Blue Growth

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

Third Interim Report

Call for tenders No. MARE/2010/01

Client: European Commission, DG MARE

Rotterdam/Brussels, 13 March 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.

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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.

The current report is an intermediate product which builds on previous deliverables, notably:

- The First Interim Report, which mainly deals with identifying the business areas to look at in terms of Blue Growth potential. Six maritime functions (or economic value chains) were identified;

- The Second Interim Report, which focuses on 13 sub-functions (maritime economic activities). For each sub-function, the study consortium conducted numerous expert interviews and produced a 30-40 page summary, explaining the value chain in detail, providing some key data, listing the regulatory environment, identifying European strengths and weaknesses, outlining the RTD context, describing the actual and potential role of policy, and finally formulating a foresight scenario ("micro-future");

Besides these, the report specifically builds on two hearings held:

- Intermediate hearing. The above documents have been reviewed by Commission services and then discussed in detail during a 2-day expert Intermediate Hearing, which was held on 9th and 10th November 2011 in Brussels. A total of 30 invited experts participated, invited by the study team as well as by Member States directly. They came from areas as diverse as marine research, small or large businesses related to the marine economy and local government. Another 10 representatives of the European Commission from 6 DGs joined in the two-day event. This expert hearing also dealt with six cross-cutting issues that have relevance for making the expected micro-futures happen: R&D, Public acceptance, Skills, Access to finance, Cluster support & standard setting and Environmental challenges. On the basis of the results of this meeting, we have regrouped the 13 sub-functions into 10 maritime economic activities.

- One day stakeholder presentation held on 26th January 2012 in Brussels, including a working document drafted as input to this day. A total of 38 stakeholders participated, invited by the study team as well as the Member States. They came from industry representations as well as environmental NGOs and regional governments. Furthermore 18 representatives from 7 different DGs as well as the Commissioner's Cabinet joined the day. The presentation dealt with findings on the maritime economic activities and the value chains concerned, as well as possible areas of policy intervention.

It should be noted that this report represents the views of the consultant, which do not necessarily coincide with those of the European Commission.

1 Introduction

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

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

Europe's long-term challenges are manifold

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:[1]

- *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 will develop 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. 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, which 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[2], 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.

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

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

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

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[1] EC DG Research (2009) "The World in 2025: Rising Asia and socio-ecological transition"

[2] See for example ECORYS (2010) "Analysis of global long-term economic megatrends shaping Europe's future environment". Copenhagen: EEA.

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. Maritime employment is all the employment (measured in terms of full time employment - fte) 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.

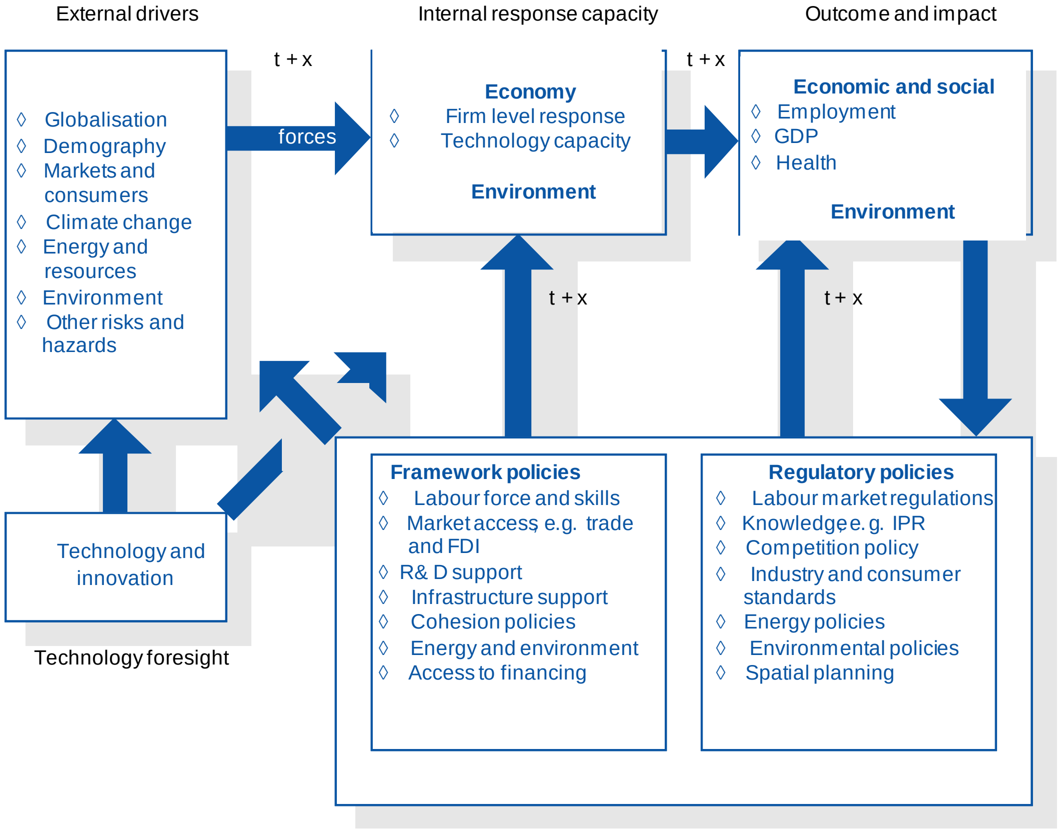
The main aim of the Blue Growth project is to provide policy-makers at EU and sea-basin level with a comprehensive, robust and consistent analysis of possible future policy options to support such smart, sustainable and inclusive growth from the oceans, seas and coasts. The Blue Growth project thereto:

- 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



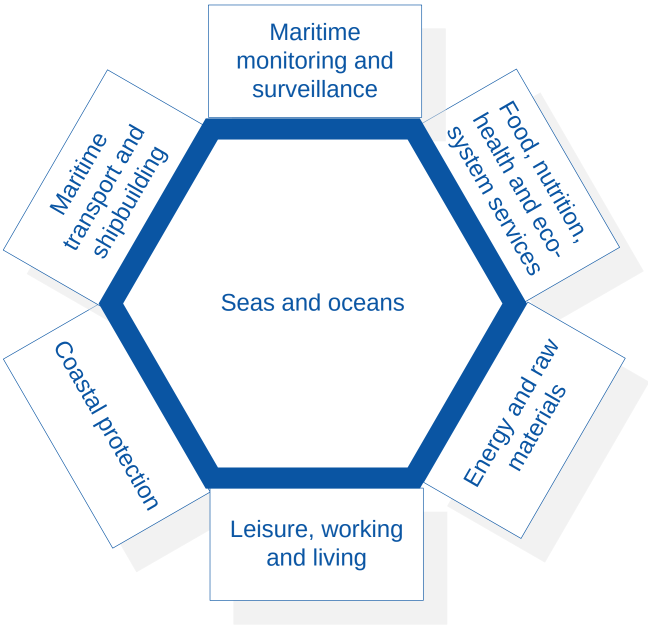
Note: t = time, t + x indicates that impacts may materialise later in time.

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 (sub-)functions. 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 sub-functions – going from wide to deep to wide

The Blue growth study 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



In the first work package of the study, these maritime functions were elaborated and a set of 27 sub-functions was defined. The approach to sub-functions was chosen as the level of analysis required asked for a more specific assessment than the six global functions did allow for. Furthermore it provided the basis for selecting the top-7 sub-functions of today, the top-7 fastest growing and the top-7 most promising in the near future. In chapter 2 of this report the main findings with regard to their economic importance are summarised in figure 2.1.

In WP1, sub-function factsheets have been drafted as part of the First Interim Report, which in WP2 have been elaborated through additional desk study and holding of interviews with key players from each sub-function.

In the First Interim Report, a selection of 13 sub-functions has been made based on top rankings with regard to current size, recent growth and future potential. The aim of this selection was not to limit Blue Growth to these sub-functions, but to allow for further in-depth analysis within the scope of the study. In the Second Interim Report the findings of the in-depth studies, including literature review and in-depth interviews with key stakeholders within each sub-function, were presented.

In this Third Interim Report, the future potential of 11 maritime economic activities are elaborated, and the scope is widened again to all maritime activities by assessing the sea basins of Europe and the synergies between economic activities as well as the tensions that are at stake. These result in a set of policy initiatives that aim to contribute to blue growth across all maritime fields.

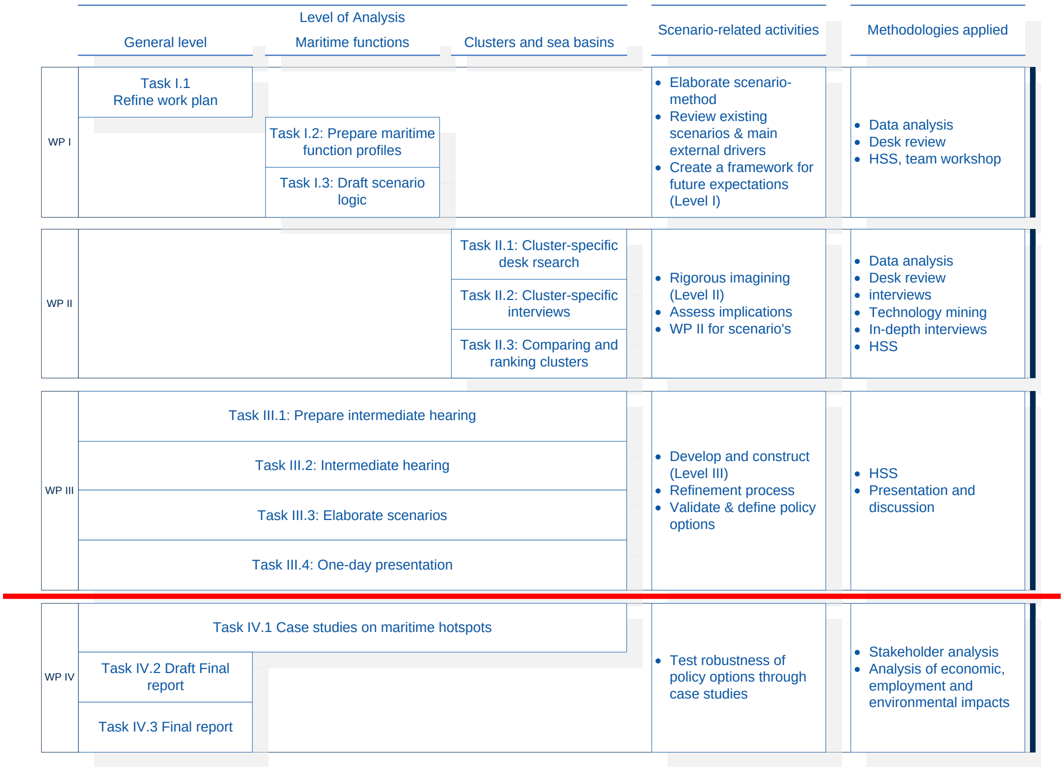
1.3 Current report and status

The above structure has been elaborated in a specific roadmap for the study. This project will have an expected duration of 20 months and consists of 4 Work packages (see **Figure 1.3**):

- Work Package I: Work Plan and Data Collection;
- Work Package II: Analysis and Classification of Material;
- Work Package III: Qualification of Material and Definition of Scenarios;
- Work Package IV: Finalisation of project.

This report is the third of three interim reports of the project. This report describes the future growth potential, building on the scenarios developed. It also elaborates on the sea basins where the future potential is to be realised, and elaborates on synergies and tensions. Finally, this report presents an exploration of policy initiatives that may contribute to capturing blue growth potential. Herewith it provides the basis for the identification of policy options in the final work package of the study.

Figure 1.3 Roadmap for the study



Structure of the third interim 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 hotspots across the sea basin. The chapter concludes with horizontal findings that feed into the subsequent chapters.

Chapter 5 provides an elaboration of synergies between the maritime economic activities, as well as geographic synergies and synergies between sea and land-based activities.

The report concludes with an exploration of policy initiatives (Ch.6).

2 The importance of maritime economic activities to date

The challenges and potential of the European seas, coasts and oceans are 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 sheer endless. As a start, we distinguish six maritime functions – each of them with a broader socio-economic value:

1. Maritime trade and transport;
2. Food, nutrition, and health;
3. Energy and Raw materials;
4. Living, working and leisure in coastal regions and at sea;
5. Coastal protection and nature development;
6. Maritime security.

2.1 Beyond sectors: towards value chains

As set out in recent Europe 2020 Flagship initiatives[3], 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 shortsea 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 the actual shipping is the visualisation of the function, but 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.

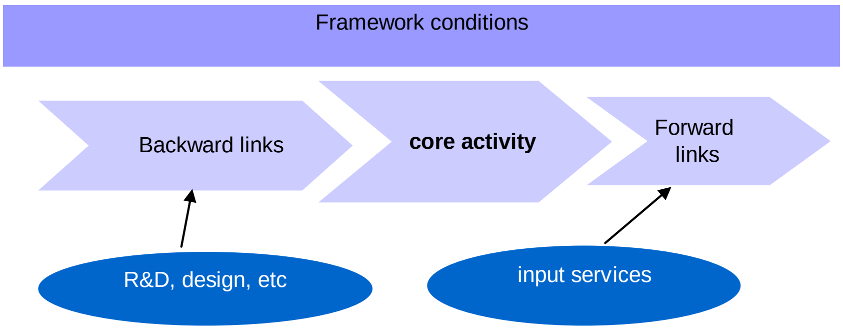
For the analysis of the maritime functions and maritime economic activities, the global value chain has been reviewed. However certain downstream parts may not be directly linked to the sea anymore (e.g.. road transport in Europe carrying containers with maritime cargoes) or is not identifiable as being 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 will be necessary to limit the value chain at the point where a direct and substantial link to sea-based activities is no longer easily possible.

[3] 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 need 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 requires assumptions to be made, which were described in the First Interim Report.

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 sub-function can be estimated using function specific indicators, in this case for the example the volumes of cargo transported. In the underlying sub-function reports, 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.



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

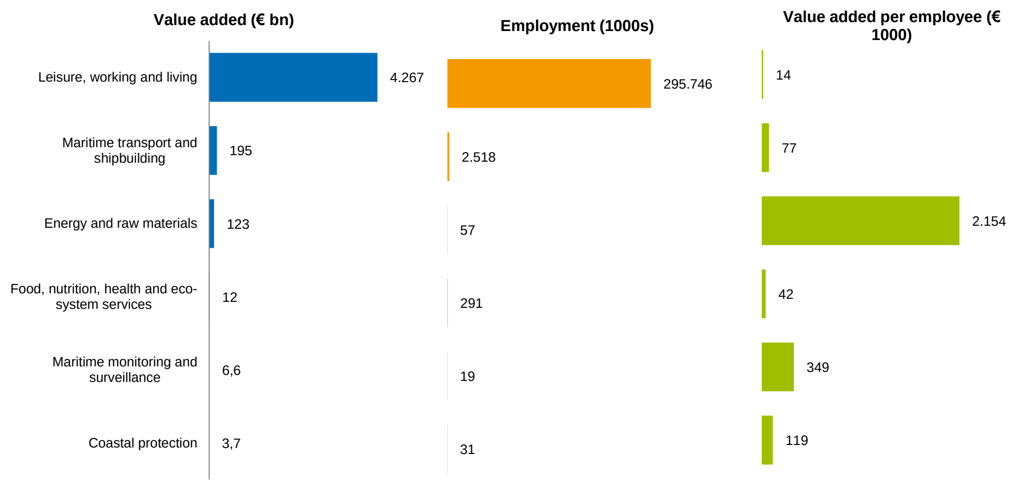
2.2 The current importance of maritime economic activities

…We estimate the GVA of these maritime economic activities to amount to € 495 bln…

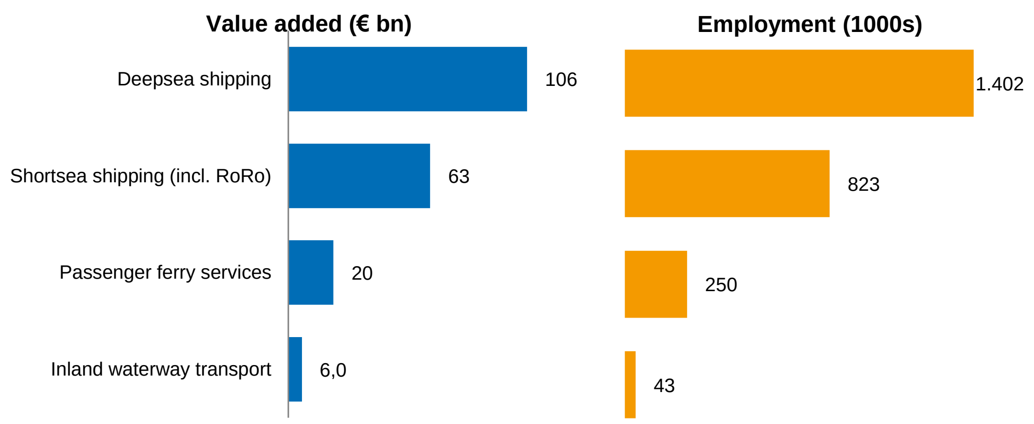
Within the 6 maritime functions, we have studied 27 specific maritime economic activities. See annex 5 for a complete list including short definitions. Estimates on the economic importance of the maritime economy can never be precise for a range of methodological reasons that go beyond the scope of this document. The GVA produced in coastal regions ('working in coastal areas') overall amounts to no less than € 4.108 bln, and we estimate the GVA of maritime economic activities in the EU to amount to € 495 bln. The overall employment in maritime economic activities in the EU is estimated at 5.6 mln., while an additional 88 mln. people are working in coastal areas, and over 205 mln. people are living in coastal areas (Figure 2.1, Annex 1). As explained to arrive at these data a number of assumptions was needed, which were reported upon in further detail in the First and Second Interim Report.

Figure 2.1 Current size of maritime economic activities in the EU (main activities and underlying sub-activities

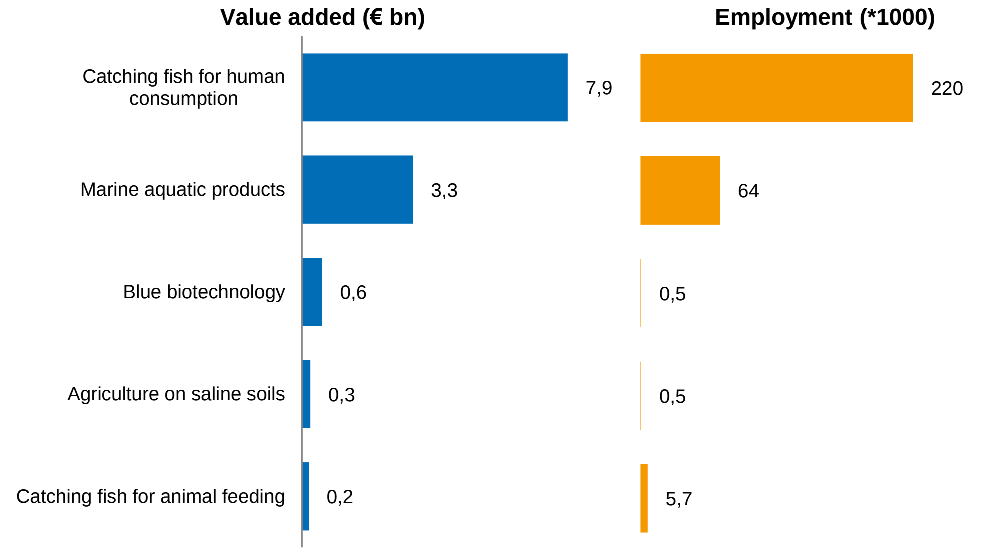
The six main maritime functions



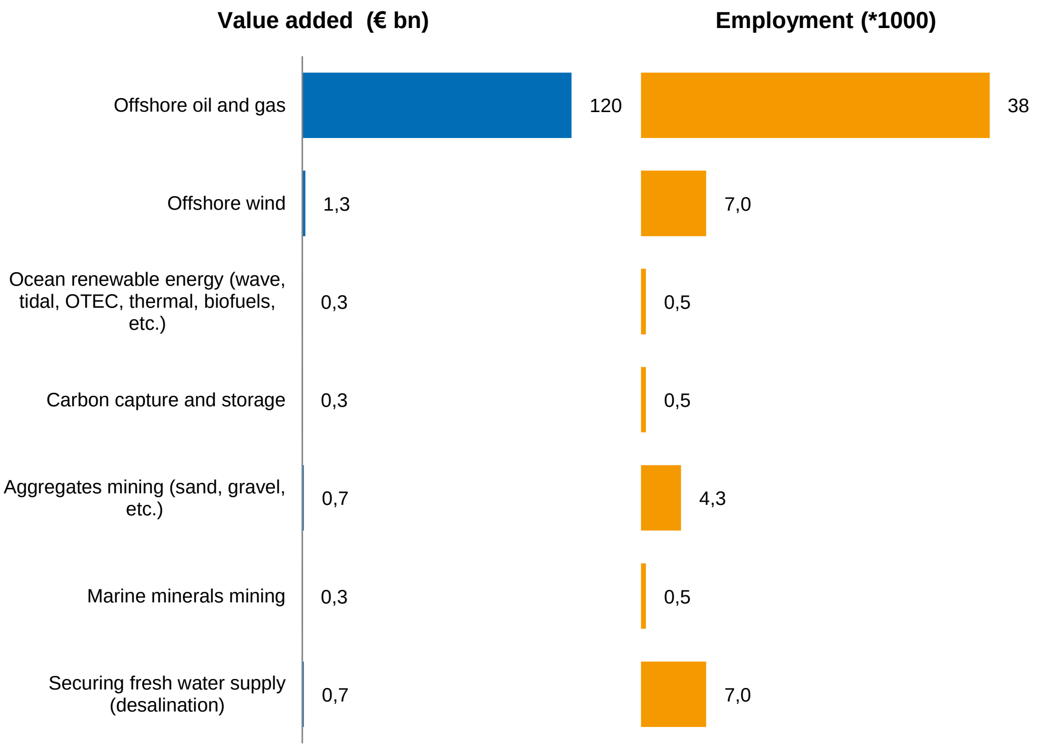
Maritime transport and shipbuilding



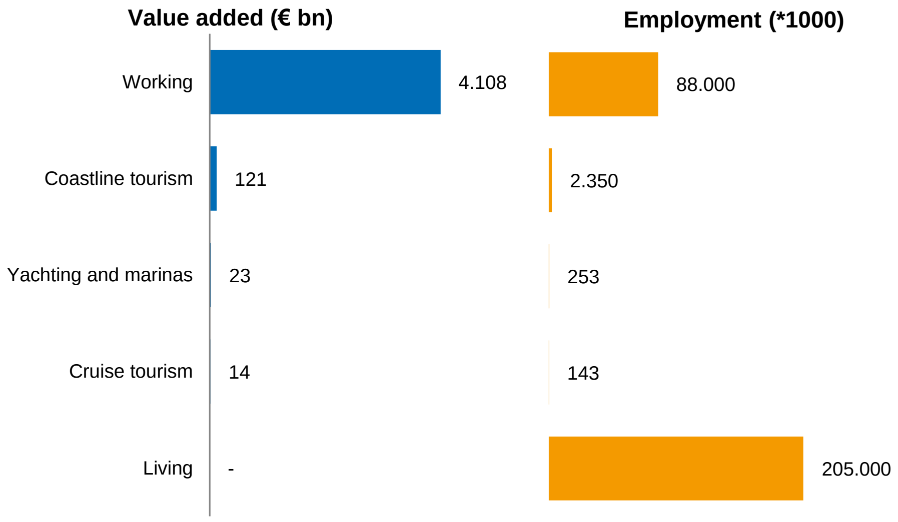
Food, nutrition, health and eco-system services



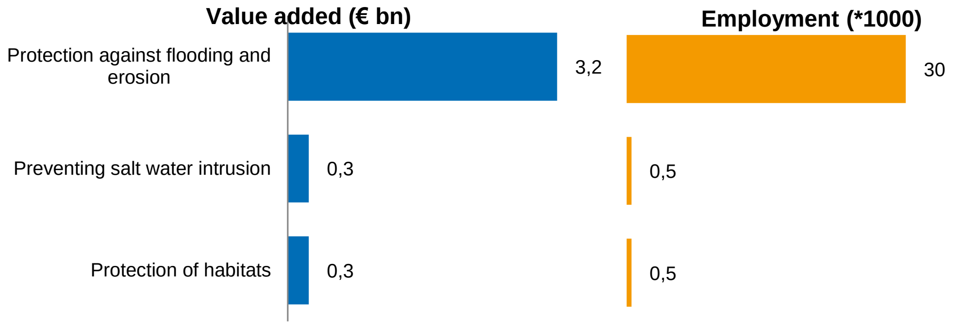
Energy and raw materials



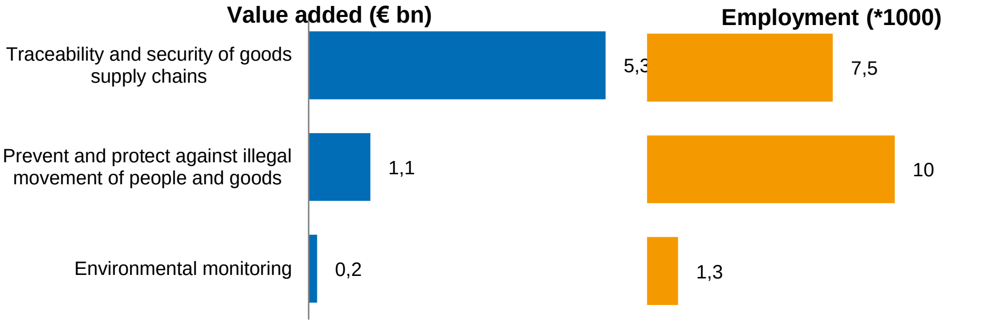
Leisure, working and living



Coastal protection



Maritime monitoring and surveillance



Note: The above sources will be updated as part of the final report stage of this project

Note: in the subsequent assessment under chapter 3, the three activities under 'Maritime monitoring and surveillance' have been assessed in combination. The same applies to 'coastline 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 over 5 mln jobs.[4] Coastline tourism and deep-sea shipping are the maritime activities which currently provide most employment, followed by shortsea shipping – all employing from almost 1 to over 2m jobs each. Oil and gas are above all important for their GVA contribution (€ 23bn). Yachting and marinas, passenger ferry services and catching fish for human consumption each provide currently around 250,000 jobs.

