to opt for healthy and fresh and local fish. The European standards on disease control and animal welfare are already high, while the same applies to the awareness of European producers and consumers to pay attention to social and environmental aspects[49]. It is expected that European consumers will be willing to choose for local, home grown and trustworthy fish over cheaper imports – where quality, freshness and origin are much harder to trace[50]. This trend is supported by voluntary labelling and certification schemes – which help to strengthen consumer confidence. A survey conducted by the Seafood Choices Alliance in the UK, Germany and Spain showed that consumers, when purchasing seafood products, value freshness (99%), health benefits (92%) and price (84%) over environmental impact (79%). Out of consumers

[45] FAO (2010) "The State of World Fisheries and Aquaculture", Rome.
[46] Guillen, Contini & Doerner (2012) “Economic Performance of the EU Aquaculture Sector (STECF-OWP-12- 03)” Scientific, Technical and Economic Committee for Fisheries (STECF)
[47] Global Aquaculture Production database. Electronic address: http://www.fao.org/fishery/statistics/global-aquaculture-production/query/en
[48] The third sub-segment is fresh-water-fish farming in lakes, ponds and basins and will not be discussed in this context.
[49] EC (2009) Building a sustainable future for aquaculture, impact assessment, SEC (2009) 453, p. 16.
[50] An example of local consumer preferences is demonstrated by the project Aquamax, a FP5-supported projected coordinated by NIFES (Norway) as presented during DG RTD's Food conference, 9th July 2010 in Brussels.

surveyed, also 40 percent indicates to be willing to pay 5–10 percent more for eco-friendly seafood[51].

The main environmental pressures of aquaculture include discharges of nutrients (in particular in coastal areas with relatively small total nutrient discharges), organic matter, microbial pathogens, drugs, herbicides and fungicides (Helcom 2010a). Farmed fish stocks of non-native origin may cause adverse impacts when escaping. Algae production is a rather new sector and therefore knowledge on environmental impacts is still limited. The level of local impact varies according to production scale and farming practices, as well as local and regional hydrodynamics and chemical characteristics.

Challenges for further development of EU aquaculture are numerous and include: limited access to space and water of the necessary quality, industry fragmentation, and pressure from imports especially from Asia, insufficiency of medicines and vaccines, public acceptance and the high standards which lead to higher costs than for competitors outside of Europe[52]. There is a clear need for innovation and technological progress, e.g. in the area of sustainable fish food[53]. Prospects are also strong for **algae growing.** While still small in size this maritime economic activity has already shown recent growth and its future is assessed positive. The product outputs are clear but commercial exploitation seems not viable yet. Also use as biofuel is being investigated (see box below for the Mabfuel project, funded through FP7). Additional R&D and piloting is necessary. By 2030, it is estimated that the algae sector may significantly grow, in a three stage progression. In the years between 2010 and 2015, the sector is expected to emerge as a niche market focused on high-priced products for the health and cosmetic sector. It will then grow as a medium-sized market producing metabolites and primary compounds (lipids, sugars) to be incorporated by the food and feed processing industry (for human consumption and animal feeding) (around 2020).

In a third stage, the algae sector will become a provider for mass product markets, with two major applications: green chemistry and energy (2025-2030). Ground-breaking photo-bioreactor designs and extraction processes will allow the micro-algae production to scale up within viable economic conditions. Popular food products are omega-3 and omega-6 fatty acids.

The vision for macro-algae is that they will develop through farms along the coast, sharing space with other sectors on multi-purpose platforms combining several activities such as integrated multi-trophic aquaculture (also called IMTA), and other activities (wind, coastal protection)[54].

Algae aquaculture is expected to provide a range of synergies with and spill-over to other maritime activities. Growing of macro-algae in the sea can play a role in wave attenuation and erosion reduction, mostly in the Atlantic and the North Sea. Algae aquaculture can contribute to advances in fish medications and contribute to shelf life improvements achieved through marine bacteriological progress.

Assumptions about framework conditions being fulfilled

- Access to finance is to be secured, allowing to attract private investors to enter the sector on the medium to long term;

[51] Seafood Choices Alliance, 2007
[52] COM (2009) 162
[53] J. Bostock et al (2009) "European Aquaculture Competitiveness: Limitations and possible strategies. Study carried out for t the European Parliaments' Committee on Fisheries.
[54] Noteworthy is the initiative in Brittany to create a new sector specifically for seaweed farming for the Japanese market, in an attempt to help oyster farmers to diversify.

- Space requirements for both aquaculture and algae growing can be high, and competition with other maritime economic activities can be strong;
- Support from large energy and food companies to invest in developing alternative resources would make a major difference (algae growing);
- The availability of potential stimulations by National/European research funds although some interviewees indicated that such stimulus may not be necessary for the micro-algae sector to develop;
- Trade regimes allowing for 'level playing field', and reducing the impact of low-cost imports with substandard environmental and health performance (aquaculture).

MABFUEL

Marine Algae as Biomass for Biofuels

(2009 – 2013)

Findings of small scale production experiments support the assertion that the use of marine algae to produce biodiesel may be the only viable method to produce sufficient bio-fuel to replace current world petrol/diesel consumption.

Project description:

Micro-algae in particular have much faster growth-rates than terrestrial crops. The yield of oil from algae is estimated to be from between 19,000 to 75,000 litres per acre, per year; this projected yield is 7 to 31 times higher than the best crop of palm oil. As terrestrial land is limited in space and competes with a variety of other economic functions, e.g. manufacturing facilities, private housing, agriculture, the potential of the marine environment as a source of biomass for bio-fuel production is taking further attention.
Hence, the project is particularly focussing on research in the production of biofuels from native seaweed and cultured micro-algae.

Project results:

The project will identify the native seaweed and cultured micro-algal processes with the most potential for fuel production, the best time and technique to harvest seaweed and the culture methodologies for micro-algae along with an economic and environmental appraisal which will identify the size of the farm required and the feasibility of a commercial size operation. This will provide the physical (biomass product) and the intellectual (methodology for production and extraction) tools to enable the bio-fuel sector to base it s business on the most suitable and profitable process.

Key data:

Funding programme: FP7 PEOPLE
Project duration: 36 months
Total project volume: € 1,430,841
EU funding received: € 1,430,841
Website: http://www.dommrc.com/project-mabfuel.html

3.4.2 Offshore wind: anywhere the wind blows?[55]

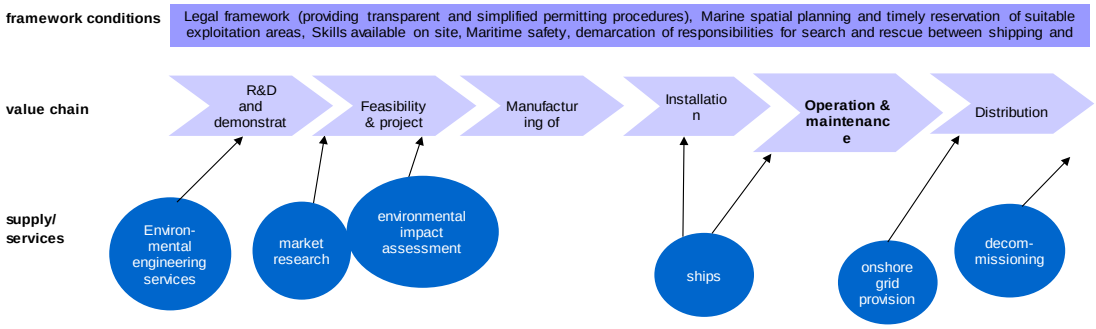
…Employment is expected to triple in the next 10 years…

Offshore wind covers all activities related to the development and construction of wind parks in marine waters, and the exploitation of wind energy by generating electricity offshore. Its value chain includes research and development, impact assessment, planning, design, manufacture, installation, operation, maintenance and decommission. For wind energy overall (offshore and onshore), wind turbine and component manufacturing provides most employment (43,000 in 2007), followed by wind farm development, installation, operations and maintenance (29,000 employed in 2007), while there were found to be another 15,000 jobs elsewhere in the value chain[56].

[55] Literature references used for drafting this section can be found in Chapter 8 under the specific heading for this economic activity.
[56] EWEA, 2009, Wind at work, p.8.

Out of these some 7,000 were related to offshore wind activities (figure 2007)[57]. In 2011 alone, 866 MW offshore capacity was added, 9% of all new wind capacity– a volume comparable to 2010. However the investments related to the installation of offshore wind were comparably high: € 2.4 billion in 2011 alone, or 19% of all investments in the wind sector[58].

In the period 2007-2010, overall employment in the wind energy sector has been growing by nearly 30% a year and the overall number of FTEs directly working in the wind energy sector has been claimed to be as high as 135,000 jobs in 2010[59]. Measuring the employment in offshore-related employment is more difficult, as many companies provide services both onshore and offshore. Nevertheless, employment growth in offshore is expected to be particularly strong, due to several reasons. Firstly, the share of offshore wind power capacity as part of total wind power is gradually increasing, from just 2% in 2007 to almost 4% in 2010, while this ratio is expected to increase to 17% in 2020 and even 37% in 2030[60]. Secondly, the generation of wind energy offshore is relatively labour-intensive, not only at installation but also at operation and maintenance stages. One estimate is that employment in offshore wind is likely to grow sharply in the years to come: from 7,000 fte in 2007 and a stated 35,000 in 2010 to possibly up to 170,000 in 2020[61]. The offshore wind sector is expected to grow in the coming decades, at rates which are higher than onshore. It is expected by some that offshore wind energy employment will exceed onshore employment by 2025.



Technological development will lead to larger production units, more robust devices, and lower energy production costs. By going further off the coast, visual pollution and competition for space can be prevented. Yet, costs will increase as well not only for construction of windmill installations and electricity grids, but also for their daily maintenance.

Offshore wind business clusters in Europe can traditionally be found in Denmark and Germany. Because the national governments of those Member States included (offshore) wind energy in their national renewable energy strategies, vast amounts of wind energy capacity were installed. This created a niche market for companies headquartered in Denmark and Germany (e.g. Vestas, Siemens Wind Power, and many smaller companies working in other parts of the value chain). Today, such clusters can be found, amongst others, in Esbjerg and Nakskov in Denmark, and Bremerhaven and Schleswig-Holstein in Germany. These clusters have a strong positive effect for

[57] EWEA (2009), Wind at Work, p.9
[58] EWEA (2011), Wind in Power, 2011 European statistics, p. 5.
[59] EWEA (2012) Green Growth, p. 36.
[60] EWEA (2012) Green Growth, p. 15.
[61] EWEA (2009), Wind at Work, p.9

the local economy[62]. Growth in offshore installations has been particularly strong in the United Kingdom (Scotland).

…The EU is leading in offshore wind development

The EU has a leading role in exports, due to state-of-the art technologies. The exports focus on wind turbine manufacturers, but component manufacturers contribute to exports as well. EU-based companies nowadays form joint ventures with hardware manufacturers, especially in China, Korea and Japan. These joint ventures have a dominant role in the worldwide export market and are pivotal in opening up the Asian market, which is growing quickly. The key challenge for European enterprises is to use their home market to foster R&D, thus keeping up with the Asian competition and continuing to be interesting Joint Venture partners.

This will be made possible by new developments such as floating platform constructions which allow to make use of higher wind speeds available over deeper water and which allow turbines to be located in deeper waters, while cutting on traditionally high costs of seabed foundations. At the same time, repairs on floating wind platforms could be carried out in ports rather than on sea. [63] Improvements of the technical robustness will contribute in lifting present constraints and a number of research projects are targeting this (see box below for an example). Scale effects, combined with raising oil prices and improved public appreciation will provide a sounder economic basis. As a result, the capacity installed is increasing.

However not all experts interviewed see offshore wind grow so fast, as various constraints would need to be overcome and various conditions to be fulfilled. For instance, fossil fuel prices would need to show a modest to strong, regular increase. In the foreseeable future, the capital expenditures (CAPEX) are expected to stabilise, because scale effects are neutralised by increasing distance to shore and installation depth. The operational expenditures (OPEX) may decrease as a result of scale effects. On balance, in the coming decade the unit price of offshore wind energy will decrease relative to conventional energy. Therefore the future growth of offshore wind depends on the readiness to accept these extra costs. Such readiness may root in the political will to become less dependent from oil imports or in strict and enforced EU environmental regulations. By heavy taxation of CO_2-emissions wind energy becomes more competitive, while the future of nuclear energy has become more uncertain after the Fukushima disaster and the subsequent German decision to close down nuclear installations. Environmental regulations and public resistance are expected to restrict large-scale installation of wind energy on land.

Uncertainties come from financing – as the horizon of financial markets is shorter than payback periods (and through the economic and financial crisis even shorter). Furthermore, it is questionable whether the public sector will have sufficient resources to invest in onshore and offshore grids and grid connections, and whether private investors have the right incentives to contribute. An additional challenge for the sector will be to balance demand and supply, and whether new storage techniques will be powerful enough to bridge short-term gaps between supply and demand[64]. Public acceptance is an uncertainty too, particularly when offshore wind installations do not benefit the local communities concerned.

The environmental consequences of individual wind parks have been studied in numerous site-specific environmental impact assessments. Impacts arise throughout the life cycle of wind farms, including: site selection, construction, operation, decommissioning and removal. Impacts include

[62] EWEA, 2009. Wind at work.
[63] The Guardian 23/4/2012 "US and UK to collaborate on 'floating' wind turbines".
[64] For example, in the windy winter of 2010, Denmark generated so much power from wind mills that the country had to pay other countries to take the surplus – during short intervals (New York Times, 22nd January 2012).

the noise effects on marine mammals and fish, disturbance and loss of habitats, bird collisions and visual intrusion. Knowledge of the wider effects of offshore wind farms on environmental quality is limited and the degree and extent of these effects is still being established. However, wind farms may also have positive impacts, when they offer chances for overexploited areas by creating fishing and shipping exclusion zones, or by creating new habitats, for instance.

A strong synergy exists between offshore wind and offshore oil & gas exploration as well as with other ocean renewables – notably through the sharing of platforms and other infrastructures (electricity grids). The development of offshore wind parks will also spur demand for new developments in environmental monitoring, such as new measuring set-ups, new constructions, new traffic to database, extra database services and data validation needs.

Assumptions about framework conditions being fulfilled

- Need for stable and clear regulatory framework, providing investors with certainty beyond 2020;
- Infrastructure (physical: grid connection, port facilities) must be put in place; this requires high investments of a public nature;
- A sound legal framework must be put in place, providing transparent and simplified permitting procedures and development of educational curricula;
- Environmentally friendly technologies will have to be available and in use. This will cause the balance between positive and negative impacts during the complete device life cycle to be favourable;
- Financing will no longer have to be a constraint; the first privately-financed major projects, started in 2010, have proven sound and have found many follow-ups. Marine spatial planning is of key importance for the timely reservation of suitable areas, the identification of synergetic activities and for solving tensions with competing activities;
- The sector is largely dependent on technically skilled staff for servicing. Shortages are already acute for engineers and Q&M and site management activities[65]. A dedicated programme is needed to ensure these are available, and to make the sector attractive compared to other functions;
- Issues of maritime safety, demarcation of responsibilities for search and rescue between shipping and wind parks have to be sorted out and arranged;
- Wide public acceptance of developing wind parks offshore.

EERA-DTOC

EERA Design Tools for Offshore Windfarm Cluster

(2012 – 2015)

The European Energy Research Alliance (EERA) as lead partner of this recently assigned project is proposing an integrated design tool combining the state-of-the-art wake, yield and electrical models as a plug-in architecture with possibility for third party models.

To decrease uncertainties around wind farm wake predictions, a measurement campaign together with the new data available from the industry partners will enable better tuning, and eventually better modelling of the far-field of wind farm wakes. The setting-up of large arrays of floating wind farms planned near long-distance grid cables independent of water depth will take momentum in the years to come. The planning and design of these will put new challenges with regards to the siting of the wind farms, the design of the interconnecting grid structure and the integration of the large amount of power into the electricity supply systems.

[65] EWEA (2009) "Wind at work", p. 29.

Project description:
The concept of the EERA-DTOC project is to combine this expertise in a common integrated software tool for the optimised design of offshore wind farms and wind farm clusters acting as wind power plants.

Project results: To overcome the current lack of reliable data on the behaviour of the wind farm wake, EERA-DTOC features a measurement campaign and collection of lidar data and high-resolution satellite images. Key industry actors working as end users of the software will help in the design of the tool, and will afterwards verify the performance of the tool using their own data and test cases.

Key data:
Funding programme: FP7
Project duration: 40 months
Total project volume: € 3,997,733
EU funding received: € 2,899,857
Website: http://www.eera-dtoc.eu/

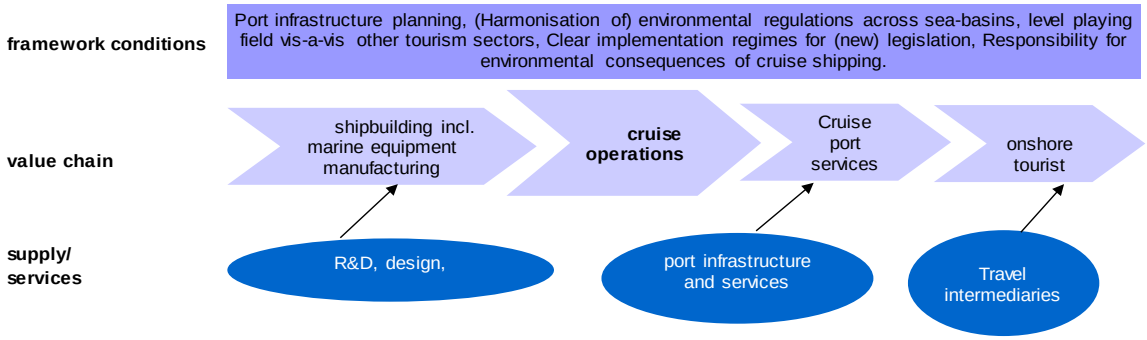
3.4.3 Cruise shipping including port cities: cruising along at high growth? [66]

…The European cruise business is strong along the value chain.

The value chain for this economic activity consists of the construction of cruise ships (led by European yards Meyer Werft (Germany), STX (Finland/France) and Fincantieri (Italy) and with important involvement of the European marine equipment industry), the operation of ships, ports facilities and associated services, as well as the travel arrangement business.

Although US companies are dominant in the EU through their European subsidiaries, the European cruise business has a strong response capacity across the value chain, allowing it to cope with many of the current and future pressures. This response capacity is especially needed at the time of writing, when the sector is recovering from the aftermath of the much-publicized Costa Concordia accident in front of the Italian coast. Also on-going research into damages regulations in particular caused by grounding of cruise vessels will contribute to the response capacity of operators (see box with project example GOALDS beneath) Cruise companies continuously adapt their strategies, by segmenting the market and by adapting their fleet to them; fleet expansion is under control, which prevents the build-up of overcapacity; labour costs are being curtailed by hiring unskilled labour from non-European migrant workers – which can lead however to socially undesirable practices such as long working hours or inadequate remuneration[67]. Shipyards invest heavily in R&D for modernisation and efficiency measures; port authorities and regional/local governments across Europe adjust their facilities and offer to the changing customer demand.

[66] Literature references used for drafting this section can be found in Chapter 8 under the specific heading for this economic activity.
[67] Such as for instance reported by The Guardian, 29 April 2012, P&O cruise ship staff paid basic salary of 75p an hour.



In 2011 some 6 million Europeans booked a cruise, a number that has more than doubled in the past decade. The worldwide cruise industry forecasts a strong growth trend in demand; the total number of passengers carried worldwide is estimated to reach 29.7 million in 2020 (+61.4% from 2010). Total employment is likely to grow as well, although not at the same rate as passengers carried due to economies of scale. By 2020, employment is expected to reach a level of 400,000, compared to 300,000 in 2010 and 200,000 in 2005[68]. Added value for the EU is estimated at a current € 14.5 billion. In 2010 there were 198 cruise ships operating in Europe ranging in size from 3,600 passengers to less than 100.

GOALDS

GOAL Based Damage Stability

2009-2012

Project description:

Based on the new damage stability regulations for dry cargo and passenger ships (SOLAS 2009), the project seeks to address the concerns regarding the calculation of the survival probability of ROPAX and mega cruise vessels; Furthermore, present damage stability regulations account only for collision damages, despite the fact that accident statistics, particularly of passenger ships, indicate the profound importance of grounding accidents.

Project results:

The research project addresses the issues by:

- Performing comprehensive model testing to investigate the process of ship stability deterioration in damaged condition and to provide the required basis for the validation of the numerical simulation results.

- Elaborating damage statistics and probability functions for the damage location, length, breadth and penetration in case of a collision / grounding accident, based on a thorough review of available information regarding these accidents over the past 30-60 years worldwide.

- Formulating a new probabilistic damage stability concept for ROPAX and cruise ships, incorporating collision and grounding damages, along with an improved method for calculation of the survival probability.

- Establishing new risk-based damage stability requirements of ROPAX and cruise vessels based on a cost/benefit analysis to establish the highest level for the required subdivision index.

- Investigating the impact of the new formulation for the probabilistic damage stability evaluation of passenger ships on the design and operational characteristics of a typical set of ROPAX and cruise vessel designs (case studies).

Preparing and submitting a summary of results and recommendations to the International Maritime Organisation (IMO) for consideration.

[68] Own estimates, based on data provided by the European Cruise Council (2011).

Key data:
Funding programme: FP7 - Transport
Project duration: 36 months
Total project volume: € 4,644,685
EU funding received: € 2,951,883

This tourism segment already developed since the 1970s, and has become accessible for larger groups since lower cost segments

Europe as a cruise destination will continue to be attractive (for instance, through improved berthing situations in attractive destination ports), while segmentation of the market leads to a broad offer of highly diverse destinations for all sorts of target groups. It is expected that both the Mediterranean and the Baltic Sea Basin will benefit from this development. Today Barcelona and Civitavecchia (Rome) are the largest cruise ports with close to or over 2 million passengers per year.

Uncertainties include a (non-) continued development of welfare, the consequences of increasing fuel prices, and evolving consumer preferences – including the environmental awareness of potential clients. Other uncertainties include the vulnerability vis-à-vis terrorism and health risks.

Concerns over the ecological footprint of the cruise industry are growing. They include energy use[69], pressures on water resources, waste management, import of consumer goods/services which themselves create traffic, traffic flows, and CO_2 emissions. An average cruise holiday emits around 4.5 times more CO2 per day than an average hotel holiday[70]. A number of regulations are already in place to respond to the water, waste and emissions concerns. In Arctic regions, in particular, cruise tourism not only represents a main source of income but also of pollution in areas that are otherwise pristine. The biggest single threat caused by ship-based activities in these regions comes from the risk of a major oil spill. Other environmental impacts include degradation of regularly-visited sites, air pollution, discharges of sewage and waste water and introduction of non-indigenous species.

…Synergies emerge through shared use of port facilities.

The cruise sector has important synergies with other shipping functions as it partly uses the same port facilities as regular shipping. Synergies with the maritime transport cluster are also related to shipbuilding, where the supplier industry located in Europe can serve a wider market of ship types.

Assessment of framework conditions being fulfilled

- Infrastructure: port authorities manage to keep pace with demand in providing berthing capacity. Location is key and should be central in port cities close to tourist cluster sites. This may require relocating other activities;
- Accidents (such as the accident with the Costa Concordia) and security risks are incidental and controlled, without longer term effect on the willingness of passengers to travel by cruise ship;
- Harmonisation of (environmental) regulations geographically (sea basins) as well as across tourism sectors, creating a level playing field for cruise to compete against other segments of the tourism industry;
- Clear implementation regimes for new legislation, allowing the shipbuilding industry to adapt timely and maintain competitive power against Asian yards and suppliers.

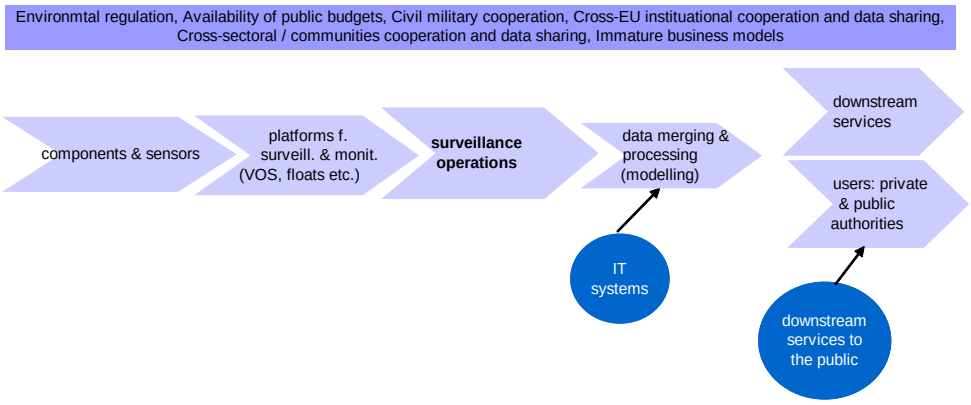
[69] See for instance Walnum (2011), Energy use and CO2 emissions from cruise ships — A discussion of methodological issues. Western Norway Research Institute

[70] Traveling large in 2010 – The carbon footprint of Dutch holiday makers in 2010 and the development since 2002, Centre for Sustainable Tourism and Transport, NHTV Breda University of Applied Sciences, 2012

3.4.4 Maritime monitoring and surveillance[71]

Maritime monitoring and surveillance aims to improve the situational awareness of all activities at sea impacting on maritime safety and security, border control, the marine environment, fisheries control, trade and economic interests of the European Union as well as general law enforcement and defence so as to facilitate sound decision making. At the equipment side, many industry players are active, partly building on systems developed for other activities, and partly integrating existing data networks. In the services component of the value chain, still new players enter based on additional applications being developed (e.g. satellite capabilities).

The European industry is rather established, with a strong technological and R&D basis rooted in military and security spending. Immature business models limit, however, the response capacity and so do slow bureaucratic procedures. US-based competitors play a strong role, but market entry by players from emerging economies remains limited so far. Market pressures will promote closer cooperation and integration of monitoring and reporting activities, better coordination, sharing of data, sharing and coordination of monitoring methods, locations and frequencies.



There is a growing demand for all of these activities due to the increasing number of (legal and illegal) activities at sea. The last decade has seen an increase in attention to potential threats, including piracy, illicit human and drug trafficking, as well as terrorism. Legislation aiming at reducing risks includes measures at sea (monitoring of commercial vessels, small boats, oil spills, etc.), coastal areas and in ports (ISPS code, selective scanning of cargoes, port and flag state control, illegal immigration etc.). Additional drivers are further legislation and existing environmental impact assessments, which increase demand for services and equipment.

…Continued security concerns and environmental awareness will lead to growth.

Continued security concerns (including those with a cross-border nature) will lead to further demand, both directly (e.g. through piracy) and indirectly as a result of increased (illegal) migration pressures from outside Europe. The sector is very wide and contains a large variety of components, hence estimating its size is difficult. Estimates suggest the current size of the European maritime security market to be in the range of € 1.8-2.3 billion, excluding indirect impacts[72]. Additionally, the traceability and security of goods supply chains is being improved by implementing new technological developments (such as Radio Frequency Identification - RFID). Currently Europe

[71] Literature references used for drafting this section can be found in Chapter 8 under the specific heading for this economic activity.

[72] Source: Homeland Security Research Corporation

represents approximated 20% of the RFID market. It is expected, however, that Europe's competitive position versus other regions of the world will increase[73]. This sector has been growing at the pace of 30-40% annually over the last few years. It is expected to continue to grow in the coming years at the pace of 15-25% annually.

Further environmental awareness policies will need to be increasingly monitored and enforced, while modern public procurement policies are expected to further drive demand. Environmental monitoring will increase with an expected doubling of turnover within the next decade (implying some annual 7% growth on average). Employment will grow at a lower pace due to the focus on labour-extensive technologies, with an estimated growth of half the turnover (a 50% increase by 2020, or 4% year on year). New ways for multiple uses of data will be developed, providing new incentives to private enterprises to share data that were previously kept secret. New technologies are developed to supply multi-purpose and multi-sectoral monitoring techniques. Automated collection and reporting of real-time data is further developed. Remote sensing is used in new applications; VOS's provide additional, world-wide data.

An important uncertainty is the dependence of maritime monitoring and surveillance on public spending, mostly by Member States. Establishing structures is costly, but on the other hand further integration and data-sharing across sectors and across Member States (eventually leading to a European system of data sharing), are expected to lead to higher efficiency and improved cost-effectiveness of maritime monitoring and surveillance, and to contribute to the growth of other activities (e.g. through natural resources mapping, licensing of ships). Research projects therefore focus on cost effectiveness and integration options (see box below for an example). It is likely that this will first start at the level of Sea-basins, following the success of several pilot projects. However, such development cannot be done overnight, as it involves institutional learning, technical developments and political negotiation before a fully functioning European integrated maritime surveillance area can be implemented.

EUROSUR - SEABILLA

Sea Border Surveillance

2010 - 2014

The policy context for this project is derived from the fight against drug trafficking in the English Channel; for addressing illegal immigration towards the EU via the Southern Mediterranean zone in coherence with the EU Integrated Maritime Policy, EUROSUR and Integrated Border Management, and in compliance with Member States sovereign prerogatives.

Project description:

The SeaBILLA project identifies gaps and opportunities for fruitful cooperative information exchange between Members States. More particularly, it 1) defines the architecture for cost-effective European Sea Border Surveillance systems, integrating space, land, sea and air assets, including legacy systems;
2) applies advanced technological solutions to increase performances of surveillance functions; and
3) develops and demonstrate significant improvements in detection, tracking, identification and automated behaviour analysis of all vessels, including hard to detect vessels, in open waters as well as close to coast.

Project results:

The project will provide concrete added value and benefits for users, by providing a solution that can be implemented at national and EU level to increase effectiveness, pool resources and address Maritime Security and Safety challenges; for world competitiveness of EU industries, by increasing knowledge and reducing risks for future product investments; for European citizens, by providing effectively deployable solutions for law

[73] According to IDTechEx[73], in 2016 Europe will have 26,1%, East Asia 37,1%, North America 34,2%, RoW 2,5% of the total RFID Market

enforcement along the European sea borders.

Key data:
Funding programme: FP7 Security
Project Duration: 48 months
Total Project Value: € 15 558 125
EU Grant-Aid: € 9 841 603
Website: http://www.seabilla.eu/cms/

…Strong potential for positive environmental impacts in other maritime segments…

This activity provides potential for strong and positive environmental impacts, as it facilitates sustainable practices within other maritime economic activities. It also leads to spill-over activities in other segments, ranging from fisheries control, to improved SAR operations, piracy prevention, etc. It further facilitates algae growing and blue biotechnology, maritime energy activities as well as leisure and tourism activities. Environmental monitoring services are also used for coastal protection purposes.

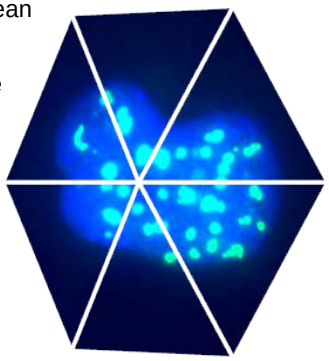
Assumptions about framework conditions being fulfilled

- Institutional and legal structures will no longer be heterogeneous and undermine the linkages between different communities of users;
- Standards and certification for interoperability in place;
- EU-RTD funding as a basis (e.g. Eurosur initiative);
- International policies to be developed in IMO framework;
- EU in general and user communities in particular are willing to pay a price for environmental monitoring.

3.5 Pre-development stage: investing in the jobs for tomorrow

Note: A full description of the below activities (sub-functions) can be found in Annex 4 of this report.

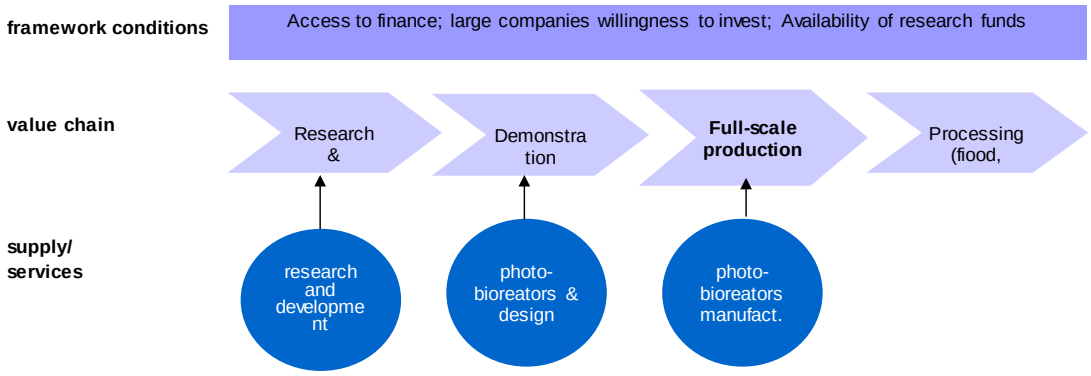
The future is bright, the future is blue. That appears to be the commonality for the maritime economic activities in the (pre-) development stage. Ocean renewable energy sources will provide a welcome supplement to other (maritime) energy sources. Based on intensive R&D, piloting and testing, blue biotechnology and algae growing have entered the mainstream by the year 2030, while a significant part of the world's minerals will be mined from the ocean floors. But how successful will European companies and players have become in embarking on this growth? And will they have sufficient scale to compete with global players who may have spotted opportunities much earlier or who have deeper pockets?



3.5.1 Blue biotechnology: a bright future for high-value applications[74]

'Blue biotechnology' involves the use of living organisms and bioprocesses from the sea, in engineering, technology and other fields requiring bio products. Blue biotechnology differs from algae aquaculture as it uses these products for manufacturing.

[74] Literature references used for drafting this section can be found in Chapter 8 under the specific heading for this economic activity.



At this moment in time, blue biotechnology still has limited economic performance, as it is R&D centred. However, an early estimate of the global market for marine biotechnology products and processes is $2.4 billion (1/3 in the USA and 2/3 elsewhere) with an upward trend (Lloyd-Evans L 2005). While still small in size the economic activity has already shown recent growth and its future is assessed positive. High value marine products will have a wide range of applications that reach the market: new medical molecules, bio-plastics, enzymes or biocides are the main ones. Slowly but surely, the potential of marine organisms not yet known will be discovered. Research is on-going and an example of the type of exploratory work is given in the box below. The marine products that will be generated will continue to have a strong appeal – and satisfy a range of diverse consumer needs that will only rise in an ageing society.

High research and patenting activities over a range of years will pay off and lead to technological breakthroughs: most molecules will be sourced through biotechnology and will not be extracted from wild material: original molecules will be sourced in marine organisms but final compounds will be optimised and produced through biotechnology. The end-product would therefore differ substantially from the marine environment they originate from.

Main challenge for this economic activity will be to gain efficiencies in high-output screening, cultivating and transportation of new species. Future potential will also depend on the sector's ability to prevent boom and bust cycles; a speculative bubble could be detrimental to the development of underlying fundamentals. High value marine products will be brought to market by existing and large players, as small and promising spin-off firms and SMEs will be acquired by them. Small companies will fail to make a critical mass on their own, and will not manage to share knowledge and to fully capitalise on the links with research institutes. But these research institutes will prove to be a real driver, as they continue to discover new species and living organisms at ever greater depths – an effort which is too great for the industrial sector itself[75].

Key commercial players will be cosmetic companies (L'Oreal, Estée Lauder...), pharmaceutical companies (Merck, Lilly, Pfizer...) but also large chemical players (Novozymes, BASF...). These industries will have preferential ties to the research institutes, through exploration contracts. Unfortunately, these contracts ban researchers to publish about their findings.

