



Blue Growth

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

High-level policy paper (draft)

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Client: European Commission, DG MARE

Rotterdam/Brussels, 5th December 2011



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About the Consortium



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- 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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Table of contents

Preface	5
Introduction	7
1.1 Blue Growth – a new pathway in Europe’s future?	7
1.2 The importance of maritime economic activities to date	8
2 Blue Growth: the future potential	12
2.1 Paving the way for possible futures	12
2.2 Mature economic activities – the bedrock of Blue Growth	13
2.2.1 Short-sea shipping: reaching out to Europe’s neighbourhood	13
2.2.2 Offshore oil, gas and methane hydrates: deeper and farther away	14
2.2.3 Coastal tourism: polarisation between places	15
2.2.4 Coastal protection: steadily reinforcing Europe and the world	16
2.3 Growth-stage: creating new jobs right now	17
2.3.1 Offshore wind: anywhere the wind blows	18
2.3.2 Cruise shipping: cruising along at high speed	19
2.3.3 Maritime monitoring and surveillance	20
2.4 Pre-development stage: investing in the jobs for tomorrow	21
2.4.1 Blue biotechnology: a bright future for high-value applications	22
2.4.2 Blue energy: tidal current as the next wave	23
2.4.3 Marine mineral mining: the EU as a player on the ocean floor?	24
2.5 Conclusions	26
3 Exploration of policy initiatives	29
3.1 Europe 2020 as a strategic framework	29
3.2 Smart responses: making combinations and building critical mass	30
3.2.1 Access to finance: crucial in the (pre-)development stage	30
3.2.2 A fresh approach to maritime R&D	31
3.2.3 Smart Infrastructure – essential for upscaling	32
3.2.4 Cluster support – helping to build critical mass	32
3.2.5 High-skilled labour: engineers wanted	33
3.2.6 Standards	33
3.3 Promoting a sustainable approach to the maritime economy	33
3.3.1 Promote integrated maritime planning at the level of sea-basins	33
3.3.2 Promote experience with new maritime spatial concepts	34
3.3.3 Promoting local, integrated development strategies	34
3.3.4 Integrated environmental regulations	34
3.3.5 Promoting sustainable maritime business models	35
3.4 Inclusiveness: Blue Growth benefits for all	35
3.4.1 Promoting public awareness	35
3.4.2 Low-skilled labour: local initiatives	35
3.4.3 Integrated approach to health and safety standards	36
Annexes	37
Annex 1: Current economic size of maritime functions and economic activities	38
Annex 2: Blue Growth: General background scenarios	40

Annex 3A: Policy options and their applicability by maritime activity

46

Annex 3B: Policy options and their applicability by maritime activity – including characterisation⁴⁷

Work in progress

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");
- 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 subfunctions into 10 maritime economic activities.

The aim of the remainder of this policy paper is to capture the essence of the findings to date, allowing to share the results with a broader group of stakeholders and policy-makers. The policy paper also aims to provide a basis for the development of policy options related to Blue Growth. It aims to provide a basis for the Third Interim Report and the subsequent finalisation of the project.

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

Introduction

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

Europe's long-term challenges are manifold

Europe's long term challenges are prominent, even though economic and financial crises are imminent and recurrent. Nevertheless, on the medium and longer term key drivers are identified which will shape our future. These appear to be stable and persistent¹:

- *Globalisation*: 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;
- *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 decarbonisation of the economy is thereto pivotal;
- *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, while obesity increases in developed countries; the global health situation is improving but new risks are emerging;
- *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 43 % 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.

When these trends continue², 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 and investment, leisure and urbanisation. A continuous search will remain for new energy sources to reduce the dependency on third countries and world regions.

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 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.

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.

...There appears to be more consensus on Europe's long-term challenges than on the short-term one's

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

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

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. 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 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.

...We propose an approach starting from 6 maritime functions.