…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 shortsea shipping have seen strong GVA growth, but not accompanied by equal job growth.

2.3 A dynamic perspective: product life cycle approach

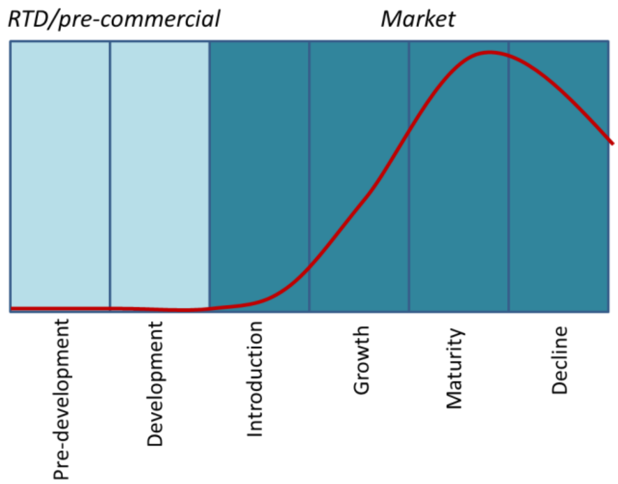
…A future-oriented study should focus on what can be expected tomorrow…

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, it is clear which players are dominating the market.

In selecting maritime economic activities for further analysis, we have focused on the biggest activities today, those which have witnessed strongest growth in the last 5 years, and those which have most potential for the future. This approach aligns with the above extended life cycle approach.

Figure 2.2 Product life cycle approach



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

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

[4] 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.

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.

On the basis of the above rankings, we have retained the below 11 maritime economic activities as most essential for further analysis and potentially for policy-support within the context of Blue Growth[5]. 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. We will present the future outlook for each of these maritime economic activities in the subsequent chapter[6].

Findings will contribute to policy recommendations for all 27 maritime economic activities identified

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.

Table 2.1 Maritime economic activities studied 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 (bn €)	Recent growth	Future potential
Mature stage			
1. Shortsea shipping	**63**	6.1%	2
2. Offshore oil and gas	**107-133**	-4.8%	1
3. Coastline tourism & yachting	**144**	3-5%	4
4. Coastal protection	**1.0-5.4**	4.0%	6
Growth stage			
5. Offshore wind	2.4[7][8]	**21.7%**	6
6. Cruise tourism	14.1	**12.3%**	5
7. Marine aquatic products	3.3	**4.6%**	4
8. Maritime monitoring and surveillance	1.8-2.3	**+**	5
(Pre-)development stage			
9. Blue Biotechnology	0.6 - 3.3	4.6%	**5**
10. Ocean renewable energy	<0.25	+	**5**
11. Marine minerals mining	<0.25	0/+	**4**

Note: Data on size, recent growth and future potential are taken from the First Interim Report
Future potential: Score is based on an evaluation of six criteria

[5] In the First Interim Report of this project, 27 maritime economic activities have been documented; in the Second Interim Report 13 of these activities have been investigated in-depth; the 10 maritime economic activities presented here take into account the results of an expert hearing. Not included here is the desalination activity, as the competitiveness of European players is considered rather weak; activities under blue biotechnology and maritime surveillance have been regrouped.

[6] 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 does seek to identify complementarities with the CFP where appropriate and relevant, and aims to identify existing or new synergies with it.

[7] No reliable GVA data could be found; the 2.4 bln.. Ecorys estimate is that GVA will in this case be close to the 2010 offshore investment.

[8] Other estimate suggests the size is much bigger, ranging from € 5-10 bn. This could however not be confirmed by written sources. In any case it does not affect the resulting list of selected sub-functions derived in WP1.

2.4 Sustainability aspects

The key challenge of the Blue Growth project is to promote the development of maritime economic functions in a sustainable manner, in sea basins that are under (sometimes severe) stress already. To achieve sustainable development, policy initiatives on Integrated Maritime Policy (IMP), Maritime Spatial Planning (MSP), the Marine Strategy Framework Directive (MSFD) and Integrated Coastal Zone Management (ICZM) were developed. These policy initiatives are addressed in chapter 6.

In this paragraph the environmental impacts of the Blue Growth economic functions are summarised, in order to help find a good fit between those impacts and corresponding policy responses (chapter 6). Our approach follows the structure of Annex 4 of the EC Working paper (EC, 2011a). The 27 economic functions of the Blue Growth project (Annex 1) were added. Then, for the selected Blue Growth functions (table 2.1) only, Annex 5 was reworked to show the environmental impacts per function (table 2.2). The impacts of the selected functions are explained in more detail below.

Shortsea shipping

The major impacts of shortsea shipping on the environment are chemical pollution due to oil spills, discharge of oil and ballast waters and pollution by anti-fouling agents such as tributyltin. Other impacts include emissions of NO_x, particulate matter and sulphide to the atmosphere. The number of shipping accidents in European seas shows that such incidents are not infrequent.

The practice of discharging ballast waters, used for ship stabilization is considered as a major vector for the introduction of invasive species threatening the marine food web production. In some cases, these species proliferate uncontrollably, causing serious damage to food web structure, functioning and production or physically hampering coastal activities (fisheries, energy plants, tourism, etc.).

Over the past hundred years, underwater noise levels have steadily increased, to levels where they have become an issue of concern. Noise from ships' propellers and engines dominates the low frequency background noise in many parts of the world's oceans and seems to be growing by about 3–5 decibels per decade in deep offshore waters. There is concern that this is having an impact on marine life, particularly marine mammals.

Building any new constructions for the transport or energy sector may turn out disadvantageous for the environment, simply because a substrate is added that wasn't there in the first place. These may create stepping stones for unwanted species or skew ecological balances towards new manmade differences in trophic situations, lowering regional resilience further

An additional pressure by shortsea shipping may be the unintended extraction of living species as a result of dredging activities near ports.

The pressures that shipping exerts on the environment are not evenly distributed, they concentrate at shipping lanes and harbours, while the impacts may be more significant near ecologically sensitive areas or near the shore.

Offshore oil and gas

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. 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.

Offshore wind

Impacts arise throughout the life cycle of wind farms, including: site selection, construction, operation, decommissioning and removal. Impacts include 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.

Wind farms may also have positive impacts, for example when they offer chances for overexploited areas by creating fishing and shipping exclusion zones, or by creating new habitats.

Ocean renewable energy

This sub-function is less mature and presently not used commercially. The main concerns relate to tidal range energy: 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.

Coastline tourism and yachting

The growth of tourism has 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. For example, the little tern has suffered reduced breeding success in the southern North Sea. The growing attraction of remote areas as tourist destinations puts these relatively pristine areas under pressure. Diving activities without control can alter underwater ecosystems, especially when coupled with illegal gathering of coral, shells or fishing.

Tourists add synthetics to the marine environment, by using oils, crèmes, selftanning etc to block out or fully use the sun; most of these end up in the sea.

On the other hand, tourism has the potential to create beneficial effects on the environment by contributing to environmental protection and conservation. 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 down drift. Dredging activities may result in the unintended extraction of species. Damage can be done in a variety of other ways (for example, anchor impacts on sea-grasses).

Cruise tourism

Cruise ships have been described as 'floating cities', whose per capita pollution is generally worse than that of a similarly populated city. This is largely due to weak pollution control laws, lax enforcement and the difficulty associated with detecting illegal discharges at sea.

Cruise ports have similar but more severe impacts on the environment as smaller harbour and marina areas. Ports and their adjacent cities may form a “stepping stone” for non-indigenous species. Also the building of deep port entries, the use of toxic paints, and anchor damage are causes of pollution and habitat destruction.

In particular in the Arctic regions, cruise tourism represents a source of disturbance and pollution in areas that are otherwise pristine. The biggest single threat caused by ship-based activities 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.

Coastal protection

The conversion of coastline 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 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..

Blue biotechnology

The main pressure expected from this function 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. For example bio-sourced polymers 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.

Marine aquatic products

The main pressures are discharges of nutrients (in particular in coastal areas with relatively small total nutrient discharges), organic matter, microbial pathogens, drugs, herbicides and fungicides (Helcom 2010a). Natural predators may be targeted to control predation of farmed fish. 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.

Marine minerals mining

There are considerable environmental concerns on the disturbance of deep-sea (> 400 metres) ecosystems by the extraction of mineral resources. The deep-sea and seafloor forms an extensive and complex system which is linked to the rest of the planet in exchanges of matter, energy and biodiversity. The functioning of deep-sea ecosystems is crucial to global biogeochemical cycles upon which terrestrial life and human civilization depend. Operations on the seafloor may destroy unique habitats and disturb deep-sea ecosystems which could entail changes in long-living fish stocks 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. The risk of ecosystem shifts in the deep sea due to multiple large pressures has not yet been assessed.

Table 2.2 shows an overview of the environmental impacts per function. Further details are presented in annex 4.

Table 2.2 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	■			■	■		■							

3 Blue Growth: the future potential

3.1 Introduction

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. *Four general background scenarios*; from a top-down approach, four more or less realistic futures 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.

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.

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.

3.2 Four general background scenarios

The general scenarios serve a twofold reason:

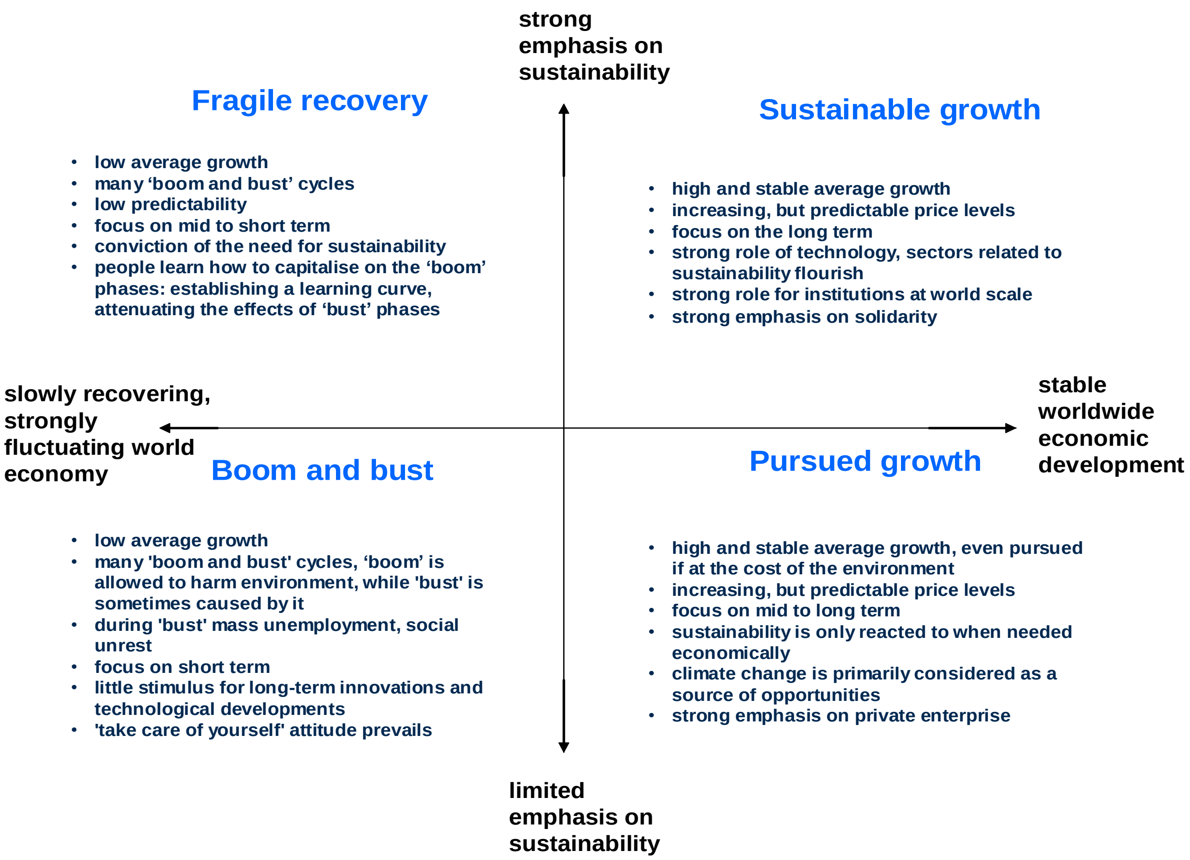
a. They will help to improve the micro-future scenarios by discussing their potential in the four different futures.
b. Findings will be used to improve the robustness of policy options, by examining and discussing their effects in the four general scenarios.

3.2.1 *The scenario matrix*

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

Based on an analysis of the Blue Growth sub-functions[9], the two most relevant and uncertain trends were identified as 'economic climate' and 'degree of sustainability'. These trends are used as the axis of the scenario matrix.

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.



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*

Sustainable Growth

The world in 2025

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

[9] Cf. Blue Growth Second Interim Report, chapter 3.1.

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 in 2025

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 in 2025

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 in 2025

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 a.o. 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 a.o. 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.

Four futures in 2025				
	A. Sustainable Growth	**B. Pursued Growth**	**C. Boom and Bust**	**D. Fragile Recovery**
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

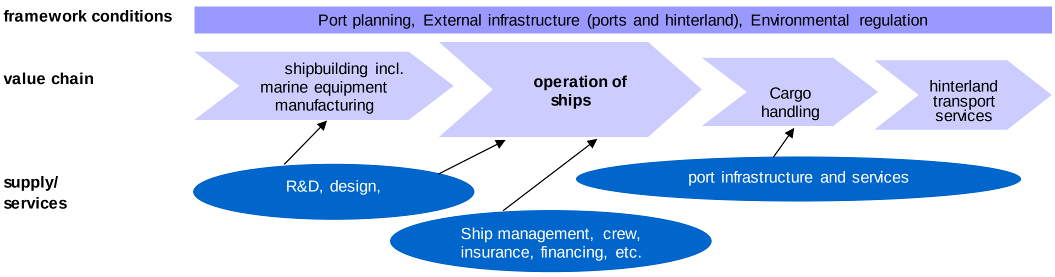
These activities currently provide high amounts of value added and employ substantial numbers of staff. Main challenge for these activities is to continue to perform in the light of strong external pressures and fierce competition from global players. Much will depend on the strategies and business models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

3.3.1 Shortsea shipping: reaching out to Europe's neighbourhood [10]

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

The shortsea 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.

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.



The transported volumes by short-sea shipping account for almost 1.7 billion tons per year, of which about 600 mln tons concerned neighbouring states and 1 billion intra-EU shipping (40% of all intra-EU transport). 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 percent for the coming decade. Employment is estimated at some 800,000 and this number is considered to remain relatively stable due to efficiency increases taking place along the value chain. Added value is estimated at €63 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 shortsea segment may be affected by the overcapacity that is being created in deepsea markets caused by the large newbuilding activity over the past years.

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

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

handling 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.

…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 shortsea shipping. Trade with Neighbourhood countries will increase – as growth in Turkey, Russia, Ukraine and North Africa will spur the demand for shortsea shipping. 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 shortsea 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 shortsea shipping on the environment currently are chemical pollution due to oil spills, discharge of oil and ballast waters and pollution by anti-fouling agents such as tributyltin (TBT). Other impacts include emissions of NO_x, particulate matter and sulphide to the atmosphere. 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.

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

In many ways, short sea shipping provides the linking pin in 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 shortsea shipping in the EU by reducing the administrative burden for intra-Community trade. [11]

Assumptions about framework conditions

- Lack of capacity in and around secondary ports and their hinterland connections will be addressed;

[11] See http://www.emsa.europa.eu/news-a-press-centre/external-news/item/684-emsa-5-year-strategy.html

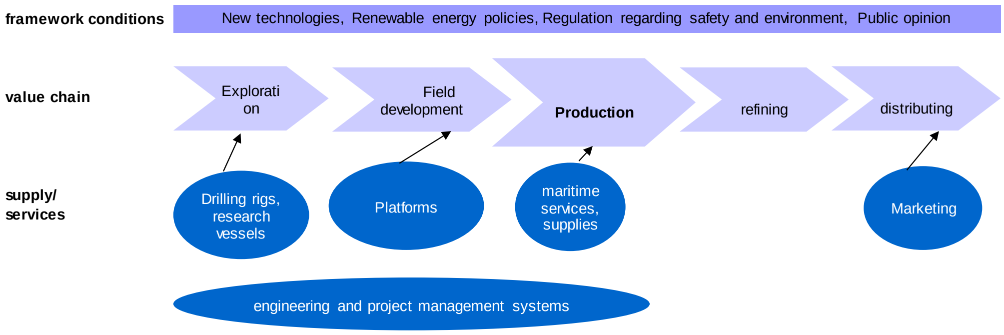
- Strong enhancements in external infrastructure (ports and hinterland);
- Environmental regulation will be increased gradually, allowing the sector to acquire funds and invest in the necessary adaptation costs.

3.3.2 Offshore oil and gas: deeper and farther away[12][13]

…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. 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. 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.

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

[13] Not included in this overview is methane hydrate exploration and carbon capture storage. Even though these could become promising activities in the longer term, most experts do not expect these 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.

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).

Assumptions about framework conditions being fulfilled:

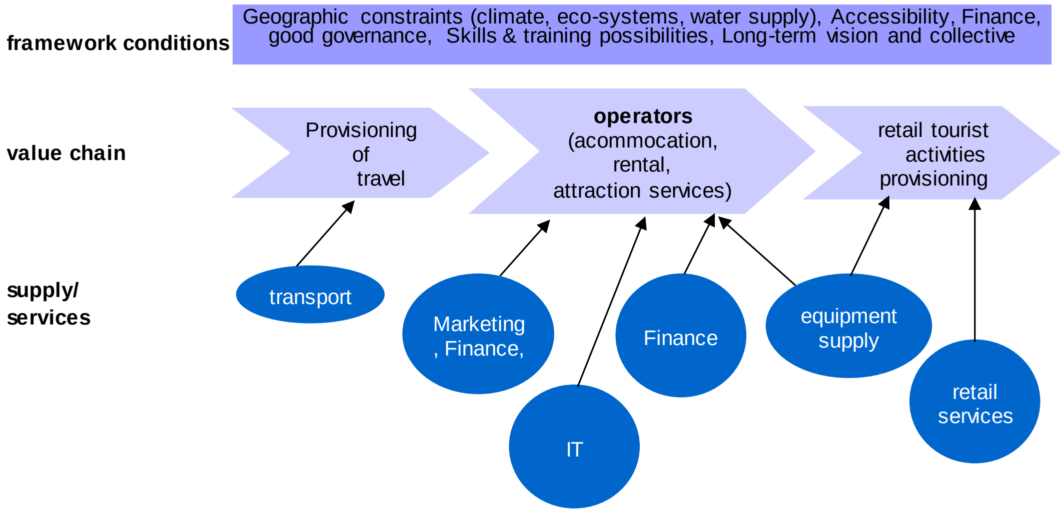
- New technologies will allow further exploitation of offshore oil fields that are currently considered almost depleted;
- Renewable energy policies will provide room still for oil & gas;
- Regulations regarding the safety and the protection of the environment will be introduced gradually;
- Public acceptance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

3.3.3 Coastline tourism and yachting: polarisation between places[14]

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.

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.

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



Increased pressure for CO_2 cuts and fuel costs will reshape the sector, as it is likely that in the long term distant short trips will decrease and local areas will become again favourite tourism destinations, particularly for the majority of low to middle income individuals. 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 mln 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[15]. Although no precise data are available for the EU the phenomenon is becoming increasingly relevant, particularly for Portugal, Spain, France and the UK[16]. 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 bln annually[17]. Main diving destinations are Spain, Malta, Cyprus, as well as Turkey and Croatia, in of which diving has allowed to extend the touristic season beyond summertime. One example is that of the Medes Islands (Spain), visited each year by about 20.000 scuba divers, where divers represent 9.3% of the tourist population[18]. 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 initiative, 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

[15] Global Surfers Surf Atlas (www.globalsurfers.com)
[16] Global Surfers Surf Atlas (www.globalsurfers.com)
[17] *European Underwater Federation (EUF),*
[18] *Recreational Scuba Training Council (RSTC)*

marketing, training and innovation activities - federated in the European Federation of Nautical Resorts[19]. 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 will be challenged by Northern and Eastern Member States (including the Baltic, North Sea, Atlantic and Black Sea Basins). Winners will be those regions and places with strong innovation and marketing capabilities and where skilled labour is available. 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 sub-functions 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, activities related to aquaculture, mineral extraction, might have negative impact on tourism development as they might 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.