Estimates on the numbers and types of employment to be created by blue biotechnology are very difficult to make, as much depends on technological and commercial breakthroughs yet to come. Initially, much of the employment will have a research focus, followed by professions in marketing and logistics. Part of the jobs will however also be more manual, e.g. in harvesting products and maintaining and supporting installations. It will remain difficult to trace employment in blue

[75] World Ocean Review, Chapter 9 "Active substances from marine creatures", p.182.

biotechnology, as many jobs will be created in existing research institutes or by large commercial players.

MAREX

Exploring Marine Resources for Bioactive Compounds: From Discovery to Sustainable Production and Industrial Applications 2010-2014

(2010 – 2014)

To more profoundly explore biodiversity in the seas, the MAREX project will collect, isolate and classify marine organisms, such as micro- and macroalgae, cyanobacteria, sea anemones, tunicates and fish from the different sea-basins.

Project description:

Extracts and purified compounds of these organisms will be studied for several therapeutically and industrially significant biological activities, e.g. anticancer, anti-inflammatory, antiviral and anticoagulant activities, as well as for ion channel/receptor modulation and plant growth regulation.

Sustainable cultivation methods for promising organisms and biotechnological processes for selected compounds will be developed, as well as biosensors for monitoring the target compounds.

Project results:

The project will expand marine compound libraries. The project aims at a better understanding of environmentally-conscious sourcing of marine biotechnology products. Besides, increased public awareness of marine biodiversity and potential. Finally, MAREX is expected to offer novel marine-based lead compounds for European industries and strengthen their product portfolios related to pharmaceutical, nutraceutical, cosmetic, agrochemical, food processing, material and biosensor applications.

Key data:

Funding programme: FP7 - KBBE
Project Duration: 48 months
Total Project Value:€ 7,895,271
EU Grant-Aid: € 5,999,974
Website: http://www.marex.fi/

Uncertainties come from the access to finance, not only for Research but mostly for Development. Besides, the technological and intellectual race with key competitors, such as the USA and Japan today, and China and India tomorrow will impose further uncertainties. A breakthrough in medication sourced from a marine organism (e.g. a cure for cancer) could provide a major boost to Blue Biotechnology. As this activity is still in its infancy, the environmental consequences of Blue biotechnology are still largely unknown – but they are likely to include strong positive impacts.

The main environmental pressure expected from this activity is the unintended extraction of species. No data could yet be found about the magnitude of this pressure. It has been mentioned that biotechnological developments may have beneficial effects by reducing energy and water requirements, recycling costs of chemical products and greenhouse gas emissions. Bio-sourced polymers, for instance, can be designed to be biodegradable and compostable in just a few weeks, which would be an important improvement compared to currently available petrochemical polymers which are not biodegradable.

…The potential of Blue biotechnology to create spill-over to other maritime activities is sheer endless…

Blue biotechnology provides a range of synergies with and spill-over to other maritime activities. Blue biotechnology can provide bio-sourced products such as coating with anti-fouling or anticorrosive properties for maritime transport and shipbuilding. Oil, gas and methane hydrates can benefit from blue biotechnology by new applications that may provide solutions to improve the extraction yield of oil ("Enhanced Oil Recovery"). Underwater constructions for ocean renewable

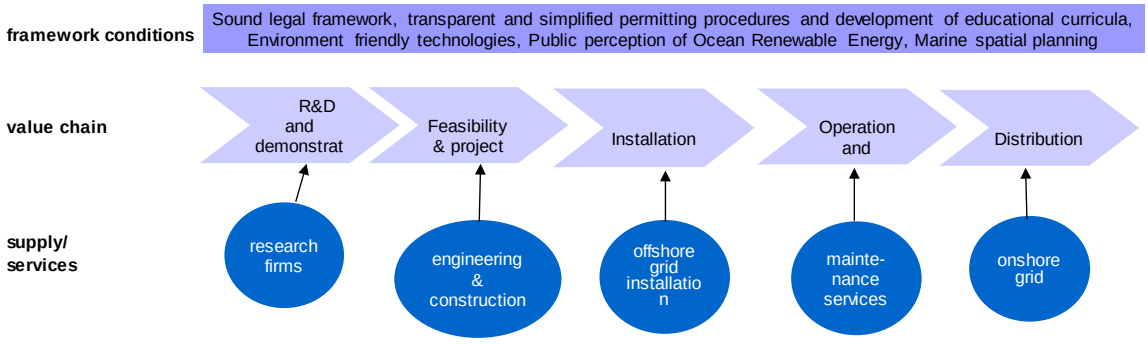
energy sources (wave, tidal, OTEC, thermal, bio fuels, etc.) could benefit from marine bio-sourced coatings with anti-fouling or anticorrosive properties. With regard to deep sea mining, recent developments show that mineral nodules may partly be of biogenic origin (Wang & Werner 2010). Unlocking the metal fixating properties of selected bacteria could improve the potential of blue biotechnology vis-à-vis this activity. Blue biotechnology can also contribute to the development of specific biopolymers and bio membranes that improve the overall efficiency of the desalination process. Ships (cargo, passenger as well as yachting) can benefit from marine bio-sourced coatings with anti-fouling or anticorrosive properties. Bio stimulation can also be used to protect natural habitats by fostering bioremediation after important pollutions (as for the Exxon Valdez oil spill when bacteria were stimulated to degrade hydrocarbons).

Overall, the potential and future importance of blue biotechnology comes from its contribution to key societal challenges, including the sustainable supply of high quality and health food, a sustainable alterative source of energy, its contribution to securing environmental and human health, and to industrial products and processes[76].

Assumptions about framework conditions being fulfilled

- Access to finance is secured: the European sector is able to attract private investors to enter the sector on the medium to long term;
- Large (energy) companies' willingness to invest in developing alternative resources. Most large oil companies have invested in micro-algae pilot productions developed by innovative SMEs, although some key players are currently sending contradictory signals by lowering their support to this sector;
- The availability of potential stimulations by National/European research funds although some interviewees indicated that such stimulus may not be necessary for the micro-algae sector to develop (policy support);
- Policies that stimulate renewable energy production and consumption, increasing costs of GHG emission rights, and increasing prices of traditional fuels will have a stimulating effect on the biofuel market as a whole;
- The capacity of the European sector to avoid key competencies to be concentrated by competing countries (China, India, South East Asia...) (e.g. prevent brain drain).

3.5.2 Ocean renewable energy: tidal current as the next wave[77]



[76] European Science Foundation/Marine Board (2010) "Marine Biotechnology: A New Vision and Strategy for Europe". Position Paper 15. See www.esf.org/marineboard.

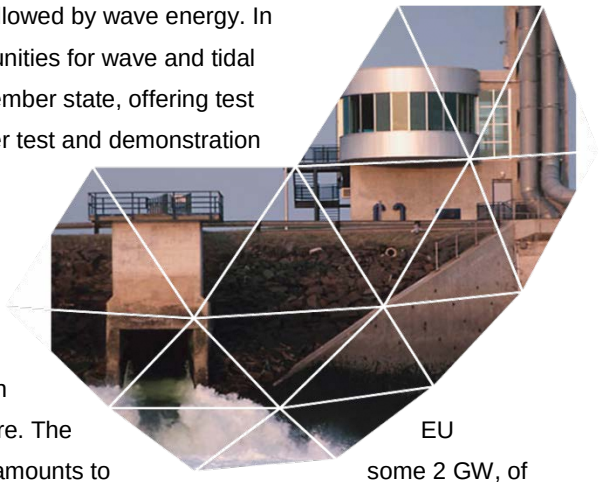
[77] Literature references used for drafting this section can be found in Chapter 8 under the specific heading for this economic activity.

'Blue energy' or Ocean renewable energy covers in principle the whole range from research to decommission (comparable to Offshore Wind). Due to its early development stage, the focus is here on the research and development phases. Segments that reach the growth stage will consecutively extend their value chain. Ocean renewable energy consists of a package of four different offshore energy segments[78]:

- Tidal energy covers tidal range and tidal current energy. Tidal range is the only technology with long-term proven viability, but we consider the environmental implications of any new schemes to be prohibitive, at least in the European seas. Tidal current has proven to be technically feasible but costs are still too high to compete with other (renewable) energy sources. It is at the threshold of introduction;
- Wave energy is still facing R&D challenges to be overcome before commercialisation comes into view. Technologies are not yet proven. Research is looking to cut down installation and operating costs. Several pioneering players have built up a prominent position over the past 10-15 years, while new entrants are arriving today indicating the segment is entering the market phase (introduction);
- Osmotic energy is based on the salinity gradient between salt and fresh water. Technology cannot yet be considered proven; the segment is not yet in its commercialisation stage. Problems to be solved are in the field of prevention of fouling and pre-treatment;
- OTEC (Ocean Thermal Energy Conversion) is based on the thermodynamic potential between the warmer upper water layer and the colder deeper water layer.

…Immediately following tidal current will be wave…

Apart from tidal range energy, which is not considered further for reasons mentioned above, tidal current energy has the most potential, directly followed by wave energy. In Europe, the Atlantic coasts offer the best opportunities for wave and tidal energy. At the moment, the UK is the leading member state, offering test facilities and favourable market conditions. Other test and demonstration sites are located or planned in Ireland, France, Spain and Portugal. The total installed and grid-connected capacity for tidal current and wave energy in the UK is expected to increase from 2.9 MW by the end of 2010, to 5.6 MW by the end of 2011, to 11 MW by the end of 2012[79], with continued growth perspectives in the further future. The EU Member States' total planned capacity for 2020 amounts to some 2 GW, of which 1.3 GW is planned in the UK[80]. ARUP (2011)[81] has developed three scenarios for the growth of tidal current and wave energy, which result in estimates of the installed capacity in 2020 in the range of 430 to 685 MW, and in 2030 in the range of 1000 to 4700 MW. Employment will increase accordingly, from 1000 fte in 2010 to potentially the order of 10,000 fte in 2020 and 20,000 fte in 2035[82]. The turnover has increased from € 4 million in 2005 to € 37 million in 2010, and may grow further to € 360 million in 2015[83]. In the longer run, all options should be kept open, but OTEC and osmotic energy still need time and technological development to prove them.



[78] The observations that follow are based on literature and interviews, as reported in the Economic activity Profile document
[79] Source: Renewable UK (@012)
[80] Source: Renewable UK (2011)
[81] ARUP is a multinational professional services firm which provides professional and consulting services for the built environment. ARUP was appointed by the UK Department of Energy and Climate Change (DECC) in October to look at the deployment potential and generation costs of renewable electricity technologies in the UK.
[82] Source: Renewable UK (2011), p.28
[83] Source: Douglas-Westwood (2010)

…But much will depend on a boost in technological development and demonstration.

For both, wave and tidal, the future potential will depend on a boost in technological development and the successful completion of demonstration projects. Research projects such as Equimar (see box below) contribute to this.

Both in tidal and in wave energy, Europe has a strong position. There have been a number of pioneering players in Europe who have built up a prominent position over the last 10 to 15 years. Examples of such companies, which have large devices operating offshore, are Marine Current Turbines (tidal, UK), Hammerfest Strom (tidal, Norway) and Pelamis Wave Power (wave, UK). After this initial phase a group of technology developers in the field of wave and tidal energy came into existence. They received specific attention, support and funding from the key industry players in the (hydro) power generation market (such as Alstom Power, Siemens, ABB, Andritz Hydro, Voith Hydro, Bosch Rexroth and Rolls Royce). Through this industrial support and available expertise, these new technology developers are catching up quickly and making significant progress.

MARINE Platform

Marine Renewable Integrated Application Platform

2010 -2014

Project description:

The research conducted within the project will establish a set of transparent criteria for the evaluation of multi-purpose platforms for marine renewable energy. Using the research findings, the project will produce a set of design and optimisation tools, notably related to the design of multi-purpose platforms, the engineering of components, spatial planning and platform grid connections, focussed on an integrative approach of various purposes.

Project results:

The ultimate objective is to produce up to three real examples of multi-purpose renewable energy platforms to unleash further synergies between maritime economic activities. These models will be preliminary engineering designs with estimates for energy output, material used, the recommended dimensions of the platforms as well as further technical specifications related to components. The aim is to test models for multipurpose platforms and to provide the ground for pilot scale platforms for testing at sea.

Key data:

Funding programme: FP7 ENERGY
Project duration: 54 months
Total project volume: € 12,761,220
EU funding received: € 8,708,660Website: http://www.marina-platform.info/index.aspx

The main environmental concerns related to tidal range energy are: the impact of tidal barrages on flora and fauna, as well as on changes in geomorphology and processes, patterns and rates of sedimentation and erosion, transport and accretion. Adverse environmental impacts of tidal current, wave, OTEC and osmosis are currently expected to be small. Research is still required to confirm this. During the construction of energy farms, the same considerations may apply as mentioned under offshore wind energy.

Important linkages and inter-dependencies exist and will grow further between the above energy sources – with regard to skills, cross-over technologies and infrastructure including ports. Synergies could also arise with short-sea shipping (e.g. through charging ships with electricity at wind turbines off-shore). The commercial viability of a tidal range scheme may be deemed greater if a wider range of functions and related economic benefits could be incorporated (Royal Haskoning, 2009). When it comes to OTEC, combinations are even more important. Examples of such combinations:

- combining OTEC with Sea Water Air Conditioning (SWAC);

- application of OTEC-technology in the production of LNG;
- combining OTEC with production of drinking water and extraction of minerals;
- combining OTEC on floating installations with reducing the problem of the plastic pulp in the oceans.

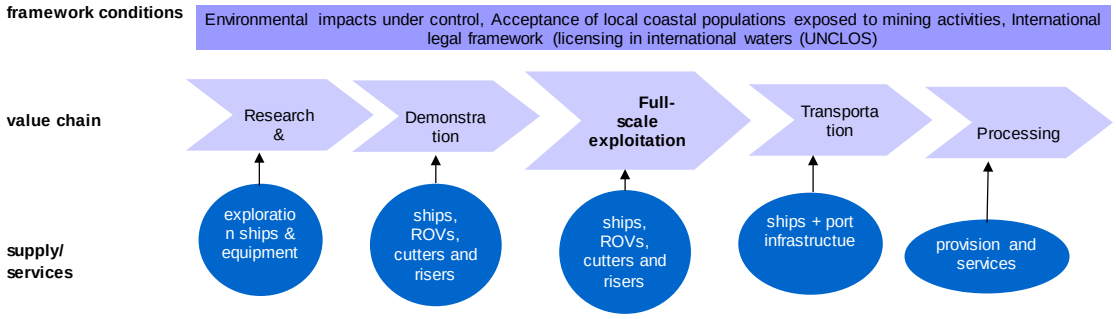
For ocean renewables in general, accurate sea-bed maps are very important. This is a synergy with the activity of 'Monitoring and surveillance'.

Assumptions about framework conditions being fulfilled

- Access to finance – for moving into the development stages and for funding demonstration projects. A reduced risk perception based on proven technology;
- Favourable financial incentives such as feed-in tariffs or green certificates;
- A wide variety of infrastructure: (smart) grid infrastructure and connections, dedicated port facilities;
- A sound legal framework, transparent and simplified permitting procedures and development of educational curricula and skills will be in place for the future situation and planned for the next decade;
- Environmentally friendly technologies will be available and in use (R&D). The balance between positive and negative impacts during the complete device life cycle is favourable;
- Ocean Energy public's perception;
- Marine spatial planning is of key importance for the timely reservation of suitable areas, the identification of synergetic activities and for solving tensions with competing activities.

3.5.3 Marine minerals mining: now is the time to explore [84]

Economic activities associated to deep sea mining of raw materials other than aggregates includes iron ore, tin, copper, manganese, cobalt, beryllium, germanium, graphite, gold, sulphides, phosphorites, diamonds and lime. Some of these are labelled critical raw materials which have a risk of supply shortage with a higher economic impact than other raw materials.



The value-chain of deep sea mining consists of five main steps:

1. In the exploration phase, different techniques for locating and testing ore content and quality is carried out through locating, sampling and drilling;
2. In the demonstration phase, small-scale extraction is initiated, and technologies tested;
3. In the extraction phase, Remotely Operated underwater Vehicles (ROVs), cutters and risers are used to carry the ore from the bottom up to the surface;
4. In the transportation phase, shipping and ship-building is in focus; and finally,

[84] Literature references used for drafting this section can be found in Chapter 8 under the specific heading for this economic activity.

5. In the processing phase, the extraction of minerals in plants is carried out. Here also the site plays a key role.

…After decades, the technology for deep sea mining is now ready for testing.

This type of mining is still in an infant state; the notion that the seabed might contain large mineral deposits exists for decades but the exploration was yet too costly. The technology for deep sea mining was not mature enough and the market price of these raw materials was not at a level that could support costly deep sea exploration. However, this is changing as in the past few years the market prices of most of these minerals have gone up significantly due to a combination of increased demand and increased supply risk. Furthermore, countries such as Russia, China and Japan have seen the strategic value of such metals as well, and have started with (state-supported) explorations. The increased demand is mainly driven by technological developments; many of these minerals are important raw materials in high-tech applications. With the rise of the computer and mobile communication era, the demand for rare earth has steepened, and shortages are imminent – mostly for geopolitical rather than for geological reasons. Meanwhile, mineral prices have been soaring and land mines are no longer sufficient to meet growing demand, especially from China. In ocean floors around the globe, vast stocks of minerals are expected to be found. Exploitation and mining are, however, still in a nascent stage. To date, no excavation of solid minerals has taken place beyond 200 m below sea-surface.

…A surge in deep sea mining is expected in 2013 – should the first mining venture succeed.

By 2020, an expected 5% of the world's precious minerals including cobalt, copper, zinc as well as rare earth can come from the ocean floors (up to 10% in 2030). Overall global annual turnover value of marine mineral mining can be expected to grow from virtually nothing up to € 5 billion in the next 10 years, and € 10 billion in the period up to 2030. Mining will focus above all on polymetallic sulphides: deposits which are the result of hot fluids being discharged through fractures (vents) between tectonic plates[85]. A surge in marine mineral mining is expected to start after 2013, should the first commercial venture for polymetallic sulphides ('Solwara 1') succeed. Commercial excavation of copper and gold from the Exclusive Economic Zones of Papua New Guinea is about to start by the Canadian mining company Nautilus Minerals Inc.[86]. It has thereto signed an agreement with the Tongling Nonferrous Metals Group, China's largest importer of copper concentrates. For the first three years, the companies involved are expecting to process annually 1.1 million tons of Solwara material, which has high concentrations of copper. The further processing and smelting of the copper will take place in China.[87] Furthermore, the Nautilus mining company has thereto designed and built a dedicated ship from a German shipyard. It will also use state-of-the art extraction tools, such as ROVs, cutters and risers developed for deep sea oil winning – supplied by European partners. The ECORD consortium (see box below) is an example of European efforts to use the jointly available skills for entering this market.

ECORD

European Consortium for Ocean Drilling[88]

2003 - 2008

[85] Halfar, J. and Fuijta, Rodney M. (2002) "Precautionary management of deep sea mining", Marine Policy, v.26, 2, p.103-106

[86] Recent estimates have increased by 20% the marine gold and copper deposits on this particular seafloor, "Nautilus IIncreases indicated marine gold and copper by more than 20%", www.mining.com , 28/11/2011.

[87] Marketwire – Mining and Metals (2012) "Undersea mining closer to reality". 23/04/2012.

[88] http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=7468755&pid=0&q=F9D9CCF772C7F922078CCF2A72936106&type=sim

Project description:

The ERA-net combined the aspects of ECORD with all areas of scientific drilling in the oceans and continents, to marine geophysical surveys which require validation by drilling, and to marine observatories. Fifteen research organisations have created a European research structure, the European Consortium for Ocean Research Drilling (ECORD). The funding agencies proposed to use the ERA-Net structure for the implementation of ECORD and move towards a single research and operational funding structure for science in Europe enabled by ocean drilling.

Project results:

In particular, the ECORD ERA-net provided state of the art and best practice for stakeholder groups in the EU in:

(i) establishing a system of mutual exchange of information via dissemination of scientific results and creation of scientific data bases;

(ii) management of pooled national funding and implementation of complex scientific programmes involving subcontracting and multi-partner activities;

(iii) opening ECORD to other EC and European countries and to efficiently building on ECORD;

(iv) structuring and funding multi-partner pre- and post-cruise science in Europe within IODP, including co-ordination of proposal preparation across Europe and involving strategies for efficient scientific staffing of three international platform operations;

(v) creating a forum of exchange in the realms of strategic actions in marine geosciences in general, including all geological studies of the European margins and the establishment of a network of long-term observatories on the sea-bed.

Key data:

Funding programme: FP6

Project duration: 57 months

Total project volume: € 2,724,966

EU funding received: € 2,638,087

Website: http://www.ecord.org/enet/ecord-net.html

The exploration of the largest known sulphide concentration, namely in the Red Sea, will soon start as well[89]. The Saudi company Manafa has already been given exclusive exploitation rights and early estimations value the deposits to $ 3.11 billion to $ 5.29 billion (copper, zinc, silver and gold). In 2020, manganese nodules and cobalt crusts are not yet expected to be commercially exploited at a large-scale, due to technological, commercial and environmental constraints[90]. The extent to which European actors can benefit from this activity will depend on the strategy of major mining companies (many of which are from the US, Australia, and Canada), and their ability to obtain licenses. European companies are amongst the world leaders in key technologies such as dredging, drilling, cutting, transport and ROVs.

Uncertainties that surround this activity are market prices for minerals that need to remain consistently high on world markets. The metal contents found in deposits on the ocean floor need to be high. And above all, technologies still need to be tested, mostly in the area of excavation devices, cutters and risers – through Nautilus' Solwara project at the Papua New Guinea coast. Cost reductions need to be achieved, particularly with regard to transport costs. Furthermore, the future of deep sea mining is expected to depend on overall public acceptance, as well as that of local communities.

[89] Bertram et al. (2011) "Metallferous Sediments in the Atlantis II Deep – Assessing the Geological and Economic Resource Potential and Legal Constraints. Kiel Working Paper No. 1688, March.

[90] World Ocean Outlook, Chapter 7 "Marine minerals and energy", p. 151.

…Considerable yet unknown environmental impacts and dependence on public acceptance…

This activity can bring about considerable but yet unknown environmental concerns, through the disturbance of deep sea ecosystems through the extraction of mineral resources. The deep sea and sea floor forms an extensive and complex system which is linked to the rest of the planet in exchanges of matter, energy and biodiversity. Operations on the sea-floor may destroy unique habitats and disturb deep sea ecosystems which could entail changes in fish stock and primary production. Pressure and impacts may also emerge from future activities related to mining, as well as carbon sequestration and gas hydrate extraction. These activities might have consequences on loss of biodiversity and on the flow of deep sea ecosystem goods and services provided by these environments. These risks are being assessed as part of exploration ventures (biologists joining these expeditions).

Marine mineral mining can develop through strong synergy with oil & gas exploration and offshore industry, also through strengthening demand for dedicated ships. Marine mineral mining also provides synergies with blue biotechnology, notably by offering the infrastructure and support for exploration into new and rare species.

Assumptions about framework conditions being fulfilled

- Access to private capital for investment and upscaling;
- Environmental impacts remain under control (and cooperation with environmental NGOs);
- Acceptance of local coastal populations exposed to mining activities;
- International legal framework: conditions for licensing in international waters (UNCLOS).

3.6 Conclusions: blue growth potential in perspective of the background scenarios

The above overview of micro-futures for 11 promising maritime economic activities include our assessment of potential development, uncertainties, synergies and tensions, and framework conditions that need to be met. At this stage, it is important to review these in the light of the uncertainties about the unfolding of the background scenarios as presented in Section 3.1. The overarching question at this stage is how these maritime economic activities are likely to unfold in the different background scenarios, and to review whether the conditions for utilising the future potential is likely to be met. Before doing so, we want to reiterate the fact that these background scenarios cannot be influenced by individual (policy) actors, and that they are acknowledged as a possible future.

Global Blue Growth economic and jobs potential is strong

There is a true strong Blue Growth potential. The economic activities presented provide clear economic and employment prospects.

Blue Growth prospects appear to profit most from a *sustainable growth* scenario – as stable economic growth combined with a growing environmental awareness and actions provide an excellent context for the majority of economic activities analysed. The long-term orientation of actors in this scenario contributes to a stable investment climate, particularly favourable for blue biotechnology, offshore wind and ocean renewable energy. Added to this scenario can be a flourishing deep and short-sea shipping (replacing substantial parts of road transport), enhanced port facilities and capacities, a strongly increasing (sustainable) tourism sector, and high investment levels in technologies for exploitation of marine biodiversity. An increased role of the seas and oceans in human food production (sustainable aquaculture), intensified monitoring activities, and intensified international coordination of the use of marine space.

A *pursued growth* scenario will also provide opportunities, especially for the mature and growing activities. Expected are a flourishing deep and short-sea shipping, enhanced port facilities and capacities, increasing coastal tourism in northern Europe driven by climate change effects and an increased demand for short trips, a strong cruise shipping sector, high investment levels in technology, an increased role of the seas and oceans in traditional human food production, and a persisting extraction of oil, gas and minerals from the deep seas, also in the Arctic, supplemented by extensive monitoring activities. Environmental awareness will however be lower in this scenario.

Prospects will be more selective and limited in the *fragile recovery* scenario, which combines a global awareness to sustainability with low and unstable economic performance but with a strong development of environmental awareness. Fluctuating transport volumes result in obsolete fleets and port facilities, a stable or declining cruise shipping sector, limited investments in developing technologies aimed at sustainability, increased role of the seas and oceans in sustainable human food production, extraction of oil and gas is slowly declining and taken over by renewables, while the extraction of minerals from deep seas is slow to develop.

Within the *boom and bust* scenario, prospects are expected to be considerably less favourable – due above all to a short-term horizon of all actors, more risk-averseness, less environmental awareness and restricted public and private investment budgets. Fluctuating transport volumes result in obsolete fleets and port facilities. Persisting extraction of oil, gas from the deep seas, however without the necessary investments as commodity price fluctuations add to uncertainty. Coastal tourism and cruise tourism will be relatively stable still, with a focus on northern Europe due to climate change effects. However limited investment will take place in developing new technologies, with dimmed prospects for offshore wind, ocean renewable energy and blue biotechnology as a consequence. Public resources for maritime monitoring activities will be limited. It is especially in this scenario that additional policy support is likely to be needed – for Blue Growth to take off.

Time horizon of stakeholders as the most crucial variable

The potential of the reviewed maritime economic activities will depend on a range of factors. Especially those activities in an early stage (pre-development or early growth stages) are vulnerable, and depend on technological breakthroughs, the ability to build critical mass, access to capital, and the outcome of demonstration and testing. Economic activities in the *(pre-) development stage* all suffer from the limited size of the sector and the limited critical mass (e.g. blue biotechnology). EU players tend to be more fragmented and depend on non-EU players in the value chain, e.g. mining companies (Marine mineral resources) or utility companies (Ocean renewable energy).

Europe will be far from alone when faring on the world's oceans and seas…

Through continued and intensified globalisation, Europe will be far from alone on the world's oceans and seas. An increasing dominance of Asia seems unavoidable. For example, analysis of patents (top assignees) supports the assertion that Asian players already are the dominant innovators in many of the marine economic activities: 62% of selected patents analysed were from Japanese, Chinese or Korean origin, followed by the EU with 21% and the US in third place (16%). The US is leading in cruise tourism and also in maritime monitoring and surveillance – due mostly to the strong military innovation capacity in these areas.

Europe has strong technological but limited commercial firing power

The EU has strong marine scientific and academic competencies, as demonstrated by high numbers of publications and citations. It has brought forward the authors of at least 4 out of 10 authors in a wide range of maritime economic activities, from those in the energy and raw materials

to the living resources domains. However, the discrepancies between patent and publication patterns points to a conclusion: the EU has excellent academic and scientific capacities in the maritime economic activities analysed, but considerably less commercial potential to embark on these. Especially activities in the developmental stage are mostly carried out by small companies, spin-offs or suppliers which are strapped from cash, wary to share knowledge, and unable to control the value chain. EU-players tend to linger in this developmental stage longer than strictly necessary, while large industrial players (mining companies, pharmaceutical, cosmetic, food companies, energy companies, and utilities) are standing aside – in the waiting room until the moment is there to acquire or buy equity positions. Meanwhile, non-EU players (often backed by their governments) tend to invest more and faster in these developmental stages (e.g. the US investing in micro-algae, China in desalination techniques, Japan in mining rare earth from the Pacific, etc.).

Sustainable maritime innovations are a European card to play

As demonstrated above, Blue growth is expected to thrive in a scenario of sustainable growth. Particularly high are expectations in this scenario for offshore wind, ocean renewable energy, blue biotechnology and marine aquatic products. Within several of these domains, Europe is in a leading position when it comes to technology and innovation: it has generated around half of the reviewed patents in offshore wind, while 1/4 of the reviewed patents in ocean renewable energy sources. A strong performance can also be recorded in sustainable innovations for marine aquatic products. Furthermore, Europe is well placed to lead on the transformation of traditional maritime economic activities, e.g. green shipping, sustainable tourism, sustainable aquaculture, but even promoting more sustainable forms of business within oil and gas or marine mineral mining. Playing out the card of sustainable maritime innovations is likely to produce growth and jobs in a world which is increasingly aware of sustainability. This card is however less likely to succeed in a world which is short-term oriented and where Europe moves from crisis to crisis.

The EU's future success in the maritime economy will therefore largely depend on its own technological as well as strategic response capacity, and its ability to bring promising and sustainable maritime innovations fast and decisively, adapted to a rapidly evolving global context.

Table 3.1 shows an overview of the environmental impacts of each economic activity. Further details are presented in annex 3 on the general scenarios.

Table 3.1 Environmental impacts of the selected Blue Growth economic activities. Grey areas indicate the *potential* impacts of the economic activities mentioned, white areas indicate that no impacts are expected.

Blue Growth economic activities	Impacts														
	Biological disturbance			Physical loss	Physical damage	Inter-ference with hydro-logical processes	Other physical disturbance		Contamination by hazardous substances	Systematic and/or intentional release of substances	Nutrient and organic matter enrichment	Potential beneficial environ-mental effects		
	- Extraction of species including non-target catches	- Non-indigenous species and translocations	- Microbial pathogens	- Smothering - Sealing	- Siltation - Abrasion - Extraction	- Thermal regime - Salinity regime	- Underwater noise	- Marine litter	- Synthetic compounds - Non-synthetic substances - Radio-nuclides	e.g. produced water, carbon storage	- Fertilisers and other nitrogen- and phosphorus-rich substances - Organic matter	reduction of greenhouse gases	creation of new habitats	increased public support for protection
Shortsea shipping	■	■		■	■	■	■		■					
Offshore oil and gas				■	■		■		■	■				
Coastline tourism and yachting	■	■		■	■	■	■		■					■
Coastal protection				■	■	■							■	
Offshore wind				■	■	■	■					■	■	
Cruise shipping		■	■	■	■	■	■				■			
Marine aquatic products	■	■	■	■	■	■			■		■	■		
Maritime monitoring and surveillance	■			■	■	■	■							■
Blue Biotechnology	■											■		
Ocean renewable energy				■	■	■	■	■				■	■	
Marine minerals mining	■			■	■		■							

4 Sea basins

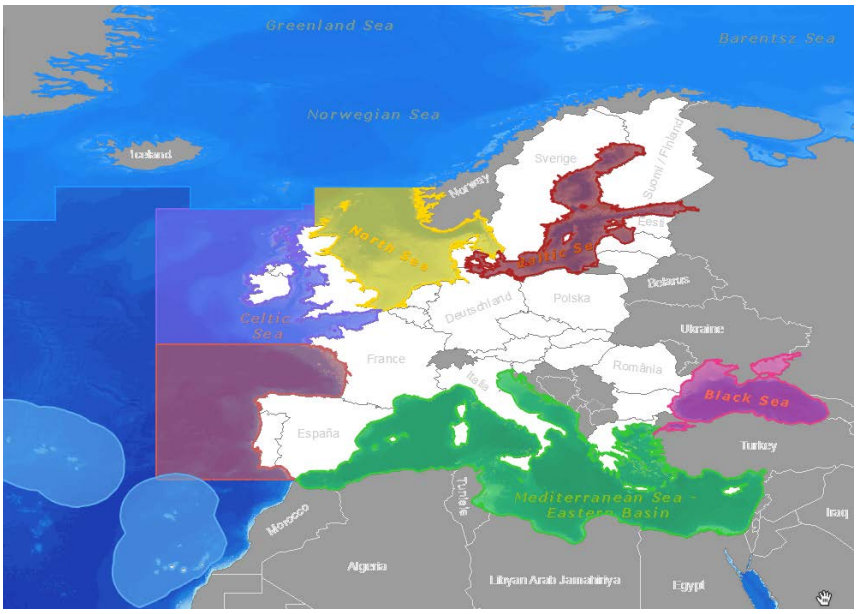
4.1 Introduction

The brief descriptions of the European sea basins, presented in this chapter, serve three purposes:

- they help to develop appreciation of the differences between the European sea basins, which in turn raise the need for differentiated policies and management;
- they describe the links between the maritime economic activities and the physical and social settings in which they develop, in order to provide policy makers with an analysis of relevant policy options at sea basin level;
- they provide information to find synergies and spatial planning as elements that are of key importance when designing policy options. These elements cannot be described at too general a level. In fact, even the sea basin level is often too high. For that reason in each of the sea basins so-called clusters are identified. Clusters are defined as "geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition (e.g. suppliers, customers, companies which share inputs, but also governments and other institutions such as universities and trade associations."[91] A preliminary overview of clusters is presented in section 6.1, while their location is indicated in the sea basin maps in this chapter.

The delineations of the sea basins are depicted below: the Baltic Sea, the North Sea, the North-East Atlantic Ocean, the Arctic Ocean, the Mediterranean Sea, the Black Sea and the Outermost Regions. Each of these basins is described in four entries: physical characteristics, socio-economic characteristics and outlook, environmental status and policy responses. Policy responses are restricted to the basin-specific integrated responses. Sector-specific policies are not addressed. A summarizing table of the findings of the descriptions and general conclusions follow in section 4.9.

Figure 4.1 European sea basins and the European parts of their catchments (source: DG MARE website).



[91] M.E. Porter (1998) "Clusters and the New Economics of Competition" Harvard Business Review, Nov/Dec. p.78.

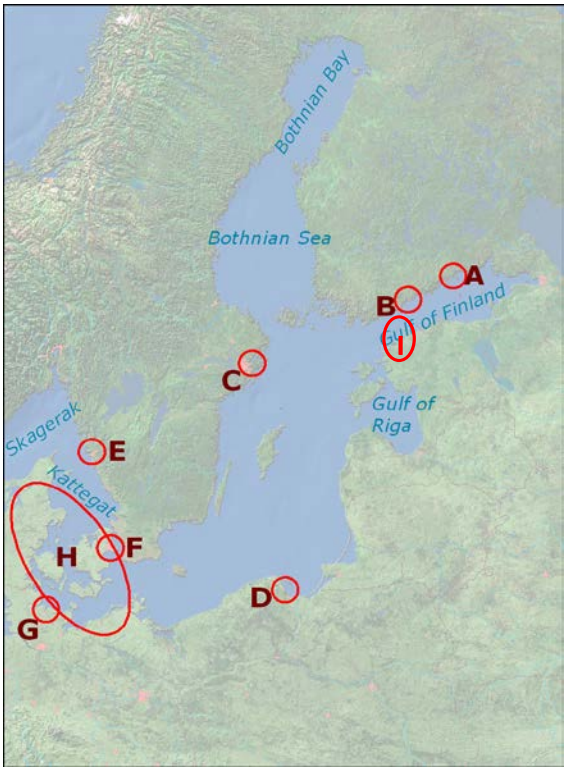
The references used in this chapter are included in section 8.2.2.