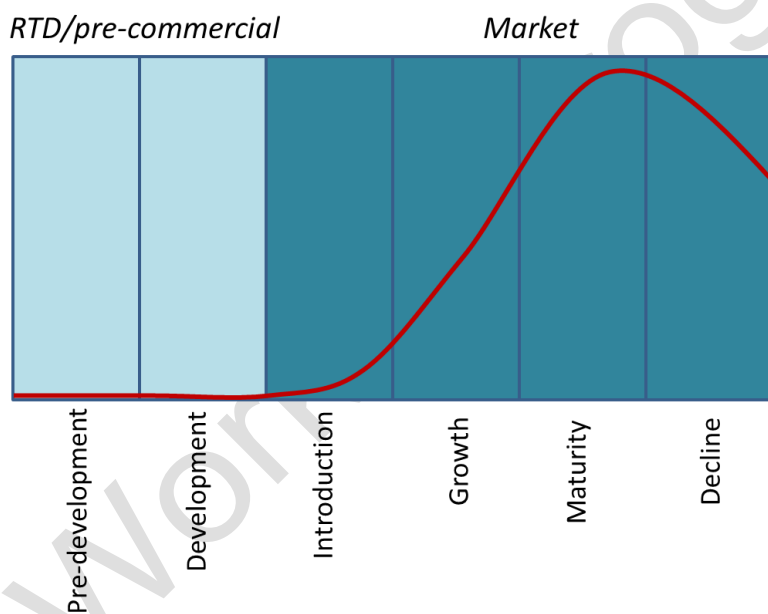
Within these 6 functions, we have studied 28 specific maritime economic activities across their entire value chains - all combining various maritime economic sectors.³

A dynamic perspective: product life cycle approach

A future-oriented study should not only focus on what is important today, but particularly on what can be expected tomorrow. We have thereto applied an extended life cycle approach to 28 specific maritime economic activities (see Annex 2) 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 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.

Figure 1 Product life cycle approach



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.

³ For example, shipbuilding has not been treated as an independent sector, but depending on the type of ships incorporated as part of the value chains in shortsea shipping, offshore, cruise shipping, dredging and surveillance.

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

The Blue Economy is important in Europe. The seven *biggest* maritime economic activities alone today provide over 5 million jobs.⁴ Coastline tourism and deep sea shipping are the maritime activities which currently provide most employment, followed by short sea shipping – all employing from almost 1 to over 2m jobs each. Oil and gas are above all important for their GVA contribution (€ 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 short sea shipping have seen strong GVA growth, but not accompanied by equal job growth.

...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 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, ocean renewable energy, maritime surveillance and deep-sea mining as most promising activities.

On the basis of the above rankings, we have retained the below 10 maritime economic activities as most essential for further analysis and potentially for policy-support within the context of Blue Growth⁵. They are balanced in terms of their current importance, their short-term growth rates, and their longer term potential. We will present the future outlook for each of these maritime economic activities in the subsequent chapter⁶.

Table 0 Shortlisted Blue Growth activities by development stage – based on size, recent growth and potential

Maritime economic activity	Size (bn €)	Recent growth	Future potential
Mature stage			
1. Shortsea shipping	63	6.1%	2
2. Oil, gas & methane	107-133	-4.8%	1
3. Coastal tourism & yachting	144	3-5%	4
4. Coastal protection	1.0-5.4	4.0%	6
Growth stage			
5. Offshore wind	1.3 ^{7b}	21.7%	6
6. Cruise	14.1	12.3%	5

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.

⁵ In the First Interim Report of this project, 28 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 Fishing and aquaculture 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 Source: Total wind power capacity in 2009 was 84 GW, of which 2.9 GW was installed offshore (EWEA, 2010). If we apply this ratio to the total employment figure of 203,100 FTE and a total turnover of € 38,222 million in 2009 (EurObserver, 2010), there were around 7,000 jobs in the offshore wind energy industry in 2009, creating a turnover of around € 1.3 billion. This is reasonably in accordance with the estimation of EWEA, which assessed the offshore wind energy employment in Europe at 2800 fte in 2007 (EWEA, 2009).

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.