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[20]. 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

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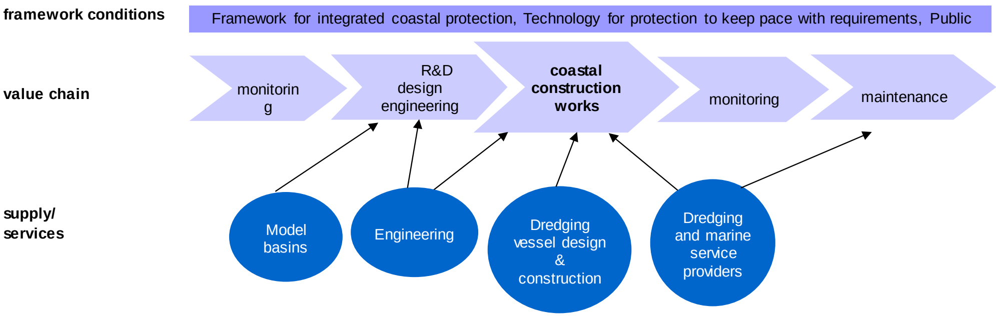
[19] www.nautical-tourism.eu

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

- Better regulation (i.e. Blue Flags) in ensuring good quality of environment, bathing water, etc.

3.3.4 Coastal protection: steadily reinforcing Europe and the world[21]

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. Growth 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, continues. 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[22] 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

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

[22] Based on EUROSION (2004).

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.

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.

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 sub-function 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 the sub-function 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

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.

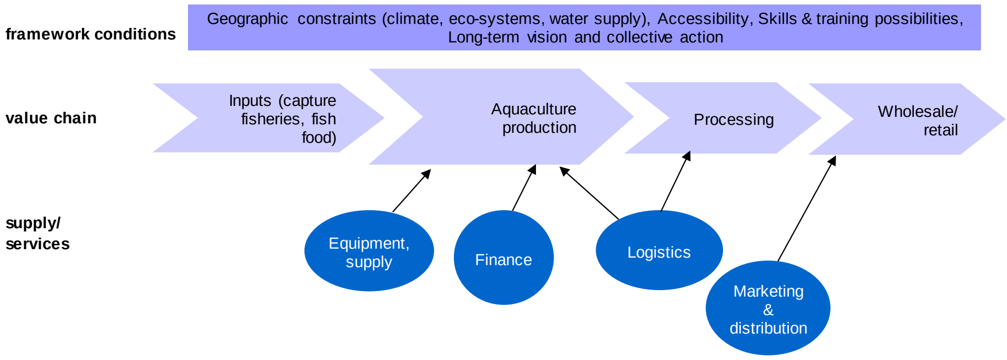
3.4.1 Marine aquatic products: a cultivated growth [23]

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.[24] .[25] 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, seabass and sea bream being the most important) and freshwater finfish farming (trout, carp, eel, etc.).

[23] 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.

[24] Council Regulation (EC) 1198/2006

[25] 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 mln. tons in 2002 to 51 mln. tons in 2006. [26] In 2005, total aquaculture production in the EU was about 1.3 mln. tonnes, worth some € 2.9 bln. The total number of employed in the sector is estimated at about 64,000. 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. [27]

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 €2.5 billion for 1.01 million tonnes in 2007[28] compared to €1.6 billion for 1.05 million tonnes in 1998. Over the period of 10 years, the evolution was not steady: the value produced has increased from 1998 to 2001 (then reaching €2.2 billion), decreased from 2002 to 2004 (€1.9 billion) and rebounded since then.

Of the three sub-sectors in aquaculture, shellfish famring and marine finfish farming can be considered maritime. [29] 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.

Prospects for Europe's marine aquatic products are expected from **sustainable** and in particular **organic aquaculture**.. [30] 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. This trend is supported by voluntary labelling and certification schemes – which help to strengthen consumer confidence. A survey conducted by the Seafood Choices

[26] FAO (2008) "The State of World Fisheries and Aquaculture", Rome.
[27] Framian (2007).
[28] It has been chosen to present data until 2007 only as Eurostat data for 2008 and 2009 are incomplete (no production value reported for large players: Greece, Germany...) or seem incoherent (production value reported for Spain and France).
[29] The third sub-segment is fresh-water-fish farming in lakes, ponds and basins and will not be discussed in this context.
[30] Aquamax, and FP5-supported projected coordinated by NIFES (Norway) as presented during DG RTD's Food conference, 9th July 2010 in Brussels.

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 surveyed, also 40 percent indicates to be willing to pay 5–10 percent more for eco-friendly seafood [31].

Challenges for further development of EU aquaculture are numerous and include: limited access to space and water of the necessary quality, industry fragmentation, 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 [32]. There is a clear need for innovation and technological progress, for example in the area of sustainable fishfood. [33]

Prospects are also strong for **algae growing.** While still small in size the sub-function has already shown recent growth and its future is assessed positive. The product outputs are clear but commercial exploitation seems not viable yet. 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). [34]

Algae aquaculture is expected to provide a range of synergies with and spill-overs 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:

- Such positive developments will require however that access to finance is secured and that the European sector would be able to attract private investors to enter the sector on the medium to long term.
- Support from large energy and food companies to invest in developing alternative resources would make a major difference.
- 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.

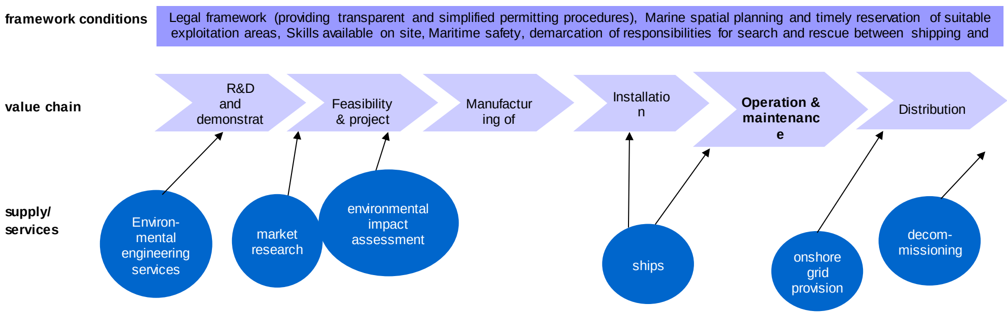
[31] Seafood Choices Alliance, 2007
[32] COM (2009) 162
[33] J. Bostock et al (2009) "European Aquaculture Competitiveness: Limitations and possible strategies. Study carried out for the European Parliaments' Committee on Fisheries.
[34] Noteworthy is the initiative in Brittany to create a new sector specifically for seaweed farming for the Japanese market, in an attempt to help oyster farmers to diversify.

- Trade regimes allowing for 'level playing field', and reducing the impact of low-cost imports with substandard environmental and health performance.

3.4.2 *Offshore wind: anywhere the wind blows?*[35]

…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. [36] Out of these some 7,000 were related to offshore wind activities (figure 2007). [37]



Within the offshore segment, the main market is the construction, operation and maintenance of large-scale, remote, deep-water wind farms. 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 the local economy[38]. 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 new technological developments, forming joint ventures with hardware manufacturers 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.

[35] Literature references used for drafting this section can be found in annex 1 under the specific heading for this economic activity.
[36] EWEA, 2009, Wind at work, p.8.
[37] EWEA (2009), Wind at Work, p.9
[38] EWEA, 2009. Wind at work.

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.

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. This will be made possible by New developments in floating platform construction and improving robustness will contribute in lifting present constraints. Scale effects, combined with raising oil prices and improved public appreciation will provide a more sound economic basis. As a result, the capacity installed is increasing. 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 bln in 2011 alone, or 19% of all investments in the wind sector. [39] The offshore-related employment 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. [40]

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. 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. [41]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 and are in principle assumed to be small. The sector has learned to perform its construction, operation and maintenance in a sustainable way, avoiding intolerable negative impacts in terms of soil disturbance, noise, collisions and emissions. In some cases favourable impacts are envisaged because of the ability of the platforms to become artificial reefs and to create new habitats. In general wind energy does not present a serious threat to marine ecosystems.

[39] EWEA (2011), Wind in Power, 2011 European statistics, p. 5.
[40] EWEA (2009), Wind at Work, p.9
[41] 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).

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.

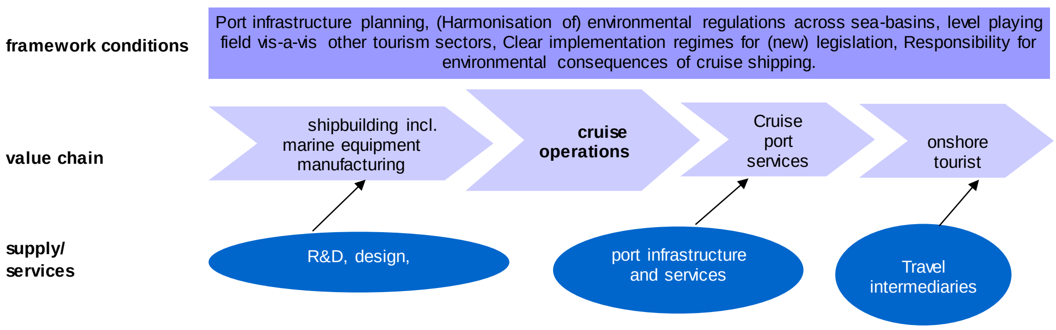
Assumptions about framework conditions being fulfilled:

- 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.[42] 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.

3.4.3 Cruise shipping including port cities: cruising along at high growth?[43]

…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

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

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

of writing, when the sector is recovering from the aftermath of the much-publicized Costa Concordia accident in front of the Italian coast. 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. 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.

The worldwide cruise industry forecasts a strong growth trend in demand; the total number of passengers carried worldwide is estimated to reach 29.7 mln. 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.[44] Added value for the EU is estimated at a current € 14.5 bln. In 2010 a total 132 cruise ships were employed by European companies.

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 mln 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 pressures on water resources, waste management, import of consumer goods/services which themselves create traffic, traffic flows, and CO_2 emissions. A number of regulations is 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 faciliities.

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:

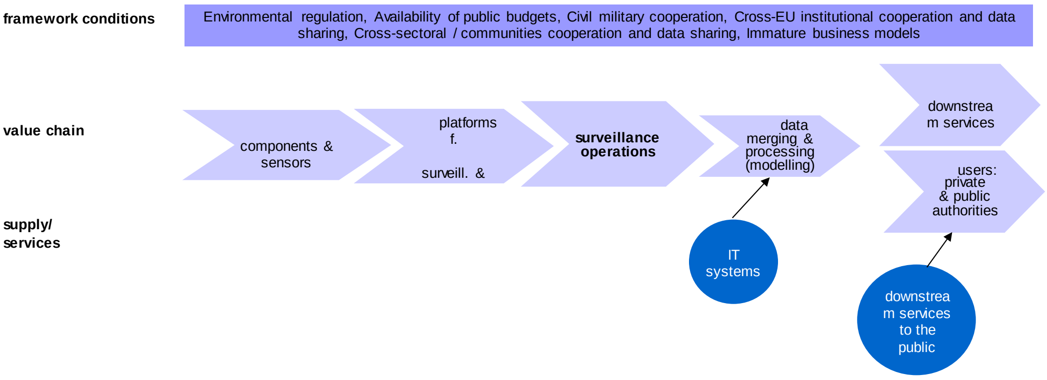
- Infrastructure: port authorities manage to keep pace with demand in providing berthing capacity. Location is key and should be central in port cities close to tourist hotspot sites. This may require relocating other activities;
- Accidents (such as the accident with the Costa Concordia) and security 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;

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

- Clear implementation regimes for new legislation, allowing the shipbuilding industry to adapt timely and maintain competitive power against Asian yards and suppliers.

3.4.4 *Maritime monitoring and surveillance*[45]

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 functions, 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 functions due to the increasing number of (legal and illegal) activities at sea. The last decade has seen an increase in 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, that 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 bn, excluding indirect impacts.[46] Further environmental awareness policies will need to be increasingly monitored and enforced, while modern public procurement policies are expected to further drive demand. Environmental

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

[46] Source: Homeland Security Research Corporation

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). 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.

…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 functions. 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 functions. Environmental monitoring services are also used for coastal protection purposes.

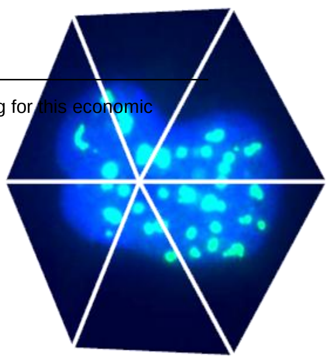
Assumptions about framework conditions being fulfilled

- 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

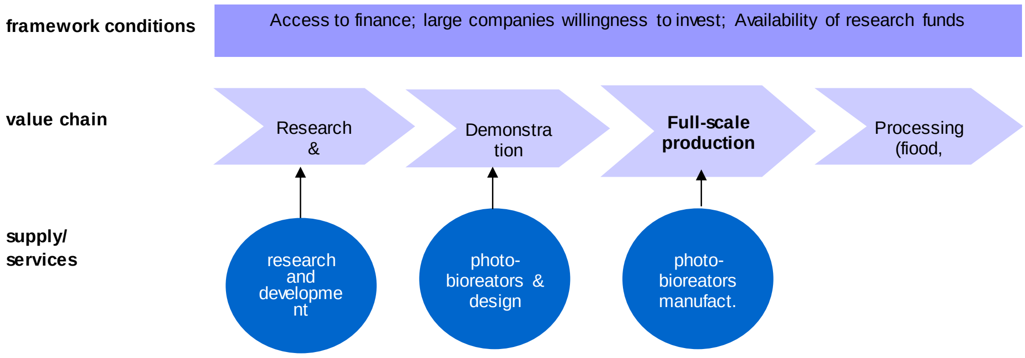
The future is bright, the future is blue. That appears to be the commonality for the sub-functions in the (pre-) development stage. Ocean renewable energy sources will provide a welcome supplement to other (maritime) energy sources. Based on intensive R&D, piloting and testing, blue biotechnology and 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[47]



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

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



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 bln (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. 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 the sub-function 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. [48]

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.

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

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

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.

Assumptions about framework conditions:

- Access to finance is secured; investors will no longer focus exclusively on algae biofuel but also become interested in other blue biotechnology applications.
- The capacity of the European sector to avoid key competencies to be concentrated by competing countries (China, India, South East Asia...).

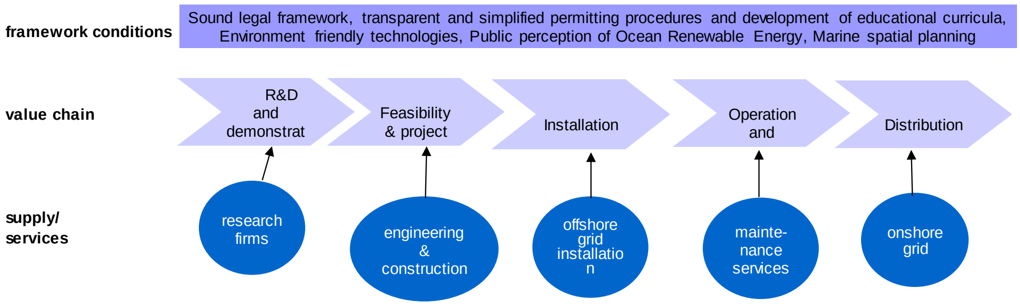
…The potential of Blue biotechnology to create spill-overs to other maritime activities is sheer endless…

Blue biotechnology provides a range of synergies with and spill-overs 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).

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 braindrain).

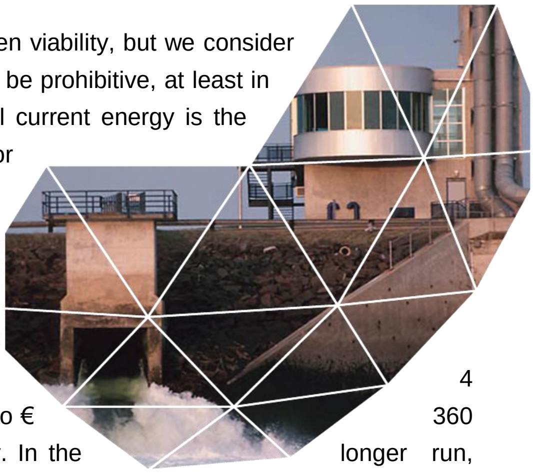
3.5.2 *Ocean renewable energy: tidal current as the next wave*[49]



'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[50]:

- Tidal energy, covering tidal range and tidal current, is the most advanced. It 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 installed 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 tidal wave…



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. Of the remaining segments, tidal current energy is the most advanced one. The yearly installed capacity for tidal current energy is expected to increase from 3.4 MW in 2010, to 22 MW in 2012, to 32,5 MW 2014 and 2015, with continued growth perspectives in the further future[51]. Employment will increase accordingly, from 1000 fte in 2010 to potentially 20,000 fte in 2035. The turnover has increased from € 4 mln in 2005 to € 37 mln in 2010, and will grow further to € 360 mln in 2015[52]. Immediately following is wave energy. In the longer run, all options should be kept open, but OTEC and osmotic energy still need time and technological development to prove them.

[49] Literature references used for drafting this section can be found in annex 1 under the specific heading for this economic activity.
[50] the observations that follow are based on literature and interviews, as reported in the Economic activity Profile document
[51] Source: Renewable UK (2011)
[52] 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.

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.

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 shortsea 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.

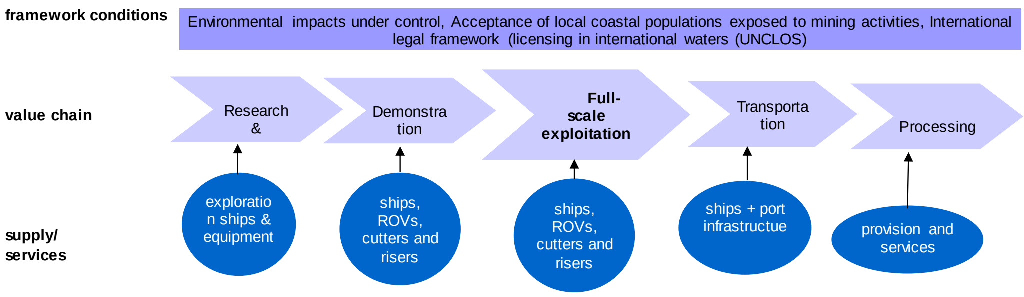
Assumptions about framework conditions being fulfilled:

- Access to finance – for moving into the development stages and for funding demonstration projects. A reduced risk perception based on proven technology;
- 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 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: the EU as a player on the ocean floor?*[53]

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.

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



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, 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,
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. 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 bln in the next 10 years, and € 10 bln in the period up to 2030. Mining will focus above all on polymetallic suphides: deposits which are the result of hot fluids being discharged through fractures (vents) between tectonic plates[54]. 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.[55]. The mining company has thereto

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

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

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 exploration of the largest known sulphide concentration, namely in the Red Sea, will soon start as well. [56] 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.[57] 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.

…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. 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).

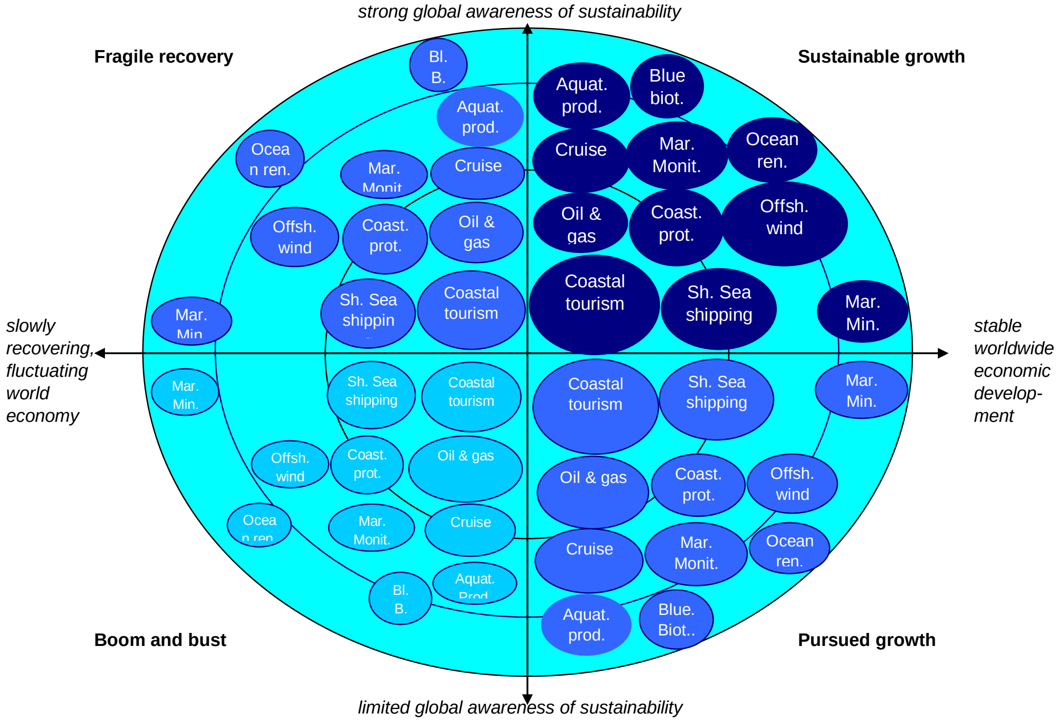
3.6 Conclusions: blue growth potential in perspective of the scenarios

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

[56] 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.
[57] World Ocean Outlook, Chapter 7 "Marine minerals and energy", p. 151.

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. Figure 3.1 below provides a schematic overview of the 11 selected maritime economic activities by future.

Figure 3.1 Expected dynamics of selected maritime economic activities by future scenario



Global Blue Growth economic and jobs potential is strong – especially in a context of stable worldwide economic development

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 functions. 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 to be the most crucial variable for Blue Growth prospects

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) points to Asian players already being 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 implementation 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 sub-functions, 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.). The EU's future success in the maritime economy will therefore largely depend on its own technological as well as commercial power.

Sustainable maritime innovations are a European card to play – but not in all scenarios

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.

4 Sea basins

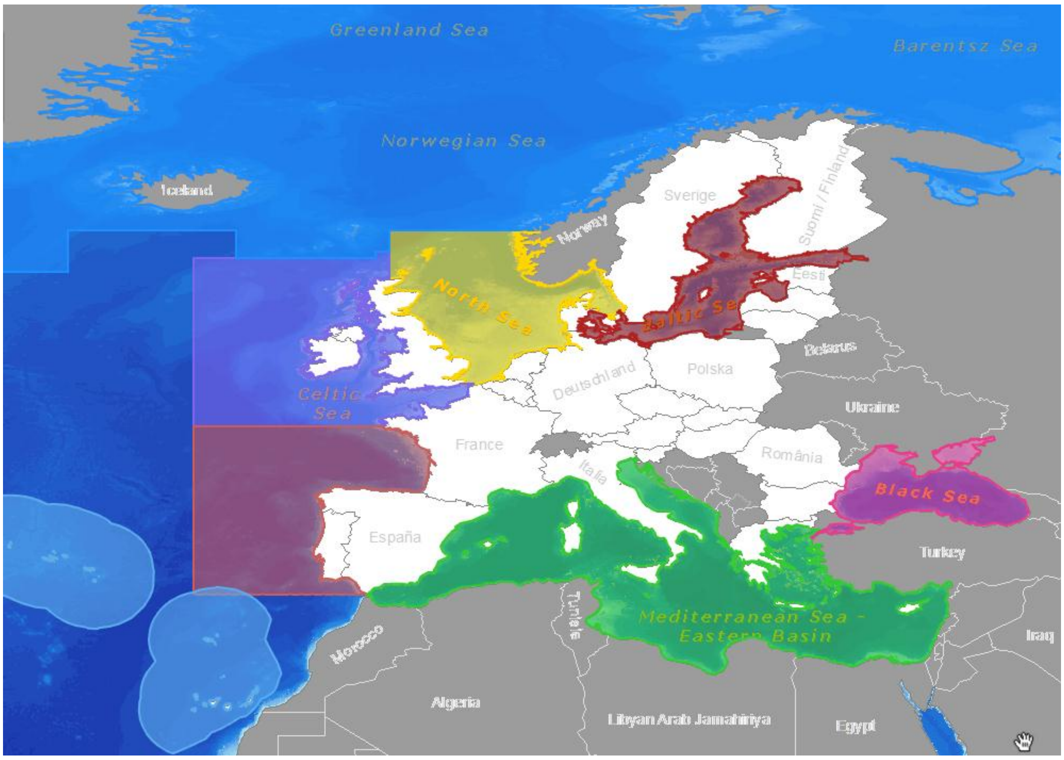
4.1 Introduction

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 functions 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 hotspots are identified. A hotspot is in this study defined as a defined space or place with a concentration of multiple (at least two) maritime economic activities. A preliminary overview of hotspots is presented in section 5.3, 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: DGMare website).