4.2 Baltic Sea

Physical characteristics

The Baltic Sea is a brackish shallow sea of approximately 377,000 km^2. The average water depth is 55 m; in small areas it can reach over 450 m. The Baltic Sea is surrounded by Denmark, Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland and Germany, of which only Russia is not an EU Member State. The Baltic Sea region hosts one fifth of the EU's population, but has a lower population density than the EU as a whole (EU Regional Policy, 2010).

Figure 4.2 The Baltic Sea region with its EU Member States' economic clusters: A=Kotka/Hamina; B=Helsinki; C=Stockholm; D=Gdansk/Gdynia; E=Goteborg; F=Copenhagen; G=Kiel; H=Western Baltic; I=Tallinn.



The Baltic Sea is connected to the Atlantic Ocean only via the small entrances of the Sound and the Belt Sea (Figure 4.2). Water exchange is extremely limited and water can remain in the Baltic for up to 30 years prior to exchange, resulting in a highly eutrophic marine environment with substantial areas of oxygen depletion throughout.

The most crucial feature of the Baltic Sea is that the salinity is low, making the Baltic the world's second largest brackish-water basin after the Black Sea. The salinity decreases in eastward and northward directions into the Baltic. The low salinity is of tremendous importance to life in the Baltic and is the key to understanding and managing the sensitive marine ecosystem. Only a few marine animals and plants are able to tolerate the low salinity, rendering them irreplaceable in the Baltic ecosystem. A system made up of so few species is not very stable, and is very susceptible to such pressures as fishing, habitat destruction, and pollution.

Socio-economic characteristics and outlook

The Baltic Sea region has experienced economic prosperity, and the highest GDP growth in the EU, since the late 1990's. There are large disparities within the Baltic Sea Region with a clear east/west divide, with the west being more prosperous than the east. Much of the west Baltic Sea region's prosperity is due to increased labour productivity and innovation. This prosperity was destabilised during the recent global financial crisis. It is hoped through future economic stabilisation and regional support for development, that the Baltic Sea region will regain high GDP growth (EU Regional Policy, 2010).

In the descriptions of the maritime economic activities of the Blue Growth project (annex 4) an estimate was made of the relative importance of each sea basin for the economic activities and their future potential. In the Baltic Sea area the importance of *shipping, coastal tourism* and *cruise tourism* is high, to a lesser extent of *offshore wind*, while the remaining activities are small. Other important economic activities, not investigated in detail in this study, include fisheries, aquaculture and aggregates mining. In the references to this chapter (Helcom, 2010a; Helcom, 2010b; Knights et al., 2011; EEA, 2010), other human economic activities in the Baltic mentioned are passenger ferrying, dredging and dumping, military areas, land-based industries, construction and use of infrastructure (cables, pipelines, roads and bridges), hunting of seals (Helcom 2010a, p.39), hunting of birds.

Short-sea shipping

Based on the gross weight of goods transported, 20 % of Short-sea shipping occurred in the Baltic Sea (Eurostat, 2010). In 2005, the Baltic Sea Area was (together with the North Sea) adopted as SOx Emission Control Area (SECA). Here, stricter emission standards apply, and fleet developments may be affected (i.e. exhaust gas handling, use of low sulphur fuel like LNG, including the development of shore based infrastructure).

Cruise tourism

The Baltic is the second largest area for cruise tourism in Europe, after the Mediterranean. Regional data estimates that the Baltic Sea accounts for 10 % of cruise passengers (Policy Research Corporation, 2009). The Baltic Sea region receives more than 350 cruise ships with over 2100 port calls each year. In 2010, three of the top-10 sea ports (in terms of passengers embarking, disembarking or making a port call) were on the Baltic: Copenhagen, Stockholm and St. Petersburg (European Cruise Council, 2011). In (COWI 2007), it was concluded that the Baltic Sea region is the fastest growing cruise market in the world. Cruise tourism in the countries around the Baltic Sea gives an annual turnover of around € 443 million and approximately 5500–11500 jobs are created (Helcom 2010b).

Offshore wind

The offshore wind energy sector has experienced strong growth over the recent years. In the last decade the trend has been visible in all Baltic Sea countries, with somewhat higher frequency in Denmark and Germany and a lower frequency in Latvia, Lithuania and Russia. In total there are 11 wind farms in the Baltic, with a total capacity of 590 MW (http://www.4coffshore.com).

Coastal tourism and yachting

The Baltic Sea countries estimate that total tourism in the region has an annual turnover of EUR 90 billion, but this figure includes all forms of tourism, not only coastal tourism. The number of employees in the sector (excluding Russia) is 156 200 (Helcom, 2010a, citing the European Commission, 2008). Tourists are predominantly attracted to the Baltic Sea region because of the natural and cultural heritage and landscapes of the area. In Denmark, Estonia and Latvia, for instance, ecosystem services include bathing beaches, varied landscapes, hiking and nature walks,

bicycle routes. In the German and Polish regions a mixture of diverse activities such as sandy beaches, seaside resorts and spas, as well as multiple sport opportunities such as golf, kite surfing, skating, cycling, diving and fishing are offered (EP, 2008).

For the future, the existing activities are expected to continue their growth. The importance of the Baltic Sea is expected to increase for blue biotechnology; offshore wind energy and maritime security (annex 4).

Environmental status

It is currently evident in the Baltic Sea region that human activities are causing widespread pressures to marine ecosystems. For example, excess nutrients entering the marine environment, from land based industry and agriculture, is causing eutrophication and algal blooms. Overfishing, land-based pollution, rising sea temperatures, the presence of hazardous compounds and adapting to climate change are causing widespread impacts to leisure activities and small-scale commercial use across the region (EU Regional Policy, 2010).

Knights et al. (2011) identify as the sectors exerting widespread pressures to the marine ecological characteristics: agriculture, coastal infrastructure, fishing, shipping, tourism and recreation. Helcom (2010a) adds aquaculture and mineral extraction (sand, gravel, maerl) to that list.

Governance and integrated policy responses

The Helsinki Commission, or HELCOM, works to protect the marine environment of the Baltic Sea from all sources of pollution through intergovernmental co-operation between the bordering states of the Baltic Sea.

The HELCOM Baltic Sea Action Plan is a programme to restore the good ecological status of the Baltic marine environment by 2021. The strategy is a stepping stone for actions to combat the continuing deterioration of the marine environment resulting from human activities.

The EU Strategy for the Baltic Sea Region (EC, 2009) helps to coordinate action by the European Union, EU countries, regions, pan-Baltic organisations, financing institutions and non-governmental bodies to promote a more balanced development of the Baltic Sea Region.

The Strategy aims to make this part of Europe more

- Environmentally sustainable (e.g. reducing pollution in the sea);
- Prosperous (e.g. promoting innovation in small and medium enterprises);
- Accessible and attractive (e.g. better transport links);
- Safe and secure (e.g. improving accident response).

Furthermore it helps to mobilise all relevant EU funding and policies. Fifteen priority areas have been identified for action in the coming years. Flagship projects are listed in an Action Plan, which is updated regularly. Progress achieved so far includes support for new projects, greater involvement of Russian partners and improved cooperation between regions and other partners, including the private sector. Furthermore, regional cooperation initiatives address Blue Growth aspects.[92]

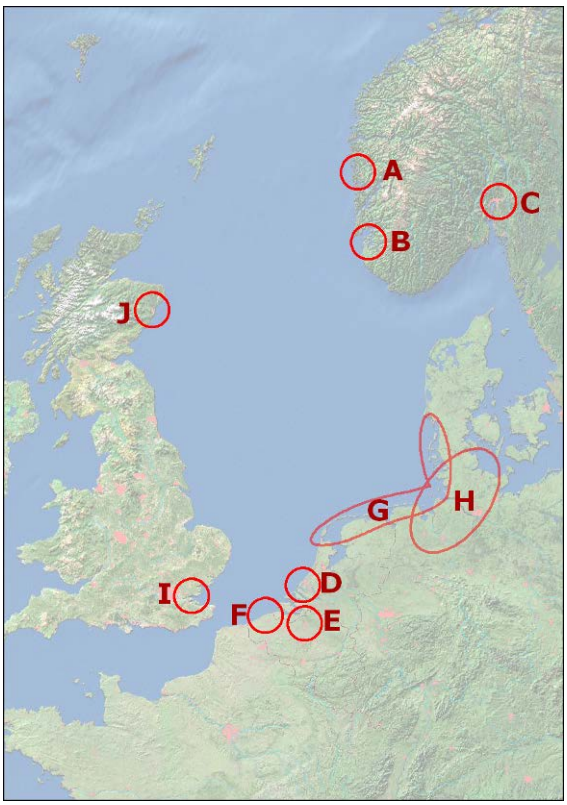
[92] See for instance www.euregionbaltic.eu

4.3 North Sea

Physical characteristics

The North Sea is a relatively shallow marginal sea of the Atlantic Ocean located between Great Britain, Scandinavia, Germany, the Netherlands, and Belgium. An epeiric (or "shelf") sea on the European continental shelf, it connects to the ocean through the English Channel in the south and the Norwegian Sea in the north. It is ca. 970 kilometres long and 580 kilometres wide, with an area of around 750,000 km^2.

Figure 4.3. The North Sea region with its economic clusters: A=Bergen; B=Stavanger; C=Oslo; D=Rotterdam; E=Antwerp; F=Oostende; G=Wadden Sea; H=Hamburg/Bremen/Kiel; I=London; J=Aberdeen.



The strong coupling between benthic and pelagic communities in the shallow parts of the sea makes it extremely productive and one of the most productive areas in the world, with a wide range of plankton, fish, seabirds, sea mammal and benthic communities. The coast of the North Sea presents a diversity of geological and geographical features. In the north, deep fjords and sheer cliffs mark the Norwegian and Scottish coastlines, whereas the south consists primarily of sandy beaches and wide mudflats.

Socio-economic characteristics and outlook

The North Sea has long been the site of important European shipping lanes as well as a major fishery area. The sea is a popular destination for recreation and tourism in bordering countries and more recently has developed into a rich source of energy resources including fossil fuels, wind, and early efforts in tidal power. The North Sea is one of the world's most important fishing grounds. The sea is rich in oil and gas. Extraction of sand and gravel is an important economic activity.

In annex 4 an estimate was made of the relative importance of each sea basin for the economic activities and their future potential. The North Sea is relatively important for shipping, cruise tourism, offshore wind and coastal tourism, while the remaining activities are small. For the future,

the indicated activities are expected to continue their growth, in particular offshore wind energy and coastal tourism and yachting.

Short-sea shipping

Based on the gross weight of goods transported, 26% of short-sea shipping occurred in the North Sea (Eurostat, 2010). Maritime transport has been a growing sector in the past 20 years and is one of the economically most important maritime sectors in the North Sea (EC, 2008). Since 1998, ship traffic in the Greater North Sea has in general been increasing in line with market developments and policies to take transport of goods off the roads. This includes an increase in the number of ships, the cargo and the size of ships. In particular, oil tanker traffic has been growing rapidly as more and more oil is progressively being brought to the global market via EU waters. The North Sea countries also host some of the biggest freight ports in Europe, including Rotterdam, Hamburg and Antwerp that act as hubs for delivering commodities across Europe. In 2005, the North Sea was (together with the Baltic Sea) adopted as SOx Emission Control Area (SECA). Here, stricter emission standards apply, which may for instance trigger the use of LNG as marine fuel, requiring also the development of land-based infrastructure. Furthermore several ports in this sea basin have set steps to attract greener ships through e.g. differentiation of port charges.

Offshore oil and gas

Although total North Sea production of oil and gas has decreased (ca. 14% since 2001 to around 442 million tonnes of oil equivalents (toeq) in 2007), the number of offshore installations has increased. This indicates a trend towards the development of smaller fields.

Offshore wind

During the last decades cumulative wind energy capacity has been increasing. In the North Sea the interest in wind farms is much higher than in other European sea basins. There are 28 operational wind farms. Eight of them are in the UK with 831 MW total capacity, eleven in Denmark with 500 MW , four in the Netherlands with 250 MW, three in Germany with 70 MW, and 2 in Belgium with 195 MW total capacity http://www.4coffshore.com, accessed 8 Feb 2012). In each of these countries a substantial addition of parks is being prepared.

Coastal protection

The conversion of coastline into artificial areas (e.g. harbours, dykes, groyne fields, seawalls, marinas, artificial beaches, dams, sea walls) is ca 16% of the total shoreline. Densely populated countries with relatively short coastlines (e.g. the Netherlands, Belgium) have the most shoreline conversion to man-made surfaces. Soft-engineering coastal structures, such as dunes and salt marshes, are increasingly being employed to act as natural buffers against rising tides. The projected rise in sea levels, storm and flood frequencies and wave loads is likely to increase the need for coastal protection measures, especially in the southern North Sea.

Ocean renewable energy

This economic activity is small and is expected to remain small for the coming decade. It is mentioned here because in the North Sea much development is taking place, especially in the development of wave and tidal energy, in test sites in Scotland (EMEC test site, Orkney Islands), Denmark and the Netherlands.

Cruise tourism

Regional data estimates that the North Sea accounts for 5 % of cruise passengers (Policy Research Corporation, 2009). The number of calls (especially first time cruisers) and destinations in northern Europe is rising steadily, a number of North Sea cruise ports has joined forces aiming at increasing their maritime accessibility and developing the North Sea as a cruise destination.

Coastal tourism and yachting

Since the 1990s, the total number of tourists visiting the North Sea Regions has increased steadily, growing from around 52 million in 1998 to around 80 million in 2007. There are continued increases in coastal infrastructure, including for accommodation and service, and an increasing demand for resources, especially in the southern part of North Sea.

Recreational boating is probably the most widespread form of marine tourism. It experienced steady growth during the past years and forecasts point to a 5-6% annual growth within the EU. Indicative are the growing development of berths and moorings available for recreational vessels. A number of specialised shipyards building recreational yachts are located in the Netherlands, Germany and some other countries.

Environmental status

Several issues have been identified as being of high importance in the North Sea: impacts of fisheries; hazardous substances, especially persistent organic pollutants; nutrient inputs from land; and a lack of knowledge on climate change (OSPAR, 2010).

On the positive side, a general downward trend of hazardous substances and plant nutrients mainly by reduced discharges from industries and agriculture are evident. Although some stocks are still under severe threat or outside sustainable limits, since the nineties several fish stocks improved and fisheries management is improving. Long-term management plans for key stocks and substantial decreases in destructive practices such as beam and otter trawl fishing in some areas are being implemented and followed up. Also the excessive discards of fish are beginning to be addressed. Fish communities near the seabed seem to recover (OSPAR, 2010).

Governance and integrated policy responses

OSPAR is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Community, cooperate to protect the marine environment of the North-East Atlantic. The North Sea is part of the OSPAR area. The fifteen Governments are Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom. Finland is not on the western coasts of Europe, but some of its rivers flow to the Barents Sea, and historically it was involved in the efforts to control the dumping of hazardous waste in the Atlantic and the North Sea. Luxembourg and Switzerland are Contracting Parties due to their location within the catchments of the River Rhine.

On 3 October 2007, the European Commission approved a transnational cooperation Operational Programme between Belgium, Denmark, Germany, the Netherlands, Sweden, and the United Kingdom (with participation from Norway). The North Sea Region Programme runs from 2007 to 2013. The Programme's main aim is to make the North Sea region a better place to live, work and invest in. It seeks to make a measurable difference by:

- increasing the overall level of innovation taking place across the region;
- enhancing the quality of the environment; and
- developing sustainable and competitive communities.

The North Sea Region 2007-13 promises to deliver a long-term strategic approach to transnational cooperation. It will provide a catalyst for cooperative projects that can support investments in infrastructure that are of transnational relevance. An additional aim is to encourage cross-fertilisation between projects that address similar issues, and that provide complementarities with other programmes – be they European, national or regional in make-up. The Programme will also

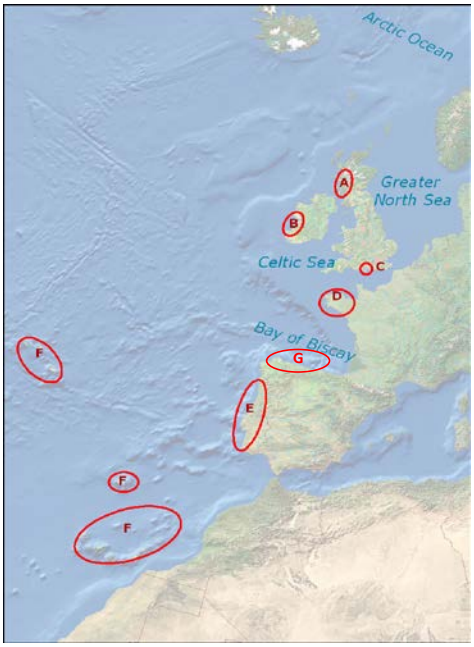
pool resources to provide critical mass while tackling transnational issues that are of genuine importance to the area.

4.4 North-East Atlantic Ocean

Physical characteristics

The North-East Atlantic and its adjacent seas is a vast area of about 13.5 million km^2 which includes a diverse range of environmental conditions and different ecosystems. These play a key role in the types and patterns of human activity in the North-East Atlantic and associated impacts on the marine environment. Figure 4.4 depicts the whole North-East Atlantic. In this chapter we use the OSPAR nomenclature, focusing on the wider Atlantic, the Celtic Seas, the Bay of Biscay and the Iberian coasts, coinciding with OSPAR's regions III, IV and V.

Figure 4.4 The Atlantic Ocean Region with its economic clusters: A=Scottish West Coast; B=Galway; C=Solent; D=Brest; E=Portuguese coast; F=Canaries, Madeira, Azores, and G=Galician coast.



Much of the coastal area in the North-East Atlantic is densely populated, highly industrialised or used intensively for agriculture. Population density is much higher on the coasts than inland, with most of the population in some areas of Northern Europe being concentrated in coastal settlements. Population density is highest on the Iberian coasts (with over 500 inhabitants per km^2) and lowest in the wider Atlantic, dominated by high seas.

The *Celtic Seas region* contains wide variations in coastal topography, from fjord sea lochs, to sand dunes, bays, estuaries and numerous sandy beaches. The large range of habitats in the region supports a diverse fish fauna. Generally, water movement is from south to north, with oceanic water from the North Atlantic entering from the south and west of the region and moving north towards either the Arctic or North Sea. However, there are also complex intermediate water movements, particularly within the Irish Sea. The strongest winds come from the west and south, with a tendency for the strongest winds to be experienced in the north and west of the region.

The bottom topography of *the Bay of Biscay and the Iberian coast* and coastlines are highly diversified, including the continental shelf and slope and parts of the abyssal plain. Ecosystems in the region are very rich, support a rich fish fauna and have a particular importance for migratory

birds. Some remarkable topographic features such as seamounts, banks and submarine canyons are to be found here. The coastline is also highly diversified with estuaries, rias and wetlands, which all support extremely productive ecosystems.

The wider Atlantic represents the deep waters of the North-East Atlantic. The North Atlantic is a pivotal region from which oceanic and climatic fluctuations are rapidly transferred to all other oceans. Movement in the upper layers of the water column is generally from west to east. Where the topography is rugged, crustal rocks may be exposed, especially along the Mid-Atlantic Ridge and in the Charlie Gibbs Fracture Zone where the seafloor was formed relatively recently. On the abyssal plains the seabed is generally covered with thick accumulations of sediment. Throughout much of the region the prevailing winds are south-westerly. The human population in the region is restricted to the Azores Archipelago.

Socio-economic characteristics and outlook

The Atlantic maritime area provides the basis for a wide range of goods and services. Marine-related industries and services contribute roughly 1.8% to the Gross Domestic Product and 2.1% to employment opportunities. More than a third of the value of the maritime sector in the North-East Atlantic is generated by coastal tourism and shipping, with tourism and the fishing industry being the largest employers. Fishing is highly significant in certain parts. Norway's offshore oil and gas industry ranks among the largest in the world. The maritime transport and seafood sectors are important for Ireland, and in France, Portugal and Spain coastal tourism is the largest employer of the maritime industries. Across the area new industries are developing, with marine renewable energy (wind, wave and tidal energy production) the fastest growing activity in coastal and offshore waters (OSPAR, 2010).

In the *Celtic Seas* region the human activities include: coastal tourism, fishing, aquaculture, sand and gravel extraction, oil and gas exploration and production, shipping, coastal industry, military activities and agriculture. Dredging and dumping, though not an economic activity in itself, are identified as important activities as well, In the *Bay of Biscay and the Iberian coast*; the main human activities include tourism, fishing and aquaculture, shipping, sand and gravel extraction, and new development of wave, tide and wind power generation. Main human activities in the *wider Atlantic* are fishing, maritime transport and tourism. The growth of the cruise industry has resulted in a considerable increase in the size of cruise ships crossing the region. Tourism is of considerable importance to the economy of the Azores. Other human activities include: sand and gravel extraction (only around the Azores), shipping, the laying of communication cables and military activities (OSPAR, 2010).

The Blue Growth project has identified the Atlantic as important for wave and tidal energy, Short-sea shipping, offshore wind energy, algae aquaculture, blue biotechnology, oil and gas, cruise tourism and coastal protection. This indicates the diversity of uses of the Atlantic.

Short-sea shipping

Based on the gross weight of goods transported, 14% of short-sea shipping occurred in the Atlantic (Eurostat, 2010).

Offshore wind

In the North-East Atlantic there are seven generating power wind farms; six of them are in UK with ca 700 MW total power and one in Ireland with 25.2 MW (http://www.4coffshore.com, accessed Feb 14 2012). A large number of wind farms are in early study or development stages in the UK, Ireland, France, Spain and Portugal.

Ocean renewable energy

This economic activity is small and though relative growth is high, in absolute terms this activity is expected to remain small for the coming decade. Most of the expected growth will be located in the Atlantic, where the most favourable conditions in Europe for wave and tidal energy are to be found along the coasts of the UK, Ireland, France, Spain and Portugal. Much research and development is taking place in test sites in these countries. For example: in 2012 the first of four OpenHydro turbines is scheduled to be installed in Brittany, France.

Cruise tourism

Regional data estimates that the Atlantic Ocean accounts for 13 % of cruise passengers (Policy Research Corporation, 2009). In 2010 two of the top-10 sea cruise ports (in terms of passengers embarking, disembarking or making a port call) were on the Atlantic (Southampton and Lisbon) (European Cruise Council, 2011).

Coastal protection

Expenditures on coastal protection in the Atlantic Ocean (1998-2015) amounted to 1.2 billion euro, placing the Atlantic third, behind the North Sea and the Mediterranean.

Strong growth is expected in offshore wind energy, wave/tidal energy and monitoring & surveillance activities. Moderate growth is expected in short-sea shipping, algae aquaculture, blue biotechnology and coastal tourism.

Fisheries and aquaculture

Most traditional fish stocks in the Atlantic are fully exploited, overexploited or depleted. Of the 600 global marine fish stocks monitored by the UN Food and Agriculture Organization (FAO), 3% are underexploited, 20% are moderately exploited, 52% are fully exploited, 17% are overexploited, 7% are depleted and 1% is recovering from depletion. North-East Atlantic fisheries peaked at 13 million tonnes in 1976 and have since fallen to around 10 million tonnes a year.

In 2006, almost 1.5 million tonnes of farmed fish and shellfish were produced in the Atlantic representing 4.2% of world mariculture production. Since 1998, production of finfish in the OSPAR area has increased by 57% mainly due to increased production in the Norwegian waters and the North Sea. Shellfish farming, which is most intensive to the south of the North Sea and in the Bay of Biscay and the Iberian coast, remained stable over the same period[93]

Environmental status

Successes

The Celtic Seas have benefited from a reduction in the discharge of radionuclide from the nuclear sector. This is the Region with the greatest proportion of monitored sites where the impacts of TBT are now at acceptable levels. Recent trends show an improvement in the structure of fish communities that live on or near the seabed, particularly in the north of the Region.

In ***the Bay of Biscay and the Iberian coasts***, a number of improvements in fishing practice have been implemented to help protect the marine environment. The establishment of the El Cachucho MPA in the Cantabrian Sea is a major achievement. This MPA protects the wildlife associated with a seamount and a system of channels and canyons, and has strong measures to manage fisheries.

[93] http://qsr2010.ospar.org/en/ch08_01_01.html

In ***the Wider Atlantic***, some deep sea habitats now have some protection and are closed to bottom fishing at the least on a temporary basis (OSPAR, 2010).

Ongoing concerns

Pressures on species and habitats of ***the Celtic Seas*** are expected to rise as coastal and offshore engineering activities increase. Many more offshore wind turbines are expected to be installed in the coming years and wave and tidal power generation developments may be introduced. Little is currently known about the long-term effects of these activities on ecosystems because there are so few and they are all relatively new. On beaches around the Irish Sea there are unacceptable quantities of litter.

In ***the Bay of Biscay and the Iberian coasts,*** there are eutrophication problems in small coastal bays and estuaries where waters are less active. Ship traffic has been increasing in this Region over the past 20 years. Vessels often hit rough seas as they enter the exposed waters of the Atlantic en route from the North Sea and Baltic regions, and older ships are particularly vulnerable to accidents that create spillage. The Prestige oil spill in 2002 killed thousands of seabirds Mercury remains a particular problem, with over 40% of sites having unacceptable levels in sediments, perhaps as a legacy of past mining activities.

In ***the Wider Atlantic,*** deep-water fishing is exerting pressure on the ecosystems. The potential for illegal, unregulated and unreported fishing is causing concern. Seabed mining could have significant impacts on the environment and marine life (OSPAR, 2010).

Governance and integrated policy responses

OSPAR is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Community, cooperate to protect the marine environment of the North-East Atlantic. It started in 1972 with the Oslo Convention against dumping. It was broadened to cover land-based sources and the offshore industry by the Paris Convention of 1974. These two conventions were unified, up-dated and extended by the 1992 OSPAR Convention. The new annex on biodiversity and ecosystems was adopted in 1998 to cover non-polluting human activities that can adversely affect the sea.

The fifteen Governments are Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom. Finland is not on the western coasts of Europe, but some of its rivers flow to the Barents Sea, and historically it was involved in the efforts to control the dumping of hazardous waste in the Atlantic and the North Sea. Luxembourg and Switzerland are Contracting Parties due to their location within the catchments of the River Rhine.

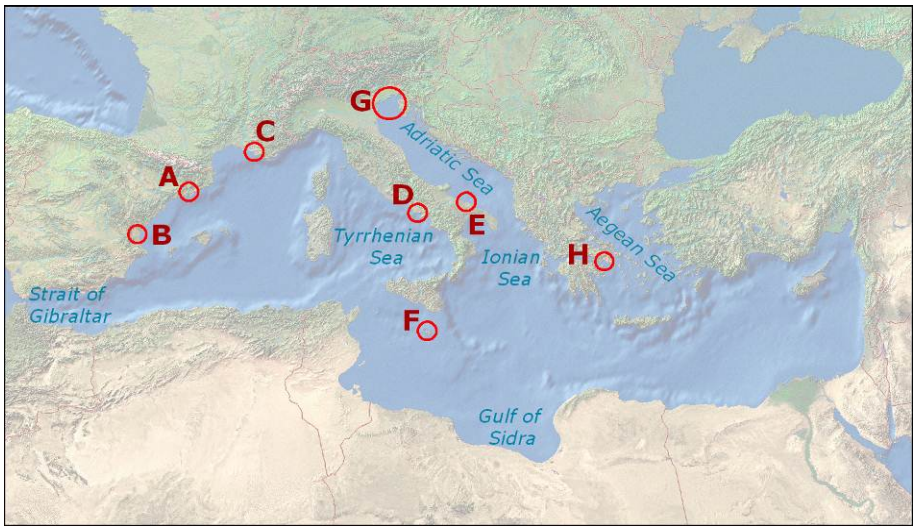
The EU Maritime Strategy for the Atlantic Area (EC, 2011) proposes a coherent and balanced approach that is consistent with the EU 2020 agenda and its flagship initiatives that promote territorial cohesion and that take into account the international dimension. It outlines the challenges: applying the ecosystem approach, reducing Europe's carbon footprint, sustainably exploiting seafloor resources, dealing with risks & emergencies and promoting socially inclusive growth. The focus in 2012 will be on the preparations for the Action Plan 2014-2020.

4.5 Mediterranean Sea

Physical characteristics

The Mediterranean is the largest (2,500,000 km^2) and deepest (average depth 1,460 m, deepest 5,267 m) enclosed sea on earth, connecting to the Atlantic Ocean through the Strait of Gibraltar and to the Sea of Marmara and the Black Sea through the Dardanelles. The Mediterranean Sea is characterized by a narrow shelf, a narrow littoral zone and a small drainage basin especially in the northern part. In the southeast, the man-made Suez Canal links the Mediterranean to the Red Sea and the Indian Ocean. A shallow ridge (at 400 m depth) in the Strait of Sicily divides the sea into its western and eastern sub-regions, which show marked differences following various gradients (Coll et al. 2010).

Figure 4.5 The Mediterranean Sea Region with its EU Member States' economic clusters: A=Barcelona; B=Valencia; C=Marseille; D=Napoli; E=Bari; F=Malta; G=Trieste/Venice; H=Athens.



High temperatures, high homothermy from 300–500 m to the bottom (12.8–15.5 ^{o}C), high salinity (37.5–39.5‰), a negative hydrological balance with evaporation exceeding precipitation and river runoff, a micro-tidal regime, high oxygen concentrations, oligotrophic conditions (increasing along both the west-east and north-south axes), and low nutrient availability especially for phosphorus (that may be buffered by inputs from highly populated coasts and riverine and atmospheric inputs) characterize the Mediterranean (EEA 2006, Coll et al. 2010).

Socio-economic characteristics and outlook

The following maritime economic activities are important in the Mediterranean: Short-sea shipping, Oil & gas, Coastal tourism & yachting, Cruise & port cities. Aquaculture and fisheries are other important economic activities (Knights et al., 2011). Security and surveillance is an important issue.

Short-sea shipping

Being at the very foundation of the development of commerce and trade, transport associated activities are still buoyant in Mediterranean countries, contributing to their growth and regional and global integration.

According to Eurostat, ca. 30% of all European short-sea shipping takes place in the Mediterranean Sea, resulting in a total volume of 500 million tons. This includes short-sea and RoRo connections to non-EU countries neighbouring the Mediterranean.

Studies undertaken within the EuroMed Transport Project have indicated that, excluding oil, freight flows will on average double over the coming 20 years, though containerized goods are expected to increase by up to eight-fold in the same period.

Offshore oil and gas

The main activities can be found in the Adriatic Sea. These fields are mature, with declining production and rising costs. Recent gas findings near Cyprus and most notably off the Israeli and Lebanon coasts (where the world's biggest gas discoveries of 2009 and 2010 were made) seem to offer high potential (http://www.rense.com/general95/newmedol.html).

Coastal tourism and yachting

Tourism is a vital economic activity for all Mediterranean riparian countries. Excellent conditions (in particular for beach tourism) can be found around the Mediterranean Sea. Drawing upon their geographical location at the crossroads of three continents, these countries attract 30% of global international tourism arrivals. In 2007, they received around 275 million international tourists. Being a job-creating and foreign currency generating sector, international tourism contributes to the countries' economic development. However, the development sustainability of this sector implies an equitable redistribution of the wealth it generates, as well as a minimisation of its environmental impacts (UNEP/MAP, 2009).

The Mediterranean is experiencing increased competition from other European coasts as Mediterranean destinations are often perceived as overcrowded. Additionally, tourists are now spending shorter periods of time in the Mediterranean but on more occasions throughout the year in order to experience different activities. The region has therefore begun to focus on new forms of tourism such as nautical tourism, wine-tasting, gastronomy, health and wellbeing and green tourism (EP, 2008). The western and more recently the middle Mediterranean seas have witnessed jellyfish blooms since the end of the nineties. Costs to mitigate and medically treat this impact represent tens to hundred of millions loss in tourist revenue per year (GFCM 2010).

Cruise tourism

The Mediterranean is the largest area for cruise tourism in Europe. Regional data estimates that the Mediterranean accounts for 71 % of cruise passengers (Policy Research Corporation, 2009). In 2010, the top-5 European sea cruise ports (in terms of passengers embarking, disembarking or making a port call) were all on the Mediterranean (European Cruise Council, 2011).

Fisheries and Aquaculture

In the Mediterranean, fishing activities are highly diversified and based on historic traditions, with non-industrial fishing featuring strongly and essentially carried out from small boats (<15m long). Mediterranean fish catches represent a small part of total catches worldwide (a bit more than 1% of total catches).This volume is significant given that the Mediterranean sea represents less than 0,8% of global oceans. Production currently ranges between 1,500,000 t to 1,700,000 t per year, 85% are attributable to six countries (Italy, Turkey, Greece, Spain, Tunisia and Algeria). Mediterranean fishing no longer satisfies demand in the riparian states (only covering 1/3 of their demand); the Mediterranean region is becoming increasingly dependent on imported fish-based products (processed fish, and especially ready-made fish dishes, etc.), which now account for over 50% of total fish consumption in some European countries (EC ENPI 2008).

Recent changes and economic pressures are creating a new situation for fishing communities in the Mediterranean. There has been a rapid rise in intensive fish farming and in fishing activity. Indeed, the trend towards modernization with its increase in boat size and effectiveness is resulting in ever more acute fishing pressure. Fish stocks are limited since they cannot be stretched by

increasing inputs as in many other fields of economic activity. This means that some major species such as red tuna are now endangered, especially due to the great demand for them from Asian markets. The risk of extinction of some major species represents a common challenge for the Basin (EC ENPI 2008). According to the General Fisheries Commission for the Mediterranean, certain species of economic and commercial importance are in an alarming state as a result of over-fishing (UNEP/MAP, 2009).

Environmental status

The major pressures on the Mediterranean marine and coastal environment have been identified as: pollution related to urbanisation and industrial activities; overexploitation of fisheries resources; and invasion of exotic species (EEA, 2005; UNEP/MAP, 2009). Also, modification and destruction of marine and coastal habitats is a major pressure.

The Plan Bleu Regional Activity Centre has published a study on the ecosystem services rendered by the Mediterranean marine ecosystems (UNEP/MAP 2010). The results illustrate the economic potential of marine ecosystems as regards the sustainable development of the riparian states. The assessment looks at the value of the flows produced by the environmental assets constituting marine natural capital.

Governance and examples of integrated policy responses

- Barcelona Convention: Pollution has increased dramatically in recent decades, and the responses to it are still insufficient despite national efforts, the Barcelona Convention for the protection of the Marine Environment and the Coastal region of the Mediterranean of 1976 and the Mediterranean Action Plan launched in 1975. The Plan's implementation is hindered by difficulties in adequately mobilising the various players and the necessary financial resources. Some 60% of urban wastewater still flows untreated into the Mediterranean; 48% of major coastal cities (over 100,000 inhabitants) have no sewage works, and less than half of liquid industrial waste is purified (EC ENPI 2008).
- Plan Bleu is one of the 6 MAP Regional Activity centres (RACs) for the regional implementation of MAP activities. Plan Bleu in France adopts a systemic and prospective approach to Mediterranean environment and development issues using observation and evaluation tools and generating indicators, incl. scenarios for reconciling the environment and the realities of socio-economic development in a drive to help Mediterranean countries make decisions with the future in mind. Other RACs are based in Italy, Tunisia, Croatia, Spain and Malta, each focusing on different aspects of MAP.
- MED POL: In 2003, MED POL launched, in the framework of the implementation of Strategic Action Programme on land-based sources of pollution in the Mediterranean, a region-wide effort to inventory industrial point-sources of pollution potentially affecting, directly or indirectly, marine ecosystems in the Mediterranean Sea. The objective is to gather national and regional baseline data of the releases in order to track eventual trends in relation to the implementation of pollution reduction policies, strategies and initiatives as prescribed in key texts and programmes, notably: the Barcelona Convention's Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities1 (LBS Protocol); the Strategic Action Programme2 (SAP-MED); the EU Horizon 2020 initiative (box 2); the GEF-MA-World Bank Strategic Partnership for the conservation of Large Marine Ecosystem of the Mediterranean (UNEP SoE 2009).
- Horizon 2020: Following the Euro-Mediterranean Ministerial Conferences on the Environment held in Helsinki (1997) and Athens (2002), the 10th anniversary Euro-Med Partnership Summit (Barcelona, 2005) launched the "Horizon 2020" initiative devised to tackle the main sources of Mediterranean pollution by the year 2020, defining the priority sectors: municipal waste, urban waste water, and industrial emission. Horizon 2020 implementation has started in 2007 with

the identification of priority projects for pollution reduction, and a start on the priority capacity building measures in partner countries (EC ENPI 2008).