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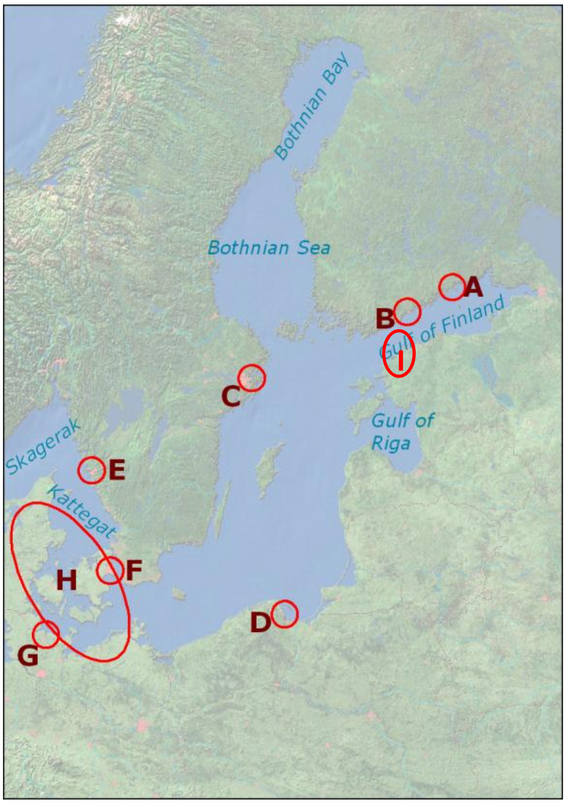
The references used in this chapter are included in Annex 2, the second part, after the references of the maritime economic activities.

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 hotspots: A=Kotka/Hamina; B=Helsinki; C=Stockholm; D=Gdansk/Gdynia; E=Goteborg; F=Copenhagen; G=Kiel; H=Western Baltic; I=Tallinn; see also section 5.3.



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, 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 Second Interim Report of the Blue Growth project an estimate was made of the relative importance of each sea basin for the economic functions 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 functions are small. Other important economic functions, 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.

Shortsea shipping

Based on the gross weight of goods transported, 20 % of Shortsea 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 mln 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).

Coastline 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 coastline 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 example, 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 functions 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 (Blue Growth, Second Interim Report).

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 proposed and/or implemented

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. Furthermore regional cooperation initiatives addres Blue Growth aspects as well.[58]

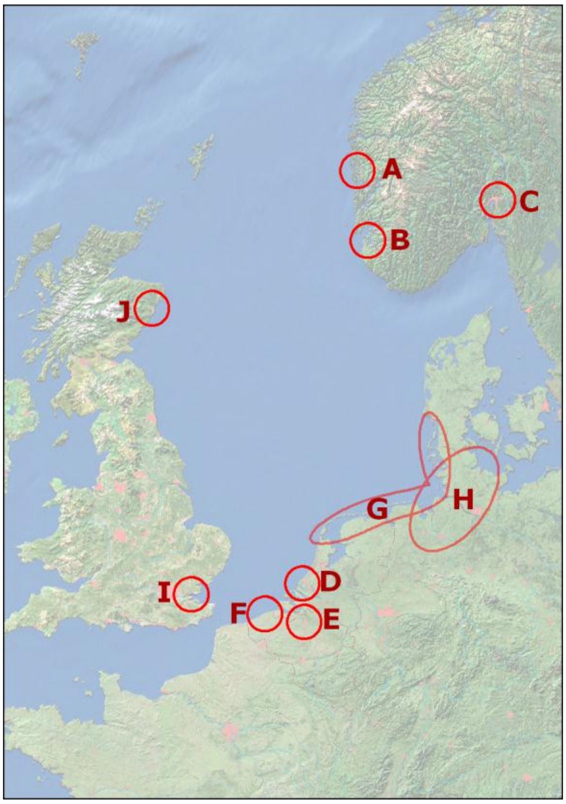
[58] See for instance www.euregionbaltic.eu

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 hotspots: A=Bergen; B=Stavanger; C=Oslo; D=Rotterdam; E=Antwerp; F=Oostende; G=Wadden Sea; H=Hamburg/Bremen/Kiel; I=London; J=Aberdeen; see also section 5.3.



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, 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 the Second Interim Report of the Blue Growth project an estimate was made of the relative importance of each sea basin for the economic functions and their future potential. The North Sea is relatively important for shipping, cruise tourism, offshore wind and coastal tourism, while the remaining functions are small. For the future, the indicated functions are expected to continue their growth, in particular offshore wind energy and coastal tourism and yachting.

Shortsea shipping

Based on the gross weight of goods transported, 26% of shortsea 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 function 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 tidal energy, in test sites in Scotland 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.

Coastline 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).

Sea surface temperature in the North Sea have increased 1 to 2 °C over the past 25 years. Plankton and fish communities and distribution patterns are changing in response to warming. Amounts of litter are a concern, especially in the northern North Sea. Concentrations of metals (cadmium, mercury and lead) and persistent organic pollutants are a concern for the breeding success of birdlife in some coastal areas (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. Many North Sea countries have met their national and international targets for reducing phosphorus inputs to eutrophication problem areas, also inputs of mercury and lead to the sea from several major rivers have decreased, although further improvements are still possible. 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 proposed and/or implemented

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, 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.

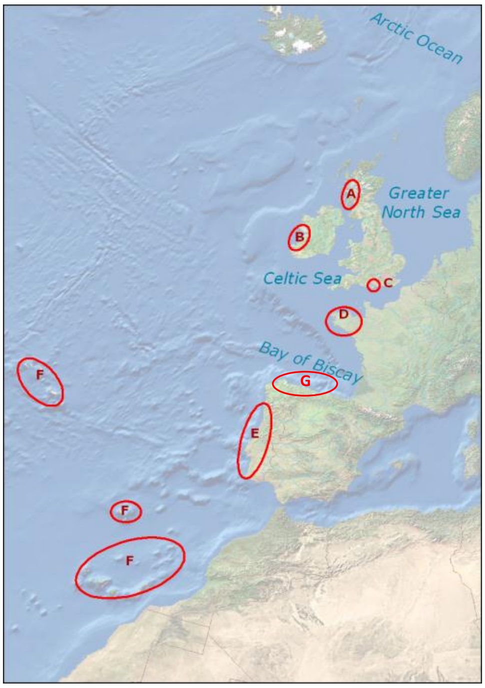
The North Sea Region 2007-13 promises to deliver a long-term strategic approach to transnational cooperation. It will provide a catalyst for cooperative projects that can support investments in infrastructure that are of transnational relevance. An additional aim is to encourage cross-fertilisation between projects that address similar issues, and that provide complementarity 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 Biscaye and the Iberian coasts, coinciding with OSPAR's regions III, IV and V.

Figure 4.4 The Atlantic Ocean Region with its economic hotspots: A=Scottish West Coast; B=Galway; C=Solent; D=Brest; E=Portuguese coast; F=Canaries, Madeira, Azores, G=Galician coast; see also section 5.3.



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 fjordic 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 Biscaye 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, 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 function in themselves, are identified as important activities as well, In the *Bay of Biscaye 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, Shortsea 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.

Shortsea shipping

Based on the gross weight of goods transported, 14% of Shortsea 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 function is small and is expected to remain small for the coming decade. It is mentioned here because in the Atlantic much development is taking place in wave and tidal energy, in test sites in Scotland, Ireland, France, Spain and Portugal.

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 (BG Function Profile).

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

Environmental status

Successes

The Celtic Seas (again using the OSPAR nomenclature) have benefited from a reduction in the discharge of radionuclides from the nuclear sector. In particular, there have been drastic reductions in the discharge of radioactive technetium from nuclear reprocessing activities at Sellafield (UK). Region III is the Region with the greatest proportion of monitored sites where the impacts of TBT are now at acceptable levels, but there are still some problem areas close to harbours and busy shipping lanes. Recent trends show an improvement in the structure of fish communities that live on or near the seabed, particularly in the north of Region III. Following the adoption of a long-term management plan, the northern hake stock recovered and is now classed as sustainable.

In ***the Bay of Biscaye 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.

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

The seabed in shallow areas of ***the Celtic Seas***, including areas of sediment, rock and some biogenic reefs, has been significantly damaged by benthic trawling. Not all fisheries are sustainable.

Pressures on species and habitats in Region III 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. Hazardous substances unacceptable at some coastal locations. Heavy metal, PAH and PCB concentrations in sediment, fish and shellfish have fallen, but are still above acceptable levels in some coastal areas of Region III, mainly around the Irish Sea. On beaches around the Irish Sea there are unacceptable quantities of litter, reaching over 1000 litter items per 100 m beach in some areas. This can be dangerous to seabirds, and to turtles and marine mammals when washed into the sea. Much of this litter probably comes from sources on land.

In ***the Bay of Biscaye and the Iberian coasts,*** the anchovy population in the Bay of Biscay has declined dramatically due to a lack of new young fish, and the fishery was closed between 2005 and 2009. The southern stock of hake is at low levels and subjected to unreported fishing. Most aspects of the demersal fish community on the French continental shelf are in a poorer state than in the mid- to late 1980s. There are eutrophication problems in small coastal bays and estuaries where waters are less active. Ship traffic has been increasing in Region IV 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, and damaged some of the last remaining colonies of the Iberian population of the guillemot. The long-term effects of this spill are still not known. Mercury remains a particular problem in Region IV, with over 40% of sites having unacceptable levels in sediments, perhaps as a legacy of past mining activities. In general, there is little information from Portugal on this type of pollution, but on other coasts, pollution from hazardous substances is found in coastal locations close to urban and industrial areas.

In ***the Wider Atlantic,*** deep-water fishing is exerting pressure on the ecosystems. There is a tendency for fishing to target accessible areas of the seabed, that is, isolated seamounts and shallower parts of the Mid-Atlantic Ridge – precisely where biodiversity is likely to be highest. Some of these areas are now protected. Deep-water fish species have been shown to be particularly sensitive to exploitation. 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 proposed and/or implemented

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.

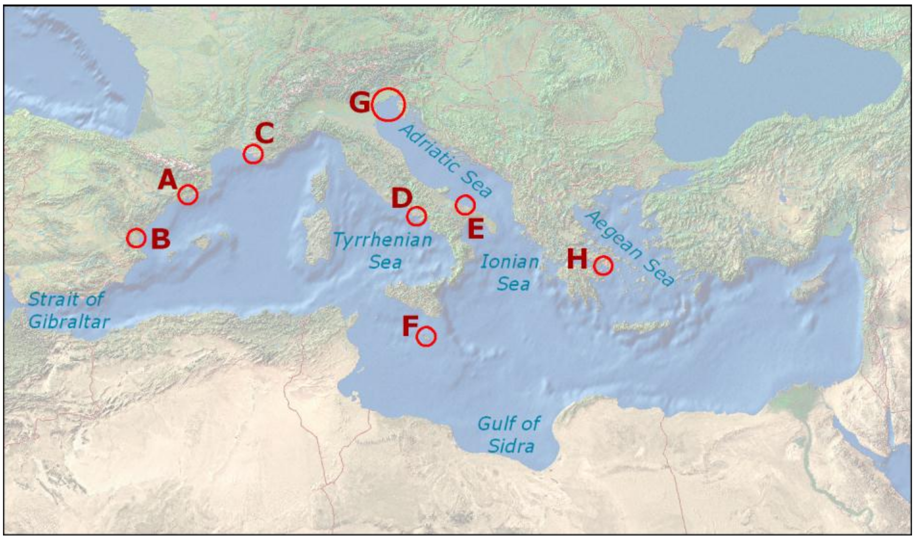
The EU Maritime Strategy for the Atlantic Area (EC, 2011) proposes a coherent and balanced approach that is consistent with the EU 2020 agenda and its flagship initiatives that promotes territorial cohesion and that takes into account the international dimension.

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 hotspots: A=Barcelona; B=Valencia; C=Marseille; D=Napoli; E=Bari; F=Malta; G=Trieste/Venice; H=Athens; see also section 5.3.



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, outlook

In the Second Interim Report of the Blue Growth project the following functions are indicated as important in the Mediterranean: Shortsea shipping, Oil & gas, Coastline tourism & yachting, Cruise & port cities. Aquaculture and fisheries are other important economic functions (Knights et al., 2011). Security and surveillance is an important issue.

Shortsea 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 shortsea shipping takes place in the Mediterranean Sea, resulting in a total volume of 500 million tons. This includes shortsea 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).

Coastline 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 (e.g. sewage and urban runoff, solid wastes, industrial effluents, eutrophication, harmful algal blooms, hydrocarbon and oil spill pollution); 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 proposed and/or implemented

- 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).

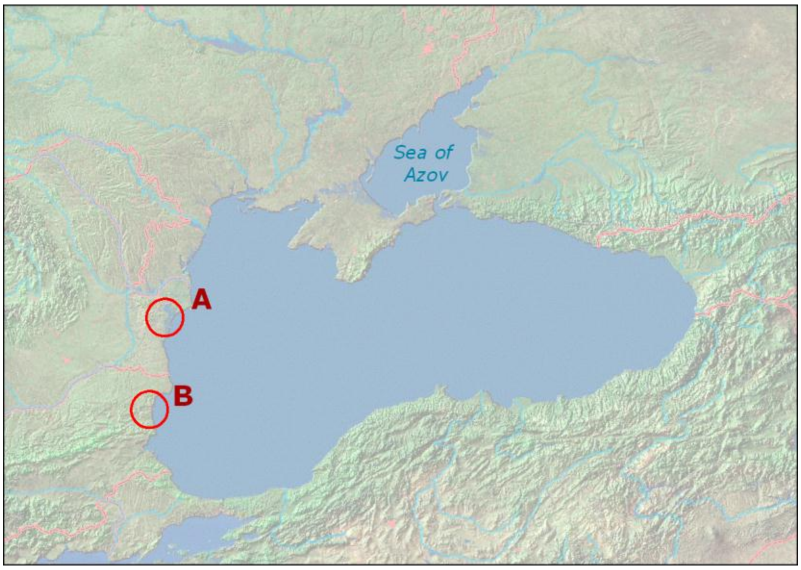
- Horizon 2020: Following the Euro-Mediterranean Ministerial Conferences on the Environment held in Helsinki (1997) and Athens (2002), the 10th anniversary Euro-Med Partnership Summit (Barcelona, 2005) launched the "Horizon 2020" initiative devised to tackle the main sources of Mediterranean pollution 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. 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 hotspots: A=Constantza; B=Varna; see also section 5.3.



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 northwestern Black Sea receives the discharge of the Danube River with a mean water discharge of about 200 km^3/yr and the Ukrainian rivers Dniepr, Southern Bug and Dniestr contributing with about 65 km^3/yr.

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 example, for its anchovies and its sturgeon. 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, 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 of the second interim report, important economic functions in the Black Sea are Shortsea 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).

Shortsea shipping

Based on the gross weight of goods transported, 6.4% of Shortsea 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.[59]

Coastline 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

Specific features of the Black Sea make it very vulnerable to disturbances of its environment and ecosystems. Owing to natural factors, the diversity of species of Black Sea fauna is approximately three times lower than that of the Mediterranean Sea. It is 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.

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

Over the past century, coastal development and the population around the Black Sea regions has expanded substantially. Reports focusing on the state of the environment of the area have identified a series of increased anthropogenic pressures that have contributed to significant environmental degradation. These are mainly eutrophication through agriculture, industrial discharges and inputs of insufficiently treated sewage associated with large cities, contamination through input of harmful substances, in particular oil products, and introduction of alien species from shipping ballast waters. 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 proposed and/or implemented

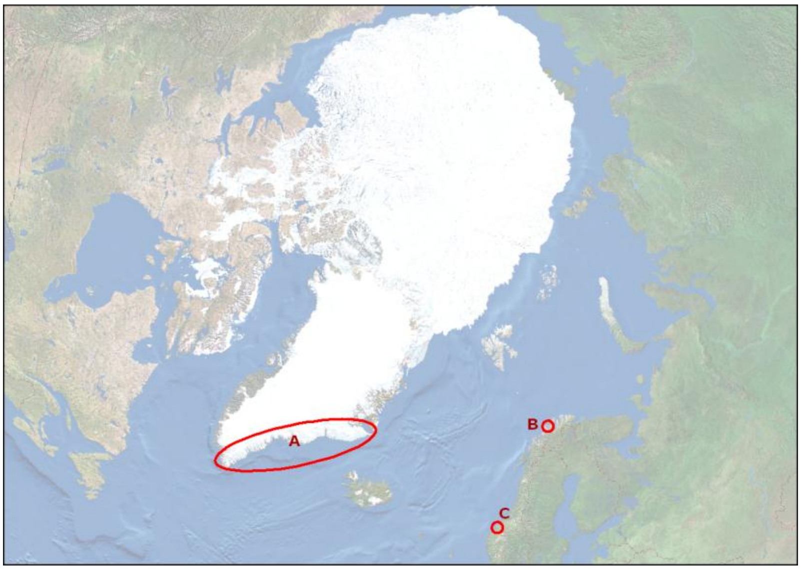
In 1992, the six neighbouring countries ratified the Convention on the Protection of the Black Sea Against Pollution (BSC) with the aims to support the Black sea littoral state to restore and/or maintain healthy status of the sea, to fully operationalize and make sustainable the Black Sea regional environment 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 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 hotspots: A=Greenland coast; B=Hammerfest; C=Alesund; see also section 5.3.



Socio-economic characteristics, 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 is becoming increasingly intercontinental, although 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. Nearly all voyages took 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, not trans-Arctic between continents. The major drivers for this will be Arctic natural resource development (fish, hydrocarbons, minerals, timber etc), regional trade and tourism (Arctic Council, 2009). 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, for example 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 nearshore 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 mln tonnes in 1989 to 1.00 mln 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. Previous climate change studies have concluded that the average temperature in the Arctic has already increased by more than twice the global average over the past 50 years; this trend is projected to continue. 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 proposed and/or implemented

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).

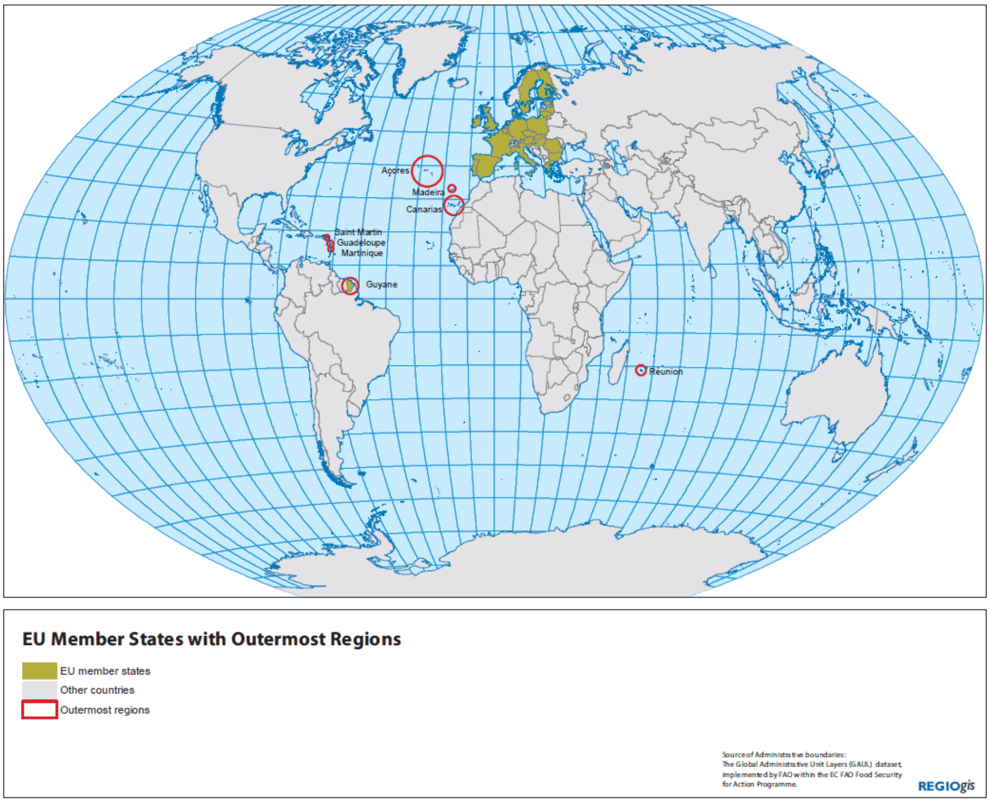
4.8 Outermost regions

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 richess 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 vulcanism 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.



Socio-economic characteristics, outlook

The Outermost Regions add an area of exclusive economic zone which is about equal to the combined area of the Mediterranean and Baltic seas (table 4.1). This is important for Europe from a geostrategical viewpoint and adds potential to the European Blue Growth perspectives. According to (RUP, 2010) 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 accessability 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

* 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).

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).

Coastline 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 a.o. 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, pers.comm.);
- 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.

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 proposed and/or implemented

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 promotes territorial cohesion and that takes 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 functions.

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.

Table 4.2 Summarizing table of the characteristics of the European sea basins. (The outermost regions are not included, because the diversity of their nature prohibits the use of averages).

Physical characteristics	Baltic Sea	North Sea	Mediterranean Sea	Black Sea	Atlantic Ocean	Arctic Ocean
Surface area (km2)	377.000	678.000	2.510.000	436.000	13.500.000	14.000.000
Catchment area (km2)	2.130.000	970.000	no data	2.000.000	no data	no data
Average depth (m)	53	90	1370	1300	no data	1040
Salinity	low	average	high	low	average	below average
Tidal range (m)	0.1	2 - 8	0.3	0.1	2 - 8	no data
Residence time of ocean water (yr)	25 - 30	1*	80-100	5 - 600**	no data	no data
Total nr.riparian states (-)	9	8	21	6	6	5
Nr. riparian EU member states and collaborating countries (-)	8	8	13	3	5	2
Most urgent environmental pressures	Baltic Sea	North Sea	Mediterranean Sea	Black Sea	Atlantic Ocean	Arctic Ocean
Agriculture / inputs of nutrients	x	x	x	x	x	x
Inputs of hazardous substances		x	x			x
Coastal infrastructure	x			x		
Fisheries	x	x	x	x	x	x
Shipping	x			x		x
- spec.:invasion of exotic species			x	x		
Tourism	x					x
Extraction of sand and gravel	x					
* order, highly dependent on wind						
** increases strongly with depth						

5 Examples of synergies

A crucial factor in the realisation of Blue Growth will be the ability to take full advantage of synergies, as they arise between various maritime economic activities.

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. During the intermediate hearing, experts unanimously agreed that 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.

In this chapter these synergies will be explored in various ways. Firstly, we will provide an overview of synergies identified in the study to date (section 5.1). We will then address in some more detail a number of functional synergies – building on value chain analysis (section 5.2), and elaborate a number of spatial synergies – many of which take place within specific sea basins and which can take the form of hotspots (section 5.3).

5.1 Identification of synergies found

Throughout the study to date, a myriad of synergies between and within maritime economic activities have been identified, and below is an overview of some of them, including coverage of all 27 subsectors. Clearly, this overview is far from complete and only a starting point for future research, even beyond the scope of this study. In the table below, synergies are expected to be caused by the maritime economic activities studied (columns) and to affect the long-list of subsectors (rows).

Table 5.1 Overview of synergies between sub-functions analysed (note to the reader: follow the columns down)

Function	Subfunction	1.2 Short-sea	2.3 Algae Aquacult	2.4 Blue Biotechno	3.1 Oil & gas	3.2 Offshore wind	3.3 Ocean rene-wable	3.6 Marine mine-rals	3.7 Desa-lina-tion	4.1 Coas-tal tour.	4.3 Cruise	5.1 Prot. against flood.	6.1.+6.2. Maritime Security Surveillance	6.3 Env. monit.
1. Maritime transport and shipbuilding	1.1 Deepsea	++			+			+	+		+		+	+
	1.2 Shortsea				+						+	+	+	+
	1.3 Passanger ferries	+								+	+		+	+
	1.4 Inland waterway	++												
2. Living resources	2.1 Fish for humans		+	+		+	+			+			+	+
	2.2 Fish for animals		+	+		+	+						+	+
	2.3 Aquaculture		++	+		+								+
	2.4 Blue Biotechnology		++											
	2.5 Agriculture on saline soils		+	+										
3. Energy & raw materials	3.1 Oil and gas	+	++	+		+		+					+	+
	3.2 Offshore wind	+			++		+		+					+
	3.3 Ocean renew. energy		++	+	+	+			+	+				+
	3.4 CCS				++									+
	3.5 Aggregate mining	+			+			+				+		
	3.6 Marine minerals	+		+	+	+								+
	3.7 Desalination			+		+	+			+				
4. Leisure, working and living	4.1 Coastline tourism	+	+				+				++	+		+
	4.2 Yachting and marinas			+						++	+	+	+	+
	4.3 Cruise and ports	+		+		+				++		+	+	
	4.4 Working	+	+		+	+	+	+		++	++	++		
	4.5 Living		+						++	+	+	++	+	+
5. Coastal protection	5.1 Protection against flood.		+				+			+				+
	5.2 Prevent salt intrusion		+				+					+		+
	5.3 Protect habitats		+	+						+		+		+
6. Marine surveillance	6.1. + 6.2. Maritime Security & Surveillance	+			+	+				+	+			++
	6.3 Environm. monitoring	+	+	+	+	+	+	+	+	+		+	++	

Shortsea shipping as a linking pin for maritime transport

In many ways, shortsea shipping provides the linking pin in the EU's maritime shipping and transport business. 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 with shortsea 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 functions: 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). Underwater constructions for ocean renewable energy sources (wave, tidal, OTEC, thermal, biofuels, etc.) can also benefit from marine bio-sourced coatings with anti-fouling or anticorrosive properties. Ships (cargo, passenger as well as yachting) can 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 sub-function.

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 functions

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 systems will not only benefit the producers of instruments and services, but also provide added-value and societal benefits. Monitoring 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 functions and sub-functions: from maritime aquatic products (algae growing) and blue biotechnology to all energy sub-functions as well as leisure and tourism functions. 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 functions 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 functions 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 functions 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 functions and related economic benefits could be incorporated (Royal Haskoning, 2009). Examples of such functions 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

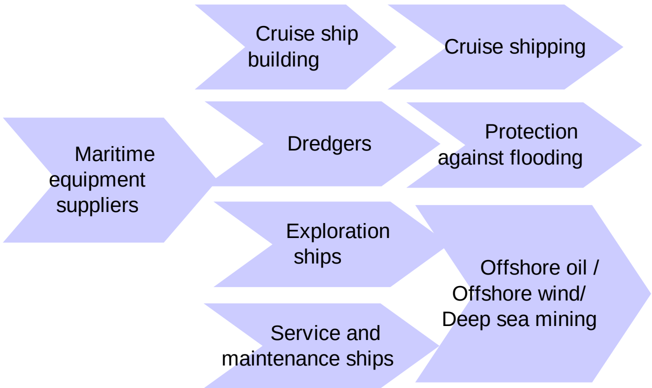
- combining OTEC with production of drinking water and extraction of minerals

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 functions, solutions currently developed often benefit both protection and other functions as well as coastal eco-systems.

5.2 Examples of functional synergies

The first type of examples is functional in nature, and based on the concept of value chains as illustrated in the previous Section 3. Value chains can be defined as "the full range of activities which are required to bring a product or service from conception, production, delivery to final consumers, and final disposal. [60]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. Value chains are global in nature and remain in tact after relocation of existing activities to other regions or countries. Value chains also include elements of 'product life cycle' thinking as well as 'cradle-to-cradle' thinking; this makes value chain analysis an interesting tool also for our current study.

Example 1: Shared inputs and upstream suppliers - shipbuilding



Europe's ability to compete and have future success in maritime economic activities such as cruising, offshore drilling, offshore wind, marine mineral extraction and shortsea shipping will have important implications for upstream suppliers. Success in rolling out tomorrow's maritime economic activities will have a positive impact on the portfolio of Europe's shipbuilders, many of which are already specialised in areas such as cruise ships, dredgers, exploration ships as well as service and maintenance ships.

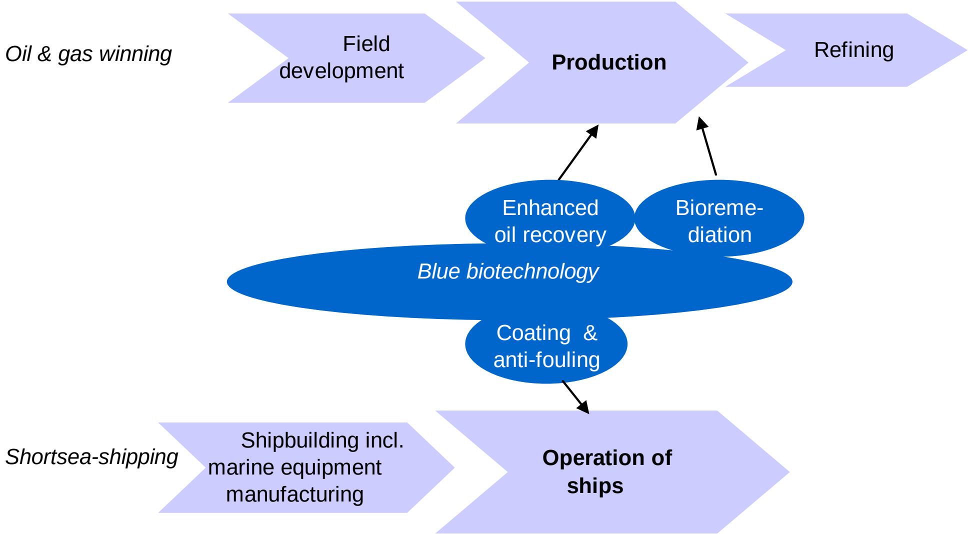
Value chains are increasingly global, and European shipbuilders already export 2/3 of their total production. European shipbuilding is therefore also expected to benefit from maritime economic activities outside of Europe. In particular cruise shipping, protection against flooding, offshore oil, offshore wind and deep sea mining are expected to provide opportunities for European shipbuilders who are relatively strong in the production of such ships. Further upstream, such global maritime developments are also expected to benefit the marine equipment industry, which currently exports

[60] R. Kaplinsky and M. Morris (2000) "A Handbook for Value Chain Research". IRDC.

almost half of its production – a percentage much higher than that in South Korea (10% export) or Japan (25%). [61]

A conclusion from this example is that Blue Growth needs to be seen in a global context: knock-on and multiplier effects of maritime economic activities on the European economy will differ by activity. 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 2: Blue biotechnology as an enabler for other maritime activities



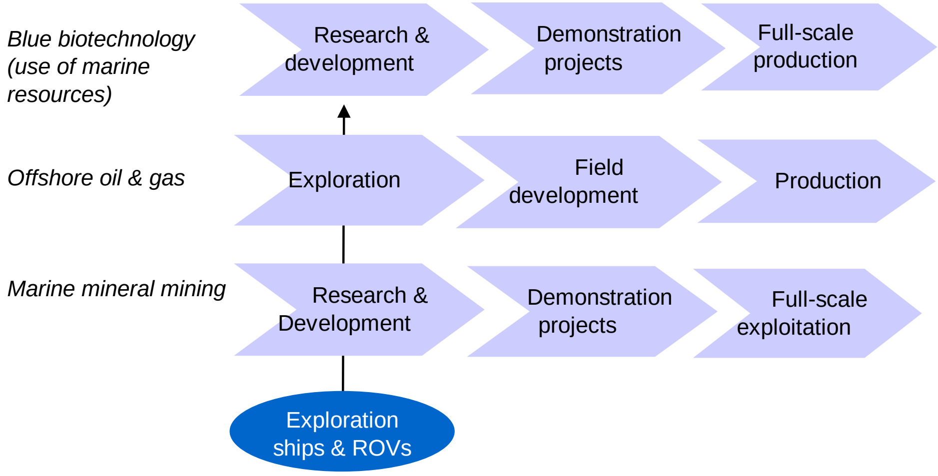
As already mentioned above, blue biotechnology provides a range of synergies with and spill-overs to other maritime activities. Biofouling is a well-known phenomenon, which implies that the fouling of the ships hulls reduces hydrodynamic performance of the ship, reduced economic performance and increased 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. 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 microorganisms 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.

[61] Ecorys (2009) "Study on the Competitiveness of the European Shipbuilding Industry. EC DG ENTR

Example 3: Shared activities – 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. [62] 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 mln. in the first year and $ 110 mln. in subsequent years. [63] 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 mln.

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.

5.3 Examples of spatial synergies: hotspots

The second type of synergies includes not only a functional but also a spatial component. These synergies are based on the notion of clusters, 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." [64] Although such clusters have a lot of commonalities with value chains, they differ

[62] World Ocean Review (2010), Chapter 9 Medical knowledge from the seas, p. 178.
[63] Committee on Exploration of the Seas (2003) "Exploration of the Seas: Voyage into the Unknown. National Research Council, National Academy of Sciences (USA).
[64] M.E. Porter (1998) "Clusters and the New Economics of Competition". Harvard Business Review, Nov/Dec, p.78

as clusters are geographic in space, and as they include framework conditions, such as infrastructure, labour markets or other elements.

Within the context of this study, we will use the term 'hotspots' and define these as a space or place with a concentration of multiple (at least two) maritime economic activities. The sea-basin specific analysis (Section 4) has pointed to a preliminary overview of maritime hotspots or hotspot areas, as depicted in Table 5.2 below.

Table 5.2 Preliminary overview of maritime hotspots as identified across sea-basins

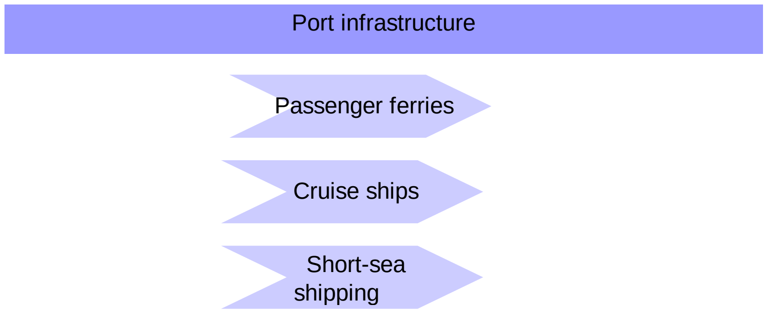
Sea Basin	hotspot area	functions involved in hotspot area	Status (mature, growing, early development)
Baltic	Kotka-Hamina region (Gulf of Finland) (SF)	cities&ports; blue biotech&algae; wind energy cluster; deep & short sea shipping	Mature
	Western Baltic (DK, D)	coastline tourism; ports; offshore wind; onshore wind; aquaculture; shipbuilding; fisheries; ferries; aggregates	Growing
	Copenhagen (DK)	Cruise tourism, ferries, coastline tourism	Mature
	Stockholm (N)	Cruise tourism, ferries, coastline tourism, yachting and marinas	Mature
	Gdansk/Gdynia (PL)	Shortsea shipping, shipbuilding, cruise tourism	Mature
	Helsinki (SF)	cruise tourism, cruise shipbuilding, ferries, coastline tourism,	Mature
	Tallinn (EE)	Cruise tourism, shortsea incl. ferries	Growing/mature
	Goteborg (S)	Cruise tourism, ferries, shortsea shipping, coastline tourism/yachting	Mature
	Kiel (D)	See under Hamburg/North Sea	Growing/mature
North Sea	Bergen (N)	Cruise tourism, shortsea shipping, offshore oil & gas	Mature
	Stavanger (N)	Offshore oil &gas, shortsea shipping, cruise tourism, aquaculture	Mature
	Oslo (N)	Shortsea shipping, cruise tourism, ferries	Mature
	Rotterdam (NL)	Deepsea shipping, shortsea shipping, ferries, inland waterways, coastal protection, marine monitoring and surveillance	Mature
	Antwerp (B)	Deepsea shipping, shortsea shipping, ferries, inland waterways, oil & gas (refineries), marine monitoring and surveillance	Mature
	Oostende (B)	Shortsea shipping, ferries, offshore wind, blue biotech	Growing
	Hamburg, Kiel, Bremen (D)	onshore wind; offshore wind; shipbuilding; maritime technology; ports; coastline tourism; cosmetics; classification; shipping; cruise tourism; equipment and supplies; RES	Growing / mature
	Wadden Sea (NL/D/DK)	coastal protection; coastline tourism/yachting, environmental monitoring	Mature
	Aberdeen (UK)	Offshore il & gas, offshore wind	Mature
	London gateway (UK)	Freight port, ferries, cruise tourism	Mature
	Solent (UK)	naval base (Portsmouth); petrochemistry,	Mature

Sea Basin	hotspot area	functions involved in hotspot area	Status (mature, growing, early development)
		refineries (Fawley); container & cruise port (Southampton); yachting; coastline tourism; heritage areas; coastal wildlife areas	
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
	Galician Coast (E)	Coastline tourism, shortsea shipping, fisheries, offshore renewable energy	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
Mediterra-nean	Barcelona (E)	Marine fisheries reserves; Env. monitoring, safety (immigration control), coastline tourism, yachting and marinas; surveillance, ferries	Growing
	Valencia (E)	Coastline tourism, ferries, yachting and marinas	Growing
	Marseilles (F)	Deepsea shipping, shortsea shipping, ferries, cruise tourism, monitoring and surveillance, defence, blue biotech	Mature
	Napoli (I)	Deepsea shipping, shortsea shipping, cruise, coastline tourism	Mature
	Bari (I)	Shortsea shipping, cruise, coastline tourism	Mature
	Malta (M)	Deepsea/shortsea shipping hub, cruise tourism, coastline tourism	Mature
	Venezia/Trieste (I)	Cruise tourism, ferries, shortsea shipping	Mature
	Athens (GR)	Ferries, shortsea shipping, yachting and marinas, fisheries	Mature
Black Sea	Constantza (RO)	Port (deepsea/shortsea hub, largest in Black Sea), coastline tourism (EU), monitoring and surveillance	Growing
	Varna (BG)	Port, coastline tourism (EU and Russia) Departure for cruises in the Black Sea	Growing Stable though underdeveloped
Outermost	Canaries, Madeira,	Cruise tourism, short sea shipping, coastline	Mature

Sea Basin	hotspot area	functions involved in hotspot area	Status (mature, growing, early development)
	Azores	tourism	

The above overview points to a sheer endless combination of maritime economic activities. The reasons for this economic clustering can be manifold, but can be broadly attributed to the availability of framework conditions, including port infrastructure, hinterland connections, as well as broader infrastructure including custom facilities, maintenance and ship repair facilities, catering, finance and insurance, etc.

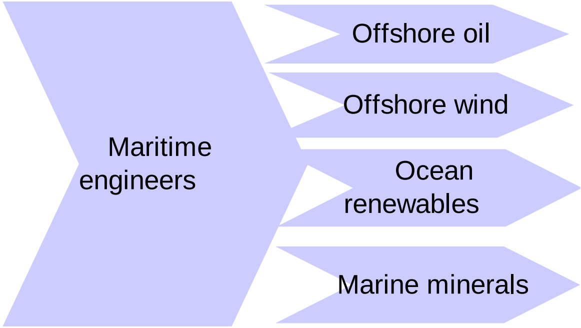
Example 4: Common use of infrastructure: ports



It goes without saying that ports are important crystallisation points for such maritime economic activities: whether cruise shipping, shortsea 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.

But 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 5: Shared input factors – labour markets



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.

In conclusion, a sheer endless amount of synergies can materialise, and become visible through maritime hotspots. While theoretical underpinnings such as economies of scale and externalities will apply to all, there will be no "one size fits all". The specifics of each location, area or coastal region will need to be fully borne in mind – and supported by maritime spatial planning and local development strategies.

5.4 Other 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 foodchains – 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?

5.5 Conclusions

This section has only touched upon benefits that can be derived from exploring synergies between maritime economic activities. Not emphasised have been so far the possible downsides, including tensions that can occur between them. Many of these tensions are spatial in nature, and become visible as part of integrated maritime development planning. Another downside of exploring synergies can be inertia: developments can be halted or slowed down while waiting for other activities to catch up. Within this context, experts have mentioned the importance to distinguishing between leading and following activities.

Furthermore, it is important to think through what strategies and actions need to be taken in order to take advantage of synergies. A top-down versus a bottom-up approach can be distinguished:

- Top-down approach: synergies can be planned and orchestrated by those who have overview, for example within the context of national maritime development policy, or in case of clear leadership by one or more maritime institutes;
- Bottom-up approach: by bringing actors together at level of localities, coastal zones and territories. Anecdotal evidence suggests that many synergies arise unexpectedly and based on serendipity.

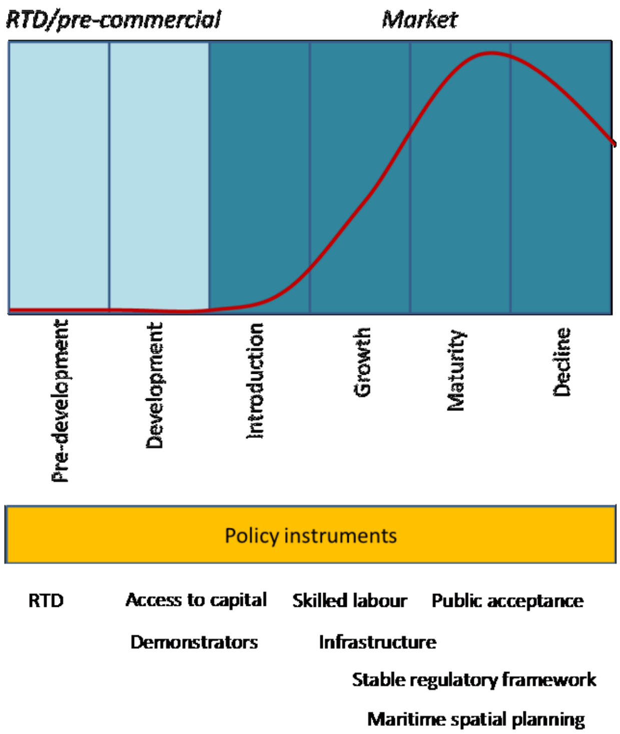
These perspectives will need to be further discussed and elaborated as part of the final study report.

6 Areas of intervention: the policy rationale

6.1 Europe 2020 as a strategic framework

Blue Growth in Europe 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. Above all, access to finance is amongst the most important barriers for economic activities in the (pre-) development stage. In general, barriers and resulting rationale for policy interventions show similarities according to the development stage of the different maritime economic activities (see Annex 3). Addressing these and other bottlenecks will become an important subject for discussion and subsequent action if Blue Growth is to be realised in Europe.

Figure 6.1 Economic life cycle and its relation to policy instruments



Blue Growth is unlikely to reach its full potential if not accompanied by a coherent, integrated and effective public support policy, at local, regional, Member State, sea-basin and EU-level. On the basis of the results to date (see Annex 3), such a policy will need to focus on access to capital, RTD and demonstrations for supporting maritime economic activities in the (pre-)development stage; it will need to focus on infrastructure, public acceptance and skilled labour for supporting the activities in the growth stage; and it will require a stable regulatory framework and maritime spatial planning to accommodate the more mature (and declining) maritime economic activities, while addressing the needs and opportunities resulting from developing and growing activities, and to make sustainable use of maritime resources.

6.2 Smart responses: making combinations and building critical mass

A smart policy response refers here to the need for smart combinations and the building of critical mass. Blue Growth is likely to emerge across a wide range of economic sectors. Nevertheless, Europe's maritime economy remains fragmented and cooperation is often confined to the players of sectors along the lines of traditional activities, which are also found back as such in statistical classifications. Smart combinations are required to produce synergies and innovations beyond these pillars, and to build critical mass required for infrastructure as well as for attracting investors as well as high-skilled workers. Important starting points for policy are the EU2020 Flagships on the Innovation Union[65], the Digital Agenda for Europe [66]as well as the New Industrial Policy Flagship. [67]

Access to finance: crucial in the (pre-) development stage

Future development potential 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 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, as they lack the specific knowledge required.

Typically, scientific research can be funded by public and leading research institutes, often co-funded by FP7 grants. However, the commercial and developmental activities take place in small spin-off companies, which 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. For other economic activities, funding is only a bottleneck where economic actors are small and therefore without direct access to loans (e.g. short sea shipping, coastal tourism).

Furthermore, dispersed economic actors face additional problems in securing finance, e.g. through venture capitalists who favour critical mass.

A fresh approach to maritime R&D[68]

The EU has excellent academic and scientific capacities in the 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 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.).

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[65] COM (2010) 546
[66] COM (2010) 245
[67] COM (2010) 624
[68] See f.i. keynote address by Lowri Evans to the European Parliament, 24 January 2012; keynote speech Commissioner Maria Damanaki to the European Parliament 7 December 2011.

The main barrier for the EU is to get from Research to Development. Financing is a major constraint, especially when getting to the last steps before commercialization (see the above point regarding access to capital). 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, due to the diversity of subjects, sectors, innovation capacity and existing collaboration patterns.

Maritime 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.

Furthermore, R&D support at the level of Member States is not always conducive to pan-European cooperation.

The EU RTD framework has started to promote maritime R&D, e.g. through the 'Oceans of Tomorrow' programme. It is important to have an open approach to maritime R&D, and to not over-specify from a top-down perspective – as it will prevent synergies to take place. The Horizon 2020 program to implement the Flagship Initiative Innovation Union also provides a stepping stone for this.

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.

Smart Infrastructure – essential for upscaling

A range of infrastructure elements are required for the growth and expansion of mature maritime economic activities. Evidently, port infrastructure and sufficiently deep waterways are quintessential for short sea-shipping and cruise tourism as well as for coastal tourism. But inland waterways and hinterland connections are equally important. For offshore as well as ocean renewable energy, the electricity grid is insufficient in many places and currently blocking future development.

Cluster support – helping to build critical mass

Maritime economic activities in the *(pre-) development stage* all suffer from the limited size of the sector and the limited critical mass. Many of these are located in sparsely populated and/or peripheral parts of Europe. This prevents early stage Blue Growth entrepreneurs to take sufficient advantages of externalities and scale economies, while it is difficult to recruit highly skilled workers.