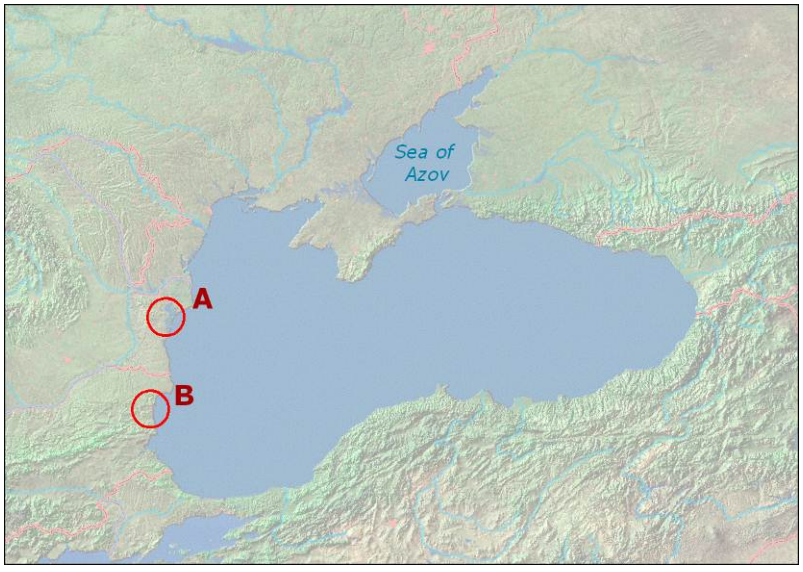
- EC COM (2009) 466 final 'Towards an Integrated Maritime Policy for better governance in the Mediterranean'. This Communication highlights the mechanisms and tools that should be mobilised to achieve an integrated approach to governing maritime activities in the Mediterranean sea-basin. It is meant to complement the various sectoral actions that the EU promotes in the Mediterranean area. While the Integrated Maritime Policy is primarily addressed to Member States, this Communication calls for an overall stronger co-operation with non-EU Mediterranean partners at the appropriate levels.
- Mediterranean Strategy for Sustainable Development (UNEP): The Mediterranean Strategy is a framework strategy. Its purpose is to adapt international commitments to regional conditions, security, to guide national sustainable development strategies and to initiate a dynamic partnership between countries at different levels of development (UNEP 2011).
- European Neighbourhood Policy Mediterranean Programme (ENPI CBCMED): The multilateral cross-border cooperation "Mediterranean Sea Basin Programme" is part of the new European Neighbourhood Policy (ENP) and of its financing instrument (European Neighbourhood and Partnership Instrument - ENPI) for the 2007-2013 period: it aims at reinforcing cooperation between the European Union (EU) and partner countries regions placed along the shores of the Mediterranean Sea (EC ENPI 2008).

4.6 Black Sea

Physical characteristics

With an area of about 420 000 km^2, the Black Sea is one of the largest inland seas in the world. It is surrounded by six countries; two countries, Bulgaria and Romania, are members of the European Union since 2007. The remaining four non-EU countries are Georgia, the Russian Federation, Turkey and Ukraine. The Black Sea is connected to the Mediterranean Sea to the west through the Bosporus Strait. The maximum extent of the sea in the east-west direction is about 1175 km, while the shortest distance from north to south is some 260 km. The average depth is 1,300 m, the maximum depth 2,245m.

Figure 4.6 The Black Sea Region with its EU Member States' economic clusters: A=Constanta; B=Varna.



The Black Sea has an extremely large drainage basin of more than 2 million km^2, collecting water from almost all European countries, except the westernmost ones. The north-western Black Sea receives the discharge of the Danube River with a mean water discharge of about 200 km^3/year and the Ukrainian rivers Dnepr, Southern Bug and Dniestr contributing with about 65 km^3/year.

The tidal range is very small, because water exchange with the Mediterranean Sea through the strait of Bosporus is very limited. The input of fresh water from rivers into the sea is higher than the evaporation. The surplus is going out to the Mediterranean Sea. Due to past geological events and the special physical conditions (deep dilution basin, high degree of isolation from the world ocean), 90% of the water volume is anoxic. Marine life is absent at depths beyond 150–200m, with the exception of a few anaerobic bacteria. Hydrogen sulphide is present in the entire lower layer of the Black Sea, which makes it the largest anoxic water basin in the world.

The structure of marine ecosystems differs from that of the neighbouring Mediterranean Sea because species variety is lower and the dominant groups are different. Living organisms are mainly concentrated in the shallow waters of the continental shelf (about 25% of the sea surface) and in river mouths along the north-western coast. The surface waters to a depth of 50 meters are fed by rivers that are naturally rich in nutrients, producing a low salinity environment that has been traditionally rich in fish and other species. Fish is an important biological resource of the Black Sea which is known, for its anchovies and its sturgeon, for instance. The marine mammals in the Black Sea are represented by dolphins. There are many important bird areas all along the Black Sea coast, with many breeding and wintering sites for waterfowl and raptors.

Socio-economic characteristics and outlook

The Black Sea Region has undergone major socio-economic changes over the past 20 years. After the regional economic collapse at the end of the 1980s and the resultant break-up of the Soviet Union, the influential economic slow-down in 1997-98 has had major social and environmental implications. Since 2000, personal wealth has increased, but not at the same rate as inflation. Furthermore, this increase in wealth has been concentrated in the hands of a small number of very rich individuals whereas the size of the middle class remains small (BSC, 2007)).

Based on the findings in annex 4, important economic activities in the Black Sea are Short-sea shipping, offshore oil and gas exploration and coastal tourism. Knights et al. (2011) identify as additional sectors: fishing, land based industry, military uses and infrastructure. Aquaculture is developing in all Black Sea countries, but it has grown rapidly into an important activity in Turkey and Bulgaria (BSC, 2007, Deniz, 2001).

Short-sea shipping

Based on the gross weight of goods transported, 6.4% of Short-sea shipping occurred in the Black Sea (Eurostat, 2010). The Black Sea's trade, oil and gas transport routes between the hydrocarbon reserves of the Caspian basin and energy-demanding Europe are all important reasons for its increasing relevance and for regional economic developments (2020 vision). Oil and natural gas still supply the main part of countries energy needs. The significant increase in upstream oil production created a midstream challenge of providing proper transportation of oil from the Caspian region to western markets. This required construction of new oil pipelines as well as expanding existing ones (Oral, 2006) pipeline construction.

Offshore oil and gas

Offshore oil and (mainly) gas production in the Black Sea is located in production fields such as Ayazli off the Turkish coast, Galata near the Bulgarian coast, and the Ana and Doina fields off Romania. The future scenarios indicate that the economic activity oil & gas is expected to become

less important. This is still uncertain, however, as Turkey is starting oil prospecting recently. In early 2010 a drilling platform made its way to the Black Sea to seek out oil and natural gas. Even more recently another drilling ship headed out from Istanbul into the Black Sea with the same hopes, as the result of a deal between the Turkish Petroleum Corporation (TPAO) and ExxonMobil to explore oil opportunities off the coasts of the Black Sea. A recent gas finding at 170 km off the Romanian coast, in waters 930 m deep, stimulates these developments.[94]

Coastal tourism and yachting

Tourism on the Black Sea is increasing (European Parliament, 2008). International tourism makes up only a small percentage of total tourism on the Black Sea (about 14 % in 2006 for Bulgaria, Russia, Turkey and the Ukraine combined); most tourists come from within the region. It is estimated that about 4 million visitors come to the Black Sea coastline each summer (BSC, 2008). The Black Sea region tries to copy the approach of the Mediterranean region, hoping to attract international tourists. It focuses on the natural and cultural heritage of the regions, offering sandy beaches, ancient monuments and modern resorts. In Bulgaria, the number of tourism establishments increased by 14 % on average per year between 2000 and 2005. Bulgaria offers seaside resorts, large hotels, motels and other tourist properties focused in the cities of Varna and Bourgas. Romania, with 14 hours of sunshine per day in the summer and warm water and air temperatures, is also experiencing growth in the tourism sector. It offers modern facilities, historical sites and monuments, spas, traditional villages, and vineyards (European Parliament, 2008).

Environmental status

Owing to natural factors, the diversity of species of Black Sea fauna is approximately three times lower than that of the Mediterranean Sea. This makes the Black Sea highly vulnerable to pressures from land-based human activities and its health is equally dependent on the coastal and non-coastal states of its basin.

The sectors exerting widespread pressures to the marine ecological characteristics of the Black Sea are agriculture, coastal infrastructure, fishing, shipping, tourism and recreation and waste water treatment.

Since the 1960s, the Black Sea ecosystem has deteriorated from a higher biodiversity ecosystem with rich biological resources to a low biodiversity ecosystem dominated by a dead-end gelatinous food chain. Fishery overexploitation coupled with adverse environmental conditions, such as manipulation of hydrological regimes of outflowing rivers for example, effectively restructured the food web and affected the fish stocks of the Black Sea. A well-known example is the collapse of the anchovy stocks, one of the most important commercial species in the whole Black Sea as well as other valuable fish commodities. Environmental degradation in the Black Sea Region has had social and economic costs in a number of sectors, one of the hardest hit being the fisheries sector where catches of the most lucrative fish species fell dramatically in the 1980s and 1990s.

Governance and integrated policy responses

In 1992, the six neighbouring countries ratified the Convention on the Protection of the Black Sea Against Pollution (BSC) with the aims to support the Black sea littoral state to restore and/or maintain healthy status of the sea, to fully operationalize and make sustainable the Black Sea regional environment governance framework. The Strategic Action Plan adopted in 1996 was replaced by the new Strategic Action Plan for the Environmental Protection and Rehabilitation of the Black Sea in 2009. Whilst acknowledging the MSFD, the BSC recognizes the need for

[94] See e.g. http://www.reuters.com/article/2012/02/22/omv-results-idUSL5E8DM0D320120222.

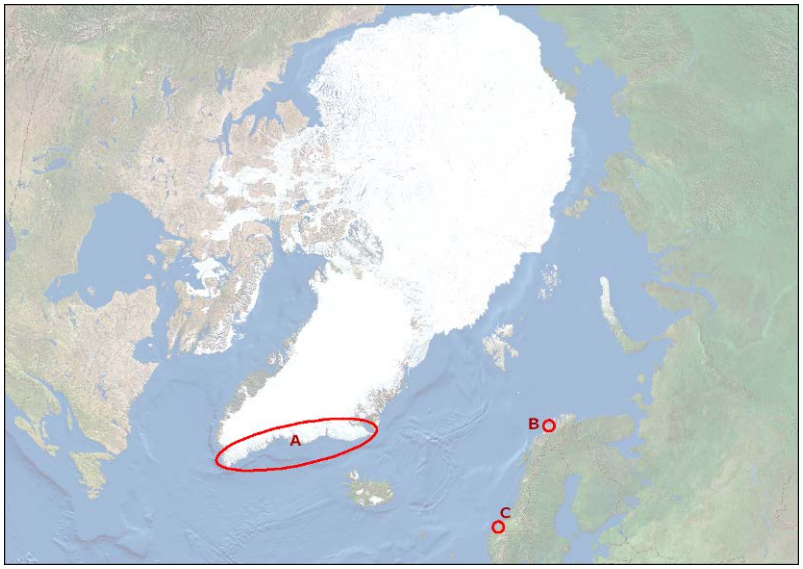
harmonization of environmental management and policies between EU members and non-member states of the Black Sea. The national and international efforts of the Black Sea coastal states are directed towards the preventing increased pressures from human activities due to the development and recovery of transitional economies of the Black Sea coastal states and restoring the environmental conditions in the Black Sea similar to those observed in 1960s. Recent evidence from the late 1990s revealed recovery signal at different levels of the Black Sea ecosystem.

4.7 Arctic

Physical characteristics

The Arctic is characterized by great expanses of sea subject to harsh climate, extreme variation in light and temperature, short summers, and extensive, but increasingly seasonally extreme snow and ice cover. Arctic plants and animals have adapted to these conditions, however this has rendered them in some cases more sensitive to increased human activities.

Figure 4.7 The Arctic Ocean Region with its economic clusters: A=Greenland coast; B=Hammerfest; C=Alesund.



Socio-economic characteristics and outlook

Historically, the harsh environment, difficult access to resources, and scattered human populations has restricted rapid development and communication in the Arctic. While increased accessibility and marine transportation will require greater support and pose increased environmental risks, there will also be opportunities for social and economic development through increased investment and infrastructure, and improved access to goods, services and supplies. Several economic sectors, including mineral resource development, oil and gas development, tourism, and commercial fishing will also be advanced and made more competitive with improved access.

The projected climatic changes in the Arctic, particularly the projected decrease in sea-ice extent and thickness, will result in increased accessibility to the open ocean and surrounding coastal areas. This is very likely to make it easier to exploit marine and coastal species, over a larger area and for a greater proportion of the year.

Arctic shipping

Shipping in the Arctic today for a large part is still destinational, conducted for re-supply of Arctic communities, marine tourism and moving natural resources like petroleum products and various types of ore out of the Arctic. It has the potential of becoming intercontinental within the next

decades, once the arctic routes will become commercially viable. Nearly all Arctic shipping voyages today take place in the periphery of the Arctic Ocean. In the central Arctic Ocean, shipping activity is low (Arctic Council, 2009). Maritime shipping in the Arctic is expected to increase with global warming and less sea ice. For the near future up to at least 2020, the dominant pattern of traffic is expected to be destinational, with marine shipping going to and from Arctic harbours. The major drivers for this will be Arctic natural resource development (fish, hydrocarbons, minerals, timber etc), regional trade and tourism (Arctic Council, 2009). In the longer term Arctic shipping is expected to become increasingly intercontinental. It will take time for trans-Arctic shipping between the continents to eventually develop into considerable volumes on regular commercial scales. Such a relocation of international shipping routes will be inhibited by several factors like a lack of major ports and critical infrastructures along the Arctic sea routes, inadequate search and rescue capabilities and problems keeping fixed timetables necessary for the “just-in-time” delivery dominating container transport. In the mean-time, traffic to and from Arctic destinations may increase to considerable volumes on some routes, e.g. in relation to the shipment of oil.

Offshore oil & gas

Extensive oil and gas activity has occurred in the Arctic, mainly on land and mostly in Russia, which has produced about 80% of the oil and 99% of the gas extracted in the Arctic so far. The Arctic is known to contain large petroleum hydrocarbon reserves, much of which (75% of known Arctic oil and 90% of known gas) are in Russia, which is expected to continue to be the dominant Arctic petroleum producer (AMAP 2008). Oil and gas activities in the marine sectors of the Arctic have been more restricted compared to activities on land (AMAP 2008). In Alaska, exploration extended offshore resulting in production from some near shore fields starting in 2001. Norway started exploration activities in the Norwegian and Barents seas in the 1980s, with production of oil and gas starting in the 1990s from fields in the Norwegian Sea and in 2007 from the ‘Snøhvit’ gas field in the Barents Sea. Production on land in western Siberia started in the 1970s, with tanker transport from northern Russia to Europe beginning in 2002. Exploration activities in the Russian offshore have identified large potential resources that so far have not been developed. Petroleum exploration has been carried out offshore in West Greenland in recent years with prospects of finding reserves that can be developed.

Cruise tourism

Arctic tourism is now a mature industry offering very different products for different client groups. Ship-based tourism with cruise activities takes place in the areas around Greenland, Iceland, Norway including Svalbard, and Alaska. The number of passengers probably doubled from 2004 to 2007 and is expected to continue to grow (UNEP 2007).

Fisheries and Aquaculture

Arctic and subarctic oceans are among the most productive in the world, and have been, and are being, heavily exploited. For example, commercial fish landings in Canada decreased from 1.61 million tonnes in 1989 to 1.00 million tonnes in 1998 (Usher et al. 2010); the five-fold decline in the cod stock in the Arctic Ocean between about 1945 and the early 1990s; and the huge decline (more than 20-fold) in the herring stock in the Norwegian Sea (Usher et al. 2010). Considerable natural annual variability in productivity, mainly due to variations in the influx of cold and warm waters to the Arctic, is a considerable challenge for fisheries management in the Arctic.

Environmental status

From a global perspective, the Arctic marine environment is generally clean, with low levels of pollution. The environmental, economic and socio-cultural changes occurring in the Arctic today are primarily driven by two key factors: Climate change and increasing economic activity. Scientific findings (e.g., IPCC) have estimated that warming of the Arctic with longer ice-free seasons will

lengthen the navigation season and opening of the fabled northern passage linking the North Atlantic and Pacific. These changes are resulting in greater access, use, and threats to the Arctic marine and coastal environments and resources. Activities such as development of hydrocarbon and mineral resources, cruise ship tourism and commercial fishing are expected to expand at an increasing rate.

The pressures that have the strongest impacts on habitat conservation and biodiversity are considered to be:

- issues relating to the exploitation of stocks of fish, birds, and mammals, and forests;
- the means by which land and water are managed, including the use of terrestrial ecosystems for grazing domesticated stock and aquatic ecosystems for aquaculture;
- issues relating to pollutants and their long-range transport to and fate in the Arctic;
- issues relating to industrial development and to the opening up of the Arctic for recreational purposes.

Governance and integrated policy responses

The Arctic Council, established in 1996, is a distinctive regional form of co-operation between governments and indigenous peoples in the region addressing all three of the main pillars of sustainable development: environmental, social and economic. Scientific and policy efforts focus on monitoring, assessing and preventing pollution in the Arctic, climate change, biodiversity conservation and sustainable use, in addition to emergency preparedness and prevention. Among these programmes is the Protection of the Arctic Marine Environment (PAME).

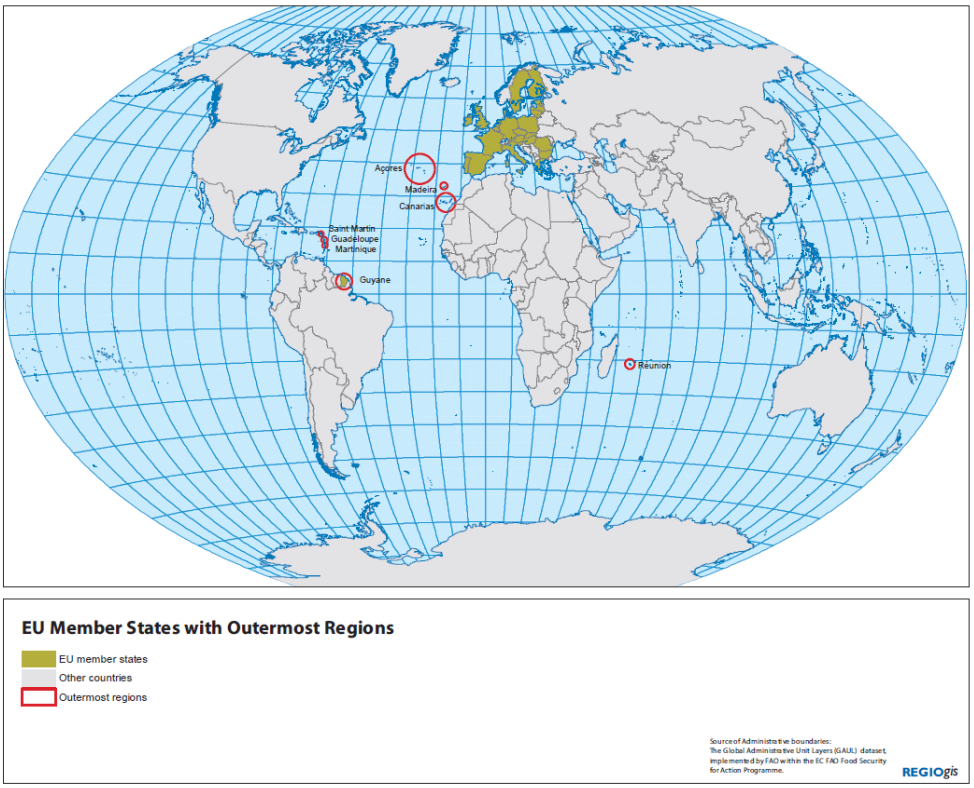
4.8 Outermost regions

Physical characteristics

The Outermost Regions each have their unique characteristics. Any analysis of status and potentials must take these into account. As many of the Outermost Regions are islands, and some of them are located at a long distance from the nearest continent, the surrounding seas are in many cases very deep. Generally speaking, the Outermost Regions constitute an exceptional geological laboratory. Strong points include the high biodiversity and richness of their marine ecosystems, in some cases unique in the EU.

Many of the Outermost Regions are vulnerable to natural and man-induced disasters. Climate change and sea level rise may affect them all. The Azores are located near the Atlantic ridge, making earthquakes a very common phenomenon (almost daily, mostly minor ones, major ones every 10 to 20 years) and volcanism a somewhat rarer event (major eruption once in 50 years).

Figure 4.8. Outermost Regions: Azores, Madeira, Canary Islands, French Guyana, Saint Martin, Guadeloupe, Martinique, Réunion. Mayotte (part of the Comores, between Madagascar and the African coast) is scheduled to join per 01/01/2014



Socio-economic characteristics and outlook

The Outermost Regions add an area of exclusive economic zones which is about equal to the combined area of the Mediterranean and Baltic seas (table 4.1). This is important for Europe from a geostrategic viewpoint and adds potential to the European Blue Growth perspectives. According to (RUP, 2010)[95] strategic sectors for the Outermost Regions could be research facilities (on geology, oceanography, biodiversity, blue biotechnology, ocean renewable energy), monitoring and surveillance (traffic, pollution control, fisheries control and illegal immigration (specifically at the Canary Islands)), improvement of accessibility of these regions, and valorisation of coastal tourism, fisheries and aquaculture.

Table 4.1 Area and number of inhabitants of the Outermost Regions

	land area (km^2)*	Inhabitants (*1000) *	area of exclusive economic zone (1000 km^2)*
Azores	2,333	242	958
Madeira	795	245	850
Canary Islands	7,447	1,976	650
French Guyana	84,000	180	130
Saint Martin	n/d	n/d	n/d
Guadeloupe	1,710	423	86
Martinique	1,080	382	47
Réunion	2,510	775	312

[95] Regions Ultrapériphériques (RUP) is the French term for Outermost Regions. Publication: RUP, 2010: contribution de la Conference des Regions Ultraperipheriques a la Consultation Publique de la CE, 05/10/2010.

	land area (km^2)*	Inhabitants (*1000) *	area of exclusive economic zone (1000 km^2)*
Mayotte	374	194	n/d

** Source: Proyecto Rupmer, 2007*

The Outermost Regions constitute an excellent area for oceanographic studies. This could turn the Outermost Regions into a natural laboratory for studies that are highly relevant to maritime sciences and to the study of marine resources (RUP, 2009).[96]

Fisheries and marine aquaculture resources

Fisheries generate some 10,500 jobs in the Outermost Regions, and constitute between 15 and 40% of the export value of the various regions. There is however a paradox between the efforts of the Outermost Regions to develop sustainable fisheries and the impacts of foreign, sometimes illegal and grand-scale fishing vessels. This holds especially for the Azores (Rupmer, 2007).

Coastal tourism and yachting

Tourism has, in principle, a high potential in the Outermost Regions, although in some cases the connections are problematic. Some areas already have a tradition in coastal tourism (Madeira, Canaries, Caribbean), and in some cases have even developed mass tourism. Operating in a highly competitive worldwide market, other areas have focused on the development of sustainable tourism. In the Azores a Marine Park has been created, at the same time developing recreational fishing, diving, whale watching, in a sustainable manner (Rupmer, 2007; Cardigos). Yachting harbours are developing in among others the Azores (Cardigos).

Ocean renewable energy

The Outermost Regions, being remote and not or poorly connected to grids from the continent, rely heavily on imports of fossil fuels. This makes them vulnerable, and has evoked a strong interest in ocean renewable energy. The RUPPlus project (2007) has assessed the potential of the Outermost Regions for various forms of ocean renewable energy. The findings can be summarised thus:

- Martinique and Guadeloupe have high potential for OTEC, average potential for wave and offshore wind energy;
- Guyana has average potential for OTEC and some potential for wave energy;
- Reunion has strong potential for wave energy, average potential for OTEC and offshore wind;
- the Canaries have average to strong potential for wave and offshore wind energy;
- Madeira has very strong potential for wave energy and strong potential for offshore wind, although the latter is questioned due to near absence of shallow waters (J. Jesus, personal comment);
- the Azores have strong to very strong potential for wave and offshore wind energy;
- none of the Outermost Regions have potential for tidal current energy (RUPPlus, 2007, p.49 summarised).

Marine minerals mining

The Atlantic seafloor near the Azores and Madeira contains various types of deposits (ferro-manganese, nickel, cobalt, copper, zinc). Economic mining of these deposits is still a major technical challenge, as described in chapter 3; this may or may not change in the future.

[96] RUP, 2009: Memorandum conjoint des régions ultrapériphériques – les RUP a l'horizon 2020. Las Palmas de Gran Canaria, 14/10/2009.

Blue biotechnology

The Outermost Regions offer opportunities by their nearby, pristine and often unique ecosystems. In Madeira, maritime resources in the pharmaceutical industry and of cosmetics are investigated, promoting the activities of the University of Madeira and the Laboratory of Maritime Biology with potential impact in the export of resources of low weight and high economic value. In the Azores biotechnology is now at a stage of economic return. Some companies that use the biotechnological resources of the islands have been established.

Environmental status

Many of the Outermost Regions still enjoy a relatively pristine environmental status. Exactly this condition makes up the attractiveness of these regions for research and for sustainable forms of tourism. In some cases however, these values are threatened; the most imminent risk being put by (sometimes illegal) fishing activities. Problems caused by invasive species have been reported from the Azores (Cardigos).

Governance and integrated policy responses

All the Outermost Regions are part of an obvious international context. The uniqueness of each of the Outermost Regions, the vastness of the Atlantic and Indian oceans, the remoteness of the Outermost Regions, and in some cases their proximity to other continents than the European, pose major challenges to governance issues. The Outermost Regions emphasise the importance of flexibility in these matters (RUP, 2010). Special attention requires the delineation used in specific arrangements, such as OSPAR or the common fisheries policy, which may be very different. OSPAR covers the Azores, but not Madeira and the Canaries.

The EU Maritime Strategy for the Atlantic Area (EC, 2011) proposes a coherent and balanced approach that is consistent with the EU 2020 agenda and its flagship initiatives that promote territorial cohesion and that take into account the international dimension.

4.9 Conclusions

The preceding descriptions have made clear that all European sea basins have their unique characteristics, which set out their ecological values and economic potentials against the other sea basins. At the same time, these very characteristics define the vulnerabilities of the related ecosystems for external disruptions.

The Baltic, Mediterranean and Black Seas are relatively isolated seas, with limited exchange of water with the ocean and with low tidal range. While their water balances dictate relatively low salinity in the Baltic and Black Sea, the opposite is the case in the Mediterranean. The Baltic and North Sea are relatively shallow seas. The Atlantic Ocean is, more than the others, exposed to strong winds and tidal currents.

All seas are used, although with varying intensity, for fishing, shipping and tourism. All of the sea basins are, for better or for worse, in many ways connected to their catchment areas. In all of the seas, the pressures caused by human activities have had negative consequences for the ecological status. Two pressures stand out as being both urgent and widespread (i.e. present in all sea basins): fisheries and land-based eutrophication. Although these issues are somewhat outside the scope of this study, they are relevant in that they co-define the limits of sustainable exploitation of the maritime economic activities.

Some of the pressures identified have basin-wide impacts, e.g. discharges of nutrients and hazardous substances. Other pressures, such as the effects of coastal structures or wind farms, are locally relevant, or have their impacts in certain zones, such as shipping. Still others have temporary impacts, e.g. during construction. These are particularities that must be taken into account when developing policy responses.

5 Synergies and tensions

5.1 Introduction

Blue growth expresses the clear ambition to develop Europe's potential of its coast, seas and oceans. Growth is not always obvious especially for economic activities in their infant stages which are faced with different constraints, which can range from spatial, financial or spatial aspects. Creating synergies between economic activities and addressing tensions clearly helps in realising the Blue Growth potential.

The future Blue Growth potential can be reinforced once synergies between them are likely to emerge. However, with a wide range of activities being developed, there are likely to emerge a range of tensions, which will be mostly of a spatial nature – and specific to sea-basins. From an economic perspective, reaping synergies and addressing tensions can be seen as a means to tap into externalities. The market failure resides in the fact that these externalities are not fully exploited without policy intervention.

Synergy is a much-used term. Here we refer to synergy in situations where several maritime economic activities combined are likely to produce more growth and jobs than the sum of their parts. It implies a form of orchestrated or spontaneous behaviour between key actors rather than fragmented behaviour. Synergies are expected to benefit maritime economic activities, especially those in the (pre-) development stage and in case of a lack of critical mass. These benefits can occur in the form of additional income sources, sharing of costs, sharing of services and infrastructure, etcetera.

5.2 Synergies

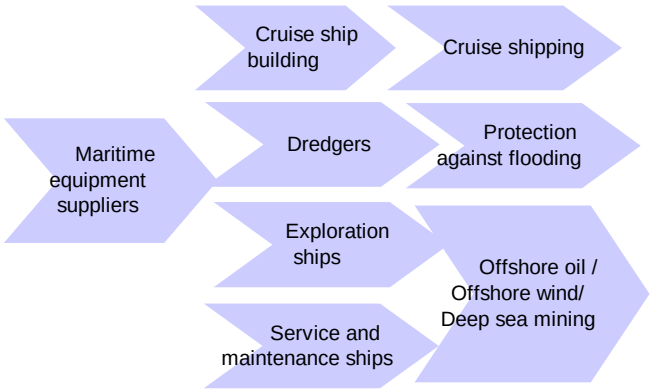
5.2.1 Type of synergies

Synergies can be triggered through various mechanisms. In the following, different types of synergies are introduced.

Type 1: Shared suppliers

Synergies of this type link to the notion that economic activities can use similar inputs. Hence this may trigger agglomeration or clustering effects in a specific region. This builds on the concept of value chains. As already stated, value chains include both forward and backward relations necessary for producing the products or services, as well as the final and intermediate customers. Linked value chains in different maritime economic activities enhance the network character of economic activities. At the same time value chains indicate that downward multiplier effects differ linked to the extent that activities are located in a single geographical are. Increasingly value chains are globalized. By the same token, Europe may indirectly still benefit from maritime growth that takes place in other parts of the world, depending on the competitiveness of supply.

Example 1: Shared inputs and upstream suppliers - shipbuilding



Type 2: Enabling activities

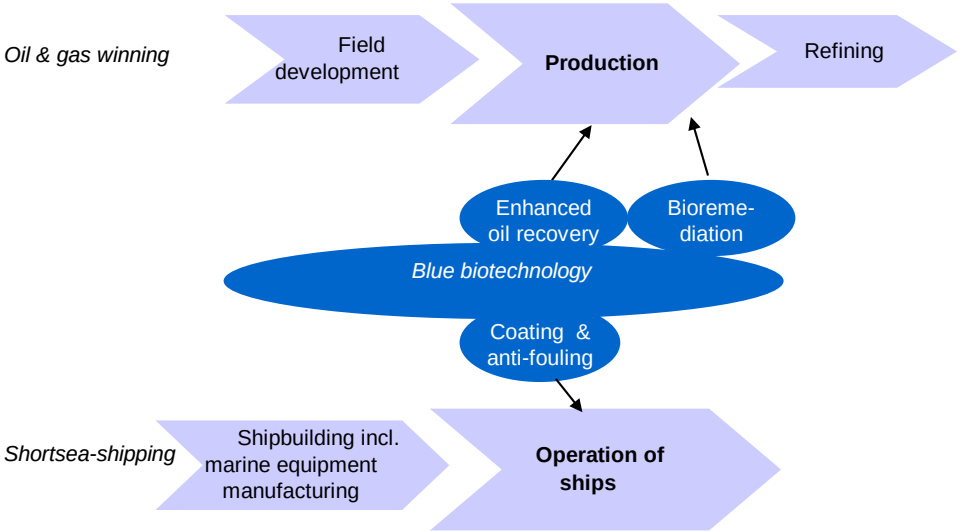
Another type of synergy is the enabling character of an economic activity which provides conditions for the development of other economic activities. For example, blue biotechnology provides a range of synergies with and spill-over to other maritime activities.

Biofouling is a well-known phenomenon, which implies that the fouling of the ships hulls reduces hydrodynamic performance of the ship, reduced economic performance and increased fuel consumption. Blue biotechnology offers biological and non-toxic anti-fouling and coating solutions that prevent or address this phenomenon. But biofouling is also a problem in oil pipelines, and this is only one of the many examples that biotechnology can offer in the oil and gas industry.

But also other enabling aspects of bio-tech in oil and gas are relevant. Currently, a series of experiments are being conducted to test the potential of various biotechnologies in this sector, and this potential is considered huge. For instance enhanced oil recovery allows micro-organisms to potentially be used for enhancing and improving oil recovery from (depleted) formations. Another example is bioremediation in case of oil spills.

A conclusion from this example is that the maritime sector as a whole has strong interest in promoting new (bio-) technologies, cross-cutting services and suppliers that can benefit more than one sector – and bring about advantages that cannot always be foreseen.

Example 2: Blue biotechnology as an enabler for other maritime activities



Type 3: Shared (multipurpose) activities

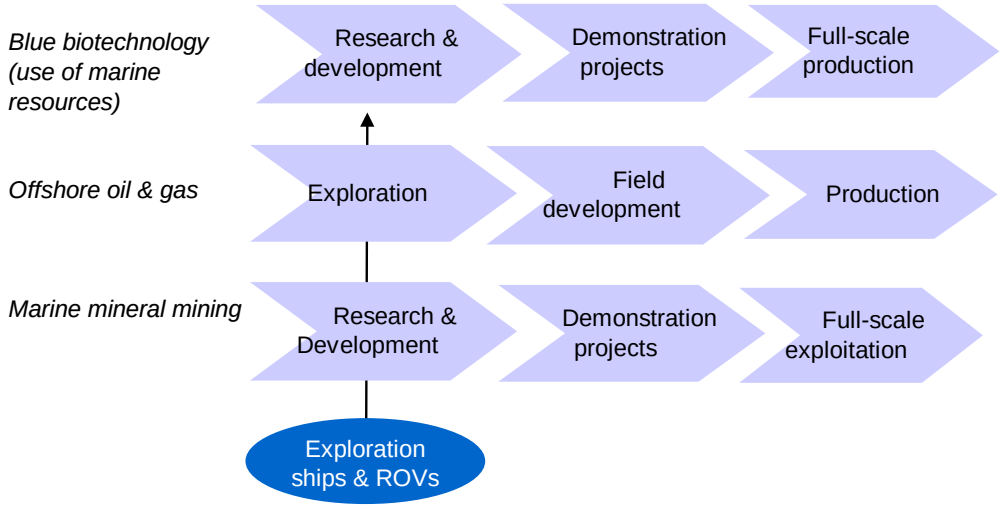
Yet another example is the existence of multi-purpose shared activities. This can be illustrated by the following example of ocean exploration.