A European Network of Maritime Clusters was set up already in 2005 to promote and reinforce the European Maritime Cluster and its maritime sectors, through 10 participating national cluster organisations. The European Network of Maritime Clusters organised itself as a flexible network in which members cooperate on a voluntary basis for issues related to their national agendas, and in a more structured way for actions at the European level. [69]

High-skilled labour: engineers wanted

Various economic activities require high-skilled staff to overcome complex technological problems (offshore wind, ocean renewable energy sources, and shipyards). Attracting these engineers is not

[69] See http://www.european-network-of-maritime-clusters.eu

so much a problem for larger companies, including global energy and engineering conglomerates, but much more so for smaller operators and start-ups. In some areas, such as micro-algae and high value use of marine resources, it is above all the (lack of) entrepreneurial culture which is limiting fast growth. Furthermore, it is more difficult to attract talented workers to the peripheral or sparsely populated regions – where much of Blue Growth is happening.

Besides the need for high-skilled, addressing the involvement of low-skilled workers also requires attention, both from an employment ambition and from a social dimension. Issues of transition low-skilled workers between working in declining and growing functions may require educational support. For both high and low skilled labour, raising mobility between maritime and non-maritime sectors may contribute to Blue Growth ambitions, but with varying needs across regions.

Standards

New regulations are affecting in particular the mature functions including shortsea shipping, Oil and gas exploration, Coastline tourism and Coastal protection. The Oil and gas exploration sector appears to be responding well to the 2010 Deepwater Horizon oil spill and its aftermath, including new regulation on safety. Oil and gas exploration is a large sector with deep pockets, allowing it to make the necessary investments and adjust to new realities and pressures.

In terms of standard setting, regulatory bodies and classification societies may lack the level of innovativeness when it comes to defining standards and have to go for the lowest level of the common denominator.

6.3 Promoting a sustainable approach to the maritime economy

A sustainable policy response favours those maritime economic activities which contribute to the overall quality of the oceans, seas and coasts. It also promotes a transformation of business models, within traditional activities which are not necessarily sustainable. Equally, it promotes local, regional and sea-basin specific actors to develop and implement integrated strategies that contribute to the long-term values of places, coast lines and sea-shores – with a particular focus on ports and marina's.

Important starting points for policy are the EU2020 Flagships on a Resource Efficient Europe the Innovation Union. The Europe 2020 strategy recognises the challenge – to connect economic performance of the European economy to its eco-performance – through its sustainable growth pillar focusing on both objectives. More specifically, the recent Flagship initiative on a Resource-efficient Europe states that: 'increasing resource efficiency will be key to securing growth and jobs for Europe. It will bring major economic opportunities, improve productivity, drive down costs and boost competitiveness. It is necessary to develop new products and services and find new ways to reduce inputs, minimise waste, improve management of resource stocks, change consumption patterns, optimise production processes, management and business methods, and improve logistics' [70].`

The Marine Strategy Framework Directive (MSFD) is important to the sustainable use of marine resources : it introduces "an ecosystem-based" approach to the management of human activities, ensuring that the collective pressure of such activities is kept within levels compatible with the achievement of good environmental status. The Directive aims to achieve good environmental

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[70] COM (2011)21, p. 2. See also the roadmap for renewable energy: (Press release) http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/1046&format=HTML&aged=0&language=EN&guiLanguage=en; COM(2011)571

status in EU marine waters by 2020 and and foresees in regular (every six years) review and updating of the basic elements of national marine strategies.

Promote integrated maritime planning at the level of sea-basins[71]

Blue Growth: will it all fit on our oceans and seas? Expanded maritime economic activities – whether inside or outside the European waters – are likely to generate tensions: on or around shipping routes 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 yet to be carved out from the material.

Promote experience with new maritime spatial concepts

New maritime economic activities and new combinations will give rise to new maritime spatial concepts – that allow the full exploitation of synergies with a minimum of spatial tensions. Will they continue to be centred on ports and coastlines, and if so how will these ports look in the future? Or will they focus on multipurpose platforms, offshore islands or in floating districts?[72] Experience in such new maritime spatial concepts is still in its infancy and not much shared. The costs of developing flawed maritime spatial concepts could be very high.

Promoting local, integrated development strategies

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 coastline tourism requires a cooperative and transparent local government, and so does the installation of desalination plants or ocean renewable energy facilities.

Integrated environmental regulations

Evidently, environmental regulations and their correct implementation are important conditions for economic activities. The linkages between such regulations and the maritime economic activities can be diverse and complex: they tend to pose challenges to shortsea shipping and oil & gas exploration, but provide strong opportunities for environmental monitoring and coastal protection.

Multiple human activities affect the marine environment and its associated human systems in complex ways, yet current management tends to consider each activity separately (Lester et al., 2010; Ban et al., 2010). For example, fisheries, water quality, coastal development, land use, shipping, and oil and gas extraction are each managed as individual sectors despite obvious potential interactions among them. Assessing the potential for cumulative impacts of multiple activities on the oceans produces a picture of the world quite different than that which emerges from single-sector assessments (Halpern et al., 2008a).

Promoting sustainable maritime business models

Many of the identified maritime activities themselves are driven by the need for sustainability: climate change will lead to global warming, give rise to sea-level rise, droughts and food scarcity – on top of scarcity for energy and commodities; giving impulses to new maritime activities. At the

[71] Reference is made to Regulation 1255 (2011), establishing a Programme to support the further development of an Integrated Maritime Policy

[72] See for example DNV (2011) "Technology Outlook 2020", p. 84 and further

same time, new maritime activities and growth of existing one's bears the risk of adverse environmental impacts, whether through high energy requirements, atmospheric emissions, habitat destruction, negative effects of eco-systems or water quality issues. The interview results point to the conclusion that those maritime businesses and actors that recognise the environmental risks and potentials in an early enough stage, willing to address these and to communicate these to society at large, are likely to be more successful – in a world where less and less room will exist for unsustainable practices.

6.4 Inclusiveness: Blue Growth benefits for all

An inclusive policy response promotes that local communities and low- as well as high-skilled workers in both central and peripheral regions of Europe benefit from Blue Growth. It favours the health and security of maritime jobs – many of which are subject to harsh conditions. It promotes training and skills development. And it promotes citizens of coastlines to take fully part in the planning and development of future maritime economic activities that may affect them. Important starting points for policy in his area is the New Skills for New Jobs Agenda [73]are the EU2020 Flagships on a Resource Efficient Europe the Innovation Union as well as the European Energy Efficiency Plan 2020.

Promoting public awareness

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 coastline tourism tend to face public resistance, and can obstruct activities if not accompanied by stakeholder consultation and mitigation measures. Large companies are especially 'suspect' and are at a 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.

Low-skilled labour: local initiatives

The maritime economy not only generates high-skilled but also a range of low-skilled labour, which can be difficult to recruit – especially when conditions are harsh.

Integrated approach to health and safety standards

Currently, maritime economic players do not always have a level playing field across the EU. For instance, Germany has much stricter legislation when it comes to servicing offshore wind parks than the UK. Intra-EU differences in health and safety standards are undesirable from a Single Market perspective, as they prevent a level playing field for maritime actors across Europe.

[73] COM (2008) 868

Annexes

The following annexes are included in this Third Interim Report:

- Annex 1: Current size of maritime economic activities in the EU
- Annex 2: Literature consulted (specific to maritime economic activities selected)
- Annex 3: Rationale for policy intervention by maritime economic activity
- Annex 4: Indicative list of human pressures and their possible pressures on the marine environment.

Annex 1 Current size of maritime economic activities in the EU

Function / activities	Current size		Sources & Comments
	Value added (€ bn)	Employ-ment (*1000)	
1. Maritime transport and shipbuilding			
1.1 Deepsea shipping	106	1,402	Eurostat database (2011); Data 2007; share in total shipping based on freight volumes
1.2 Shortsea shipping (incl. RoRo)	63	823	Eurostat database (2011); 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	6	43	Eurostat database (2011); Data 2007
2. Food, nutrition, health and eco-system services			
2.1 Catching fish for human consumption	7.9	200-240	Anderson and Guillen 2009; Data 2007
2.2 Catching fish for animal feeding	0.2	5.7	Eurostat database (2011); Data 2007
2.3 Marine aquatic products	3.3	64	Eurostat database (2011); Framian 2007; Production data 2007, employment data 2005
2.4 Blue biotechnology	0.6	<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	<0.5	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.)	0.7	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
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.

Function / activities	Current size		Sources & Comments
	Value added (€ bn)	Employ-ment (*1000)	
4.3 Cruise tourism	14.1	143	European Cruise Council (2010); Based on expenditure data for 2009
4.4 Working	4,108	88,000	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	0.6-1	5-10	Own estimate based on EC (2006)
6.2 Prevent and protect against illegal movement of people and goods	1.1	10	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	0.1-0.2	1-1.5	Ecorys (2010); Sub-function still in early stage of its development

Annex 2 Literature consulted

This annex contains three main categories:

- Annex 2.1 References related to maritime economic activities
- Annex 2.2 References related to the assessment of sea basins
- Annex 2.3 Other references

Annex 2.1 Maritime economic activities

Shortsea shipping

- Blikom, L.P. (2011), A review of the World fleet of LNG fuelled ships, blog post on blogs.dnv.com
- Blue Belt Pilot Project (2011), information flyer
- Bruckner-Menchelli, N. (2009), Scrubbers versus distillates, Bunkerworld May/June 2009, pg24
- Bunkerworld forums (2010), Will LNG take over as the main marine fuel some day?
- COM(2011) 144 final, White Paper Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system
- Directive 2005/EC/33 on the sulphur content of marine fuels
- Drew Marine (2010), Low sulphur regulatory solutions
- Ecofriendlyllc.com (2011), Norway and Poland build LNG vessels and LNG conversions.
- Ecorys (2009), Study on the Labour Market and Employment Conditions in Intra-Community Regular Maritime Transport Services Carried out by Ships under Member States' or Third Countries' Flags.
- IMO (2008) resolution MEPC.176(58)
- Parsons, S. (2009), The world's first cargo ship propelled by solar panels.
- Richard, M.G. (2008), Cargo ship with kites: first trans-atlantic trip a succes!
- Stokholm, R.M. and J.S. Roaldsøy (2002), LNG used to power the ferry "Glutra" in Norway. – The world first ferry to run on LNG.

Offshore oil and gas

- Bently, R.W. (2002). Global oil & gas depletion: an overview. Energy Policy 30 189-205
- Directive 2008/92/EC of the European Parliament and of the Council of 22 October 2008 concerning a Community procedure to improve the transparency of gas and electricity prices charged to industrial end-users
- Directive 2009/73 /EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC
- DNV technology outlook (2009)
- EC (2009) "EU Energy Security and Solidarity Action Plan: Second Strategic Energy Review".
- Ecorys (2011), Investment needs for future adaptation measures in EU nuclear power plants and other electricity generation technologies due to effects of climate change.
- Eurostat (2011), statistical database, http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/database
- Jernelöv, A(2011). The Threats from Oil Spills: Now, Then, and in the Future. AMBIO: A Journal of the Human Environment 39, pp. 353-366.
- Kvenvolden, K.A (1988) Methane hydrates and global climate. Global Biogeochemical Cycles 2 221-229
- Kvenvolden, K.A. (2003). Methane hydrate - A major reservoir of carbon in the shallow geosphere? Chemical Geology 71 41-51
- Lasschuit, W and Thijssen, N. Shell (2009). Supporting supply chain planning and scheduling decisions in the oil and chemical industry. Shell report.

- Maribus (2011), World Ocean Review.
- Makogon, Y.F. (1997) Hydrates of Hydrocarbon. Book published at PennWell Publishing, pp. 485
- NPC Global Oil & Gas (2007). Oil and Gas Technology development. Topic #26
- OGP (2010) Environmental performance in the E&P industry - 2009 data
- OGP (2010) Oil & gas for Europe - it's about time and innovation
- Patin, S. (1999). Environmental impact of the offshore oil and gas industry, 425 pp.
- Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks
- Sloan, E.D. (2003). Fundamental principles and applications of natural gas hydrates, Nature 426, pp. 353-363
- Steele, B.C.H. (1999). Fuel-cell technology: Running on natural gas. Nature 400 619-621
- Tzimas, E., A. Georgakaki, C. Garcia Cortes and S.D. Peteves(2005). Enhanced Oil Recovery using Carbon Dioxide in the European Energy System. DG JRC Institute for Energy report
- World Energy Outlook 2009. OECD/IEA (2010).
- World Energy Outlook 2010. OECD/IEA(2011).

Coastal tourism incl. yachting and marinas

- Collet, I. (2010), Portrait of EU Coastal regions, Eurostat: Statistiscs in focus 38/2010, Luxembourg.
- Ecorys (2009a), Study on the Competitiveness of the EU tourism industry: - with specific focus on the accommodation and tour operator & travel agent industries. Rotterdam/ Brussel.
- Ecorys (2009b), Study on Competitiveness of the European Shipbuilding Industry. Rotterdam/ Brussel.
- Ecorys, 2010. Economic importance of recreations and tourism Voorne Putten.
- EC (2000), Towards quality coastal tourism: Integrated quality management (IQM) of coastal tourist destinations. Brussels.
- EC (2006), A renewed EU Tourism Policy: Towards a stronger partnership for European Tourism, Communication from the Commission. Brussels.
- EC (2007), Agenda for a sustainable and competitive European tourism (COM(2007) 621 final). Brussels.
- EC (2008), REGIONS 2020, An Assessment of Future Challenges for EU Regions. Brussels.
- EC (2010), Europe, the world's No 1 tourist destination – a new political framework for tourism in Europe (COM(2010) 352 final), Brussels.
- EC (2009), European Union Strategy for the Baltic Sea Region (COM(2009) 248/3), Brussels.
- EEA (2009), CFP reform response by EEA, CIPS/FIPS-M and EFTTA. Brussels.
- Global Surfers, http://www.globalsurfers.com/#
- IPK International (2010), Global travel trends.
- SRN, Ecorys, Euromapping (2007), Classification of European recreational waterways; final report, Driebergen/ Rotterdam.
- UNWTO (2009), Tourism 2020 Vision, Tourism Highlights 2008, Madrid.
- World Recreational Scuba Training Council (WRSTC): http://www.wrstc.com/main.php

Coastal protection

- Bruun, P., (1962). Sea-level rise as a cause of shore erosion. American Society of Civil Engineers Proceedings, Journal of the Waterways and Harbors Division 88, 117–130.
- Ciscar, J.C. (editor), (2009). Climate change impact in Europe. Final report of the PESETA research project.
- European commission, (2004). Results from the Eurosion Study.
- European commission, (2009). The economics of climate change adaptation in EU coastal areas – Summary report.

- Hillen, M.M., et al., (2010). Coastal defence cost estimates – case study of the Netherlands, New Orleans and Vietnam.
- Hinkel, J, Nicholls, R. J. , Vafeidis, A. T., Tol, R. S. J., Avagianou, T, (2010). Assessing risk of and adaptation to sea-level ris in the European Union: an application of DIVA
- Mangos, A. et al., (2010). The economic value of sustainable benefits from the meditteranean marin ecosystem.
- Marchand, M (Editor), (2010). Concepts and Science for Coastal Erosion Management. Concise report for policy makers.
- Policy Research Corporation, (2009). The Economics of climate change adaptation in EU coastal areas.
- Policy Research Corporation, (2009). The Economics of climate change adaptation in EU coastal areas.
- SWIPA (2011), Snow, Water, Ice and Permafrost in the Arctic.
- Van Rijn, L.C., (1998). Principles of coastal morphology.
- Van Rijn, L.C., (2011). Coastal erosion and control, accepted by Journal for Ocean and Coastal Management
- Van Rijn, L.C., (2011). Coastal erosion control based on the concept of sediment cells, Report Conscience.

Marine aquatic products and blue biotechnology

- Australian Department of Resources, Energy and Tourism (2010). Australian Energy Resource Assessment, 358p.
- Bregnballe J. (2010) Guide to Recirculation Aquaculture. Eurofish, Copenhagen, Denmark. 66p.
- Bostock J. et al. (2008). Prospective Analysis of the Aquaculture Sector in the EU. PART 1: Synthesis Report. IPTS JRC
- Bostock J. et al. (2009), European aquaculture competitiveness: limitations and possible strategies, Study for the European Parliament's Committee on Fisheries (PE 431.569).
- Chen G.-Q. & Chen F. (2006). Growing phototrophic cells without light, Biotechnology Letters 28:607–616.
- Collaborative Working Group on Marine Biotechnology (2009), Background and recommendations on future actions for integrated marine biotechnology R&D in Europe
- COMMISSION REGULATION (EC) (2009), No 162/2009 of 26 February 2009 amending Annexes III and X to Regulation (EC) No 999/2001 of the European Parliament and of the Council laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies
- DFO (2002). Aquaculture Policy Framework. Fisheries and Oceans Canada.
- Dismukes G.C., Carrieri D., Bennette N., Ananyev G.M. & Posewitz M.C. (2008). Aquatic phototrophs: efficient alternatives to land-based crops for biofuels, Current Opinion in Biotechnology, 19:235–240.
- EC (2009). Building a sustainable future for aquaculture - A new impetus for the Strategy for the Sustainable Development of European Aquaculture - Impact Assessment. Commission staff working document accompanying the communication from the Commission to the European Parliament and the Council. SEC(2009) 453
- Ernst & Young, AND-I, Eurofish & Indemar (2008). Etude des performances économiques et de la compétitivité de l’aquaculture de l’Union Européenne. Etude 3 dans le cadre du contrat cadre Lot 3 – études relatives à la mise en oeuvre du FEP.
- European Parliament (2009). European Aquaculture Competitiveness : limitations and possible strategies. Directorate-General for Internal Policies, Department Structural and Cohesion Policies – Fisheries.
- FAO (2008).The State of World Fisheries and Aquaculture. Rome

- Fisheries and Oceans Canada (2009). National Aquaculture Strategic Action Plan Initiative - Strengthening Sustainable Aquaculture Development in Canada.
- Framian (2009). Review of the EU aquaculture sector and results of costs and earnings survey.
- Garofalo, R. (2010). Potential and Challenges for algae biofuels and biomass development in Europe - the role of the EABA. Presentation at the “World Biofuels Markets” conference, Amsterdam, March 15th, 2010.
- Halfar, J. and Fuijta, Rodney M. (2002) "Precautionary management of deep-sea mining", Marine Policy, v.26, 2, p.103-106
- Lloyd-Evans L (2005a) “A study into the prospects for marine biotechnology development in the United Kingdom- volume 1 – strategy” FMP Marine Biotechnology Group – 02 – Volume 1, 86p.
- Lloyd-Evans L (2005b) “A study into the prospects for marine biotechnology development in the United Kingdom- volume 2 – Background & Appendices” FMP Marine Biotechnology Group – 02 – Volume 2, 241p.
- Marine Board-ESF (2010), Marine Biotechnology: A New Vision and Strategy for Europe. Position paper 15. September 2010
- Perez-Garcia O., Escalante F.M.E., de-Bashan L.E. & Bashan Y. (2011). Heterotrophic cultures of microalgae: Metabolism and potential products, Water Research 45. 11-36.
- REFUEL (2008). Eyes on the track, Mind on the horizon. From inconvenient rapeseed to clean wood: A European road map for biofuels, 52p.
- Sea Food Choices Alliance (2005), Constant Cravings – the European Consumer and Sustainable Seafood choices, Public Opinion Polling.
- Stratton R. W., Wong H. M. & Hileman J. I. (2010). Life Cycle Greenhouse Gas Emissions from Alternative Jet Fuels”. PARTNER Project 28 report. Version 1.1 (report no. PARTNER-COE-2010-001), 143p.
- Sturrock H. et al. (2008). Prospective Analysis of the Aquaculture Sector in the EU. PART 2: Characterisation of Emerging Aquaculture Systems. IPTS JRC
- The Research Council of Norway (2005), Aquaculture 2020 - Transcending the Barriers – as long as… A Foresight Analysis”, 168p.
- US Department of Energy (2010). National Algal Biofuels Technology Roadmap. A technology roadmap resulting from the National Algal Biofuels Workshop - December 9-10, 2008 - College Park, Maryland
- Wang X. and Werner W.E.G. (2010) “Are Polymetallic Nodules, Crusts and Vents Biominerals?” J. Sci. Hal. Aquat., 2:05-20.
- Wigmosta M. (2011). 2011 DOE Biomass Program Analysis and Sustainability Platform Review. Algae Resource Assessment. Pacific Northwest National Lab
- Wijffels R.H. & Barbosa M.J. (2010). An Outlook on Microalgal Biofuels. Science 329:796-799.
- Norwegian Ministry of Fisheries and Coastal Affairs (2009), Strategy for an Environmentally Sustainable Norwegian Aquaculture Industry.

Offshore wind

- Assessment of non-cost barriers to renewable energy growth in EU Member States – AEON. Ecorys, 2010
- Delivering Offshore Wind Power in Europe. Policy recommendations for large-scale deployment of offshore wind power in Europe by 2020 by the European wind energy association, 2007.
- EC (2010) Communication(2010) 677/4
- EEA (2009) Europe’s onshore and offshore wind energy potential. An assessment of environmental and economic constraints.
- EurObserver (2010). The state of renewable energies in Europe, 9th EurObserver Report.
- EWEA (2011a) Fact sheet EWEA: Operational offshore wind farms in Europe, end 2010.
- EWEA (2011b) The European offshore wind industry key trends and statistics 2010
- EWEA (2010a). Wind in power, EWEA report

- EWEA (2010b), Wind Barriers, July 2010
- EWEA (2010c), Powering the energy debate, Annual Report 2010. The European Wind Energy Association, April 2010
- EWEA (2010d), European Wind Initiative, June 2010.
- EWEA (2010e), The European offshore wind industry – Key trends and statistics: 1st half 2010, August 2010
- EWEA (2009a), Wind at work – wind energy and job creation in the EU
- EWEA (2009b) - Annual Report 2009.
- EWEA, (2007). Delivering Offshore Wind Power in Europe. Policy recommendations for large-scale deployment of offshore wind power in Europe by 2020.