Vast portions of the ocean remain unexplored today and only a fraction of marine organisms are known today. New technology such as nuclear magnetic resonance can be used to identify and analyse unknown molecules[97]. Although ocean exploration is a respected stand-alone research activity funded by oceanographic institutes around the world, there is increasing commercial interest from a range of maritime economic activities. Indeed, private organisations have contributed strongly to recent advances in our ability to explore the deep sea. However the costs of ocean exploration are high. An earlier attempt to undertake a truly large-scale ocean exploration programme that would incorporate a dedicated flagship and a modest fleet of underwater vehicles pointed to a requested funding of $ 270 million in the first year and $ 110 million in subsequent years. [98] Our own research pointed to the fact that the cost of a dedicated ship for marine mineral mining, currently being built in Germany, already amounts to over € 100 million.

The case is therefore strong to share the use of exploration ships for multiple purposes, including oceanographic research, the search for active substances from marine creatures (blue biotechnology), oil and gas, as well as marine minerals including manganese nodules, cobalt crusts and massive sulphides. Furthermore, the exploration for oil and gas as well as marine minerals requires involvement of marine biologists and related experts to allow the early measurement of environmental impacts.

Conclusion from this example is that any systematic exploration of the oceans requires high investments that may need to be shared by multiple stakeholders, whether maritime economic activities or even nations.

Example 3: Shared activities – ocean exploration



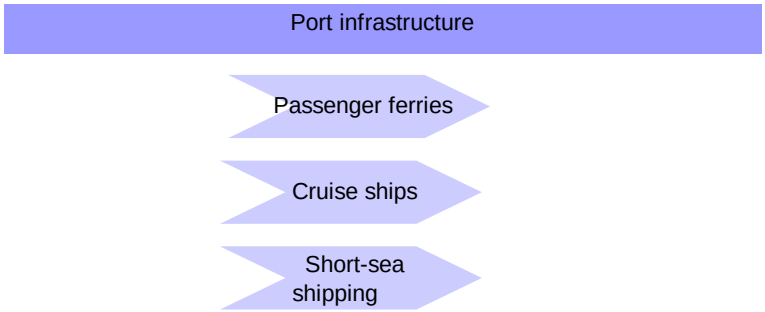
[97] World Ocean Review (2010), Chapter 9 Medical knowledge from the seas, p. 178.
[98] Committee on Exploration of the Seas (2003) "Exploration of the Seas: Voyage into the Unknown. National Research Council, National Academy of Sciences (USA).

Type 4: Common use of infrastructure

Infrastructure can be used by different economic activities. Ports are a fine example of this type of synergy. It goes without saying that ports are important crystallisation points for maritime economic activities: whether cruise shipping, short-sea shipping, deep sea shipping, passenger ferries, fishing, marine mineral mining, oil drilling, offshore or maritime monitoring, they all require ports and ports infrastructure. It is however important to rethink the role of ports, and to develop views on how these can be transformed into crystallisation points for accommodating and promoting the maritime economic activities of tomorrow.

Future maritime economic activities are not only expected to be centred on ports. New maritime spatial concepts may be required to allow the full exploitation of synergies with a minimum of spatial tensions. An example are offshore islands, which can host wind turbines, ocean renewable energy sources as well as algae growing, while simultaneously providing coastal protection. Experience in such new maritime spatial concepts is still in its infancy and not much shared.

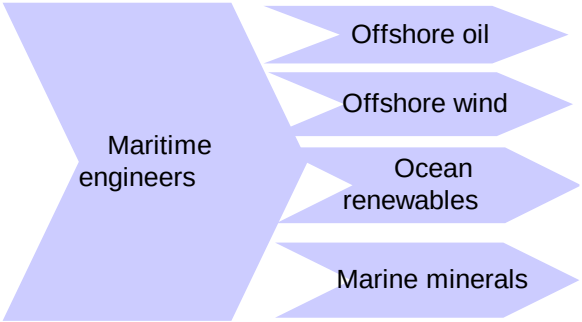
Example 4: Common use of infrastructure: ports



Type 5: Shared input factors

Equally important can be the availability of shared input factors, notably specialised workers such as maritime engineers, often locally trained by dedicated maritime training institutes. The geographic clustering of maritime activities is both advantageous for employers and employees: firms have a potentially large pool of worker to choose from, while workers have a variety of employment possibilities. Anecdotal evidence, however, suggests that the 'externalities' arising from this geographic proximity to do not always materialise. For example, engineers in offshore oil tend not to be attracted by the offshore wind sector, and vice versa.

Example 5: Shared input factors – labour markets



Other types of examples

In addition to the above functional and spatial synergies, yet other synergies have been identified throughout our research, however they have not yet been categorised yet. Important to mention here are synergies in environmental impacts, where direct output-input relations contribute to increased sustainability – in the spirit of 'cradle-to-cradle' concepts.

For example in aquaculture, layered aquaculture can somehow reproduce food chains – with algae and seaweed being eaten by smaller fish, being eaten by larger fish. Desalination in combination with OTEC is another possibility; so is aquaculture near treatment plant outlets. The point of these examples is that valuation of economic activities can actually strengthen the potential of ecosystem services.

Yet another unexplored synergy is that between maritime and land-based activities. What can marine aquaculture learn from land-based forms; id. wind, etc? But also: what can shipbuilding learn from car or train manufacturing?

5.2.2 Synergies between maritime activities are manifold, but far from being fully exploited

A myriad of synergies between and within maritime economic activities have been identified. The overview below presents an identification of synergies between maritime economic activities. The overview does not pretend to be complete, but already indicates the huge potential once synergies are fully explored and exploited. In practice this is often not fully realised yet, as is also illustrated in the next chapter, for a variety of reasons. This will require careful additional actions and clear planning decisions to establish these synergies and accelerate the Blue Growth.

Table 5.1 Overview of synergies between economic activities analysed and other economic activities (note to the reader: follow the columns down)

Function	Maritime economic activity	Short-sea	Grow i aqua-tic	Blue bio tech	Oil & gas	Offsho w ind	Ocean rene-w able	Marine mine-rals	Desa-lina-tion	Coas-tal tour.	Cruise	Coast prot.	Mon & survei
Maritime transport and shipbuilding	Deepsea shipping	++		+				+	+		+		++
	Shortsea shippnig			+							+	+	++
	Passanger ferries	+		+						+	+		+
	Inland w aterw ay	++		+									
Living resources	Fish for humans		+	+		+	+			+			+
	Fish for animals		+	+		+							+
	Grow ing aquatic products		++	+		+							
	Blue biotech												
	Agriculture on saline soils		+	+									
Energy & raw materials	Oil and gas	+	++	+		+		+					+
	Offshore w ind	+							+				+
	Ocean renew . energy		++	+		+			+	+	+		+
	CCS					+							
	Aggregate mining	+						+					
	Marine minerals	+	+	+		+							+
	Desalination		+	+						+			
Leisure, working and living	Coastline tourism	+	+				+				+	+	+
	Yachting and marinas			+								+	
	Cruise and ports			+						+		+	
	Working	+	+				+			++	++	++	
	Living		+									++	
Coastal protection	Protection against flood.		+							+			+
	Prevent salt intrusion		+									+	+
	Protect habitats		+	+								+	+
Marine monitoring & surveillance	Tracing goods	+											+
	Tracing people	+											+
	Environm. monitoring		+	+	+	+	+	+	+	+		+	+

A short description of synergies that can occur in major areas is presented below.

Short-sea shipping: synergies with other types of shipping

In many ways, short-sea shipping provides synergies with other types of shipping. There are obvious synergies with deep-sea shipping, which not only provides the overseas cargo, but also shapes the main ports. Passenger ferries also provide synergies with short-sea shipping (e.g. RoRo), while inland shipping is another essential component of the chain.

Blue biotech: enabling other maritime economic activities

Blue biotechnology is well-suited to address a problem common to many maritime economic activities: corrosion and the need to withstand the impact of rough weather conditions. Blue biotechnology can provide bio-sourced products such as coating with anti-fouling or anticorrosive properties (maritime transport and shipbuilding). Ships (cargo, passenger as well as yachting) and underwater constructions for e.g. ocean renewable energy sources (wave, tidal, OTEC, thermal, biofuels, etc.) can also benefit from marine bio-sourced coatings with anti-fouling or anticorrosive properties.

Oil and gas can benefit from blue biotechnology by new applications that may provide solutions to improve the extraction yield of oil ("Enhanced Oil Recovery"). Bio stimulation can also be used to protect natural habitats by fostering bioremediation after important pollutions (as for the Exxon Valdez oil spill when bacteria were stimulated to degrade hydrocarbons).

Recent developments show that mineral nodules may partly be of biogenic origin (Wang & Werner 2010). Unlocking the metal fixating properties of selected bacteria could improve the potential of blue biotechnology vis-à-vis this maritime economic activity.

Blue biotechnology can also contribute to the development of specific biopolymers and bio membranes that improve the overall efficiency of the desalination process.

Marine monitoring & surveillance – enabling other activities

The strength lies in the combination of the three aspects of observations (namely remote sensing, in situ observations and modelling) and the integration of monitoring strategies at a European scale. Together this will generate new powerful insight and forecasts, and coherence. The implementation of integrated monitoring and surveillance systems will not only benefit the producers of instruments and services, but also provide added-value and societal benefits. Monitoring and surveillance can then generate substantial economic effects including increased efficiency and cost reduction for other maritime economic activities, as for policy (for instance MSP and EMODNET).

Environmental monitoring provides synergies and benefits for a wide range of maritime activities: from maritime aquatic products (algae growing) and blue biotechnology to all energy activities as well as leisure and tourism activities. Environmental monitoring services are also used for coastal protection purposes. Vice versa – the risk for erosion and flooding may result in increased efforts in environmental monitoring.

The impact of increased maritime surveillance will generally be positive for most other activities of the maritime economy. These impacts will be particularly high in sea basins with greater security threats, notably the Mediterranean and Atlantic areas.

Leisure, working and living – place-based synergies

Coastal tourism has important connections with coastal protection, e.g. marina infrastructure contributing to coastal protection of land and property from erosion by the ocean.

The cruise sector has important synergies with other shipping activities as it uses the same port facilities as regular shipping. Synergies with the maritime transport cluster are also related to shipbuilding, where the supplier industry located in Europe can serve a wider market of ship types.

Energy & minerals: both functional and spatial synergies

Oil & gas provides synergies with shipping and ports (imports, oil & gas terminal development).

There is strong synergy between oil &gas exploration and offshore as well as other renewables through the sharing of platforms and other infrastructures. Both literature and interviewees stress the importance of synergies with related activities and value chains in this domain.

The development of offshore wind parks will demand for new developments in environmental monitoring, such as new measuring set-ups, new constructions, new traffic to database, extra database services and data validation needs. Offshore islands can also provide the right conditions for marine aquatic products, including the growing of algae and seaweed.

The commercial viability of a tidal range scheme may be deemed greater if a wider range of activities and related economic benefits could be incorporated (Royal Haskoning, 2009). Examples of such activities are infrastructure (improved transport networks), leisure and tourism, or flood control. Related observations that come forward from the interviews:

- combining OTEC with Sea Water Air Conditioning (SWAC);
- application of OTEC-technology in the production of LNG
- combining OTEC with production of drinking water and extraction of minerals

Coastal protection – enabling other maritime economic activities

Coastal protection decreases the risk for erosion and flooding, but the protection work can also interfere with coastal tourism, shipping and offshore energy (wind and other renewables). As approaches to coastal protection design have been more and more integrated with other activities, solutions currently developed often benefit protection and other activities as well as coastal eco-systems.

5.3 Tensions

5.3.1 Generic tensions

Next to synergies, tensions may exist between different activities. An optimal strategy aims to avoid tensions and to optimize synergies. Most tensions are spatial in their nature. Hence a strong link exists with maritime spatial planning to address these tensions. Tensions may occur between economic activities (activities do not combine well), but can also relate to the activity and the marine environment. In the following sections these types of tensions are subsequently described.

5.3.2 Tensions between activities

Table 5.3 presents and overview of areas where tensions between maritime economic activities may occur.

Table 5.3 Overview of possible tensions between maritime economic activities analysed (market orange. Note to the reader: follow the columns down)

Function	Maritime economic activity	Short-sea	Grow i aqua-tic	Blue bio tech	Oil & gas	Offsho w ind	Ocean rene-w able	Marine mine-rals	Desa-lina-tion	Coas-tal tour.	Cruise	Coast prot.	Mon & survei
Maritime transport and shipbuilding	Deepsea shipping					-	-				-		
	Shortsea shippnig		-	-		-	-				-		
	Passanger ferries		-	-		-	-				-		
	Inland w aterw ay												
Living resources	Fish for humans	-		-					-			-	
	Fish for animals	-		-								-	
	Grow ing aquatic products								-				
	Blue biotech												
	Agriculture on saline soils												
Energy & raw materials	Oil and gas			-						-			
	Offshore w ind									-			
	Ocean renew . energy					-							
	CCS												
	Aggregate mining	-	-				-						
	Marine minerals												
	Desalination												
Leisure, working and living	Coastline tourism	-	-										
	Yachting and marinas			-									
	Cruise and ports			-									
	Working												
	Living									-			
Coastal protection	Protection against flood.												
	Prevent salt intrusion												
	Protect habitats	-	-		-	-		-	-	-	-		
Marine monitoring & surveillance	Tracing goods												
	Tracing people												
	Environm. monitoring												

A short description of the major tensions per (main) function is described below.

Maritime transport and shipbuilding

Tensions with other functions emerge on or around shipping routes, while competition of space can be fierce in ports and surroundings. Tensions apply to fishing, aggregate mining, coastal tourism and protection of habitats mostly.

Living resources

Overfishing may reduce the volume of raw material delivered to the blue biotech sector (cosmetic and nutraceutical).

Aquaculture could also have a negative impact on water quality in the surrounding environment. With R&D developments in the field of mitigating measures, these tensions are expected to decrease, but will remain an issue when the sector grows.

Oil& gas (and to a less extent offshore wind, and ocean renewables) can lead to mild tensions due to competition for space, and is expected to be more stringent in basins where competition for space is more important (North Sea, Baltic).

Aggregates mining (sand, gravel, etc.) can lead to competition for space, which is expected to be more stringent in basin where competition for space is more important (North Sea, Baltic). Coastal tourism is also competing for space – including need for visual quality (Mediterranean, Black Sea).

Energy and minerals

Oil & gas provides tensions with virtually all other maritime economic activities because of competition for space. The confidentiality of resource locations and the levels of security desired around are factors complicating this tension. Furthermore oil & gas winning can cause pollution and infrastructure development can have a negative impact on the eco-system (also tension with Natura2000). Accidental spills may reduce locally marine biodiversity, and threaten its function.

Leisure, living and working

Cruise and ports can lead to spatial tensions with maritime transport, in crowded ports (competition for terminals) and sea-corridors. This can provide synergies (e.g. access channel already deepened), but also cause conflicts.

Litter from cruise-ships can cause damage to food, nutrition, health and ecosystem services, e.g. through marine litter affecting ecosystem services.

Coastal tourism and related infrastructure development can lead to pollution and adverse impacts on natural and living environment (also tension with Natura2000).

Coastal protection

As dredging and nourishment affects the seabed, it may impact certain segments of the fisheries activities.

Marine monitoring & surveillance

No tensions with other maritime economic activities have been recorded to date.

5.3.3 Tensions in relation to the marine environment

Besides tensions between maritime functions, there are tensions caused by the pressure of function on the wider marine environment, both in environmental and safety terms. Three examples are elaborated here to illustrate this: safety at sea, marine waste and oil spills.

Safety at sea

Intensive use of oceans and seas by man causes the probability of accidents to increase. In Europe, a number of *accident black spots* can be identified in the vicinity of major ports, along major navigation routes and in areas that are difficult to navigate especially in bad weather. In the North Sea, critical areas include the English Channel, in particular the Port of Antwerp and the Kiel Canal in Germany. In the Baltic Sea, the Danish and Swedish coastlines are particularly prone to shipping accidents, whereas in the Mediterranean Sea, the Aegean Sea is the major black spot.

Figure 5.1 Overview of the spatial distribution of the shipping incidents around the EU for 2009

Source: EMSA, 2010[99]

Marine waste

Litter is a main problem amongst Europe's coasts, with strong variations and differences in measurement – which make comparisons across Sea-basins difficult. Plastic litter is common in the (Northern) North Sea, the Mediterranean and the Black Sea – where glass litter is also widespread.

Table 5.4 Quantities of marine litter found on Europe's beaches[100]

Region	Sea	Litter (items/100 meter beach)
North East Atlantic (OSPAR, 2009b)	Northern North Sea	600–1 400
	Southern North Sea	200–600
	Celtic Seas	600–800
	Bay of Biscay and Iberian coasts	100–300
		Most common items on all beaches in this region were small plastic/polystyrene pieces
Baltic Sea (HELCOM/UNEP/RSP 2007)		High: 700–1 200 Low: 6–16 30–60 % were plastics
Sea	**Location**	**Litter (kg/km²)**
Mediterranean (Koutsodendris et al., 2008)	Greek Gulfs of Patras, Corinth, Echinades and Lakonikos	6.7–47.4 Plastic litter: 56 % Metal: 17 % Glass: 11 %
Black Sea		Plastics: 333–6 250 Glass litter: 222–1 455

Although above table does not comprise all European beaches, it is likely that litter volumes on other seas/coast within Europe have similar ranges (see e.g. OSPAR, 2011, UNEP, 2011).

[99] European Maritime safety Agency (2010) Maritime accident review 2009

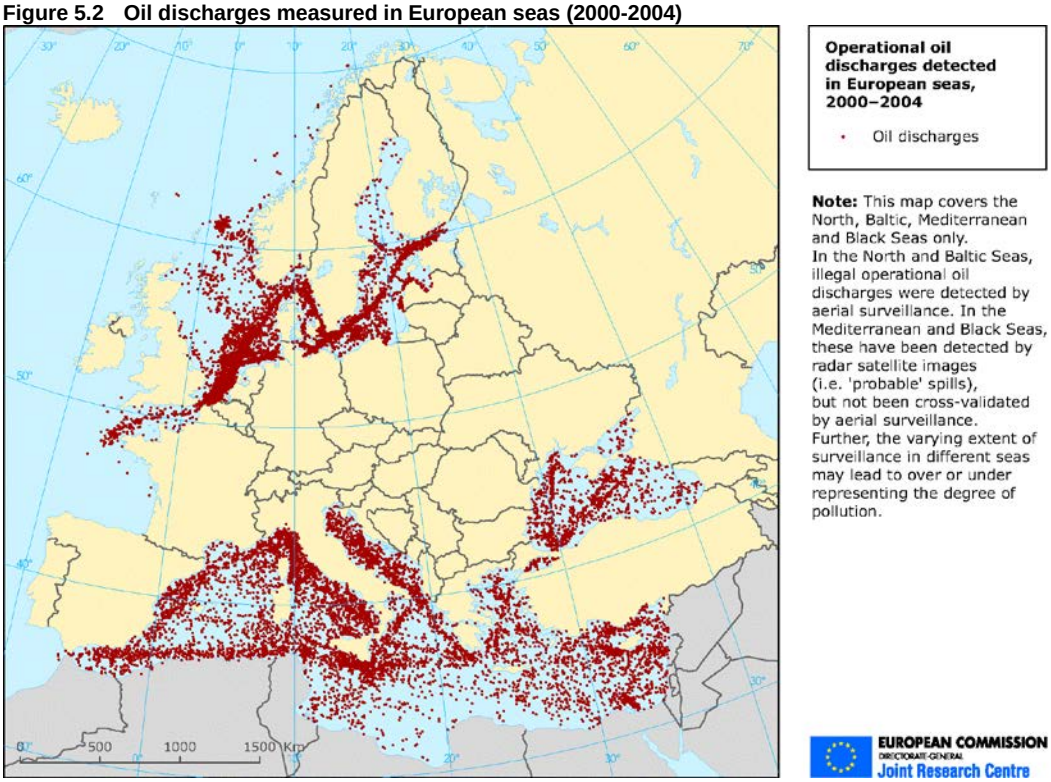
[100] EEA 2010, The European Environment State and Outlook 2010- Marine and Coastal Environment

Besides litter found on coasts, plastics in open sea, especially in pelagic zones, is a possible threat to marine eco-systems, and measurements indicate that as much as 94 percent of seabirds living in the North Sea region have plastic particles in their stomachs (OSPAR, 2011).

Oil spills

Leakage or spilling of oil can be by accident or on purpose. Monitoring data indicate the spills are found mainly along the shipping routes across European waters, as figure 5.2 shows.

Figure 5.2 Oil discharges measured in European seas (2000-2004)



Source: European Commission, Joint Research Centre

5.4 Conclusions

Individual maritime economic activities do not always have the critical mass to prosper alone. Furthermore, conditions for growth are not always realised, particularly if they are located in sparsely populated or peripheral regions of Europe. The potential of Blue Growth can be reinforced by taking advantage of synergies. In the Blue Economy, synergies are therefore not a luxury but a pre-condition for future growth and development.

Important maritime economic activities which already have such critical mass are shortsea shipping, cruising, offshore drilling, offshore wind and coastal tourism. Such activities can have substantial knock-on effects for both upstream and downstream suppliers. Successfully rolling out tomorrow's maritime economic activities can, therefore, have a positive impact on an entire portfolio of other maritime economic activities, namely those of a cross-cutting nature such as shipbuilding, maritime monitoring and surveillance and blue biotechnology.

Different types of synergies have been identified in this chapter. They include:

- Type 1 - Shared suppliers: several economic activities make use of similar inputs (e.g. shipbuilding as input to cruise shipping, shortsea shipping, coastal protection, offshore wind, offshore oil and gas, and marine mineral mining);

- Type 2 - Enabling activities: an activity which provides conditions for the development of another activity (e.g. blue biotechnology allows for bioremediation of oil and gas fields, which suffer from pollution and spills);
- Type 3 - Shared (multipurpose) activities: one activity serving several maritime functions (e.g. the use of exploration ships for oceanographic research, the search for active substances from marine creatures (blue biotechnology), oil and gas, as well as marine minerals);
- Type 4 - Common use of infrastructure, including ports but also offshore islands (e.g. offshore islands, which can host wind turbines, ocean renewable energy sources as well as algae growing, while simultaneously providing coastal protection);
- Type 5 - Shared input factors, including specialised workers such as maritime engineers (e.g. engineers in offshore oil are also servicing the offshore wind sector, and vice versa);
- Type 6 - Alignment of environmental impacts; common output-input relations contribute to increased sustainability – in the spirit of 'cradle-to-cradle' concepts.

Next to synergies, tensions can exist between different maritime economic activities directly, but also indirectly, for example if one activity puts pressure on the marine environment – thus compromising the potential of another activity. Most tensions are spatial in their nature. Hence a strong link exists with maritime spatial planning to address these tensions. An optimal strategy aims to avoid tensions and to optimise synergies.

6 Clusters

6.1 Introduction

Note: A full description of four cluster studies in Ireland, Gulf of Venice, Gdansk and Oostende is presented in Annex 5 of this report.

In the previous chapters, we have assessed maritime economic sectors at the EU level, and zoomed in to the various sea basins. In order to further understand the cooperation between stakeholders and the relevance of geographic levels. Hence in this chapter we address clusters: geographic regions where larger industries, smaller suppliers as well as education and research institutes are reinforcing each others' performance using their close proximity. Clusters are deemed important for Blue Growth especially since the development of maritime economic sectors – notably those in a pre-development or growth stage – is dependent on establishing the appropriate interlinkages and reinforcing growth potential.

Box 6.1 The concept of clusters

Clusters are traditionally defined as "geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition (e.g. suppliers, customers, companies which share inputs, but also governments and other institutions such as universities and trade associations)." [101] We will define clusters:

- At the level of companies and institutions across sectors; clusters tend not to fit well within standard industrial classification systems;
- Including both forward and backward relations between companies;
- Including both competitors and cooperating companies and institutions;
- Including the intermediate and final consumer;
- Including elements from the framework conditions, whether infrastructure, labour markets or other elements;
- Geographic in space, although the geographic delineation of a cluster often highly varies.

Based on our analysis of the maritime economic activities and the sea basins presented in the previous chapters we have identified a long list of clusters across Europe (see Table 6.1).

Table 6.1 Preliminary overview of maritime clusters as identified across sea-basins

Sea Basin	cluster area	Activities involved in the cluster area	Status (mature, growing, early development)
Baltic	Kotka-Hamina region (Gulf of Finland) (SF)	cities&ports; blue biotech&algae; wind energy cluster; deep & short-sea shipping	Mature
	Western Baltic (DK, D)	coastal tourism; ports; offshore wind; onshore wind; aquaculture; shipbuilding; fisheries; ferries; aggregates	Growing
	Copenhagen (DK)	Cruise tourism, ferries, coastal tourism	Mature
	Stockholm (N)	Cruise tourism, ferries, coastal tourism,	Mature

[101] M.E. Porter (1998) "Clusters and the New Economics of Competition". Harvard Business Review, Nov/Dec, p.78

Sea Basin	cluster area	Activities involved in the cluster area	Status (mature, growing, early development)
		yachting and marinas	
	Gdansk/Gdynia (PL)	Short-sea shipping, shipbuilding, cruise tourism	Mature
	Helsinki (SF)	cruise tourism, cruise shipbuilding, ferries, coastal tourism,	Mature
	Tallinn (EE)	Cruise tourism, short-sea incl. Ferries	Growing/mature
	Goteborg (S)	Cruise tourism, ferries, short-sea shipping, coastal tourism/yachting	Mature
	Kiel (D)	See under Hamburg/North Sea	Growing/mature
North Sea	Bergen (N)	Cruise tourism, short-sea shipping, offshore oil & gas	Mature
	Stavanger (N)	Offshore oil &gas, short-sea shipping, cruise tourism, aquaculture	Mature
	Oslo (N)	Short-sea shipping, cruise tourism, ferries	Mature
	Rotterdam (NL)	Deep sea shipping, short-sea shipping, ferries, inland waterways, coastal protection, marine monitoring and surveillance	Mature
	Antwerp (B)	Deep sea shipping, short-sea shipping, ferries, inland waterways, oil & gas (refineries), marine monitoring and surveillance	Mature
	Oostende (B)	Short-sea shipping, ferries, offshore wind, blue biotech	Growing
	Hamburg, Kiel, Bremen (D)	onshore wind; offshore wind; shipbuilding; maritime technology; ports; coastal tourism; cosmetics; classification; shipping; cruise tourism; equipment and supplies; RES	Growing / mature
	Wadden Sea (NL/D/DK)	coastal protection; coastal tourism/yachting, environmental monitoring	Mature
	Aberdeen (UK)	Offshore oil & gas, offshore wind	Mature
	London gateway (UK)	Freight port, ferries, cruise tourism	Mature
	Solent (UK)	naval base (Portsmouth); petrochemistry, refineries (Fawley); container & cruise port (Southampton); yachting; coastal tourism; heritage areas; coastal wildlife areas	Mature
Atlantic	Galway /Western Ireland (IRL)	cruise and nautical tourism; renewables; windfloat areas; aquaculture; deep sea technologies (synergies)	Growing
	Scottish West coast (UK)	Offshore wind, marine aquatic resources, fisheries, ocean renewable energy, shipbuilding, blue biotech	Growing
	Portuguese coast (P)	deep and short-sea shipping; coastal, nautical and cruise tourism; offshore gas (south) and oil (north) *(oil noted with question mark)*, marine minerals mining	Growing
	Bretagne, Brest (F)	Defence, blue biotechnology, shipbuilding, fisheries, ocean renewable energy	Mature

Sea Basin	cluster area	Activities involved in the cluster area	Status (mature, growing, early development)
	Galician Coast (E)	Coastal tourism, short-sea shipping, fisheries, offshore renewable energy	Growing
	South West England (UK)	Marine equipment, yachting, coastal tourism, ocean renewable energy (wave and tidal), fisheries	Growing
Arctic	Greenland (DK)	Marine minerals mining, cruise tourism	Early development
	Alesund (N)	offshore oil & gas; cruise tourism; shipbuilding; fisheries	Growing
	Hammerfest (N)	offshore oil & gas; LNG; fisheries, cruise tourism	Growing
Mediterranean	Barcelona (E)	Marine fisheries reserves; Env. monitoring, safety (immigration control), coastal tourism, yachting and marinas; surveillance, ferries	Growing
	Valencia (E)	Coastal tourism, ferries, yachting and marinas	Growing
	Marseilles (F)	Deep sea shipping, short-sea shipping, ferries, cruise tourism, monitoring and surveillance, defence, blue biotech	Mature
	Napoli (I)	Deep sea shipping, short-sea shipping, cruise, coastal tourism	Mature
	Bari (I)	Short-sea shipping, cruise, coastal tourism	Mature
	Malta (M)	Deep sea/short-sea shipping hub, cruise tourism, coastal tourism	Mature
	Venezia/Trieste (I)	Cruise tourism, ferries, short-sea shipping	Mature
	Athens (GR)	Ferries, short-sea shipping, yachting and marinas, fisheries	Mature
Black Sea	Constantza (RO)	Port (deep sea/short-sea hub, largest in Black Sea), coastal tourism (EU), monitoring and surveillance	Growing
	Varna (BG)	Port, coastal tourism (EU and Russia) Departure for cruises in the Black Sea	Growing Stable though underdeveloped
Outermost	Canaries, Madeira, Azores	Cruise tourism, short-sea shipping, coastal tourism	Mature

From this list we have selected four cases which have been studied and which will be presented in the remainder of this chapter. The criteria for selection have been:

- Geographic balance (coverage of at least 4 different sea-basins, notably North Sea, Atlantic, Mediterranean and Baltic);
- Diversity in the composition of maritime economic activities, including the mature, growing and emerging activities;
- Divergence in spatial level and governance structure.

Below follows a synopsis of the four clusters analysed: Ireland, Gulf of Venice, Gdansk and Oostende. A more elaborate case study description has been included as Annex 5 of this report.

6.2 Ireland

Characteristics of the region

The case of Ireland presents an interesting example for a multi-level governance dimension of Blue Growth. Local and regional bottom-up approaches are often coordinated in the framework of a wider national policy and steered by national (research) actors. Hence, an analysis of synergies and tensions in Ireland will need to take into account both rather locally anchored clusters as well as the national context. Among the most prominent reasons identified are:

- The rather small surface of the country (70,280 square km) [102] and comparably small size of population[103] (4.2m). These two factors explain the close proximity of maritime economic actors, which in turn facilitates frequent interaction between different sectors and access of local/regional actors to national clusters.[104] Besides, the awareness of the need towards a more national and unified approach to the development of the maritime economy.
- the national heritage of Ireland as a maritime country, i.e. that maritime economic policy and maritime stakeholders always played a prominent role in politics, as compared to other, less maritime EU-countries.[105]
- a strategic, research-driven maritime policy, with the Marine Institute (Ireland) coordinating the further development of the maritime sector in Ireland towards research-driven emerging maritime sectors.

Main maritime economic sectors present and future potential

Strong sectors on a national level are the maritime services sector, which contributed to more than 50% of the combined direct turnover of companies employed in the sector. The shipping sector with its centres in Dublin and Cork, records the highest economic output and the highest economic employee multiplier of all the marine sectors on a national comparison[106].

In general, the Irish maritime transport sector has a two-fold portfolio: shipping firms, service providers and government agencies serve mainly the local market. A more recent and smaller international market, consisting of ship-owners and shipping service providers has emerged and provides international shipping services[107]. It is perceived that a more sustained and focussed strategy on creating a dedicated shipping service centre in Ireland could lead to growth in new employment.

Dublin and Cork are the main ports of call for cruise liners. Cities like Galway position themselves as locations for international marine sports events. The 2009 Volvo Ocean Race stopover in Galway[108], which lasted two weeks, provides an interesting example of economic return and location branding generated through integrated sports events. Besides that, the Irish national Tourism Development Authority (Failte Ireland) aims at expanding the growing market for adventure holidays in the future, particularly alongside its Atlantic shores. This relates to targeted investments in infrastructure, business support and promotion of active engagement and authentic adventure experience[109].

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[102] As stressed by several interviewees as one important element conducive to frequent exchange and cooperation of local stakeholders with the national level – compared to much bigger countries in terms of surface and population

[103] In terms of population, Ireland as a whole is nearly as big as the cluster Venice, including its main cities Trieste (IT), Chioggia (IT), Koper (SI) and Pula (CR)

[104] Such as the iMERC cluster in Cork and the Maritime Transport Cluster

[105] As stressed by some interviewees

[106] Irish Maritime Development Office, 2008: Strategic Review of the Irish Maritime Transport Sector: 27

[107] Our Ocean Wealth, Towards an Integrated Marine Plan for Ireland. Part II Sectoral Briefs: 10

[108] And which will be repeatedly organised in Galway between 30th June and 8th July 2012. More information: http://www.galwayvolvooceanrace.com/

[109] Our Ocean Wealth, Towards an Integrated Marine Plan for Ireland. Part II Sectoral Briefs: 32

Located on the edge of the Atlantic Ocean, the country is well placed to harness potential wind and wave resources available[110]. Within the national Offshore Renewable Energy Plan (OREDP)[111], a number of assessment areas are identified which focus on the main geographical areas of resources identified for offshore wind (fixed and floating) and ocean renewable energy (wave and tidal energy)[112]. Besides, it identifies where economic development is most likely to occur, including potential environmental constraints and assess the levels of future development[113].

The ocean energy programme[114] has made Ireland move some significant steps with companies, such as Wavebob, Ocean Energy and Open Hydro[115]. The Irish economy is assembling other key elements of the ocean energy, i.e. utility project developers and other companies working in the supply chain activities. The market potential on a national basis is up to 30,000 jobs on a 2030 horizon.[116] Besides, an estimated €1bn per annum in earning potential by 2020 is expected[117]. Existing of a rather indigenous industry structure, the wave and tidal energy industry is an indigenous industry, and consists of a group of knowledge-based and innovative companies which focus mainly on the pre-commercial design stage[118]. Ireland has a considerable resource with electricity generation and existing strengths in ocean energy research and developments due to the University of Galway, the Irish Marine Institute and other industry players[119]. Joint collaboration in the form of public-private partnerships with industry partners, e.g. Vattenfall, has been undertaken to also cover the whole environmental aspects of the test site[120].

Oil exploration is challenging, with water depths offshore Ireland 7 to 8 times deeper than in the North Sea.

With initiatives such as the SmartBay Galway, maritime Monitoring and Surveillance is a particularly strong sector in Ireland. Initiated as a national research infrastructure project[121], SmartBay is a national research infrastructure project which comprises a network of buoys, seafloor cables and other infrastructure that are supporting a range of sensors and information systems. The objective of the project is to develop the basis for real time oceanographic monitoring[122].