Cruise tourism

- Carnival Corporation & PLC (2011), *2010 Annual Report,* Miami/ London.
- Cruise Lines International Association (2008), *Cruise Market Profile Study*, Fort Lauderdale.
- Cruise Lines International Association (2010), 2010 CLIA Cruise Market Overview: Statistical Cruise Industry Data Through 2009, Fort Lauderdale.
- Dowling, Ross K. (ed.) (2006), *Cruise Ship Tourism*, CAB International.
- Gui, L. & A.P. Rosso (2011), *Cruise ports: a strategic nexus between regions and global lines: evidence from the Mediterranean,* In: Maritime Police & Management, Vol. 38, no 2. , pp 129-150.
- Leakakou, N. (ed.) (2010), The Economic Impact of Cruise to Local Economies: The case of an Island, Presented at The 2011 Athens Tourism Symposium. Athens.
- Leakakou, N. (ed.) (2010), Which Homeport in Europe: The cruise industry's selection criteria. Tourismos.
- New York Times (2012), Obstacles to Danish Wind Power, author: James Kanter. Article published online at http://www.nytimes.com/2012/01/23/business/global/obstacles-to-danish-wind-power.html. Last accessed on 17th Feb. 2012
- Ecorys (2011), *Green growth opportunities for the shipbuilding industry* (forthcoming November 2011)
- Ecorys (2011), *CBA for cruise infrastructure in the Grand Harbour, Malta* (forthcoming August 2011)
- Ecorys (2009), *Study on Competitiveness of the European Shipbuilding Industry*. Rotterdam/ Brussel.
- European Cruise Council (2010), *The growing European Cruise Sector, Environmental Responsibility and Cultural Tourism (presentation),* Brussels.
- European Cruise Council (2011), *The Cruise Industry (2011 edition),* Brussels.
- European Cruise Council (2011), Contribution of Cruise Tourism to the Economies of Europe (2011 edition), Brussels.
- The Naval Architect (February 2011), New look to future cruising, London.
- Papathanassis, Prof. dr. A (2011), Farming ice bergs: Cruise destinations in the Northern Atlantic. Presentation at the Cruise Gateway opening conference, 17 February 2011, Hamburg.
- Policy Research Corporation (2009), *Tourist facilities in ports, The economic factor*, Antwerp/ Rotterdam.
- Policy Research Corporation (2009), *Tourist facilities in ports, The environment factor*, Antwerp/ Rotterdam.
- Port statistics provided by Transport Malta
- Peisley, T. (2008), *2020 Vision: New Focus for the Global Cruise Industry.* Seatrade. Colchester, UK.
- Wild, G.P. (2008), *The prospects for developing Malta as a fly-cruise and stay destination*, June 2008

Maritime monitoring and surveillance

- Acitores, M, R&D industry efforts towards enhanced EU maritime border security, Lessons learnt during the last decade experience, Guidelines for the future, May 2010.
- Anyanova, E, The EC and enhancing ship and port facility security, Vol.2, Issue 1 (2007).
- Argo brochure: An array of profiling floats observing the ocean in real-time. Five years of progress, decade of potential
- Bauer, A and Fischer, Y, Object-Oriented Sensor Data Fusion for Wide Maritime Surveillance, 2010.
- Bende-Michl et al. (2011), Monitoring strategies and scale-appropriate hydrologic and biogeochemical modelling for natural resource management: Conclusions and recommendations from a session held at the iEMSs 2008
- Brown et al. (2011), Benthic habitat mapping: A review of progress towards improved understanding of the spatial ecology of the seafloor using acoustic techniques, Estuarine, Coastal and Shelf Science 92, 502-520
- Centre for Strategy and Evaluation Services (2011), Ex-post evaluation of PASR activities in the field of Security and Interim Evaluation of FP7 Security Research: Maritime Security and Surveillance Case Study.
- Dessi et al. (2008), Modis data processing for coastal and marine environment monitoring: A study on anomaly detection and evolution in Gulf of Cagliari (Sardinia-Italy). The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B8. Beijing 2008
- Diercks-Horn et al. (2011), The ALGADEC device: A semi-automated rRNA biosensor for the detection of toxic algae, Harmful Algae 10, 395–401
- Diercks et al. (2008), Development and adaptation of a multiprobe biosensor for the use in a semi-automated device for the detection of toxic algae, Biosensors and Bioelectronics, 23, 1527–1533
- Ecorys (2009), Study on the Competitiveness of the EU security industry, Final Report for DG Enterprise and Industry, November 2009
- Ecorys (2009), Study on the Competitiveness of the EU security industry, Final Report for DG Enterprise and Industry, November 2009
- European Commission, Towards a strategy to protect and conserve the marine environment, COM/2002/0539 final
- European Commission, On the sixth environment action programme of the European Community 'Environment 2010: Our future, Our choice', COM (2001) 31 final, 24 January 2001
- European Commission Green Paper, Towards a future Maritime Policy for the Union: A European vision for the oceans and Seas, COM(2006) 275 final, 7 June 2006
- European Commission, Towards a Shared Environmental Information System (SEIS)", COM(2008) 46 final, 1 February 2008
- European Commission, Building a European marine knowledge infrastructure: Roadmap for a European Marine Observation and Data Network, SEC(2009) 499, 7 April 2009
- European Commission, Towards the integration of maritime surveillance: A common information sharing environment for the EU maritime domain, COM(2009)538 final, 15 October 2009
- European Commission, European Marine Observation and Data Network Impact Assessment, COM(2010) 461, SEC(2010) 999, 8 September 2010
- European Commission, Marine Knowledge 2020 marine data and observation from smart and sustainable growth, SEC(2010) 461, 8 September 2010
- European Commission, Draft Roadmap towards establishing the Common Information Sharing Environment for the surveillance of the EU maritime domain, COM(2010) 584, 20 October 2010
- EUROSTAT and Flemming (2007), SEPRISE – Socio – Economic Analysis Scoping Report

- European Commission (2007), Communication on Pre-commercial procurement: Driving innovation to ensure sustainable high quality public services in Europe, SEC (2007) 1668, Brussels.
- European Commission (2007), Communication on Pre-commercial procurement: Driving innovation to ensure sustainable high quality public services in Europe, SEC (2007) 1668, Brussels.
- European Commission (2008), Examining the creation of a European Border Surveillance System (EUROSUR), Press release of 13th February 2008, Brussels
- European Commission (2008), Examining the creation of a European Border Surveillance System (EUROSUR), Press release of 13th February 2008, Brussels
- European Commission (2009), Towards the integration of Maritime Surveillance: A common information sharing environment for the EU maritime domain, COM (2009)538 final, 15th October 2009, Brussels.
- European Commission (2010), Communication from the European Commission on a Draft Roadmap towards establishing a Common Information Sharing Environment for the surveillance of the EU maritime domain, COM(2010) 584 final, Brussels.
- European Commission (2010), Communication from the European Commission on a Draft Roadmap towards establishing a Common Information Sharing Environment for the surveillance of the EU maritime domain, COM(2010) 584 final, Brussels.
- European Commission, Single Window Road Map, 2011.
- European Commission, Staff Working Paper: Secure Trade and 100% Scanning of Containers, February 2010.
- European Defence Agency, Maritime Surveillance in Support of CSDP, The Wise Pen Team Final Report to EDA Steering Board, 26 April 2010.
- European Maritime Safety Agency, The EU Long Range Identification and Tracking of Ships Data Centre.
- European Organisation for Security, EU Maritime Surveillance Issues Linked to Security “Sea4All“ Approach, November 2009.
- European Organisation for Security, Recommendations from the Security Industry for the development of a Harmonized Global Maritime Surveillance Architecture for the EU, 24 May 2010.
- European Science Foundation (2007). Marine Board: Impacts of Climate Change on the European Marine and Coastal Environment. Ecosystems Approach, May 2007
- ESFRI (2011), Strategy Report on Research Infrastructures Roadmap 2010
- Export America Magazine (2002), Global Environmental Technologies: Trends, Markets, and Prospects by the Office of Environmental Technologies Industries, Trade Development, Vol 3 No 11
- Ex-post evaluation of PASR activities in the field of Security and Interim Evaluation of FP7 Security Research: Maritime Security and Surveillance Case Study.
- Fisher et al. (2010), Ocean Information for society: sustaining the benefits, realizing the potential, OceanObs’09 (21-25 September 2009, Venice, Italy) conference statement
- Gallouet, E, These Doctorale, Le Transport Maritime de Stupefiants, 14 January 2011.
- Greidanaus, H et al (2010), R&D in support of EU Maritime Policy, European Commission – JRC, Conference paper, Security Research 2010, Ostend, September 22-24 2010
- Greidanaus, H et al (2010), R&D in support of EU Maritime Policy, European Commission – JRC, Conference paper, Security Research 2010, Ostend, September 22-24 2010
- Hayes, B, Homeland Security comes to Europe, State Watch, vol 19 no 3, July-September 2009.
- HSRC (2008), “Global Homeland Security, Homeland Defence and Intelligence Markets Outlook 2009-2018”

- HSRC (2008), Global Homeland Security, Homeland Defence and Intelligence Markets Outlook 2009-2018"
- Joint Research Centre, European Commission, Integrated Maritime Policy for the EU, Working Document III on Maritime Surveillance Systems, 14 June 2008, Ispra Italy.
- Joint Research Centre, R&D in support of EU Policies on Maritime Border Surveillance, Centre for Strategy and Evaluation Services (2011),
- Marlow, P (2010), Maritime security: an update of key issues, Maritime Policy and Management, December 2010, Vol 37 No 7, pp. 667-676
- METO, The National Cooperative METO Report, 12 March 2007, Helsinki.
- Morel, M and Broussolle, J, Interoperable sensors & Information sources for Common detection of abnormal vessel behaviours and Collaborative suspect events analysis.
- Morel, M and Claisse, S, Integrated System for Interoperable sensors & Information sources for Common abnormal vessel behaviour detection & Collaborative identification of threat (I2C), IEEE Conference Publishing, Piscataway, NJ USA.
- MRAG Ltd (2008), Legal Aspects of Marine Environmental Data Framework Service Contract, No. FISH/2006/09
- MRAG Ltd. (2009), Marine Data Infrastructure, Framework Service Contract, No. FISH/2006/09
- One Earth Future Foundation (2010), The Future Economic Cost of Piracy, at www.oneearthfuture.org, accessed 15th July 2011
- Pira International Ltd., University of East Anglia and Knowledge View Ltd. (2000), Commercial exploitation of Europe's public sector information
- Price Waterhouse Cooper (2008), INFOMAR Marine Mapping Survey Options Appraisal Report
- Ryder (2007), Sustainable Marine Environmental Information Services to Meet Collective European Needs, EuroGOOS publication No. 26
- Science (2008), FerryBoxes Begin To Make Waves, Vol 322
- Send et al. (2010) Towards an integrated observing system: In situ Observation, OceasnObs'09 (21-25 September 2009, Venice, Italy)
- SMRU Ltd (2010), Approaches to marine mammal monitoring at marine renewable energy developments Final Report MERA 0309 TCE
- Security & Defence Agenda, SDA Discussion Paper: Maritime Security in the Mediterranean: Challenges and Policy Responses, June 2011.
- Technical Advisory Group ('TAG') on integration of maritime surveillance, First six month report, November 2010-April 2011, 12 May 2011.
- Testor et al. (2010), Glider White Paper: Gliders as a component of future observing systems
- Timmerman et al. (2010), Analyzing the data-rich-but-information-poor syndrome in Dutch water management in historical perspective. Environ Manage. 45, 1231-42
- United Nations, "World Population to 2300", 2004.
- Uunk et al. (2010), Automated mapping of the intertidal beach bathymetry from video images. Coastal Engineering 57, 461-469
- Veenstra T.S. and Churnside, J.H. (2011), Airborne sensors for detecting large marine debris at sea. Mar. Pollut. Bull. doi:10.1016/j.marpolbul.2010.11.018

Ocean renewable energy

- ABS Energy Research, 2009. The Ocean Energy Report, fourth edition
- Achilla, A. et al. (2009) Power generation with pressure retarded osmosis: An experimental and theoretical investigation. Journal of Membrane Science 343, pp. 42-52
- Arup, 2011. Review of the generation costs and deployment potential of renewable electricity technologies in the UK. Study Report, REP001, Final | June 2011. http://www.decc.gov.uk/assets/decc/What%20we%20do/UK%20energy%20supply/Energy%20mix/Renewable%20energy/policy/renew_obs/1834-review-costs-potential-renewable-tech.pdf

- Beurskens, L.W.M. and M. Hekkenberg (2011) Renewable Energy Projections as published in the National Renewable Action Plans of the European Member States covering all 27 EU Member States. EEA/ECN report.
- Brogioli, D. (2009), Extracting renewable energy from a salinity difference using a capacitor. Physical Review Letters 103
- Deltares (2010), Renewable Energy from Water & Subsurface.
- Dlugolecki, P. et al. (2009) Practical potential of reverse electrodialysis as process for sustainable energy generation Environmental Science & Technology 43, pp 6888–6894
- Douglas-Westwood (2010) The world wave and tidal market report 2011-2015.
- EC (2009). Communication 519 final. Investing in the Development of Low Carbon Technologies (SET-Plan)
- EC (2010) Communication 639 final. Energy 2020 - A strategy for competitive, sustainable and secure energy.
- EC: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:en:PDF
- EC: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:200:0031:0045:EN:PDF
- EC: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0055:0093:EN:PDF
- Ecorys (2011) Financing Renewable Energy in the European Energy Market. Report for the EC, DG ENER
- Equimar project website - see www.equimar.org
- European Ocean Energy Association (2010) Oceans of Energy - European Ocean Energy Roadmap 2010-2050
- IEA (2010) Implementing Agreement on Ocean Energy Systems (www.iea-oceans.org)
- IEA (2011) World Energy Outlook 2010. IEA-OECD annual report.
- IEA-OES (2009) Ocean Energy: Global technology development status. IEA-OES doc nr T0104
- IEA-RETD (2011) Accelerating the deployment of offshore renewable energy technologies, IEA-RETD report
- European Science Foundation (2010). Marine Board: Marine Renewable Energy; Research Challenges and Opportunities for a new Energy Era in Europe.
- Nihous, G.C. et al. (1990) Conceptual Design of an Open-Cycle OTEC Plant for the Production of Electricity and Fresh Water in a Pacific Island. Ocean Energy Recovery, pp. 207-216
- NOAA - NOAA Technical Memorandum NMFS F/SPO-116 – Environmental Effects of Tidal Energy Development. www.depts.washington.edu/nnmrec
- Olsson, M. et al. (1979), Salinity gradient power – utilizing vapour-pressure differences. Science 206, pp. 452-454
- PMSS (2011) Marine Special Report 2011 (www.pmss.co.uk)
- Post, J.W. (2009), Blue Energy: Electricity production from salinty gradients by reverse electrodialysis. PhD thesis, pp. 224
- ReCharge newspaper (accessed on May 3, 2011) (www.rechargenews.com)
- RenewableUK (2011) State of the industry report (www.renewable-uk.com accessed on May 15, 2011)
- Royal Haskoning (2009) Tidal Energy - Lessons learnt from the United Kingdom and opportunities for the Netherlands.
- Sorensen, H.C. and Weinstein, A. (2008) Ocean Energy: Position paper for IPCC, pp. 8
- Thorsena, T. and Holt, T. (2009), The potential for power production from salinity gradients by pressure retarded osmosis. Journal of Membrane Science 335, pp. 103-110
- Turek, M. and Bandura, B. (2006), Renewable energy by reverse electrodialysis. Desalination 205, pp. 67-74
- Vega, L.A. (1992) Economics of Ocean Thermal Energy Conversion (OTEC). Ocean Energy Recovery, pp 152-181
- Waveplam, http://www.waveplam.eu/page/ (accessed on June 22nd, 2011)

- Wu, C. (1990) Specific power optimization of closed-cycle OTEC plants. Ocean Engineering 17 pp. 307-314

Marine minerals mining

- Bertram, Christine., Anna Krätschell, Killian O'Brien, Warner Brückmann, Alexander Proelss, Katrin Rehdanz (2011). Metalliferous Sediments in the Atlantis II Deep – Assessing the Geological and Economic Resource Potential and Legal Constraints. Kiel Working Paper No. 1688 | March 2011
- Birney, Kirsten., Amber Griffin, Jonathan Gwiazada, Johnny Kefauver, Takehiko Nagai, Douglas Varchol (2006). Potential Deep-Sea Mining of Seafloor Massive Sulfides: A Case Study in Papua New Guinea. Donald Bren School of Environmental Science & Management. Final group report from MESM
- BGS (2010) European Mineral Statistics 2004-08: A product of the World Mineral Statistics Database. British Geological Survey 2010
- Denegre, Julien (2011) Personal communication with Mr. Denegre, business developer at Technip. Interview via telephone 13 July 2011 by J.M. de Vet.
- Glasby, G. P. (2000) Lessons Learned from Deep-Sea Mining. Science 28. Vol. 289. No.5479.
- Grenelle de la Mer (2010) Exploration et mise en valeur des ressources minérales et de la biodiversité de la Zone Économique Exclusive (ZEE) française: la campagne d'exploration des fonds sous-marins au large de Wallis et Futuna est en cours. Press release, Paris 6 September 2010.
- EC (2011) Tackling the challenges in commodity markets and on raw materials. COM(2011) 25 Final.
- EC (2010) Critical raw materials for the EU: Report of the Ad-hoc Working Group on defining critical raw materials. Version of 30 July 2010. DG Enterprise.
- EC (2007) The deep-sea frontier: Science challenges for a sustainable future. DG Research.
- Halfar, Jochen, and Fujita, Rodney M., (2002) Precautionary management of deep-sea mining. Marine Policy, v. 26, 2, p. 103-106
- Hayden, David (2004) Exploration for and Pre-feasibility of mining Polymetallic Sulphides - a commercial case study. David Haydon, Nautilus Minerals Ltd. ISA Workshop presentation 2004.
- Horst U. Oebius, Hermann J. Becker, Susanne Rolinski, Jacek A. Jankowski (2001) Parametrization andevaluation of marine environmental impacts produced by deep-sea manganese nodule mining. Deep-Sea Research II 48 (2001) 3453–3467
- ISA (2011) The Russian Federation Applies For Approval Of Plan Of Work For Exploration For Polymetallic Sulphides. International Seabed Authority. http://www.isa.org.jm/en/node/627
- ISA (2011b) Seabed council approves four applications exploratory contracts with authority in the deep seabed area. ISA Press release from the 17th session of the ISA, 19 July 2011, SB/17/11
- ISA (2011c) Draft environmental management plan for the Clarion-Clipperton Zone. ISBA/17/LTC/WP.1. Seventeenth session, 11-22 July 2011.
- ISA (2010a) COMRA Applies For Approval Of Plan Of Work For Exploration For Polymetallic Sulphides. International Seabed Authority. http://www.isa.org.jm/en/node/518
- ISA (2010b) Seabed Authority Concludes 16th Session; Adapts Draft Regulations On Polymetallic Sulphides And Elects New Council Members. International Seabed Authority. http://www.isa.org.jm/en/node/515
- ISA (2006a) Polymetallic nodules. (http://www.isa.org.jm/files/documents/EN/Brochures/ENG7.pdf)
- ISA (2006b) Polymetallic sulphurs. (http://www.isa.org.jm/en/documents/technical)
- ISA (2006c) Mining techniques. (http://www.isa.org.jm/en/documents/technical)

- ISA (2004) Marine mineral resources: Scientific advances and economic perspectives. International Seabed Authority, United Nations Division for Ocean Affairs and the Law of the Sea, and Office of Legal Affairs.
- Jarowinsky, Michael (2009) Studie mit dem eines aktionsplans fur den bereich marine mineralische rohstoffe. July 2010.
- Jones, Nicola (2011) Sea holds treasure trove of rare-earth elements. Published online 3 July 2011, Nature. (http://www.nature.com/news/2011/110703/full/news.2011.393.html)
- Kato et al (2011) Deep-sea mud in the Pacific Ocean as a potential resource for rare-earth elements. Nature Geoscience: Letters, NGEO 1185
- Kojima, Kazuhiro (1999) Report on the cobalt-rich manganese crust resources in the waters of the federate states of Micronesia. SOPAC Technical report 94. August 1999
- Maribus (2010) World Ocean Review 2010: Living with the oceans. Published by Maribus in cooperation with Kiel Marine Sciences, International Oceans Institute, and mare.
- Maribus (2010) World Ocean Review 2010: Living with the oceans. Published by Maribus in cooperation with Kiel Marine Sciences, International Oceans Institute, and mare. Chapter 7 "Marine minerals and energy", p. 151
- McLeod, Jodie (2008) New Frontier Mining Under the Sea. Mining-technology.com, 26 Nov 2008, (http://www.mining-technology.com/features/feature46357/)
- Merlo, J.L. (1964) The mineral resources in the sea. Elsevier Publishing Company, Amsterdam
- Mining Magazine (2005) Nautilus plans ocean-bed mining. Mining Magazine, October 2005. (http://www.nautilusminerals.com/i/pdf/MiningMag05.pdf)
- Petersen, S. (2011) Modern Seafloor Massive Sulfide Deposits: Challenges and Opportunities. IFM-GEOMAR, Presentation to Marine Geosciences and Geotechnology Santos, February 14.-16. 2011.
- Reuters (2011) Nautilus Forms Strategic Partnership and Secures Vessel. Press release 13 April 2011 from Nautilus Minerals Inc. (http://www.reuters.com/article/2011/04/14/idUS31105+14-Apr-2011+MW20110414)
- OceanflORE (2011) http://www.oceanflore.com/
- Scott, S. et al (2008) Mineral Deposits in the Sea: Second Report of the ECOR Panel on Marine Mining (September 2008). (http://www.oceanicresources.org/specialist-panels/ecor-2006-symposium-panel-working-group-reports/)
- Smith. C, et al (2010) Areas of particular environmental interest (or “protected areas”) for ecosystem based management of the Clarion-Clipperton Zone: Rationale and recommendations the International Seabed Autorithy. Presentation at ISA 2010 (http://www.isa.org.jm/files/documents/EN/Workshops/2010/Pres/SMITH.pdf)
- Shaffner, Justin (2008) Concerns over deep sea mining escalate. Post 3 June 2008. (http://themelanesian.org/2008/07/03/concerns-over-deep-sea-mining-escalate/)
- Thakur, Anrika (2011) Nautilus Minerals to get ship for offshore copper mine ops; shares up. Reuters. 14 April 2011. (http://www.reuters.com/article/2011/04/14/nautilusminerals-idUSL3E7FE2HB20110414)
- U.S. Congress, Office of Technology Assessment (1987) Marine Minerals: Exploring Our New Ocean Frontier, OTA-O-342, Washington, DC: U.S. Government Printing Office, July 1987
- Van Dover, Cindy Lee (2011) Mining seafloor massive sulphides and biodiversity: what is at risk? ICES Journal of Marine Science (2011), 68(2), 341–348.
- Van Muijen, Henk. and Jan Willem van Bloois (2011) Interview at IHC Merwede 16 July 2011.
- WTO (2010) Trade growth to ease in 2011 but despite 2010 record surge, crisis hangover persists. PRESS/628, 7 April 2011 (http://www.wto.org/english/news_e/pres11_e/pr628_e.htm)

Annex 2.2 References consulted for the sea basin descriptions

Baltic Sea

- COWI (2007): Unprecedented demand for cruises in the Baltic. Weblink: http://www.cowi.com/menu/ news/newsarchive/2007/Pages/unprecedenteddemandforcruisesinthebaltic.aspx
- EC (2008): The role of maritime clusters to enhance the strength and development of European maritime sectors. Report on results. The European Commission, Directorate-General for Maritime Affairs and Fisheries. Weblink: http://ec.europa.eu/maritimeaffairs/clusters_en.html.
- EC Communication COM(2009) 248 final concerning the European Union Strategy for the Baltic Sea Region
- EC Communication COM(2009b) 248 final concerning the European Union Strategy for the Baltic Sea Region - Action Plan. December 2010 version.
- EC (2010) Commission Staff Working Document Accompanying the
- EEA, 2010. The European Environment, State and Outlook 2010 - Marine and Coastal Environment. Copenhagen. ISBN 978-92-9213-158-6
- EU Regional Policy (2010) The European Union Strategy for the Baltic Sea Region - Background and Analysis. ISBN 978-92-79-15757-8
- European Cruise Council (2011), The Cruise Industry (2011 edition), Brussels.
- European Cruise Council (2011), Contribution of Cruise Tourism to the Economies of Europe (2011 edition), Brussels.
- European Parliament, 2008. The Impact of Tourism on Coastal Areas: Regional Development Aspects, European Parliament IP/B/REGI/IC/2006-166-Lot01-C03-SC01 (http://ec.europa.eu/maritimeaffairs/documentation/studies/documents/the_impact_of_tourism_en.pdf).
- Eurostat, 2010, Short Sea Shipping of goods 2008. Data in focus (http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-QA-10-026/EN/KS-QA-10-026-EN.PDF).
- HELCOM, 2010a. Ecosystem health of the Baltic Sea. HELCOM Initial Holistic Assessment. Baltic Sea Environment Proceedings no. 122
- HELCOM, 2010b. Maritime activities in the Baltic Sea - An integrated thematic assessment onmaritime activities and response to pollution at sea in the Baltic Sea region. Baltic Sea Environment Proceedings no. 123
- Kadin, M. (2008) Trends and scenarios exemplifying the future of the Baltic Sea and Skagerrak Ecological impacts of not taking action. Swedish Environmental Protection Agency, Report 5875.
- Knights, A.M., Koss, R.S., Papadopoulou, N., Cooper L.H. and L.A. Robinson (2011). Sustainable use of European regional seas and the role of the Marine Strategy Framework Directive. Deliverable 1, EC FP7 Project (244273) ‘Options for Delivering Ecosystem-based Marine Management’. University of
- Liverpool. ISBN: 978-0-906370-63-6: 165 pp.
- Policy Research Corporation, 2010. Study on the economic effects of Maritime Spatial Planning, Final Report, DG Maritime Affairs and Fisheries, (http://ec.europa.eu/maritimeaffairs/studies/economic_effects_maritime_spatial_planning_en.pdf).