Synergies and tensions

Two particular synergies have been identified for Ireland:

- From sector to sector: marine biotechnology and biopharma show some synergies alongside local companies. Besides that, marine biotechnology and the medical devices industry across

[110] Our Ocean Wealth, Towards an Integrated Marine Plan for Ireland. Part II Sectoral Briefs: 16
[111] Compiled by the Department of Communications, Energy and Natural Resources with input from South-East Development Agency and
[112] Strategic Environmental Assessment (SEA) of the Offshore Renewwable Enery Development Plan (OREDP) in the Republic of Ireland, 2010. Environmental Report, Volume 2. Main Report. October 2010
[113] Strategic Environmental Assessment (SEA) of the Offshore Renewwable Enery Development Plan (OREDP) in the Republic of Ireland, 2010. Environmental Report, Volume 2. Main Report. October 2010: 17
[114] The overall Ocean energy programme benefits from a financial envelope of € 26m, which includes €2m to support the development of grid-connected wave energy test site (notably the Quarter Scale Wave Energy Test site in Galway bay) and grants under the Ocean Energy Prototype Fund which will help developers in the commercialisation of their devices.
[115] Our Ocean Wealth, Towards an Integrated Marine Plan for Ireland. Part II Sectoral Briefs: 15
[116] Hence, this allows only approximations for the development of employment in Galway county. Seen the existing strong infrastructure and the Ocean Energy TestSite located in Galway Bay, implications for the county can be estimated to be significant.
[117] Own estimates of Ocean Energy Ireland – available under: http://www.oceanenergy.ie/markets/irish.html
[118] Our Ocean Wealth, Towards an Integrated Marine Plan for Ireland. Part II Sectoral Briefs: 16
[119] According to qualitative interview with a representative from the energy authority
[120] http://www.vattenfall.com/en/ocean-energy.htm and also according to the qualitative interviews
[121] SmartBay brochure, Page 1: the project was established by the Irish Marine Institute and the Environmental Protection Agency Ireland in 2007. More information on: http://www.marine.ie/home/services/operational/SmartBay/SmartBay.htm
[122] http://www.marine.ie/home/services/operational/SmartBay/SmartBay.htm

the country. Besides, and through the Quarter Scale Test Site for ocean energy (wave and tidal), there are new experimental ways of synergies emerging between short-sea vessels, using the infrastructure for recharging. From a more policy-based perspective there are synergies between ocean energy and fishing (from a spatial planning point of view). This is related to the fact that fishing and ocean energy are seen as two important factors to consider when compiling maritime spatial planning;

- From sea-based to land-based technologies and skills, e.g. in maritime monitoring and surveillance to use the data generated on the sea about wave and tidal from the back-office onshore. In this synergy, the Irish Marine Institute, through its co-funded Quarter Scale Test Site facilitates synergies and has attracted some key industry players to become involved(e.g. IBM).

One particular tension between ocean energy and offshore wind is the development of the offshore grid. The extension of the offshore grid system[123] may hamper the development of the emerging ocean energy sector due to construction works and other factors. Another offshore to offshore tension is the issue of large-throughput electricity transmission cables. The latter relates to attempts to bypass the mainland onshore grid and transmit electricity directly to other countries via offshore based points of key electricity transmission capacity. This could create tensions with efforts to extend the onshore (mainland) grid.

The utilisation of offshore sea space, by renewable energy and ocean energy creates tensions with other marine economic activities, in particular with marine aquaculture and cruise tourism.

Cooperation between stakeholders and existing structures

The Marine Institute is a national agency responsible for Marine Research, Technology Development and Innovation (RTDI). Set-up in 1991, its mission is to undertake and co-ordinate marine research and development that will promote economic development and create employment and protect the marine environment[124]. Beyond that, it also acts on a political level by entertaining close links with the National Ministries, in particular the department for Agriculture, Food and the Marine, Communications, Energy and Natural Resources and Transport, Tourism and Sports. On an international level, it supports the government of Ireland in shaping the Irish and EU maritime agenda[125].

Across Ireland, initiatives are developed and cooperation is sought with specialised institutes and clusters. Examples are

- The University of Galway's Ryan Institute based on leads marine biodiscovery, marine functional food and aquaculture programmes. Through its dedicated research station[126] it provides a practical platform for bioresource research, notably on exploratory aquatic investigations, as well as research on novel species for aquaculture[127];
- The Marine Socio-Economic Research Unit (SEMRU), which focuses on the economic importance of coastal and off-shore marine environments. This involves examining the economic utility of the marine environment (e.g. transportation, recreation) and ecological value (e.g. fisheries, aquaculture) derived from the productivity of associated ecosystems.

[123] Which is currently supported by various EU projects, e.g. the ISLES project http://www.islesproject.eu/. ISLES is an INTERREG Iva co-funded project with the participation of the Northern Ireland Executive, the Scottish Government and the Government of Ireland

[124] http://www.marine.ie/home/aboutus/

[125] Not least shown by the participation to the Expert Hearing Blue Growth on behalf of DG MARE in November 2011 in Brussels or active participation of the CEO as panel speaker at the European Maritime Days 2012 in Gothenburg, to mention a few examples

[126] Carna Research Station

[127] http://www.ryaninstitute.ie/facilities/carna-research-station/

- The Galway-Mayo Institute of Technology (GMIT) involved in a range of research activities collaborations with other higher education centres and industry[128];
- The iMerc Cluster in Cork: its vision is to promote Ireland as a world-renowned research and development location, Further to that, it aims at integrating diverse research and industry expertise through the development of a national innovation-led cluster, notably to underpin the nascent ocean energy (wave and tidal) sector[129]. The cluster regroups the business development activities of three actors, i.e. the University College Cork, the Cork Institute of Technology and the Irish Naval Service. The concrete actions to develop synergies are to provide researchers, technology providers, local and international companies and investors the tools to enhance their relationship building;
- The SMARTOCEAN Cluster, launched in 2010 (ICT for the Sea) seeks to harness Ireland's natural marine resources and specialist expertise in marine science and ICT to establish Ireland as a leader in the development of high value products and services for the global marine sector The Cluster is a national co-operative platform of research centres, academic institutes, Multinational Enterprises (MNEs) and indigenous Small to Medium sized Enterprises (SMEs). These facilitate the provision of remote sensing systems, data management and visualisation tools, modelling, simulation, forecasting and engineering design supporting operational management. A number of companies have also developed products and services based on patented research from National Centres of Research Excellence.

Cooperation patterns in Ireland are both bottom-up initiatives, e.g. attempts by local business development institutions to develop a marketing strategy for positioning Irish ports within the Volvo Ocean Race, for instance. At the same time, and taking the particular case of Ireland into account, the Irish Marine Institute and others are having formal cooperation patterns to facilitate synergies in the country and to create critical mass in the relatively small sized economy that Ireland is. Among them is the "Fisheries Partnership Committee". This partnership convenes every 2nd month, gathering the heads of Irish fishermen and Irish marine scientists, to assess technological issues and to jointly overcome barriers for local and regional collaboration of stakeholders. The Irish Marine Institute is a key player there; they tend to bring different stakeholder groups together, e.g. fishermen and scientists to clarify potential disagreements on where fish stock levels are located. Besides, they organise regular workshops for different subsectors, e.g. for fishing and the biotech sector.

Governance issues

On a national level, a number of initiatives have been taken to address synergies between sectors:

- "Sea Change: A Marine Knowledge Research and Innovation Strategy for Ireland 2007-2013", by the Irish Marine Institute, including the organisation of stakeholder groups that reflected areas of tensions, synergies, policy departments and national heritage[130];
- The national programme Marine Biotechnology Ireland, led by the Irish Marine Institute in collaboration with NUI Galway[131], with the objective to 1) promote the opportunity that marine biotech presents for development of Ireland, 2) simulate the interaction between industry and research, understanding the landscape, the industrial needs, technological bottlenecks, allowing these actors to talk and engage towards collaborative projects.[132] The programme has successfully enabled Irish maritime stakeholders to participate in EU funded projects. An

[128] http://www.gmit.ie/presidents-office/about-gmit/
[129] http://www.imerc.ie/pages/about.html
[130] According to an interviewee from the Irish Marine Institute
[131] The marine biotechnology programme is part of the Marine, Knowledge, Research and Innovation Strategy 2007 – 2013 ("Sea Change")
[132] http://www.marine.ie/home/research/SeaChange/NationalMarineBiotechnology/

example among others is the INTERREG co-funded project SHArEbiotech.net.[133] The project aims at connecting the research actors in the field of biotechnology in Ireland;
- Ireland's Offshore Renewable Energy Development Plan (OREDP) which describes the policy context for development of offshore wind, wave and tidal stream energy in Irish waters for the period to 2030;
- The National Renewable Energy Action Plan (NREAP), submitted in July 2010 to the European Commission and for which Ireland included a "non-modelled renewable electricity export scenario";
- the Ocean Energy Development programme comprising environmental planning, developing awareness and mobilising the supply chains of the other adjacent sectors, such as marine renewables, for instance;
- The White Paper: "Delivering a sustainable Energy Future for Ireland - the Energy Policy Framework 2007-2020", which sets out a number of strategic goals including a specific ocean (wave and tidal) energy target of 500 MW by 2020.

Policy needs identified

To acknowledge the context-specific approach towards Blue Growth, since there is no single governance level to role out Blue Growth. National actors can facilitate local and regional bottom-up initiatives. A strong research-driven approach can strengthen the means to create synergies on the ground; hence more research and funding (also EU) into particularly the nascent sectors would help.

6.3 Gulf of Venice

Characteristics of the region

The Gulf of Venice comprises the Italian coastline from the Po Estuary to Trieste, the complete Slovenian coastline and coastline of the peninsula of Istria in Croatia. As such it can be characterised as a transnational region.

It is a region with intense use of the maritime and coastal area, hosting several major ports like Venice, Trieste, Koper, Rijeka, and many smaller ports, which together generate around 100 million tons of freight and 4.2 million passengers per year. An intensive tourism industry is found along the entire coastline, but notably in/around Venice, eastward of Venice, along the Slovenian and Croatian coastline. Furthermore the region hosts a number of industrial complexes, amongst which large shipbuilding and repair yards in the coastal regions, notably in Italy: Porto Marghera (near Venice), Monfalcone, Trieste, but also Koper and Rijeka. Fishing vessels are operating from several smaller ports, aquaculture practiced at several places along the coastline.

At the same time, the coastal area in Italy consisting of coastal plains, wetlands and lagoons in Italy is an environmentally vulnerable area. The city of Venice and the Lagoon are particularly prone to flooding; an extensive project (MOSE project) is under execution aimed at flood protection of the city of Venice. The Croatian coastline is rocky, with many small bays and inlets of high natural value.

Main maritime economic sectors present and future potential

The area is characterised by a few well developed economic sectors that have been practiced there for decades if not ages: maritime transport, coastal industry (among others shipbuilding), coastal and cruise tourism and fisheries. Though these are rather mature industries, in particular maritime

[133] http://www.sharebiotech.net/case-studies

transport and tourism are still growing. Shipbuilding is fairly stable and fisheries are declining. New of developing sectors are not playing an important role in the region. Aquaculture is at some places being developed, partly replacing marine fishing. In the energy sector there is a small wind farm in the Gulf of Trieste and an offshore LNG terminal near Porto Levante.

Synergies and tensions

Synergies between the maritime economic sectors are not widely spread, and are found between tourism and fisheries. Apart from the fact that artisanal fishery ports often are great tourist spots, fishermen increasingly rent out their boats to tourists for fishing trips. Furthermore there are more established synergies between the maritime transport function and the shipbuilding and repair industry. Both activities have developed jointly and mutually reinforced each other, profiting from the strong maritime position of the region that dates back to the era of the Republic of Venice. Though somewhat eroded by globalisation of both industries, these synergies still exist.

A possible synergy that could be pursued is between coastal protection, aquaculture and tourism. Where currently coastal protection activities, to be funded by governments, is facing budget limitations, if well set-up, fish farming production could rise and additional revenues from tourism services may be realised. However cooperation between private sector and governments in this respect seems limited still.

Tensions on the other hand are faced across all sectors and all parts of the Gulf of Venice's coastline. The mainly relate to available space and pressures on the environment, which are caused by the intensive use of the coastline and the high levels of shipping services provided in the region. From an environmental perspective, particularly the Slovenian coastline space is under pressure: along the 47km of coastline one industrial port, several fishing ports and several marinas and touristic developments are competing for space. Environmental tensions related to tourism are due to pressure on discharges into the sea, construction developments for touristic purposes in environmentally fragile areas such as the Venice Lagoon, and sand extraction for supplementation of beaches. A particular tension is between flood protection (particularly the MOSE project) and the existing economic activities: tourism (notably cruise), maritime transport, fisheries and aquaculture in the Gulf of Venice may all be affected by the use of flood barriers. This tension is recognised in the project.

Several initiatives have been taken in this region. Examples are AdriaMET (weather forecast and environmental monitoring aimed at the navigation sector (fishing, transport, sports navigation), funded from the INTERREG programme, or AdriaMOB, funded under the IPA program and involving accession countries, on passenger transport across the region (see box below).

Box 6.2 the AdriaMOB

AdriaMOB - Sustainable Coast Mobility in the Adriatic Area
(February 2011 – January 2014)

Funding Programme: Instrument of Pre-Accession (IPA) CBC Adriatic
Project Duration: February 2011 – January 2014 (36 months)
Total Project Value: € 2,881,770
Website: http://www.adrimob-ipa.eu/

Partners: 18 project partners among which: PROVINCIA DI RAVENNA, PROVINCIA DI BRINDISI, PROVINCIA DI PESARO E URBINO, PROVINCIA DI PESCARA, PROVINCIA DI VENEZIA (ITALY), CITY OF ROVINJ (ISTRIA; CROATIA), PORT AUTHORITY OF BAR (MONTENEGRO), MUNICIPALITY OF RAB (CROATIA), MUNICIPALITY OF DURAZZO (ALBANIA), INTERMODAL TRANSPORT CLUSTER, RIKA (CROATIA).

Project Description:
ADRIMOB is defined taking into consideration the specific background and problems identified starting from the general overview on EU politics in the field of sustainable mobility, the analysis of the mobility situation in the Adriatic area, down to the specific state of art and problems raised by the partners in such field. Travellers are often discouraged to organise their journey by combining different means of transport because of lack of services, infrastructures, networking and efficiency. In this framework, sea mobility could play a crucial role, however it is still not enough enhanced and exploited although its unquestioned potential and cheapness comparing to the road transport (ref. White Paper on Transport).

The core issue is to adequately organise a proper system and connected services to allow a major use of multimodal transport toward a sustainable development strategy in the framework of the "Regional Strategy on Sustainable Development" adopted in the Mediterranean region in 2005 within the framework of the Mediterranean Action Plan, and the relevant EC policy and Directives.

The project has two primary objectives, 1) to structure and develop an infra-Adriatic system to allow and encourage the use of means of transport alternative to car, and 2) to plan an integrated strategy of sustainable transport to favour the sustainable movement of the increasing number of people travelling for different reason: work, tourism, business, etc.

This is translated into specific objectives, i.e.
1. Strongly encourage and favour the use of sea transport for passengers both between and along the coasts.
2. Strengthen and integrate the existing infrastructure networks and structure and promote new / complementing links between ports and inland areas.
3. Create new job opportunities.
5. Improve/strengthen the short-sea shipping sea routes.
6. Encourage the Public relevant Authorities in the Adriatic area to improve the quality level and the effectiveness of safety of navigation and protection of the marine environment in the whole Adriatic basin by implementing the relevant EC Directives aimed at achieving the development of sustainable maritime transport and traffic in the area.

Cooperation between stakeholders and existing structures

Several cooperation structures exist in the region. The major ports of the Northern Adriatic Sea – Venice, Trieste, Ravenna, Koper and Rijeka – have formed a port association named NAPA (North Adriatic Port Association) that promotes port cooperation and lobbies in favour of their interests. One of their main interests is to enhance inland connections and promote the Baltic-Adriatic Axis as a part of the Trans European Network. Furthermore more informal cooperation structures exist within mature sectors like the shipbuilding industry, with Fincantieri as a major yard being connected to hundreds of specialised suppliers.
Furthermore there are several fishermen cooperatives, which are (partly) responsible for the management of fishing grounds.

The international Cooperation in the Ionic-Adriatic area is particularly developed and it is further increasing (e.g. Trilateral Commission Italy-Slovenia-Croatia). The main reason is that the area is in a strategic position for the maritime traffic towards and from far and middle east.
Also cooperation through the Euroregione Adraitica (Adriatic Euroregion) takes place.

Box 6.3 The Fincantieri cluster

Shipyard Fincantieri, with its headquarters in Triest, Italy, is one of the largest employers in the Gulf of Venice, and one of the three European cruise ship builders, along with Meyer Werft (Germany) and STX (Finland/France). The company exists for over a century and has passed through several development cycles broadening or narrowing its activity base (e.g. in the past marine equipment activities were part of the group but later disposed of. One may discuss its competitive position as until recently Fincantieri was among the three only cruise shipbuilders worldwide, but Asian yards are increasingly challenging this position and have gained ground with two orders placed last year and more expected. As a mature industry facing non-EU competitors, a repositioning need is identified.

Still today, it purchases components and services from hundreds of suppliers located in the region, ranging from suppliers of carpets or furniture to high tech companies delivering engine, navigation or air condition technology. Fincantieri cooperates with them in a number of research & development and promotion activities. Its location is considered advantageous, having access to both high quality technology industries in the Italian Po Delta and skilled workers at still lower wage costs from the other side of the Adriatic. The latter advantage will likely fade away with economic growth and wage level increase in these countries.

The economic crisis and non-EU competition faced by Fincantieri is reflected in the numerous smaller enterprises that are working for them. In addition, there is also a social problem as many of previous Fincantirei workers were extra-Europeans and by losing their job they had to go back to their own countries.

In terms of promoting maritime economic activities, in Italy the regions of Veneto and Friuli-Venezia Giulia are instrumental in the sense that they promote their regions as attractive places for tourism as well as location for investments. This includes a maritime focus in the coastal regions, though not only. On the other hand it appears cooperation between the regions, or their provinces, is limited, instead each region developing ambitions on its own. Furthermore the regional chambers of commerce do play a role in promoting sectors, but a specific maritime strategy was not identified.

Governance issues

From the three countries that share the gulf of Venice, Slovenia is the most advanced in regulating to prevent arising conflicts at its limited territorial waters. The adoption of a National Marine Spatial Planning framework is designating specific areas for specific economic activities to prevent conflicts and unlimited spatial resources competition. Navigation corridors, ship waiting areas, artisan-fishing waters, saltpans etc. are some of the characterizations that are introduced. However, the other two countries are less advanced in this process, let alone designing putting priority on synergies between economic activities rather that averting conflicts alone.

Policies aimed at relieving the tensions between various activities or tensions caused by certain activities are increasingly tackled in a coordinated way:

- In Slovenia, the National Marine Spatial Planning Framework coordinates the various functions along the coastline;
- ISPRA (Institute for Environmental Protection and Research) in Italy has a specific office for the Venice Lagoon, aiming at maritime surveillance through monitoring and implementation of the maritime strategy;
- The MOSE project, aimed at protecting the Venice Lagoon from flooding, takes into account the effects on tourism, the environment, fisheries and maritime traffic.

There have been examples of coordinated policy development or exchange of information and best practices in the INTERREG programmes, such as the New Adriatic Proximity Plan (aimed at creating an Adriatic macro-region) and the Adriatic Action Plan 2020 (aimed at creating a more coordinated framework for sustainable development, rather than leaving initiatives spread over

various levels of coordination). From 2013 onwards, the Adriatic region will have its own EU financing source for cross-border cooperation development projects.
Another example showing regional cooperation is the European funded project SHAPE (Shaping a Holistic Approach to Protect the Adriatic Environment between coast and sea). This project includes study work on the relevance and dimension of the maritime sectors in the region, which will be completed by February 2014.

Policy needs identified

The region is facing a number of tensions between maritime economic activities with a spatial character. Hence further attention to the implementation of Integrated Maritime Planning is considered necessary. To do so, coordination between the regions, not only within Italy but also with those in Slovenia and Croatia is vital. INTERREG has proven to be useful in bringing these stakeholders at the table and might contribute to further steps as well.

6.4 Gdansk

Characteristics of the region

Gdańsk Bay lies within the Baltic Sea mainly on the Polish territory. The Bay is separated by the Vistula Spit. The Western part of the Bay is formed by the shallow waters of the Bay of Puck. The Pomerania region forms a large part of the Polish part of the bay (Cape Rozewie, Hel Peninsula). One of the key issues determining the climate of the Gdańsk Bay is the wind. Throughout the year most of the winds are West winds while in the summer there is also a significant share of North East and East winds. The wind strength is the strongest in the winter season. A specific type of wind that affects the climate of the shores is breeze.

Main maritime economic sectors present and future potential

For many years Gdańsk served as a major transport and trade node in Poland. In the 1960s and 1970s the traditional maritime industries were supported by the government and shipyards played an important role in the area's economy. The opening of the market and decline in the world demand for ships led to the decline of this industry. Initially a challenge for the regional economy this has led to diversification of the production and services offered in the region in a longer term. Construction of small luxurious yachts, motor boats and tourism development became extremely important for the voivodships (regions) of Pomerania and Warmińsko-mazurskie. New sectors show potential for development such as renewable energy and building of wind energy constructions. They are expected to show strong growth in the future and provide inclusive jobs.

The main economic activities in the region are:

- traditional maritime industry (shipbuilding shows decline & diversification, deep sea maritime transport and short-sea shipping show growth, passenger ferry services show small decline);
- energy and raw materials (onshore refinery of oil & gas is strong);
- tourism (coastal tourism, yachting and marinas show growth);
- coastal protection: protect habitats (increased importance and awareness).

Economic activities that show strong growth potential are offshore wind, ocean renewable energy as well as leisure, working and living (coastal tourism, yachting and marinas).

Synergies and tensions

The cities of Gdańsk, Gdynia and Sopot are all located in a very close proximity from one another. Each of the cities of the so called Tri-city is different from the other. Gdańsk is a well developed touristic base, has the largest port in Poland and has various historical monuments and traditions. Gdynia is a so called port city while Sopot is a typical touristic destination with beautiful resorts and

clean beaches. Together with the Hel peninsula, they form a combination of various economic activities in the region. This leads to economic spin-offs and spin-ons. A large number of stakeholders in a number of sectors are located in the area which provides opportunities for intensified cooperation and new initiatives development.
The ports are important employers in the region but they also lead to development of various maritime related sectors. These include logistics services development, refinery of oil products, fisheries and fish processing, etc. Additionally, the redevelopment activities of the old port buildings and areas take place in the region.
The shipyards have been restructured and some had been privatized. The role of their core business has decreased and the businesses have diversified. As a result of these changes, the current portfolio of the enterprises (formerly just shipyards) is much broader.
Finally, a synergy, if one would look at this in a time perspective, is between the declining fishery sector and increasing role of tourism with respect to yachting and marinas, using obsolete fisheries infrastructure. Many marinas have been constructed in the last two decades in place of or next to a number of small fishing ports along the coastline.
The regional Tri-city cooperation in various economic aspects between stakeholders plays a crucial role in the synergies development

The following tensions between the economic activities have been identified in the Gdańsk Bay economic cluster:

- development of port activities (port area expansion, sea traffic, inland traffic) versus protection of environment and habitats;
- potential capacity constraints in ports of Gdańsk (DCT) and Gdynia;
- offshore wind, ocean renewable energy development versus protection of environment and habitats;
- insufficient key personnel in logistics, lack of schools and logistics teaching programmes;
- maritime institutes have a strong position in the region (stronger than the Technical Universities or Economic Schools) which can create knowledge spin-offs as well as tensions between the academic centres.

Cooperation between stakeholders and existing structures

The regional cooperation is in the Gdansk region is considered an example of great success. The Tri-city governments (Gdansk, Gdynia and Sopot) together with the Pomerania Voivodship Marshall's Office are capable of creating maritime policy as well as of gaining political support for their initiatives both on national and international level. They also enable a framework for cooperation of various universities and research institutes such as the Polytechnic University of Gdańsk, the Maritime University in Gdańsk, the Institute of Oceanology[134] of the Polish Academy of Sciences (IO-PAN) in Sopot, the Maritime Institute in Gdańsk, the Institute of Oceanology of the University of Gdańsk, the National Marine Fisheries Research Institute in Gdynia, the Inland Fisheries Institute in Olsztyn. The Employers Association Ship Forum (industry), the Polish Chamber of Maritime Commerce (ports and transport) and the Polish Ship owners Association provide platforms for cooperation of businesses from their respective sectors. A relatively new initiative is the Polish Offshore Wind Energy Society that is active in promoting offshore wind and other renewable energy sources. The Polish Maritime Cluster Platform[135] creates a network for the members and associated partners and it includes near 100 individual experts from national and regional administration, business, and education.

[134] http://www.iopan.gda.pl/
[135] http://www.tci-network.org/cluster/initiative/3851

Governance issues

The Pomerania regional government plays an important role in ensuring favourable framework conditions for the region's economic development. The Marshall's Office, especially in the last few years, is very active and supports various sea related initiatives, port and transport infrastructure development, cluster formation, renewable energy development, knowledge sharing, etc. The role of the regional government is broader than the region itself. The government has strong leadership and well established ties with the national government. This ensures a faster implementation of various regional or local initiatives that require decision at the national level. Finally, the regional government is also active in a number of international initiatives focused on the development of Baltic Sea region (Baltic seaway and international corridors).

The strong regional cooperation and active individuals on both regional and national level led to successful implementation of a number of initiatives, examples include:

- An agreement aimed at development of the international inland waterway E-70 was reached (July 2011)[136];
- The National Centre for Baltic Studies, created in 2011[137];
- An agreement on the development of the inland waterway E40 (relevant section between Gdansk – Warsaw) between the Voivoidship´s Marshalls[138] in March 2012;
- On the 16th of March this year, 48 institutions signed an intention letter on the creation of Pomeranian Group of Cluster competences[139] aimed at further development of the existing synergies in the region within and between different sectors;
- In April 2012 a new Maritime Scientific Consortium was initiated - an agreement of five scientific institutes in order to conduct joint research focused on the protection of Baltic Sea waters and the use of the marine resources[140].

Policy needs identified

Strong development of competences is crucial is in the area of fast developing logistics services (storage, transport, freight forwarding, supply chain management, etc.). A renewal of the engineering and technical capacities potential is also needed. The focus should be put on the design and sea based skills (the exception is sea-farers).

Policies not yet addressed

- creation of a logistics competence centre;
- efficient use of rail and inland waterway links mainly between Gdańsk and Warsaw;
- creation of a rail link between Gdańsk and the East (Kowno/kaunas).

Lessons to be learned - what is transferable from Gdańsk to the rest of Europe

- Important role of the regional government and its leaders;
- Baltic Sea cooperation with other countries;
- Diversification of industry and services.

[136] http://www.elnews.pl/index.php/artykul/pokaz/1268
[137] http://www.ocean.ug.edu.pl/pages/posts/2011.07.05-br-narodowe-centrum-badan-baltyckich-ncbb---spotkanie-5.07.2011-r-101.php
[138] http://www.kujawsko-pomorskie.pl/index.php?option=com_content&task=view&id=20978&Itemid=1
[139] http://innopomorze.pomorskie.eu/aktualnosci/pomorskiej-grupy-kompetencji-klastrowych-powolana.html
[140] http://www.pi.gov.pl/PARP/chapter_86197.asp?soid=532B93D613124A529B855C216A6C5E59

6.5 Oostende

Characteristics of the region

The cluster addressed is largely concentrated in and around the port of Oostende and as such can be characterised as a local cluster. The Port of Oostende is situated in Europe's busiest maritime area on the Belgian North Sea coast.

The port of Oostende has shown several cycles of growth and regression over the past decades. At the end of the 90s, initiatives were started to revitalize the port area. In 1997 a new autonomous port authority was set up. Since then, the port has been modernised in both infrastructure and organisation and it is now a leading force in the industrialisation of the hinterland. Since 1997, 27 new companies were established in the area, creating 1500 jobs. The overall added value of the maritime cluster of the port of Oostende is estimated at € 120 million in 2010 (Allaert, 2012). Since the end of the 90s the port of Oostende has successfully focused on renewable energy, both offshore and onshore.

In recent years, since 2008, the more traditional maritime activities (maritime transport, passenger transport) are shrinking as a result of the economic crisis. Oostende has an unemployment rate of 9.5%, higher than the average in Belgium which is 6.5%. In the tourism season however, the demand for employees cannot be fulfilled locally and workers are attracted from northern France (source: interview).

Main maritime economic sectors present and future potential

Oostende is a typical distribution port; all goods are for intra-European distribution. Oostende serves primarily as a gateway to the UK. Port handling increased from 3 million tons in 1999 to 8.5 million tons in 2008 (Port Oostende, Allaert 2012), but since then has declined to 3.8 million tons in 2011. Similar trends are visible in RoRo, numbers of passengers and number of containers – container transport has stopped altogether in Oostende since 2008.

The port and city of Oostende offer all the right ingredients for a successful cost effective turnaround call for visiting cruise ships: an easy access to the berths at all tides, no locks, no sailing on narrow inland canals, an attractive though small historical city, and attractive tourist destinations like Brugge and Gent nearby. The number of calls declined sharply from 2009 to 2010, from 13 calls / 3814 passengers in 2009 to 6 calls / 1740 passengers in 2010. For 2011 and 2012 these numbers were expected to increase again.

The port of Oostende is making a considerable effort to facilitate investment in renewable energy, both for off-shore and on-shore application. The port is making land and infrastructure available for construction, assembly, storage, distribution and maintenance of renewable energy projects on among others wind farm components. These efforts have been quite successful; the construction of windmills on the Thorntonbank in the North Sea has brought an entirely new industry to Oostende. Investments are made by several consortia; some of them based in Oostende, others in Zeebrugge, among others C-Power and Greenwind. The port of Oostende has invested in a new infrastructure on the East Banks of the port, which made it possible to construct and transport the windmills to sea. New projects are planned in the future. Total investments amount to 1.3 billion euro up to date, creating some 260 jobs (150 in construction and 100 to 120 in operation and maintenance). Planned total investments amount to 10 billion euro until 2017/8. For the longer term, the port of Oostende aims at keeping an important role in operation and maintenance. Yearly expenditures on operation and maintenance are estimated at 5% of invested value (interview), eventually leading to a yearly turnover in this sector of 500 million euro, and a permanent employment of 600 to 800 fte's, many of which high-skilled.

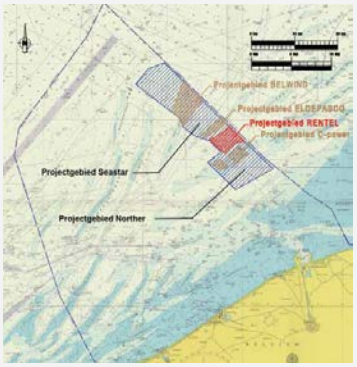
Oostende also houses research and development facilities for wave and tidal energy. Amongst others DEME-Blue Energy is investing in renewable development in Oostende. Experimental set-ups for wave and tidal energy conversion have been or are being installed. However, these activities are still in an early stage of development. Furthermore the link is being made with other, land-based types of renewable energy, and the whole renewable energy sector is supported by the Greenbridge innovation and Incubation Centre which focuses entirely on renewable energy.

Overall, it is estimated that coastal tourism is the most important maritime economic activity in Oostende, though this seems hardly to be interconnected with the above activities. Also this sector has faced a period of decline, but this trend has been turned around by developing into a 'four-seasons destination', by organising off-season activities, indoor activities such as shopping facilities, museums, an aquarium, and by restoring historic sites and buildings. Some examples are Earth Explorer, Fort Napoleon, the Casino Kursaal, the Sea heroes square and the restored Venetian Galeries.

Fisheries in Oostende have declined over the past decades, from about 200 vessels in 1960 down to about 25 in 2010. There is little marine aquaculture activity in Belgium. Developments in algae growth must be regarded in connection with the development of a bio-based economy, use of biomass for fuel and high-value products, both land- and sea-based. Co-operation between several Flemish government departments to develop a Flemish bio-economy strategy has started. Another recent development is the FISCH project (Flanders strategic Initiative for Sustainable Chemistry), part of which focuses on bio-based chemistry, with a branch to the marine environment for algae, enzymes and metabolites.

Box 6.4 Offshore wind development

The project "Thorntonbank" of the company C-Power consists of the construction of: 60 turbines of 5MW on the Thorntonbank 28.7 km from the Belgian coast in water depths of 12 to 27.5 m. The first 6 windmills were constructed in this area in the period 2007-2008, and made operational in 2009. Another four project phases are due to follow by 2013. Phase 2 implies the construction of 24 windmills and another 24 windmills are foreseen in Phase 3.



The windmills are transported from the construction area to a specially constructed quay with a high bearing capacity. From there on, the foundation is lifted by a work platform and then the entire platform with foundation is towed away with a tug to the exact location on the Thornton bank. The wind farm will have an installed capacity of up to 300 megawatts and is expected to produce around 1,000 gigawatt-hours of electricity per year. This volume is sufficient to meet

Construction activities for off-shore windmills (source: Port of Oostende).

the requirements of about 600,000 people. It is to be equipped with 60 turbines of the 5 megawatt class. The wind farm will meet a substantial part of the development targets of the Belgian government for renewable energies.

Synergies and tensions

A number of synergies have been identified, of various types:

- directly between two maritime activities: offshore wind and wave / tidal current energy sharing platforms and know-how , coastal tourism and coastal protection served by broadened beaches or even islands , offshore wind and fisheries sharing platforms;
- via improvements by the national or Flemish government or by port authorities of shared framework conditions: e.g. road infrastructure. high-load quays which can be used by several sectors;
- via shared research and development efforts;
- from land-based to sea-based technologies and skills, e.g. the application of geotextiles in the offshore industry;
- within a maritime activity, by building sufficient mass, which stimulates developments and helps to extend the value chain;
- from scale to scale: from offering functionalities at municipal or regional level to upscaling to provincial, national, EU and even global level. An example are the data services provided by Vliz, the Flanders Marine Institute;
- a special case of scale to scale synergy is the co-operation between regional ports as investigated in the INTERREG/PATCH project (stimulating co-operation between 9 regional ports) and the Zeebroos initiative (promoting the co-operation between the ports of Zeebrugge and Oostende);
- a major challenge is to fully exploit the potential synergies between existing port-related SME's and the large, internationally operating enterprises involved in renewable energy.

Box 6.5 The PATCH project (INTERREG IV A 2Seas Programme)

PATCH

Ports Adapting to Change

(2010 – 2012)

The ports and logistics industries are the economic backbone of the 2seas-area. The Patch project aims to ensure their continued contribution to the GDP of the participating countries by making them more resilient to change, more responsive to entrepreneurship/innovation, and adaptable to market changes.

Project Description:

Internally, ports need to focus on high added value operations, fast track investments, by modernizing the infrastructure. Externally, ports overall competitiveness must be increased to be attractive for all users. Therefore, PATCH focuses on the improvement of the quality of the management of the ports, the enhancing of the diversification of economic activities in ports and the improvement of the quality of the logistic operations on both landside and seaside.

Results:
The project has supported the ***management in ports*** by facilitating:
° staff exchanges among the participating partners (management and technical staff);
° an eLearning platform, including live training sessions and videos;
° a number of specialised cross-border workshops on PPP&SPV, energy efficiency & eco-innovation, renewable energy and offshore wind farms, master planning;
° summary papers of technical reports on various port-related issues (cold ironing, sustainable energy saving and energy re-use in ports) and video interviews with external experts on diverse subjects (marketing, anti-silting systems, master planning);

Ports play a significant role in delivering the EU ***Renewable Energy Policy*** objectives for 2020 and beyond. PATCH has provided opportunities for the partners to benefit from cross border sharing of expertise, benchmarking new technologies and techniques and lead the way with demonstration projects that are resource efficient, economic and sustainable.

Through workshops and fairs, collaboration has been established with professionals from the UK, France, Belgium and the Netherlands to promote innovation and demonstration in the fields of energy efficiency, waste, smart metering, small scale renewables, kinetic energy generation as well as intelligent information to travellers and hauliers to reduce emissions and costs.

The ***port and logistics industry sector*** has become a truly global business. PATCH has implemented measures and small scale investments which improve the quality of the logistic operations in their port areas, on both landside and seaside, i.e.:
° optimisation of the inner-port infrastructure capacities, including sustainable warehousing and quay development;
° identification of pilots and joint development of management-systems for inter-modal infrastructure in ports (rail, inland waterways);
° development and innovation of the outer-port infrastructure (pilot actions to improve the effectiveness of the cross-border logistic gateways).