North Sea

- Eurostat, 2010, Short Sea Shipping of goods 2008. Data in focus (http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-QA-10-026/EN/KS-QA-10-026-EN.PDF)
- OSPAR Commission, 2009. Trend analysis of maritime human activities and their collective impact on the OSPAR maritime area, Document Poo443-BA6: pp55.
- OSPAR Commission (2010). Quality Status Report 2010. London, ISBN 978-1-907390-38-8
- Policy Research Corporation, 2010. Study on the economic effects of Maritime Spatial Planning, Final Report, DG Maritime Affairs and Fisheries, (http://ec.europa.eu/maritimeaffairs/studies/economic_effects_maritime_spatial_planning_en.pdf).
- http://www.ewea.org/index.php?id=1861 of the European Wind Energy Association
- http://www.europeancruisecouncil.com/ The European Cruise council (ECC)
- http://www.sailcoast.eu/ Schéma d'Aménagement Intégré du Littoral (SAIL)
- http://www.oceansatlas.org/ The UN Atlas of the Oceans.
- http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators/all_indicators EUROSTAT.
- http://www.eea.europa.eu/themes/water/european-waters/europes-seas-and-coasts
- http://jncc.defra.gov.uk for active seabed mapping European seas.

North East Atlantic Ocean

- EC Communication COM(2011) 782 final Developing a Maritime Strategy for the Atlantic Ocean Area
- European Cruise Council (2011), The Cruise Industry (2011 edition), Brussels.
- European Cruise Council (2011), Contribution of Cruise Tourism to the Economies of Europe (2011 edition), Brussels.
- Eurostat, 2010, Short Sea Shipping of goods 2008. Data in focus (http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-QA-10-026/EN/KS-QA-10-026-EN.PDF)
- OSPAR Commission (2010). Quality Status Report 2010. London, ISBN 978-1-907390-38-8
- Policy Research Corporation, 2010. Study on the economic effects of Maritime Spatial Planning, Final Report, DG Maritime Affairs and Fisheries, (http://ec.europa.eu/maritimeaffairs/studies/economic_effects_maritime_spatial_planning_en.pdf).

Mediterranean Sea

- Blue Growth SIR report subfunction 1.2 2011. Deliverable under WP2 of the Blue Growth Project by Ecorys / Deltares / Oceanic Developpement.
- Blue Growth SIR report subfunction 2.1 2011. Deliverable under WP2 of the Blue Growth Project by Ecorys / Deltares / Oceanic Developpement.
- Borja A, E. M., J. Carstensen, A.S. Heisdanen and W. van de Bund. 2006. Marine Management - Towards an integrated implementation of the European Marine Strategy Framework and the Water Framework Directives. Marine Pollution Bulletin 60:2175-2186.
- CEFP 2010. Ecosystem Profile – Mediterranean Basin Biodiversity Hotspot. Critical Ecosystem Partnership Fund. (http://www.cepf.net/Documents/Mediterranean_EP_FINAL.pdf)
- Claudet, J., Fraschetti, S., 2010. Human-driven impacts on marine habitats: A regional meta-analysis in the Mediterranean Sea. Biological Conservation, 143, pp. 2195-2206.
- Coll, M., C. Piroddi, J. Steenbeek, K. Kaschner, F. B. Lasram, J. Aguzzi, E. Ballesteros, C. N. Bianchi, J. Corbera, T. Dailianis, R. Danovaro, M. Estrada, C. Froglia, B. S. Galil, J. M. Gasol, R. Gertwagen, J. Gil, F. Guilhaumon, K. Kesner-Reyes, M. S. Kitsos, A. Koukouras, N.

Lampadariou, E. Laxamana, C. M. L. F. de la Cuadra, H. K. Lotze, D. Martin, D. Mouillot, D. Oro, S. Raicevich, J. Rius-Barile, J. I. Saiz-Salinas, C. San

- Costello, M. J., M. Coll, R. Danovaro, P. Halpin, H. Ojaveer, and P. Miloslavich. 2010. A Census of Marine Biodiversity Knowledge, Resources, and Future Challenges. Plos One 5(8):e12110.
- EC 2009. COM(2009) 466 final Towards an Integrated Maritime Policy for better governance in the Mediterranean
- EC ENPI 2006. European Neighbourhood and Partnership Instrument EUROMED Regional Strategy Paper (2007-2013) and Regional Indicative Programme (2007-2010) for the Euro-Mediterranean Partnership. http://ec.europa.eu/world/enp/pdf/country/enpi_euromed_rsp_en.pdf
- EC ENPI 2008. Cross-Border Cooperation within the European Neighbourhood and Partnership Instrument – Mediterranean Sea Basin Programme 2007-2013. http://www.enpicbcmed.eu/documenti/29_38_20090108120940.pdf
- EEA 2004. Development and testing new indicators for biological and hydromorphological quality elements. Progress Report, ETC Internal draft, January 2004
- EEA 2006. The Changing Faces of Europe's Coastal Areas. Copenhagen.
- EEA 2006. UNEP-MAP Priority issues in the Mediterranean environment. (http://reports.eea.eu.int/eea_report_2006_4/en)
- EEA 2007. Halting the loss of biodiversity by 2010: proposal for a first set of indicators to monitor progress in Europe. (EEA Technical report No 11/2007). http://reports.eea.europa.eu/technical_report_2007_11/en/Tech_report_11_2007_SEBI.pdf
- EEA. 2010. The European Environment - State and Outlook 2010:Synthesis. Copenhagen.
- EEA/UNEP 2000. State and pressures of the marine and coastal Mediterranean environment. Environmental Issues series No. 5.
- Eurostat. 2011. Eurostat Maritime Statistics. http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Maritime_ports_freight_and_passenger_statistics
- GFCM - General Fisheries Commission for the Mediterranean, SAC - SCMEE Workshop on Algal and Jellyfish Blooms, Turkey, Istanbul, 6-8 October 2010 http://151.1.154.86/gfcmwebsite/SAC/2010/SCMEE_Algal_Jelly/docs.html
- Knights, A.M., Koss, R.S., Papadopoulou, N., Cooper L.H. and L.A. Robinson, 2011. Sustainable use of European regional seas and the role of the Marine Strategy Framework Directive. Deliverable 1, EC FP7 Project (244273) 'Options for Delivering Ecosystem-based Marine Management'. University of Liverpool. ISBN: 978-0-906370-63-6: 165 pp.
- MAP/REMPEC, 1996. 'List of alerts and accidents in the Mediterranean'.
- UNEP 2006. Accounting for Economic Activities in Large Marine Ecosystems and Regional Seas. UNEP Regional Seas Reports and Studies No.181
- UNEP 2011. Plan Bleu - Mediterranenan Strategy for Sustainable Development Follow-Up: Main Indicators, 2011 Update.
- UNEP/MAP-Plan Bleu MEDPOL 2004. Plan Bleu MEDPOL presentation on Marine Pollution Indicators. Fouad Abusamra. (http://www.planbleu.org/methodologie/imdd_mai2005/session3_medpol.pdf)
- UNEP-MAP 2007. Report On Marine Pollution Indicators in Mediterranean Countries. Review Meeting of MEDPOL monitoring activities and the use of indicators Athens, 12-14 December 2007, UNEP(DEPI)/MED WG.321/Inf.7.
- UNEP/MAP-Plan Bleu 2009. State of the Environment and Development in the Mediterranean, UNEP/MAP-Plan Bleu, Athens, 2009.
- UNEP/MAP-Plan Bleu 2010. The economic value of sustainable benefits rendered by the mediterranean marine ecosystems. Blue Plan Papers no. 8, July 2010.

Black Sea

- BSC 2007. Black Sea Transboundary Diagnostic Analysis. The Commission on the Protection of the Black Sea Against Pollution (BSC), Istanbul, Turkey.
- Commission on the Black Sea Against Pollution, 2009. Strategic Action Plan for the Environmental Protection and Rehabilitation of the Black Sea http://www.blacksea-commission.org/_bssap2009.asp
- Commission on the Black Sea, 2010. A 2020 Vision for the Black Sea Region
- Deniz, H. 2001. Environmental impact of aquaculture in Turkey and its relationship to tourism, recreation and sites of special protection. CIHEAM-IAMZ, Zaragoza, Spain.
- European Parliament, 2008. The Impact of Tourism on Coastal Areas: Regional Development Aspects, European Parliament IP/B/REGI/IC/2006-166-Lot01-C03-SC01
- Eurostat, 2010, Short Sea Shipping of goods 2008. Data in focus (http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-QA-10-026/EN/KS-QA-10-026-EN.PDF)
- Knights, A.M., Koss, R.S., Papadopoulou, N., Cooper L.H. and L.A. Robinson, 2011. Sustainable use of European regional seas and the role of the Marine Strategy Framework Directive. Deliverable 1, EC FP7 Project (244273) 'Options for Delivering Ecosystem-based Marine Management'. University of Liverpool. ISBN: 978-0-906370-63-6: 165 pp.
- Oral, N. 2006. Black Transit: The Geopolitics of trans-Balkan oil pipelines. University of Amsterdam, Amsterdam.
- Strategic Action Plan for Rehabilitation and Protection of the Black Sea (http://www.imo.org/)
- http://www.blacksea-commission.org/main.asp

Arctic Ocean

- Arctic Council 2009, Arctic Marine Shipping Assessment 2009 Report http://www.pame.is/images/stories/PDF_Files/AMSA_2009_Report_2nd_print.pdf
- AMAP/UNEP, 2008. Technical Background Report to the Global Atmospheric Mercury Assessment.
- Arctic Climate Impact Assessment - http://www.acia.uaf.edu http://www.arctic-council.org
- EC, 2008. Communication from the commission to the European Parliament and the Council. The European Union and the Arctic Region. COM(2008) 763 final.
- UNEP, 2007. http://maps.grida.no/go/graphic/northern-sea-route-and-the-northwest-passage-compared-with-currently-used-shipping-routes
- United Nations Framework Convention on Climate Change - http://unfccc.int/
- Usher et al. 2010; Usher et al. 2010; Arctic Climate Impact, section 10.3 Assessmenthttp://www.eoearth.org/article/Human_impacts_on_the_biodiversity_of_the_Arctic#endnote_11#endnote_11
- http://www.eoearth.org/article/Human_impacts_on_the_biodiversity_of_the_Arctic#endnote_11#endnote_11
- Arctic Marine Strategic Plan - http://www.pame.is
- Biodiversity and Ecosystem Integrity - http://www.caff.is
- Pollution Prevention - http://www.amap.no
- Northern Sea Route - http://www.fni.no/insrop
- PMSS (2011) Marine Special Report 2011 (www.pmss.co.uk)

Outermost Regions

- Cardigos, F. (no date). Blue Growth: future of marine and maritime innovation in Europe. Powerpoint presentation.
- Projets RupPlus, 2007. Etude de Modélisation pour l'Exploitation des Ressources Marines pour la Production d'Électricité dans les Régions Ultrapériphériques. Novembre 2007.
- Proyecto Rupmer, 2007. Las RUP y la politica maritima Europea
- RUP, 2009. Memorandum conjoint des regions ultraperipheriques - les rup a l'horizon 2020. Las Palmas de Gran Canaria, 14/10/2009.
- RUP, 2010. Contribution de la Conference de Presidents des Regions Ultraperipheriques a la Consultation Publique de la CE, 05/10/2010.
- Scott, S, 2011. Mineral Resources in the Deep Sea. Powerpoint for the Lisbon Atlantic Conference, November 2011.

Annex 2.3 Other references

- DNV (2011) "Technology Outlook 2020", p. 84 and further
- EC (2011a), COMMISSION STAFF WORKING PAPER Relationship between the initial assessment of marine waters and the criteria for good environmental status SEC 2011 1255 final
- EC (2012), keynote address "Our Blue Future – Perspectives on the Role of Research in the Sustainable Development of Ocean Resources" by Lowri Evans to the European Parliament, 24 January 2012
- EC (2011b), keynote speech "The Future of Marine and Maritime Innovation in Europe" at the European Parliament by Commissioner Maria Damanaki, 7 December 2011.
- EC (2011c), REGULATION (EU) No 1255/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 November 2011 establishing a Programme to support the further development of an Integrated Maritime Policy
- COM (2010) 546, Europe 2020 Flagship Initiative - Innovation Union
- COM (2010) 245, Europe 2020 Flagship Initiative – A Digital Agenda for Europe
- COM (2010) 624, REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the establishment of an evaluation mechanism to verify application of the Schengen acquis
- COM (2011)21, Europe 2020 Flagship Initiative – A Resource Efficient Europe, p. 2
- EC (2010), Innovation Union Flagship Initiative on 'Integrated New Industrial Policy in the Globalisation era', COM 2010 (614)
- EC (2009), "The World in 2025: Rising Asia and socio-ecological transition", DG Research & Technological Development
- EC (2009), Impact Assessment Guidelines, 15 January 2009
- ECORYS (2010) "Analysis of global long-term economic megatrends shaping Europe's future environment". Copenhagen: EEA.
- EWEA (2011), Wind in Power, 2011 European statistics
- Hemmes, Kas (2009). Towards multi-source multi-product and other integrated energy systems. In: International Journal of Integrated Energy Systems, Vol. 1, No. 1, January – June 2009.
- Insitut für Innovation und Technik and dsn (2010), Maritime Qualifizierungskompetenzen am Standort Hamburg. Study on behalf of the Freie und Hansestadt Hamburg, October 2010.
- Policy Research Corporation (2008), Sound Solutions Based on Scientific Research, The role of Maritime Clusters to enhance the strength and development of maritime sectors, Country report – France, 13th November 2008
- Porter Michael E. (1998) "Clusters and the New Economics of Competition". Harvard Business Review, Nov/Dec, p.78

- THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION, Having regard to the Treaty on the Functioning of the European Union, and in particular Articles 43(2), 91(1), 100(2) and 173(3), Articles 175 and 188, and Articles 192(1), 194(2) and 195(2) thereof,
- UNEP (2012). GREEN economy in a Blue World. Synthesis Report.
- US National Research Council of the National Academies (2003). Exploration of the Seas – voyage into the unknown. Committee on Exploration of the Seas; Ocean Studies Board; Division on Earth and Life Studies; The National Academic Press, Washington D.C.

Annex 3: Rationale for policy intervention for the maritime economic activities studied

<table>
<tr><th colspan="2" rowspan="2">Maritime Economic activity</th><th colspan="5">Smart growth</th><th colspan="2">Sustainable growth</th><th>Inclusive growth</th></tr>
<tr><th>Access to finance</th><th>Maritime R&D</th><th>Infrastructure</th><th>Cluster support</th><th>Skills and labour market</th><th>Integrated maritime planning at sea-level basins</th><th>Standards & Regulation</th><th>Public awareness</th></tr>
<tr><td rowspan="4">Mature economic activities</td><td>Shortsea shipping</td><td></td><td></td><td>Need for development of port infra, also in neighbouring trade partners (outside EU)</td><td rowspan="5">Need to retain critical mass within and across maritime economic activities for attracting investors, services, infrastructure, skilled workers and visibility</td><td>Need for health and safety standards</td><td></td><td>Need for gradual sharpening or enhancement of standards for emission and pollution</td><td></td></tr>
<tr><td>Offshore oil, gas & methane hydrates</td><td></td><td>Need for development of techniques for more effective exploitation (preventing depletion)</td><td>Need to ensure full access to ports</td><td>Need for health and safety standards</td><td>Decommissioning (as part of licensing agreements)/ alternative use of platforms</td><td>Need for candid implementation of renewable energy policy</td><td>Need for addressing public opinion (e.g. oil spills)</td></tr>
<tr><td>Coastal Tourism</td><td>Limited bankability of tourism; hence limited access to loans</td><td></td><td>Need to improve coastal access through sustainable transport modes</td><td>Limited attractiveness of the sector as an employer</td><td>Limited long-term visions and strategies at local & sea-basin level</td><td>Need for uniform warning signals (Blue Flags)</td><td></td></tr>
<tr><td>Coastal Protection</td><td></td><td>Need for new technologies to respond to sea level rise</td><td></td><td></td><td></td><td>Need for integrated coastal protection frame</td><td>Need to increase public awareness of sea-level rise</td></tr>
<tr><td></td><td>Marine aquatic products</td><td></td><td>Need for innovation and technological progress, e.g.</td><td></td><td></td><td>Need for spatial planning which provides optimal area choice</td><td>Need to secure animal health and welfare; need for consumer health</td><td>Need to increase awareness of health benefits of aquatic foods</td></tr>
</table>

	Maritime Economic activity	Smart growth					Sustainable growth		Inclusive growth
		Access to finance	Maritime R&D	Infrastructure	Cluster support	Skills and labour market	Integrated maritime planning at sea-level basins	Standards & Regulation	Public awareness
			in sustainable fish food (EATIP)					protection	
Growth-stage	Offshore Wind			Energy grids/ connections/Ports	Need to build critical mass within and across maritime economic activities for attracting investors, services, infrastructure, skilled workers and visibility	Need for health and safety standards	Need for timely reservation of suitable areas	Need for sound legal framework	Need to secure public acceptance of large operations
	Cruise Shipping			Ensuring ports and berthing capacity		Need for acceptable working conditions		Harmonisation of regulations	Need for public acceptance
	Maritime Monitoring & Surveillance		EU RTD framework provides a necessary basis					Harmonisation of standards	
Pre-development stage	Blue Biotechnology	Limited access to risk capital ('valley of death'	Need for technological breakthroughs		Need to build critical mass within and across maritime economic activities for attracting investors, services, infrastructure,	Need to attract high-skilled researchers, especially to SMEs in remote regions		New consumer products will require a formal approval framework	Need for public acceptance
	Ocean renewable energy	Limited access to capital for pilots ('valley of death')	Need for technological breakthroughs	(Smart) energy grids and infrastructure		Need to attract engineers		Need to address environmental impacts related to sea bed mining	Need for public acceptance

	Maritime Economic activity	Smart growth					Sustainable growth		Inclusive growth
		Access to finance	Maritime R&D	Infrastructure	Cluster support	Skills and labour market	Integrated maritime planning at sea-level basins	Standards & Regulation	Public awareness
	Marine mineral mining	Limited access to private capital for demonstration projects	Need for pilot projects and demonstration projects		skilled workers and visibility	Need to attract engineers	Need for consistent and balanced international legal framework (international as well as territorial waters)		Need for public acceptance

Annex 4. Indicative list of human activity and their possible pressures on the marine environment

Adapted from (EC, 2011a), by adding related Blue Growth functions, selected Blue Growth functions in bold script, and potential beneficial environmental effects.

Human activities and uses of marine waters (MSFD)		related Blue Growth economic activities		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 environmental effects		
Activity theme	**Activity/use**	**BG nr.**	**BG activity**	- 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
Extraction of living resources	Fisheries incl. recreational fishing (fish and shellfish)	2.1	Catching fish for human consumption	■			■	■		■	■						
		2.2	Catching fish for animal feeding	■			■	■		■	■						
		4.1	**Coastline tourism and yachting**	■			■	■		■	■						■
	Seaweed and other sea-based food harvesting	**2.3**	**Marine aquatic products**	■			■	■							■		
	Extraction of genetic resources/bioprospecting/maerl	**2.4**	**Blue Biotechnology**	■			■	■							■		
Food production	Aquaculture (fin-fish and shellfish)	**2.3**	**Marine aquatic products**		■	■						■		■			
Man-made structures (incl. construction phase)	Land claim, coastal defence, flood protection	**5.1**	**Coastal protection**				■	■	■							■	
	Port operations and other coastal infrastructure	**all**	**virtually all activities**		■		■	■	■								
	Placement and operation offshore structures (except energy production)	**1.1, 1.2, 1.3**	**Shipping and ferries**				■	■	■								
		2.3	**Marine aquatic products**				■	■	■								
		3.7	Desalination				■	■	■								
		4.2	**Yachting and marinas**				■	■	■								■
		5.1	**Coastal protection**				■	■	■								
		6.3	**Environmental monitoring**				■	■	■								
	Submarine cable and pipeline operations	**3.1**	**Offshore oil and gas**				■	■		■							
		3.2	**Offshore wind**				■	■		■					■	■	
		3.3	**Ocean renewable energy**				■	■		■					■	■	
		3.4	Carbon capture and storage				■	■		■					■		
Extraction of non-living resources	Marine mining (sand and gravel, rock)	3.5	Aggregates mining	■			■	■		■							
		3.6	**Marine mineral resources**	■			■	■		■							
	Dredging, incl. for navigation	**1.1, 1.2, 1.3**	**Shipping and ferries**	■			■	■	■	■		■					
	Water abstraction, desalination, salt production	3.7	Desalination						■								
Energy production	Marine-based renewable energy generation (wind, wave, tidal power)	**3.2**	**Offshore wind**				■	■	■	■	■				■	■	
		3.3	**Ocean renewable energy**				■	■	■	■	■				■	■	
	Marine hydrocarbon (oil and gas) extraction	**3.1**	**Offshore oil and gas**				■	■		■	■	■	■				
Transport	Shipping	1.1	Deepsea shipping		■			■		■	■	■					
		1.2	**Shortsea shipping**		■			■		■	■	■					
		1.3	Passenger ferry services		■			■		■	■	■					
Waste disposal	Solid waste disposal incl. dredge material	**-**	**-**				■	■									
	Storage of gasses	3.4	Carbon capture and storage										■		■		
Tourism and recreation	Tourism and recreation, incl. yachting/boating, bathing, diving	**4.1**	**Coastline tourism and yachting**		■			■		■	■	■					■
Research and survey	Marine research, survey and educational activities	**6.3**	**Maritime monitoring and surveillance**	■						■							■
Military	Defence operations	**-**	**-**							■							
	Dumping of munitions	**-**	**-**					■		■		■	■				
Land-based activities and industries	Industrial discharges and emissions	**-**	**-**						■		■	■	■				
	Agricultural and forestry run-off and emissions	**-**	**-**								■	■	■	■			
	Municipal/domestic waste discharges and emissions	**-**	**-**			■					■	■	■	■			

N.B. The authors of this report have attributed the potential negative impacts of 'Extraction of genetic resources/ bioprospecting/ maerl' on Physical loss and Physical damage primarily to the extraction of maerl. Blue Biotechnology as defined in this report does not include the extraction of maerl. Therefore in table 2.2 no impacts of Blue Biotechnology on Physical loss and damage are indicated.

Annex 5 List of maritime economic activities and definitions

Function	Sub-function	Short description
1. Maritime transport and shipbuilding	1.1 Deepsea shipping	International (freight) transport by sea with large vessels that often sail fixed routes (containers, major bulks) or tramp shipping.
	1.2 Shortsea 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 deepsea 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 Coastline 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.

Function	Sub-function	Short description
	4.3 Cruise tourism	Tourism based on people travelling by cruise ship, having the 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.

Source: First Interim Report

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