Finally, the PATCH project has provided opportunities for its partner ports to support and collaborate with the ***maritime industry*** via:
° trans-national Business to Business events and stakeholder engagement which cross-link relevant sectors (energy, transport, logistics,) and can boost economic growth;
° investment in R&D, skills, training, eco-innovation;
° research into the value and agglomeration benefits of marine clustering, as well as the drivers for business attraction and foreign direct investment within the marine sector.

The main tensions that have been identified are:

- spatial tensions on the sea, due to the limited size of Belgium's EEZ;
- spatial tensions on land, as a result of competition for space between the various port-related economic activities.

Cooperation between stakeholders and existing structures

Four main organisations have been identified that are instrumental in cooperation between stakeholders in the Oostende maritime cluster.

The Vliz, the Flanders Marine Institute, founded in 1999 aims to establish a platform of services (logistics, data) for the research community. This turned out to be very successful and has gradually extended to European and even global level activities, housing the secretariat of the Marine Board, and facilitating the coordination activities for data and standards for UNESCO-IOC (International Oceanographic Commission)-IODE (International Oceanographic Data & Information Exchange. Other major activities are the management of the Flanders Marine Data and Information Centre (VMDC), the Infodesk, the Sea Library and the research vessel 'Zeeleeuw'.

The Flanders Maritime Cluster (FMC) was founded in 2010, driven by Belgian dredging companies (Jan de Nul, DEME) who realise that they needed to combine their marketing expertise and efforts to win big contracts, and to find ways of keeping people at work and niche activities alive and build on the development of new markets, such as wind energy, offshore, communication technologies.

The Coordination Centre for Integrated Coastal Zone Management in Belgium is a point of contact in the coastal zone where cross-sectoral themes are discussed. Its mission is to stimulate the sustainable management of the Belgian coastal zone.

Greenbridge is the West Flemish science park of Gent University, located in the outer port of Oostende. It houses the Greenbridge incubator that supports specifically high-tech start-ups and spin-offs in the development of their enterprise.

Furthermore there are several other initiatives to support cooperation, such as informal meetings organised by FMC, the set-up of the INTERREG IVA project PATCH (Ports Adapting to Change), and Zeebroos, a bilateral initiative towards closer cooperation between the ports of Zeebrugge and Oostende.

Governance issues

It is important to recognise the specific governmental arrangements in Belgium between the levels of the Federal State and the Flemish Region, which have their impact on sea-related management.

Because the levels of federal State, Region, province and municipality all have their specific roles and responsibilities in the coastal area, organising decision making on coast-related matters is sometimes complicated.

Policy needs identified

- Access to finance is an important issue. The port of Oostende, being a small port, finds it difficult to get EIB funding, while national funding schemes are slow.
- Availability of trained and skilled personnel, required for the construction, operation and maintenance of offshore wind farms, is already a constraint. And one which is expected to increase in the future. Policies aimed at both education of new employees and at re-schooling personnel from adjacent sectors (e.g. SME's active in fisheries) will be beneficial. Initiatives aimed at re-schooling available personnel should take good notion of existing cultural differences and address them, because such differences were identified as a bottleneck (interview);
- Adapt EU regulations to the potential of individual ports;
- A lot of progress can be made by connecting people. Efforts in that direction should be stimulated. Consider the development of some guidance in order to safeguard direction and momentum.

6.6 Overall findings and messages to transfer to other regions

The case study analysis on Ireland, Gulf of Venice, Gdansk and Oostende point once more to the enormous variety of maritime economic activities on the ground. The fact that so many of the maritime economic activities as described in Chapter 3 are effectively in operation across such different parts of Europe confirms that the potential for Blue Growth is real.

Traditional versus new sectors in place

In Gdansk and Venice, the importance of traditional maritime sectors like short-sea and deep sea shipping, a number of industrial complexes as well as cruise tourism is high and dominating over sectors that have developed more recently. In Italy the role of 'new' sectors is particularly small compared to the other clusters, and one may question the need for a diversification strategy to increase resilience against future decline scenarios. In Galway and Oostende the role of traditional sectors is much smaller (although a sector like coastal tourism is large everywhere) and developments are largely driven towards a further increasing development of new sectors like ocean renewable energy and blue biotechnology.

Synergies – mirage or miracle?

The main aim of this cluster analysis was to identify synergies which are taking place already. However, the analysis shows that the synergies identified are not as strong and impressive as we would have hoped for.

This can point to two different possibilities. The first possibility is that the potential for synergies is actually limited in practice. This could be the case as the maritime economic activities are self-supporting and stand-alone activities, which do not need to take advantage of other maritime economic activities. However this argumentation is not supported by the evidence from this study, as well as the strong views of experts as expressed throughout our work. Which brings us to the second possibility, a much more likely one: the potential and need for synergies between Blue Growth activities is large, but it remains underexploited due to a pillarised-sectoral approach which is seen as the traditional way of doing maritime business. The policy implication of this reasoning is that specific tailor-made initiatives need to be taken at local, regional, national or transregional level by those who have the competence and overview to lead or to facilitate.

The impact of economic decline periods on renovating the economic growth base

Several regions have faced economic decline in the past, causing high levels of unemployment and forcing the regions to search for alternative job creating activities. Oostende is a clear case of this where a strategy was developed in the 1980s after the decline of the traditional maritime sectors, to build a new industrial structure based on sustainable energy and biotechnology. Research institutes located in the city were pivotal to this. In Gdansk, a similar situation is seen after the liberalisation of the Polish economy in the early 1990s, and EU accession in 2004. Mature sectors in place like the ferry sector and the shipbuilding industry have (at least partly) been able to transfer to other sectors such as the manufacturing of luxury yachts and wind turbines, while short-sea shipping connections with western European mainports have helped to rebuild the port sector. In Ireland, the decline of the fisheries industry also triggered the development of a strategy to develop new maritime sectors in the country. In Italy economic decline periods have been of much less influence, which may be explained by the development of the tourism sector in the 1980s largely compensating for the loss of jobs in other traditional maritime sectors.

Geographic level of cooperation

In a country like Ireland a strong national guidance is found with national strategies in place from which the Galway region can benefit. In Italy the regional governments are more important especially with regard to spatial planning issues, whereas in Oostende the developments are strongly locally steered. In Poland, an in-between situation seems to be in place with Gdansk and Gdynia together with Sopot cooperating with the Voivodship and with gradually strengthening ties with the national policy makers. Furthermore the region is very actively participating in Baltic Sea cooperation partnerships and projects.

Secondly with regard to geography, in some regions strong intra-regional cooperation is found, as is the case in Poland where Gdansk and Gdynia ports are cooperating actively and each playing their role with regard to strength of the one port vis-à-vis the other. In Italy this is much less found with low levels of synergies between Venice and for other regional ports like Triest or Koper found.

Policies in place to support synergies within the cluster regions

In both Oostende and Galway, the strategy to develop emerging sectors, driven through the establishment and support of research institutes 'pulling the wagon', has turned out to be successful by creating critical mass in the region.

In the tri-city region of Gdansk, Sopot and Gdynia, an active voivodship policy to develop a Pomeranian maritime cluster has been set-up. Furthermore there are plans to improve rail and IWT links with hinterland regions, notably the Warsaw area. In Oostende the cluster is rather well developed as is the case in Ireland. In Venice, no well-developed cluster supporting cross-sectoral cooperation seems to be in place.

In Oostende, the INTERREG programme has been helpful and the PATCH project is noteworthy to mention as a mechanism to promote synergies between regional ports.

Addressing tensions – a vital part of managing Blue Growth

Competition for space is an issue in all regions, and seems most problematic in the Gulf of Venice, where coastal tourism competes with all other activities on an intensively used coastline. The problem is most urgent on the Slovenian coast where on a stretch of only 47km all activities are to be accommodated. Furthermore the coastline is vulnerable to erosion. Besides the provinces developing spatial plans – largely separating activities – the dedicated institutes of ISPRA (in Italy) and NMSPF (in Slovenia) coordinate and monitor developments. The MOSE project aiming to protect the Venice Lagoon is a specific addition to this.

A call for Blue Growth leadership

As a corollary, there is a need to acknowledge the need for leadership, for Blue Growth to be advanced in practice. An obvious starting point when looking for such leadership is port authorities, which in many ways are well-suited to promote Blue Growth. However, it would be too easy to assume that port authorities are always best placed to do so. After all, it is unclear whether they would have the incentives/means/mandate/culture to do so. For many of them, it may be more attractive to stick to core activities and to continue business as usual, rather than embarking on diversification and new activities without clear returns. The incentive for smaller, secondary ports to do so appears to be larger, especially in the case of radical change or crisis (e.g. Oostende). Pinpointing Blue Growth to one geographical level seems therefore not the right thing.

However, the case studies point to the fact that this leadership can come from various organisations, such as a research institute (Ireland), a region (Gdansk), or a port and city (Oostende). We have focused on a city (Oostende), region (Gdansk, Galway), and a transnational region (Venice etc.). At the same time we need to acknowledge the importance of national level (Ireland!). The underlying dilemma seems to be that Blue Growth requires critical mass, which can rarely be found in a limited geographic area – hence the push for local actors to upscale and focus on wider territories – however without a clear governmental structure, these are unlikely to be cohesive areas that really produce synergies.

A good starting point for bringing Blue Growth to Europe would be to organise a specific communication campaign, stimulating Blue Growth platforms and initiatives, and accrediting already existing initiatives. These need to be part of a more comprehensive policy agenda, which will be elaborated in the next Chapter.

7 Ways forward: areas of intervention and policy rationale

As shown in the previous chapters Blue growth offers a true potential for Europe. At the same time is has become clear that it does not materialise automatically and that there is a clear justification for further policy actions. It has also became clear that these actions do require strong local and regional involvement as the Blue Growth potential is strongly driven in clusters throughout Europe. This chapter further elaborates on the way forward and the different areas for intervention.

7.1 An emerging policy rationale for Blue Growth

A Maritime pillar of the Europe 2020 strategy

As an elaboration of Europe 2020, a Blue Growth strategic framework is ideally suited to promote future maritime economic and employment opportunities through the lens of smart, sustainable and inclusive policy actions. At the heart of Europe 2020 as an overarching policy framework are knowledge and innovation, the promotion of a more resource efficient, greener and more competitive economy and the need for fostering a high-employment economy delivering social and territorial cohesion. Key to Blue Growth are the Europe 2020 Flagship initiatives, which are now in the stage of implementation.[141] In this respect, of particular importance are the Flagship Initiative on the Innovation Union (including the Horizon 2020 and the new Cohesion policy proposals including those on the European Maritime and Fisheries Fund) and the one on a Resource efficient Europe (including the modernisation of Europe's electricity and gas networks, the phasing out of environmentally harmful subsidies and advancing green taxation). Also relevant are the Flagship on "An industrial policy for the globalisation area" (including the Action Plan to improve Access to finance for SMEs[142]) and "An agenda for new skills and jobs" (including Life-long learning policies and the EU Skills panorama). Also vital for the implementation of Europe 2020 will be the involvement of local governments and regions, as highlighted already before by the Committee of Regions.[143]

Blue Growth can contribute to the 'Growth and Jobs' ambition. However, the Europe 2020 strategy alone may not provide sufficient guidance on how to focus the strategy. Hence a Blue Growth policy framework needs to create this focus in order to give a precise policy steer. Most jobs in the short term are expected to be generated in coastal tourism, for instance, but will they be sustainable? If sustainability is the main focus, then it would be better to focus on offshore wind or ocean renewable energy. If the aim is to focus on added value, then it is better to promote oil & gas, while it would be advisable to focus on blue biotech if a long-term focus is adopted.

Member States already take a range of initiatives

Blue Growth can not be seen as an exclusively EU-affair. To the contrary, the successful development of the Blue Growth initiative depends for a large part on existing and new initiatives supported by Member States. The previous chapter has pointed already to a number of maritime clusters, some of which forming an integral part of national development strategies.The Scottish offshore energy cluster, for instance, is part of a national ambition to push forward the renewable

[141] See EC (2011) Progress Report on the Europe 2020 Strategy – Annex to the Annual Growth Survey 2012. COM(2011) 815 final

[142] EC (2011) An Action Plan to improve access to finance for SMEs. COM (2011) 870

[143] See for instance the Committee of Regions publication (2009) on Building a European culture of multilevel governance.

energy sector. By the same token, Brest, as the largest French maritime clusters, plays a pivotal role in the implementation of the "Pôle de competitivité mer".

By way of example we could also mention other Blue Growth-related initiatives, such as the programme on Integrated Mapping for the Sustainable Development of Ireland's Marine Resources (INFOMAR). An equally good example is the refurbishment of the German Bremerhaven port, allowing it to cater to the needs of manufacturers and suppliers in the offshore wind industry.

The specific rationale: Need to explore maritime synergies

Next to the overall policy rationale a specific rationale exists to develop a Blue Growth strategy, which focuses on creating maritime synergies. Maritime synergies take place in situations where several maritime economic activities combined are likely to produce more growth and jobs than the sum of their parts.

Experts consulted during this study unanimously agreed that synergies are expected to benefit maritime economic activities, especially where these continue to be 'pillarised'. Numerous examples of such synergies can be provided. Such synergies are particularly important for maritime economic activities which are in (pre-) development stage or in case of a lack of critical mass. Benefits can occur in the form of additional income sources, sharing of costs, sharing of services and infrastructure, etcetera.

Europe's ability to compete and have future success in maritime economic activities such as cruising, offshore drilling, offshore wind, marine mineral extraction and short-sea shipping will have important knock-on effects for both upstream and downstream suppliers. Success in rolling out tomorrow's maritime economic activities will therefore have a positive impact on a whole portfolio of other maritime economic activities, especially those of a cross-cutting nature such as shipbuilding, maritime monitoring and surveillance, and blue biotechnology. Value chain analysis also provides concrete possibilities to improve the sustainability of maritime economic activities, e.g. by incorporating 'cradle-to-cradle' thinking; this makes value chain analysis an interesting tool not only for the current study but also for subsequent policy analysis.

Many synergies are *spatial* in nature, and based on the concept of clusters. Clusters are traditionally defined as "geographic concentrations of interconnected companies and institutions in a particular field". Clusters encompass an array of linked industries and other entities important to competition (e.g. suppliers, customers, companies which share inputs, but also governments and other institutions such as universities and trade associations." Although such clusters have a lot of commonalities with value chains, they are spatially concentrated and, and as such they include framework conditions, including infrastructure, labour markets, specialised institutions.

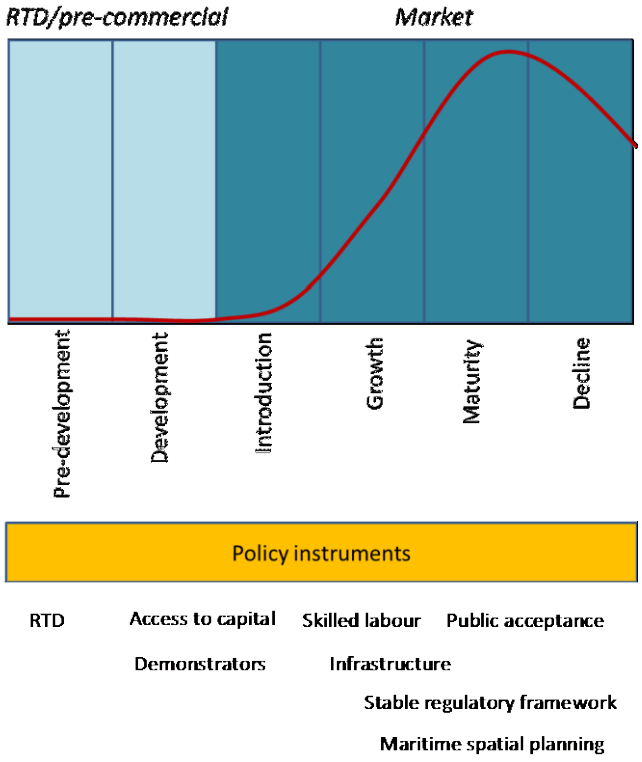
At the same time tension between economic activities clearly occur. The analysis of a number of regional clusters has shown that especially spatial tensions are relevant, although these can take various shapes, ranging from the inertia caused by vested interests, to competition for space, or impacts of certain economic activities on the performance of other activities. Also related to tensions offering the appropriate framework conditions and to avoid or mitigate obvious tensions.

Policy interventions can help to improve such framework conditions, and to tailor them to the specific needs of a cluster. Blue Growth requires a range of framework conditions to be fulfilled: adequate infrastructure (including transport infrastructure, but also high-voltage and cross-border electricity grids), high-skilled staff as well as access to low-skilled workers are amongst the obvious ones. But public acceptance, a solid international legal framework regarding the international waters, and good governance at local and regional levels are essential as well. At the same time

choices need to be made as it become clear as not all activities can be combined and space is not unlimited. This requires clear (maritime) spatial planning and spatial developments initiatives.

The Blue Growth study has demonstrated that the importance of framework conditions varies by economic life cycle or development stage of the maritime economic activities concerned (see Figure below).

Figure 7.1 Economic life cycle and its relation to policy instruments



Addressing these framework conditions will become an important subject for discussion and subsequent action if Blue Growth is to be realised in Europe.

On the basis of this rationale, and in order to promote Blue Growth, policy initiatives focusing on framework conditions will need to focus above all on support to the pre-development and development stages of the Blue Economy, such as blue biotechnology and ocean renewable energy. Such a policy will need to focus on access to capital, RTD and support to demonstration projects.

On the basis of this rationale, additional policy initiatives will need to focus on support to specific value chains and clusters. By definition, both synergies and tensions of a spatial nature lean themselves better for policy support, e.g. through maritime spatial development and promoting integrated local development strategies. Specific attention would also be needed for support to public engagement, allowing citizens and other stakeholders to contribute to Blue Growth in ways that are most appropriate from their own governance perspective.

7.2 Towards policy aims

The policy aims for Blue Growth flowing from this rationale are as follows:

General aim: To promote smart, sustainable and inclusive growth and jobs in Europe's maritime economic activities, both in the short, medium- and longer term.

Specific aim: To promote synergies and foster framework conditions in support of specific maritime economic activities and their value chains, with a particular focus on activities in the (pre-)development stage, and targeting the level of sea-basins, maritime clusters and localities.

Main areas for policy fields that follow from these aims are:

I) Promote maritime Research & Development;
II) Boost access to finance;
III) Invest in smart infrastructure;
IV) Provide cluster support;
V) Anticipate maritime skills needs;
VI) Promote maritime spatial planning;
VII) Foster integrated local development;
VIII) Stimulate public engagement.

These areas for policy action do not point to the needs of much additional regulation, but rather to offer the appropriate set of framework conditions to facilitate Blue Growth and to trigger activities to happen.

Each of these policy actions will require coordinated action at multiple levels of government. The below overview (Table 7.1) indicates which levels are relevant for each area of intervention.

Table 7.1: Indicative overview of policy actions and the government levels most involved

Level of government Policy action	a) EU- level	b) Member state level	c) Sub national/ sea-basin/ regional level	d) Local level
I) Promote maritime R&D	**X**	**X**	**X**	
II) Boost access to finance	**X**	**X**	**X**	**x**
III) Invest in smart infrastructure	**X**	**X**	**X**	**x**
IV) Provide cluster support	**x**	**x**	**X**	**X**
V) Anticipate maritime skills needs	**x**	**X**	**x**	**x**
VI) Promote maritime spatial planning	**X**	**X**	**X**	**X**
VII) Foster integrated local development	**x**	**x**	**x**	**X**
VIII) Stimulate public engagement	**x**	**x**	**X**	**X**

7.3 Emerging policy actions

Policy field I) Promote Maritime RDI

Policy rationale

New sources of growth are triggered by continuous innovation. At the same time innovation activates labour productivity improvements which have a direct impact on economic growth. Hence research, development and innovation are at the heart of any Blue Growth strategic framework. The EU has excellent academic and scientific capacities in the economic activities analysed, but shows

considerably less commercial power to embark on these, as illustrated in section 2.4 and annex 2, which contain an analysis of patents and bibliometrics (publication and citation) of Europe versus other countries in the world. This problem is considered to be a European 'innovation deficit': European firms are to a large extent present in more traditional, less R&D intensive sectors while investment needs are strong in more innovation-based growth sectors, for which there are lower market prospects and which are held back by an incomplete Single Market.[144]

The level of business innovation can be measured by various indicators, including the number of publications and citations, the number of patents, R&D spending by companies etc. In addition it is important to identify knowledge intensive services and innovative and high tech sectors within the total economy as these are often triggers for future growth. Finally, (inter)national collaboration networks on R&D can be mapped as these create insight in existing innovation networks.

Young firms are at the heart of innovation. Also maritime activities in the developmental stage are mostly carried out by small companies, spin-offs or suppliers which are strapped from cash, wary to share knowledge, and unable to control the value chain. EU-players tend to linger in this developmental stage longer than strictly necessary, while non-EU players (often backed by their governments) tend to invest more and faster in these developmental stages (e.g. the US investing in micro-algae, China in desalination techniques, Japan in mining rare earth from the Pacific, etc.). In addition, in certain maritime economic activities, e.g. Blue Biotechnology, the number of private sector players and especially SMEs is limited; this limits their ability to take part in larger (public) research programmes.

Although publication data show a strong position of Europe in many maritime activities, maritime research research is fragmented in Europe: actors are not fully informed on all relevant R&D, or fail to share with others due to lack of trust. Industrial players with strong in-house capacity are keen to protect their intellectual property rights and to capture the benefits from their own research. Also R&D support at the level of Member States is not always conducive to pan-European cooperation.

As mentioned the main barrier for the EU is to get from research to development and innovation. In this respect upscaling and testing new applications and innovations is a major challenge. But also the lack of a clear market orientation in the development stage is in many cases an impediment to market introduction.

Clearly, there is no 'one size fits all' business model for promoting maritime R&D and translating research findings into development and innovation, due to the diversity of subjects, sectors, innovation capacity and existing collaboration patterns.

Ongoing Policy initiatives

Specific policy attention to maritime research has been paid in the form of the European Strategy for Marine and Maritime Research.[145] The approach is to take concrete measures and mechanisms to improve the efficiency and excellence of marine and maritime research in order to address the challenges and opportunities presented by the oceans and seas. The strategy acknowledges that a purely sectoral and thematic approach to research is no longer sufficient.[146]

[144] COM(2011) 815 final, p.5.
[145] COM (2008) 534
[146] COM (2008) 534

Concrete measures taken since are the initiatives taken within the current EU RTD framework, notably through the 'Ocean of Tomorrow' programme, which provided specific calls in 2010 and 2011 already. "The Ocean of Tomorrow 2012" initiative is consistent with the two previous cross-thematic calls FP7-OCEAN-2010 and FP7-OCEAN-2011. The Ocean of Tomorrow programme aims to address research gaps about the definition and monitoring of the "Good environmental status of EU waters" to be achieved by 2020. It also gives particular importance to mitigation measures and to SME involvement as appropriate. The programme takes as a starting point that coordinated topics require a multi-disciplinary approach, and the involvement of a range of scientific and technological fields, including industrial partners and SMEs. The current (2012) programme has a budget of € 42 million, most of which dedicated to the Theme Food, Agriculture and Fisheries and Biotechnology (€ 25 million) followed by Environment including climate change (€ 13 million). [147]

With regard to future R&D funding, the Horizon 2020 proposals aim for a single specific programme and a single set of rules for participation and dissemination. It includes as key novelties the simplification of procedures, an inclusive approach open to new participants outside of the mainstream, integration of funding from idea to market and more support for innovation and activities close to the market and business opportunities addressing 'societal challenges'. [148]

Additional Blue Growth Initiatives

Within the above context, additional Blue Growth Policy Actions are suggested to focus on the development of a structural approach that could further promote Maritime R&D but also enhance business innovation. Experts and stakeholders consider it important to have an open approach to maritime RDI, and to not over-specify from a top-down perspective – as it will prevent synergies to take place. Other points of attention for ensuring that Blue Growth can take full advantage of the new Horizon 2020 programme:

- A need to create critical mass in R&D funding. Possibilities in linking up EU, MS and private funds in a better way should be further explored. Also establishing appropriate collaboration R&D networks remain important, possibly around a innovation theme, as this addresses the current fragmentation in European R&D;
- A specific point would be to address synergies already in the R&D stage (e.g. inventions that can benefit multiple economic sectors). This enhances the potential benefits (and hence increase the chances on follow-up) plus aids cross-sectoral knowledge transfer and creates new collaboration networks;
- Going from R&D to Innovation/Implementation. Various aspects play a role ranging from more general issues such as the promotion of entrepreneurship in general to a need to close the funding gap (in the process of commercialising research findings). As such R&D should be linked to 'Access to finance' recommendations. The angle can be two ways: aiding R&D outputs/stakeholder to the follow-up funding source (e.g. Structural Funds), and also vice versa targeting R&D topics more under the SF programme;
- R&D should not be seen just with a sectoral or functional scope, but also more generally with regard to environmental impacts and eco-systems to address the sustainability element of R&D;
- Monitoring role of government (providing data etc.) also in relation to R&D, but also support specific R&D activities in sector that are seen as promising; In addition, business innovation in general should be monitored and supported where necessary, as long as normal completion rules are being abided to;

[147] See Ocean for Tomorrow 2012 info day slides: http://ec.europa.eu/research/agriculture/ocean2012/pdf/jacques_fuchs-presentation-infoday.pdf

[148] EC (2011) Horizon 2020 – The Framework Programme for Research and Innovation. COM (2011) 808

- A specific point for action is to explore the possibility of setting up a marine Knowledge and Innovation Community (KIC) under the EIT. A KIC is intended to stimulate world leading innovation and. involves key actors from the three sides of the knowledge triangle: research, higher education, and innovation-entrepreneurship-business[149].

Policy field II) Boost Access to finance

Policy rationale

The future development potential of a Blue Growth strategy strongly depends on the ability of the economic actors to find a business model which fits the developmental stage and the global developments. Economic activities in the (pre-) development stage are still exploring for the right business models, and often have a lack of market focus. To be able to move from the demonstrator to the market phase and to upscale production significant cash resources are needed. A typical phenomenon in business in this stage is the "Valley of Death" where depleted cash resources impede entering the market. However, once confidence of the future potential is established, new players can easily enter the business, invest, upscale and grow the business. Once risks subside, large industrial players (e.g. from pharmaceutical, chemical and cosmetics, but also energy, utility and mining companies) are expected to become interested in Blue Growth.

Access to finance is therefore amongst the most important barriers for the maritime economic activities in the (pre-) development stage. Clearly, investment risks are substantial in this phase, but so can be the rewards. The economic and financial crisis has made access to finance even more difficult, as traditional banks are more prudent than ever before. Furthermore, banks are often not well-placed to assess business plans and make risk assessments in these specific economic activities. Whereas scientific research can typically be funded by public and leading research institutes, often co-funded by FP7 grants, the commercialisation of research findings is a key issue. When the commercial and developmental activities take place in small spin-off companies, these are more reliant on private capital. Venture capital is available at small scale and in certain locations, however not sufficiently widespread to provide an overall boost to the sector. Large companies are only likely to step in (e.g. by acquiring start-up companies) in a later stage.

Apart from funding of activities in the development phase, access to finance can block the realisation of investment plans and new business initiatives. The financial crisis has aggravated this situation as has also been recognized in the Europe 2020 communication. Especially for small scale companies access to financing proves to be a bottleneck in fostering their economic growth.

Ongoing Policy initiatives

Access to finance has been clearly recognized by the Commission, and provisions are made to provide these in the future both in the form of grants, loans and guarantees.

The proposals for the new structural funds 2014-2020 (including ERDF and the reshaped Maritime and Fisheries Fund[150]) offer a basis for grant support to foster Blue Growth. The Common Provisions (COM(2011) 615)[151] for the CF, ERDF and ESF, as well as the European Agricultural Fund for Rural development (EAFRD) and the Europe Maritime and Fisheries Fund (EMFF) provide the primary legal basis. Building on these, the proposals for the European Maritime and Fisheries

[149] http://eit.europa.eu/kics/

[150] COM(2011)801. The newly proposed Maritime and Fisheries Fund aims at achieving the objectives of the reformed CFP and of IMP

[151] http://ec.europa.eu/regional_policy/sources/docoffic/official/regulation/pdf/2014/proposals/regulation/general/general_proposal_en.pdf

Fund (COM 2011) 804), aim (amongst others) to foster the development and implementation of the EU's Integrated Maritime Policy, in a complementary manner to cohesion policy and to the CFP, and to promote the balanced and inclusive territorial development of fisheries areas.

An action plan to improve access to finance was released at the end of 2011[152]. It includes increased financial support from the EU budget and the EIB for SMEs, including €1.4 billion of new financial guarantees under the Programme for the Competitiveness of Enterprises and SMEs (COSME) (2014-2020) whereas the EIB will remain highly active to pursue its SME loan activity at a level of approx. €10 billion. EIB also continues the operation of its Risk Sharing Finance Facility (RSFF) to promote RDI in among other new unproven markets. In addition, regulatory initiatives are announced to improve access of SMEs to capital markets and ease rules on the operation of venture capitalists in Europe. Also the role of EIF in promoting access to venture capital for SMEs is continued. As such, not the existing financial support mechanisms appear to be the key bottleneck in the coming programming period, but mainly the awareness among potential users.

Additional Blue Growth Initiatives

- Promote the use of the newly proposed EMFF for Blue Growth;
- Promote the use of other and existing structural funds, notably through the ERDF and the EAGGF – taking full advantage of the Common Provisions;
- Explore and promote the use of Horizon 2020 funds for pre-development stage activities, notably for demonstration projects;
- Promote the use of existing EIB financial support mechanisms that support access to finance towards Blue Growth activities.

Policy field III) Invest in Smart infrastructure

Policy rationale

A range of infrastructure elements are required for the growth and expansion of mature maritime economic activities. Additional investments will be needed particularly in Europe's energy infrastructure, and to interconnect networks across borders to meet the EU's energy targets. Currently, existing or planned electricity grids, between EU states or their aggregation will not provide the network that will be needed to carry maritime renewable power generated in our Northern seas to the economic centres of central Europe. In particular, the required infrastructure to connect the planned and foreseen large-scale offshore wind turbines are considerable, the more as these installations will require peak capacity to be processed in rather peripheral territories with only weak electricity grids. [153] More recently, the need is emphasised to link such a European electricity network to North Africa, allowing to take advantage of the solar energy potential in the sub-Saharan region.[154]

High quality port infrastructure and sufficiently deep waterways are prerequisites for short-sea-shipping and cruise tourism as well as for coastal tourism. Inland waterways and hinterland connections are equally important to ensuring that freight finds its way to intermediate and final consumers and that passengers can easily reach places of berthing. Ports are also relevant in the development of many other maritime economic activities. Hence ports can bee seen as key nodes in building a Blue Growth strategy.

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[152] COM(2011)870

[153] For example in Malta, a private company has proposed to set up a 460-metre diameter floating wind farm off Malta's coast, with a potential to generate a peak of 54 megawatts of electricity. See http://www.independent.com.mt/news.asp?newsitemid=141855

[154] See http://ec.europa.eu/environment/integration/research/newsalert/pdf/269na5.pdf

Ongoing Policy initiatives

Within the context of the Flagship Initiative on a Resource Efficient Europe, the need to substantially increase investment in energy infrastructure, and energy transmission networks is recognised.

Building on the TEN policy framework, the Commission has proposed a new European infrastructure package based on The Connecting Europe Facility (CEF). The aim of this facility is to streamline and facility EU support to infrastructures by optimising the portfolio of instruments available, and capitalise on possible synergies between them. Of the overall € 50 billion funding for the period 2014-2020, € 9 billion is expected to be allocated to energy, while € 21.7 on transport and (excluding amounts earmarked in Cohesion Fund for transport). [155]

Over and above these EU and public initiatives, the private "Supergrid" initiative needs to be mentioned. The concept is defined as "a pan-European transmission network facilitating the integration of large-scale renewable energy and the balancing and transportation of electricity, with the aim of improving the European market". [156] Unlike point to point connections, Supergrid will involve the creation of "Supernodes" to collect, integrate and route renewable energy to the best available markets. Supergrid is a trading tool which will enhance the security of supply of all the countries of the EU.

With regard to port infrastructure, the Commission's recent Transport White Paper is of importance. In maritime transport, the EU should strive to improvement of the environmental record of shipping, both by technology and better fuels and operations: overall, the EU CO_2 emissions from maritime transport should be cut by 40% (if feasible 50%) by 2050 compared to 2005 levels. Europe needs a 'core network' of corridors, carrying large and consolidated volumes of freight and passengers traffic with high efficiency and low emissions, thanks to the extensive use of more efficient modes in multimodal combinations and the wide application of advanced technologies and supply infrastructure for clean fuels. At the same time, the uptake should be encouraged by requiring their deployment on TEN-T infrastructure and a gradual integration of modal systems.[157] Also initiatives aiming at improving the single market in maritime transport, such as the Blue Belt pilot project, are of direct relevance in this respect.

The Transport White Paper is congruent with the already established Motorways of the Seas concept, which distinguishes 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);

[155] EC (2011) "A Growth package for integrated European infrastructures" COM (2011) 676/2.
[156] See website "Friends of the Supergrid" http://www.friendsofthesupergrid.eu/a-supergrid-for-europe.aspx
[157] EC (2011) Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. COM(2011)144

- 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). [158]

Additional Blue Growth Initiatives

- During the study the importance of investing in smart infrastructure was confirmed by both experts and stakeholders. Synergies in constructing such an offshore grid are not automatically exploited. The step-by-step roll out of wind parks now results in individual shore connections. Coordination is needed as well as substantial amounts of funding to develop this into a 'supergrid' – which may well exceed the already foreseen amounts. Government or EU involvement can also be justified from the energy security perspective (reliability of supply). An efficient and high-capacity pan-European electricity grid is seen as a condition for exploiting the potential provided by offshore wind as well as Ocean renewable energy sources. Investments in high-voltage power grid infrastructure will require the combination of a variety of funds, including the Cohesion Fund, Connecting Europe (TEN-T), EIB loans and private sector funds;
- Synergies in the use of infrastructure may be hampered by existing operating practices in for instance the insurance sector (e.g. not allowing multi-use of wind piles for growing algae);
- Support investment schemes for port development. Although the amount of investments funds which has been made available for infrastructure investment (including ports) is significant it is expected that the need for additional port investments exist. This does not only reflect the need for investments in the EU, but also in Neighbourhood countries such as Turkey, Russia, the Ukraine and North Africa – as it is in these regions that major investments are yet to be made. Within this context, the European value added of funding of Instruments for Pre-Accession Assistance (IPA) should be demonstrated more extensively. In addition, attention should be paid to mobilising co-investment funds both in the EU and these other countries. This includes not only public funding but also the introduction of more innovative private-public funding on new financing instruments (bonds, loan guarantees etc.).

Policy field IV) Promote cluster support

Policy rationale

Clusters are traditionally defined as "geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition (e.g. suppliers, customers, companies which share inputs, but also governments and other institutions such as universities and trade associations." [159]

Clusters are primarily market-driven and examples world-wide demonstrate that clusters can provide powerful engines of growth and jobs. However, within Europe clusters are seen to be suffering from market fragmentation and weak industry-research linkages. [160] These weaknesses also appear to apply to maritime clusters, which can lack a critical mass, in particular when positioned within peripheral or remote regions. Policy initiatives should focus on the provision of the appropriate framework conditions to such clusters.

[158] See http://ec.europa.eu/transport/maritime/motorways_sea/motorways_sea_en.htm
[159] M.E. Porter (1998) "Clusters and the New Economics of Competition". Harvard Business Review, Nov/Dec, p.78
[160] EC (2008) "Towards world-class clusters in the EU: implementing the broad-based innovation strategy. COM 2008 (652) final/2

Ongoing Policy initiatives

The EU supports clusters notably through[161]:

- Establishing a high-level European Cluster Policy Group to explore ways on how to best assist EU countries in supporting clusters;
- Expanding the policy dialogue under the European Cluster Alliance;
- Fostering transnational cooperation between cluster organisations;
- Promoting excellence of cluster organisations;
- Further developing the European Cluster Observatory into a full-fledged information service on clusters for enterprises and thereby improving the integration of innovative SMEs into clusters.

Of particular importance is the European Network of Maritime Clusters[162], which aims to promote and reinforce the European Maritime Cluster and its maritime sectors. The purpose of the European Network of Maritime Clusters is to put the entirety of the European maritime cluster on the map, and to do so through national cluster organisations. The network is eager to attract EU authorities' attention to maritime clusters and to promote a more integrated approach The Network can contribute to this integrated approach by pushing the national clusters to gather the various maritime sectors of their respective countries and by bringing national clusters together.

Additional Blue Growth Initiatives

- Explore the use that can be made of the European Network of Maritime Clusters as well as its limitations;
- Test the concept of 'maritime clusters (clusters)' and their implementation in practice as geographical nodes to promote maritime synergies. The role of national and regional governments is also of direct importance in this respect;
- Strongly promote the awareness of Blue Growth to make regional and local stakeholder aware of its possibilities in stimulating new jobs and growth;
- Promote transnational, transregional exchange of best practices and shining examples;
- Promote the creation of multi stakeholder initiatives to overcome initial hurdles in creating cluster activities;
- Support regional cluster analyses to define key strengths and main bottlenecks and define the appropriate cluster approach and strategy at a practical level that suits the respective region/locality.

Policy field V) Anticipate Skills needs

Policy rationale

Shortage of skilled labour is an issue in many maritime sectors in Europe although differences exist between countries and sectors. This refers both to white-collar professions (e.g. naval architects), but also to skilled blue-collar jobs. With the ageing population this situation may even be aggravated in future. This is strongly linked to the perceived attractiveness of maritime jobs: there is a problem of image, a problem of working conditions (especially in those professions where employers are faced with cost pressures), but also problems related to health and safety especially when working at sea itself. Challenges exist not only in recruitment but also in retention. This creates an enormous hurdle in exploiting the Blue Growth potential.

This eventually feeds back in the number of people who choose technical education, which prepares them for such professions, but may also have a relation to maritime R&D. A more positive image of the maritime sector in general would be welcomed. Norway is seen as a positive example

[161] See http://ec.europa.eu/enterprise/policies/innovation/policy/clusters/
[162] See http://www.european-network-of-maritime-clusters.eu/

in this respect, where the maritime sector is perceived as an important economic sector and has reached a high level of visibility in society. An increased awareness of possible career paths is needed.

The EC recognises [163] that the mismatch between skills needs and supply has also a geographical component: skills shortages and bottlenecks in high growth areas coexist with areas of persistent high unemployment. Within this context, it is important to recognise that many maritime economic activities are taken forward in remote or peripheral regions with weak labour markets. As was confirmed during the expert meeting, attracting skilled workers to these regions can be particularly challenging.

Ongoing Policy initiatives

The EU's Flagship initiative New Skills for new Jobs aims to The 'Agenda for new skills and jobs' will boost inclusive growth by raising the employment rate with more and better jobs, helping people of all ages anticipate and manage change by equipping them with the right skills and competences, modernising labour markets and welfare systems, and ensuring the benefits of growth reach all parts of the EU. [164]

Within this context, particularly relevant for Blue Growth is the EU's initiative to produce an EU Skills Panorama to improve transparency for jobseekers, workers, companies and/or public institutions. The Panorama will be available online and contain updated forecasting of skills supply and labour market needs up to 2020. It will provide: i) up-to-date information on the top 25 growth occupations in the EU, and on the top five 'in demand' occupations per Member State; ii) an analysis of skills requirements based on the European Vacancy Monitor; iii) an analysis of skills mismatches and use of skills in the workplace, through surveys of employers, learners and graduates; iv) foresight analysis at sector level, based on the work of the European Sector Councils' on Skills and Employment; and v) CEDEFOP and Member States' projections. Where relevant the Panorama will report on skills needs in particularly important areas such as science, technology, engineering and mathematics.

The same Agenda also aims to step up efforts to promote job mobility within the EU: regulatory and non-regulatory factors influence interregional and transnational mobility: housing, language, the employment opportunities of partners, return mechanisms, historical 'barriers', and the recognition of mobility experience, particularly within SMEs. Recent efforts to improve geographical mobility have focused on the removal of legal and administrative obstacles (e.g. in the area of recognition of qualifications and portability of supplementary pension rights). Citizens must now be better informed of these changes to embrace with confidence cross-border career moves; more emphasis must also be put on raising the transparency of job vacancies across the EU.

Particularly relevant for Blue Growth is the fact that some professionals must still comply with long and cumbersome procedures before their qualifications are recognized. The Commission is currently carrying out an evaluation of the Professional Qualifications Directive, in order to identify possible solutions such as a professional card and simplify the current situation.

The European Structural Funds – and in particular the ESF – provide a wide range of funding opportunities for (lifelong) learning and training that can be applied to the maritime economy.

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[163] See EC (2011) "An agenda for new skills and new jobs: a European contribution towards full employment. COM (2010) 682 final

[164] Ibid

Finally, The Commission seeks to further improve health and safety of workers. Within this context, the EC is preparing an initiative to include seafaring workers of vessels in EU labour law. [165]

Additional Blue Growth Initiatives

- The European Social Fund could be used to promote project initiatives aiming at the training and increasing awareness at schools and universities for the maritime economy;
- The skills mismatch in the maritime economy can also be addressed by strengthening the links between universities and companies (e.g. as is done in Germany);
- Ensure that the EU Skills Panorama is developed in such a way that it is most beneficial for the maritime sector;
- Take part in the preparation of the policy initiative regarding the seafaring of workers of vessels in EU labour law bearing Blue Growth aims in mind;
- At the local level of maritime clusters and clusters, encourage job mobility between various maritime economic sectors. This includes initiatives that foster perspectives for jobs on land after having spent longer periods on sea.

Policy field VI) Promote Maritime spatial planning

Policy rationale

Blue Growth: can we reconcile it with a good environmental status? Will it all fit on our oceans and seas? Expanded maritime economic activities – whether inside or outside the European waters – are likely to generate not only synergies but also tensions: on or around shipping routes and in and near congested ports, but also where renewable energy will be generated, where leisure activities take place, and where natural habitats are to be protected.

Clear is that more geographic differentiation is needed in the analysis: developments differ strongly by sea-basin, and this variety is to be carved out further from the material.

The increasing complexity of spatial use in the maritime environment calls for maritime spatial planning. This need is reinforced by the ambition to develop economic activities, with sometimes adverse environmental impacts, in basins that are under stress already. From a Blue Growth perspective, there is a need for an integrated approach, in line with the Resource Efficiency Flagship. For instance, the litter on the seas is not only an environmental problem but can also interfere with maritime value chains. For instance, it can cause economic damage to coastal tourism.

Ongoing Policy initiatives

Maritime spatial planning (MSP) can be defined as analysing and allocating parts of the three-dimensional marine spaces to specific uses, to achieve ecological, economic, and social objectives which are determined through political processes. Thus it reflects a vision of the future of the marine space and ecosystem.

Maritime spatial planning is a mechanism for the integrated management of maritime areas in which a central vision for the future of the area, in conjunction with knowledge of activity interactions and impacts, guides the location, timing, intensity and future development of all activities in the maritime space. A comprehensive understanding of the maritime environment is crucial for successful MSP, as is a thorough understanding of how maritime activities impact each other and the environment. This knowledge is used in conjunction with specific ecological,

[165] See http://ec.europa.eu/governance/impact/planned_ia/docs/2008_empl_014_labour_law_seafaring_workers_2012_en.pdf

economic and social objectives to decide which activities should take place as well as how, when and where. In order for MSP to provide this sort of “big picture” management, it is necessarily an iterative process involving significant initial research and ongoing monitoring of the impacts of marine activities (EEA, 2012, in prep.).

Taken together, information about the location, intensity, and cumulative impact of multiple human activities and an understanding of the social drivers of these impacts can inform maritime spatial planning. Some activities are simply incompatible, as with military zones and fishing and shipping (for security and safety reasons), while many others lead to high cumulative impact when they co-occur (Halpern et al., 2009). Spatially separating such activities is one tool for minimizing negative interactions among activities while still allowing them to occur to the greatest extent possible (EEA, 2012, in prep.).

The Marine Strategy Framework Directive (MSFD) adopted in July 2008 aims at achieving or maintaining a good environmental status by 2020 at the latest. It is the first legislative instrument in relation to the marine biodiversity policy in the European Union, as it contains the explicit regulatory objective that "biodiversity is maintained by 2020", as the cornerstone for achieving good environmental status. It enshrines in a legislative framework the ecosystem approach to the management of human activities having an impact on the marine environment, integrating the concepts of environmental protection and sustainable use. In order to achieve the objective the Member States have to develop Marine Strategies which serve as Action Plans and which apply an ecosystem-based approach to the management of human activities. An important point is the regional cooperation required at each stage. A major challenge in the implementation of the MSFD is to attain the necessary scientific knowledge of the elements that define the state of the marine environment and a substantial need to develop additional scientific understanding to underpin the Decision and to secure a successful revision. For a number of criteria and indicators the need for further development and additional scientific information has been identified. Increasing scientific knowledge on the marine environment and its processes is required to adequately achieve the Directive's goal. This knowledge needs to the developed, in particular, through the EU Strategy for Marine and Maritime Research (COM (2008) 534) in the framework of the IMP.

Additional Blue Growth Initiatives

In view of promoting Blue growth the following additional suggestions are made:

- Existing regulation and spatial planning should be assessed on its potentially adverse impacts on limiting new opportunities, but where possible stimulate new opportunities(e.g. design of wind farms);
- Where possible aim at a further standardisation of procedures across Europe;
- Sustainability remains crucial in maritime spatial planning. Develop clear view on how to address these adequately. In this respect it should also be reflected in relevant policy measures by including a polluter pays principle in economic activities where possible (or introduce charges to internalise externalities);
- In view of sustainability it is suggested to bundle all national MSFD-plans to a EU vision on sustainability;
- In certain spatial planning issues still knowledge gaps exist on the interaction between various activities and their environment. Further research should clarify these knowledge gaps;
- In spatial planning fisheries is a priority field because of it s enormous impacts. Proposed policy options could be to introduce zoning, and low-impact fisheries;
- In many sea basins a primary stressor is the discharge of nutrients and pollutants from land-based sources. It is important to keep this in focus in policy development and implementation, looking for synergies with sea-based economic activities;

- Although formally not part of maritime spatial planning port planning is seen as an essential area for attention. Distinguishing secondary ports from primary ports, or classifying ports according to their characteristics, may be a good starting point as especially new economic activities in their growth of development phases appear to lose the competition for space in primary ports and find a better breeding ground at secondary ports, which increasingly might become crystallisation point for more new and upcoming economic activities.

Policy field VII) Foster local development strategies

Policy Rationale

Various Blue Growth activities are hampered by fragmented, bureaucratic and/or non-cooperative local public actors. Indeed, several of the (mature) economic activities rely strongly on local planning and good local governance. Coastal protection measures as well as port extensions require local permissions at the least, and are often delayed due to stringent local planning regulations and procedures. Sustainable coastal tourism particularly requires a cooperative and transparent local government, and so does the installation of desalination plants or ocean renewable energy facilities.

Ongoing Policy initiatives

The proposal for the new European Maritime and Fisheries Fund [166] provides a framework for sustainable development of fisheries areas through integrated local development strategies (Article 61).

The EMFF proposal builds on the general principles for integrated local development as laid out in the new General Structural Funds Regulations[167], but focuses on the fisheries and aquaculture sectors. Such local development strategies must respond to the opportunities and needs identified in the area and may include diversification. Member States shall define in the operational programme for the EMFF the criteria for the selection of local development strategies.

Additional Blue Growth Initiatives

- Optimise opportunities for promoting local development strategies under the new Structural Funds as well as the EMFF[168];
- Promote best practice exchange of local development strategies across European actors, at the level of maritime clusters;
- Specific toolkit to bring 'Blue Growth' to maritime clusters, allowing them to take best advantage of Blue Growth opportunities and tailor these to local conditions.

Policy field VIII) Stimulate public engagement

Policy Rationale

Blue Growth should benefit large groups of citizens and stakeholders across Europe. But this is not likely to come by itself. A range of maritime activities analysed is new to the public, living in coastal regions. Many of them are attached to the qualities of the natural environment, and likely to resist any change in their pristine surroundings. Offshore wind, oil & gas exploration and coastal tourism tend to face public resistance, and can obstruct activities if not accompanied by stakeholder consultation and mitigation measures. Large companies are especially 'suspected' and are at a

[166] COM(2011) 804
[167] COM(2011) ….
[168] The EMFF adopted by the European Commission:
http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/1495&format=HTML&aged=0&language=EN&guiLanguage=en

disadvantage vis-à-vis local populations. Mining of mineral resources is another activity prone to public disapproval, if not carefully recognised and accounted for. It remains to be seen how pilots in developing countries succeed in this respect.

Therefore, public engagement is vital in order ensure that Blue Growth benefits all.

Ongoing Policy initiatives

The Aarhus Convention (on access to information, public participation in decision making and access to justice in environmental matters) empowers non-governmental organisations to hold EU Member States to account. Consequently the issue of transparency will gain increased importance, as will linkages between human and environmental rights. Such public interest-based activism on the part of NGOs has the potential to enforce the developing framework for stakeholder engagement within MSP. Yet the modes of including meaningful public participation in the decision-making process for MSP remain undetermined.

The Integrated Maritime Planning states (p. 3): This Communication lays the foundation for the governance framework and cross-sectoral tools necessary for an EU Integrated Maritime Policy and sets out the main actions that the Commission will pursue during the course of this mandate. These actions will be guided by the principles of subsidiarity and competitiveness, the ecosystem approach, and stakeholder participation.

Regulation (EU) No 1255/2011 mentions public awareness raising as one of the operational objectives.

Additional Blue Growth Initiatives

In the Blue Growth project (Intermediate Hearing, Stakeholder Day and project team) the following additional suggestions were formulated:

- Focus should be on transparency, early involvement, buy-in, added value of local knowledge;
- Leadership and vision are critical and often challenge;
- Need for support to a clear feasible methodology of stakeholder engagement (skills, costs, long term engagement);
- Incorporate both a top-down and a bottom-up approach in the formulation of Blue Growth. The latter should start at community level, asking them for views and ideas and initiatives to promote Blue Growth;
- A large body of experience in public participation and engagement of local communities was developed in the EU Water Framework Directive. Public participation in maritime affairs should profit from the lessons learned there. A practical handbook on participation in water management was developed in the HarmoniCOP project, see http://www.harmonicop.uos.de/handbook.php

7.4 Conclusion

A more coherent and focused Blue Growth policy frame is likely to produce more effects than a fragmented or 'ad hoc' foundation. The evidence emerging from the study provides a basis for preparing a policy frame with a strong focus on an integrated approach. In addition, an important outcome of the stakeholder and expert meetings is that there are important connections to be made between many of the policies actions highlighted above, which are insufficiently captured by current policies at this moment, e.g.:

- Between R&D and (implementation) funding;
- Between R&D and available (research) infrastructure;
- Between infrastructure and cluster support;

- Between funding and cluster support;
- Between skills and cluster support.

Finally, some of the above policy areas, such as accessing finance or integrating local development, are not necessarily specific to Blue Growth. Nevertheless, it is important to bear in mind that such policies need to be always tailored to the maritime environment which typically includes remote, sparsely populated areas. Such areas always have their specific challenges. The study confirms that Integrated Maritime Planning – and particularly maritime spatial planning – can be a powerful tool as part of any Blue Growth journey.

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8.3 Interviewees

8.3.1 Interviewees for the selected sub-functions

Shortsea shipping

Interviewee	Organisation	City/country	Specific theme	Interviewer	Face to face, or telephone
Antonis Michail, Martina Fontanet	ESPO	Brussels, Belgium	SSS - ports	Eric van Drunen	Face-2-face
Alphons Guinier	ECSA	Brussels, Belgium	SSS - shipowners	Eric van Drunen	Face-2-face
Yannick Texier	EMSA	Brussels, Belgium	SSS - safety, security	Eric van Drunen	Tel
Willy de Decker	Shortsea.be	Antwerp, Belgium	SSS – promotion	Eric van Drunen	Face-2-face
Wye Keong Lai	Valletta Gateway Terminals	Valletta, Malta	SSS – port operations, Mediterranean	Eric van Drunen	Face-2-face
Diederik Blom	Samskip	Rotterdam, the Netherlands	SSS – shipping company Baltic/North Sea	Eric van Drunen	Tel
Stijn Effting	Port of Rotterdam	Rotterdam, the Netherlands	SSS – strategic port development	Eric van Drunen	Face-2-face
Glenn Murphy	Irish Maritime Development Organisation	Dublin Ireland	SSS	Matteo Bocci	Tel
John van der Horst	Unifeeder	Rotterdam, the Netherlands	SSS feeder shipping Baltic and North Sea	Marjan van Schijndel	Tel
Paul Kyprianou	Grimaldi lines	Naples, Italy	SSS – Ro-ro operator Mediterranean	Matteo Bocci	Tel

Offshore oil & gas

Interviewee	Organisation	City/country	Specific theme	Interviewer	Face to face, or telephone
Bram van Mannekes	NOGEPA	The Hague, Netherlands	Offshore oil and gas exploration and production	Sil Boeve	F2F
Aart Tacoma	NOGEPA	The Hague, Netherlands	Offshore oil and gas exploration and production and environmental affairs	Sil Boeve	F2F
Jorg Mutschler	VDMA	Hamburg, Germany	Offshore construction	Sil Boeve	Tel.

Annabel Holroyd	OGP	Brussels, Belgium	Upstream part of the oil and gas sector in Europe	Sil Boeve & Johan Gille	Tel.
Leo Hendriquez	Ministry of Economic Affairs	The Hague, Netherlands	Regulator, enforcement	Eric van Drunen	Tel.

Coastline tourism

Interviewee	Organisation	City/country
Jan Kappel	European Anglers Alliance	Netherlands
Ceri Williams	IWA international windsurfing	UK
Dr Michael Frenzel (Chairman)	TUI AG	Hanover, DE
PhD Tihomir Luković	University of Dubrovnik, University of Lulea, Sweden and University of Lapland, Finland	Dubrovnik, Croatia
Mirna Cieniewics	European Boating Industry	Brussels, BE
M. Tempelman	Kenniscentrum Kusttoerisme	Netherlands
Mark Hampton	Kent Business Schook, Centre for Tourism in Islands & Coastal Areas	UK
David Mitchell	ATM	Gainesville, USA
Alex Hekman	Grontmij	Alkmaar, NL
Damien PÉRISSÉ (Director - Responsible for innovation and competitiveness and follow-up of the Baltic Sea Commission)	Conference of Peripheral Maritime Regions of Europe (CPMR)	Brussels, BE/Rennes, FR
Glenn Wastyn (Commercial Director)	BCD Travel	Mechelen, BE
Óscar Perelli del Amo (Head of Research)	Exeltur	Madrid, ES
Eva Aimable/Olivia Ruggles-Brise	World Travel & Tourism Council (WTTC)	London, UK
Jean Paul Chapenau (President) / Andrea Cagnotti	Jeanneau	Paris, FR / Rome, IT
Flavia Maria Coccia (Operatiions Director)	ISNART (National Institute for Tourism Research)	Rome, IT

Coastal protection

Interviewee	Organisation	Country
Luigi Cipriani	Regione Toscana	Italy
Dr Robin McInnes	Isle of wight	United Kingdom
Per Sørensen	Danish Coastal Authority	Danmark
Dr. Stefan Aarninkhof	Royal Boskalis and Ecoshape	The Netherlands
Dr. Anneke Hibma	Van Oord and Ecoshape	The Netherlands
Soraya Van Donink	Policy Research Association	Europe
Rob Steijn	Arcadis	Europe
Prof. Vrijling	Technical University Delft	The Netherlands
Ian Thomas	Pevensey Coastal defence	United Kingdom
Dr Adrian Stanica	Director of research in GeoEcoMar	Romania

Marine aquatic products

Interviewee	Organisation	City/country
Jean Guezennec	IFREMER	Brest, France
Corentin Renard	Société Gloria Maris Production	Ajaccio, France
Dr Tim Atack	Vikingfish Farms ltd; Ardtoe Marine Laboratory	Argyll – UK
Pierre Caleja	Fermentalg	France
Dr Martin Ecke	Roquette Klötze GmbH & Co. KG	Germany
Aad Smaal	Institute for Marine Resources and Ecosystem Studies	The Netherlands
Dr. Willem Brandenburg	Plant Research International - Wageningen University	Netherlands
Pr Jérélmy Pruvost	GEPEA - Université de Nantes	France
Álvaro Naranjo Villalonga	BTM (Biotecnología de Microalgas)	Spain

Offshore wind

Interviewee	Organisation	City/country
Robert Pollock Audrey Martin Lisa Hardie	Argyll and Bute Council	Argyll and Bute, Scotland, UK
Chris Westra	Co-owner and director at DC Offshore Energy BV.	Delft, the Netherlands
Anne-Benedicte Genachte, Remi Gruet	European Wind Energy Association (EWEA)	Brussels, Belgium
Feargal Brennan	Cranfield University	Cranfield, UK
Trine Ulla	Statoil	Norway

Cruise tourism

Interviewee	Organisation	City/country
Mr. Antonis Michail (policy advisor)/ Mrs Martina Fontanet (policy advisor)	European Sea Ports Organisation	Brussels – BE
Mr. Lorenzo Gui (Professor)	Venice International University	Venice/ Italy
Mr. Thomas Weigend, Mr. Christian Wolken, Mr. Hermann-Josef Mammes	Meyer Werft	Papenburg, Germany
Mr Mario Habig (Division Head)	TUI AG	Hamburg, Germany
Mr Mannes Boelen (Commercial manager)	Port of Amsterdam	Amsterdam, NL
Mr. Rob Ashdown (Director of Technical, Environmental and Operational matters)	European Cruise Council	Brussels, BE
Mr. Dick de Graaff Commercieel Manager	Passenger Terminal Amsterdam, Atlantic Alliance, Cruise Europe	Amsterdam, NL

Maritime security

Interviewee	Organisation	City/country
Nicola Iarossi	EOS	Brussels, Belgium
Jacques Mouysset / Michel Morel	DCNS	Brussels, Belgium / Toulon, France
Prof. René Leray	University St Louis	Brussels, Belgium
Prof. Georges Estievenart	Sciences Po, Paris	Paris, France
Lennart Dreier	Swedish Coast Guard	Brussels, Belgium
Robert Light	DG TAXUD, European Commission	Brussels, Belgium
Jean-Francois Mirigay	CE-CLAD	Toulon, France

Environmental monitoring

Interviewee	Organization	City/ Country
Trine Christensen	EEA/EioNET	Copenhagen Denmark
Franciscus Colijn	MODEG	

Pierre Bahurel	Mercator Ocean	France
Dick Schaap	MARIS	Netherlands
Seppo Kaitala	SYKE	Finland
Stephen Hodgson	MRAG Ltd	Belgium
John Shaw	Mainstream Renewable Power (Energies)	Dublin
Iain Shepherd	European Commission	DG MARE, Brussels

Blue biotechnology

Interviewee	Organisation	City/country
Dr Hordur G. Kristinsson	Matís ltd	Iceland
Dr Xavier Briand	BiotechMarine (high tech lab from Groupe Roullier)	France
Dr Catherine Boyen	Station Biologique de Roscoff	France
Dr Jan Buch Andersen	ArcticZymes AS	Norway
Dr Werner Müller	BIOTEC marin Gmbh	Germany
Luis Mora	Pharmamar	Spain
Christine Bodeau	Laboratoire Sciences et Mer	France
Dr Charlie Bavington	GlycoMar Limited	UK
Dominique Pradines or Benoit Sirop	Thalgo	France

Ocean renewable energy

Interviewee	Organisation	City/country
Remi Blokker	Bluerise	Delft, Netherlands
Kas Hemmes	Technical University Delft	Delft, Netherlands
Nathalie Rousseau	European Ocean Energy Association	Brussels, Belgium
Stein Erik Skilhage	Statkraft	Oslo, Norway
Emmanuel Brochard	DCNS	Paris, France
Eoin Sweeney	Sustainable Energy Authority Ireland	Dublin, Ireland
Roberto Lacal-Arantegui	JRC	Petten, Netherlands
Sian George	Aquamarine Power	Edinburgh, Scotland
François Lienard	IMI	Brussels, Belgium
Oliver Wragg	RenewableUK	London, UK

Marine minerals mining

Interviewee	Organisation	City/country
Prof. Dr. Uwe Jenisch	Christian Albrecht University	Kiel/Germany
Michael Jarowinsky	MC Marketing Consulting	Kiel/Germany
Henk van Muijen	IHC Merwede	Sliedrecht/Netherlands
Julien Denegre	Technip	Paris/France
Jorg Mutschler	VDMA	Hamburg/Germany
Paul Tyler	National Oceanographic Centre	Southampton/UK

Desalination

Interviewee	Organisation	City/country
Mr. Broens	Norit Former chair of the European Desalination Association	Enschede, the Netherlands
Mrs. Aleid Diepeveen	Director of Innovation Bureau Water Technology, NWP	Delft, the Netherlands
Mr. Enrico Drioli	Prof. at School of Engineering of the University of Calabria Visiting prof. department of energy engineering Hanyang University Seoul Korea Fouding director of the Institute of Membrane technology	Italy/ Korea
Mrs. Maria Kennedy	prof. Water Treatment Technologies, UNESCO/IHE	Delft, the Netherlands
Mrs. Sabine Latteman	German Federal Environmental Agency Water Desalination & Reuse Center (WDRC)	King Abdullah University of Science and Technology, Kingdom of Saudi-Arabia
Mr. Scoullos	Chairman of the Mediterranean Information Office for Environment Culture and Sustainable Development (MIO-ECSDE) and the Global Water Partnership-Mediterranean (GWP-Med) Professor of Environmental and Marine Chemistry at the University of Athens	Greece

8.3.2 Interviewees for the clusters

Ireland

Name	Organisation	Thematic areas
Barbara Fogarty	National Co-ordinator National Marine Technology	Can advise on potential industry / academia

Dermot Hurst	Irish Marine Institute	Programme Manager
Eoin Sweeney	Sustainable Energy Association of Ireland (SEAI)	Head of the Ocean Energy Development Unit
Dr. Stephen Hynes	SEMRU, University of Galway	Senior Researcher, National University of Galway, Ireland. SEMRU
Dr Peter Heffernan	Irish Marine Institute	CEO, Irish Marine Institute
Dr. Ilaria Nardello	Irish Marine Institute	Coordinator – Ireland's National Marine Biotechnology Programme

Gulf of Venice

Name	Institution
Claudio Redolfi	Veneto Region – Dpt of Management and Monitoring of Aquaculture and Fisheries
Maurizio Ferla	ISPRA (Institute for Environmental Protection and Research, Dpt for Marine and Inner Waters, Office for the Venice Lagoon)
Trieste Port Authority	Trieste Port Authority
Dino Rincolato	RDG Bio.Solution

Gdansk

Name	Institution
Piotr Dwojacki, CEO	Academic Initiative Foundation in Gdynia (the Foundation plays a role of the academic entrepreneur incubator and technology transfer centre).
Dr Magdalena Kłopott	Gdynia Maritime University
Dr Robert Marek	Gdynia Maritime University

Oostende

Name	Institution	Role
Jan Dekock	Flanders Maritime Cluster, Oostende	Technology expert
Kathleen D'Hondt	Flemish Department of Economy, Science and Innovation (EWI), Brussels	Researcher
Rudy Herman	Flemish Department of Economy, Science and Innovation (EWI), Brussels	Researcher
Geert Hoorens	Westtoer, Oostende (tourism)	Regional manager, coastal region
Georges Allaert	Gent University, Gent,	professor dept. Mobility and Spatial Planning
Paul Gerard	Autonomous Port of Oostende	director
Wim Stubbe	Autonomous Port of Oostende	business development manager
Simon Pascoe	Autonomous Port of Oostende	PATCH coordinator

8.4 Participants expert hearing

List of participants of the Intermediate Hearing Blue Growth, 9-10th November 2012, Brussels

	FIRST NAME	SURNAME	ORGANISATION
1	Charles	Bavington	Glycomar
2	Frédérique	Lafosse	Soliance
3	Willem	Brandenburg	Wageningen University and Research Centre
4	Robert	Pollock	Argyll County / Scottish Government
5	Kas	Hemmes	TU Delft, Faculty Technology, Policy and Management
6	Mark	Hampton	University of Kent / Tourism Management
7	Antti	Haahti	University Lapland / Prof. of Tourism
8	Michael	vom Baur	President of European Maritime Heritage Congress
9	Michael	Jarowinsky	Marine metals consultant
10	Agustín	Sánchez-Arcilla	Universitat Politècnica de Catalunya, Laboratori d'Enginyeria Marítima
11	Barbara	Zanuttigh	Assistant Professor DICAM - University of Bologna
12	Geoffrey	O'Sullivan	Marine Institute Ireland
13	Manuel	Lago	ECOLOGIC Think Tank / might be representing EU Envi Agency
14	Jan-Stefan	Fritz	German Marine Research Consortium
15	Antoine	Dosdat	IFREMER - French Institute for Exploration of the Sea
16	Reinhard	Lueken	CESA Community of EU shipyards association
17	Nadia	Theuma	Institute for Tourism, Travel and Culture University of Malta
18	Alice	Jude	NECSTOUR
19	Rune	Petersen	Danish Maritime Authority
20	Esteban	Mas	Balearic Islands EU Office
21	Torbjørn	Mæland	Ministry of Trade and Industry, Norway / Deputy Director General Maritime Department
22	David	Kerr	Permanent Representation of Malta to the EU
23	Michael	Zirpel	Federal Ministry of Transport, Building and Urban Development, Germany

	FIRST NAME	SURNAME	ORGANISATION
24	Teodoro	Ramirez	Spanish Oceanographic Institute
25	Peter	van den Bergh	DEME Blue Energy
26	Bernard	Malherbe	Jan de Nul Group
27	Ciara	Delaney	Permanent Representation of Ireland to the EU
28	Roderick	Sant	European Commission, DG MARE
29	Ronald	Vopel	European Commission, DG MARE
30	Fabrizia	Benini	European Commission, DG MARE
31	Lieselot	Marinus	European Commission, DG MARE, E.1.
32	Lucie	Berger	European Commission, DG MARE, D.1.
33	Isabella	Pirolo	European Commission, DG MARE, A.1.
34	Waddah	Saab	European Commission, DG RTD
35	Christos	Pipitsoulis	European Commission, DG MOVE
36	Anne	Devouche	European Commission, DG MOVE
37	Josep	Casanovas	European Commission, DG MOVE
38	Michail	Papadoyannakis	European Commission, DG ENVI
39	Antje	Wittenberg	European Commission, DG ENTR, G.5.
40	Fabrice	Terrac	European Commission, DG ENTR
41	Taf	Powell	European Commission, DG ENER
42	Loic	Blanchard	Maritime expert

8.5 Participants stakeholder meeting

List of participants of the Stakeholder Meeting Blue Growth, 26th January 2012, Brussels

	First name	Last name	Organisation
1	Yves	Auffret	European Commission
2	Dimitri	Banas	European Community Shipowners Associations
3	Dora	Barreira Ramos	European Commission
4	Fabrizia	Benini	European Commission DG MARE
5	Lucie	Berger	European Commission DG MARE-D1
6	Loic	Blanchard	Independant consultant - Marine energy expert
7	Wulf	Blumenstein	Rep. of Niedersachsen to the EU
8	Beatrix	Boenisch	Informationsbuero Mecklenburg-Vorpommern
9	Fausto	Brito e Abreu	Permanent Representation of Portugal to the EU
10	Agnieszka	Brzeska	European Commission, DG EMPL
11	Karen	Burt	Scotland Europa
12	Jan-Bart	Calewart	European Science Foundation
13	Josep A.	Casanovas	European Commission DG MOVE
14	María José	Castellano Fuentes	PROEXCA
15	Peter	Claeyssens	FPS Mobility and Transport
16	Graham	Clarke	ECMAR (European Council for Maritime Applied R&D)
17	Ciara	Delaney	Permanent Representation of Ireland to the EU
18	Thomas	Engelke	Hanse-Office
19	Lauticia	Feray	Basse Normandie EU Office
20	Franz	Folker	BusinessEurope
21	João	Fonseca Ribeiro	Portugal Government
22	Jan-Stefan	Fritz	KDM German Marine Research Consortium
23	Giorgio	Gallizioli	European Commission DG MARE

	First name	Last name	Organisation
24	Anne-Bénédicte	Genachte	EWEA
25	Daniela	Gritti	European Commission
26	Wolfgang	Hehn	European Commission DG Enterprise
27	Marja	Holopainen	Helsinki EU Office/ BIC Kymi
28	Clemens	Holtmann	Hamburg/Schleswig-Holstein
29	Charlotte	Jagot	European Commission
30	Amaia	Juanicotena	Delegation of Navarra
31	Paula	Kobler	Hanse-Oiffce
32	Paola	Lancellotti	EMEC
33	Lidia	Luca	CESA
34	Torbjorn	Maeland	Ministry of Trade and Industry
35	Marta	Marrero	Maritime Cluster Canaries
36	Monica	Martinez	Secretaría general del mar
37	Luciana	Milella	Puglia region italy
38	Pilar	Ocón Garcés	Regional office of Cantabria in Brussels
39	Jannis	Okun	Representation of the Free State of Bremen to the EU
40	Damien	Perisse	CPMR
41	Ditte	Petersen	Hanse-Office
42	Rune	Petersen	Danish Maritime Authority
43	Nila	Petralli	European Commission
44	Isabella	Pirolo	European Commission DG MARE
45	Thomas	Rammelt	North Sea Foundation/Seas At Risk
46	Karina	Rembiewska	Pomorskie EU Office
47	Waddah	Saab	European Commission
48	Roderick	Sant	European Commission DG MARE

	First name	Last name	Organisation
49	Szymon	Sroda	JPI Healthy and Productive Seas and Oceans
50	Charlotte	Sugliani	Espace interrégional européen bretagne/pays de la loire/poitou-charentes
51	Stephanie	Verbeek	WWF Netherlands
52	Maria Sofia	Villanueva	European Commission DG MARE
53	Ronald	Vopel	European Commission DG MARE
54	Antje	Wittenberg	European Commission
55	Janette	Worm	WaterPlanetEarth
56	Anna	Zito	European Commission

Annexes

The following annexes are part of this final report:

- Annex 1: List of maritime economic activities in the EU, economic data and selection process, and methodologies applied
- Annex 2: R&D technology mining report (Thomson Reuters)
- Annex 3: General background scenarios
- Annex 4: detailed reports for selected individual maritime economic activities
  - Shortsea shipping
  - Offshore oil & gas
  - Coastline tourism
  - Coastal protection
  - Marine aquatic products
  - Offshore wind
  - Cruise shipping
  - Maritime surveillance
  - Environmental monitoring
  - Blue biotechnology
  - Ocean renewables
  - Marine minerals
  - Desalination
- Annex 5: detailed reports for the selected clusters:
  - Oostende
  - Gdansk
  - Ireland
  - Gulf of Venice
- Annex 6: Outcomes of the intermediate hearing

Sound analysis, inspiring ideas