Maritime economic activity	Size (bn €)	Recent growth	Future potential
7. Maritime surveillance (incl. Environmental monitoring)	1.8-2.3	+	5
(Pre-)development stage			
8. Blue Biotechnology (including algae growing)	0.6 - 3.3	4.6%	5
9. Ocean renewable energy sources	<0.25	+	5
10. Marine mineral resources	<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 index 1-6*

Work in progress

2 Blue Growth: the future potential

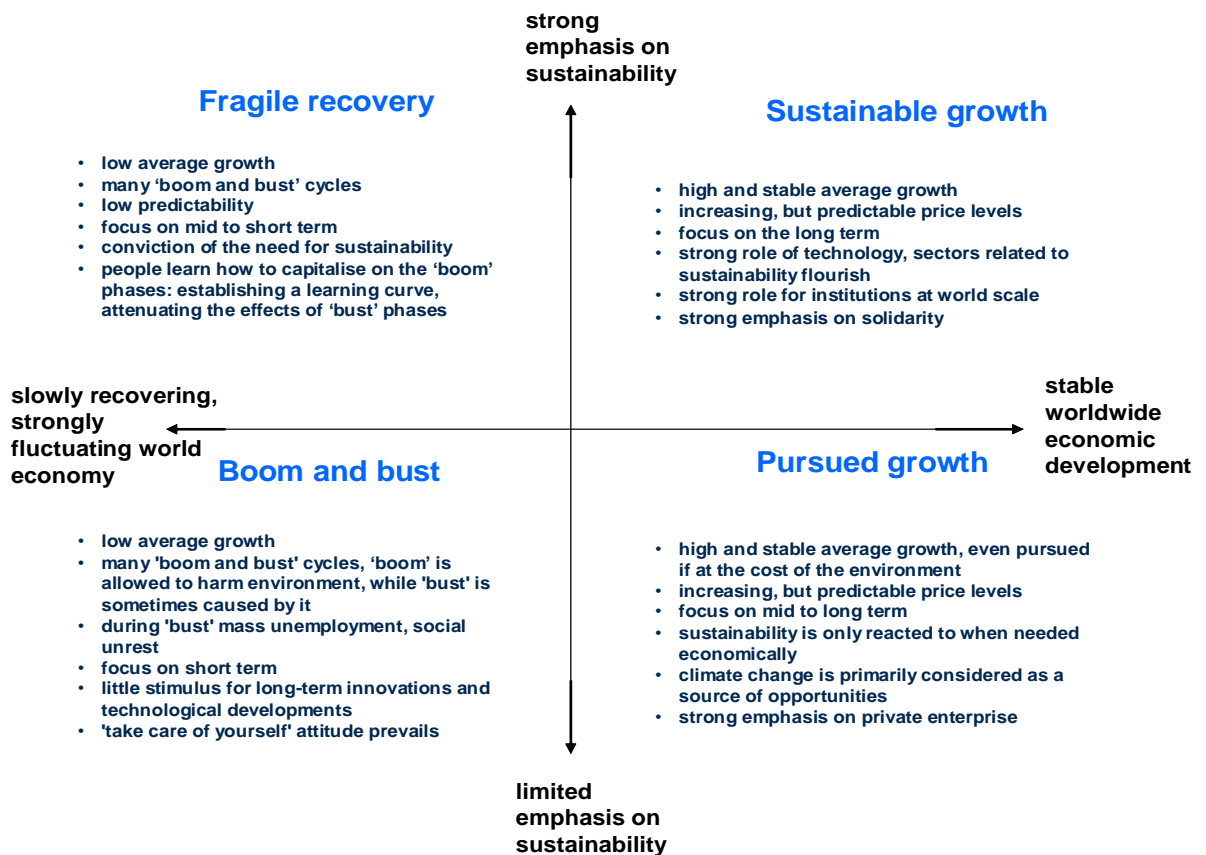
2.1 Paving the way for possible futures

The future is by definition uncertain, now more than ever. The future is thereto approached here from two different perspectives: a) Top-down – four possible background scenarios; and b) Bottom-up – Micro-futures specific to the economic activities analysed:

Top-down: Four possible background scenarios

Based on an in-depth analysis of the Blue Growth maritime economic activities, 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: four possible futures.

Figure 2: Four possible background scenarios for Blue Growth



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

These four background scenarios are external scenarios, which mean that they are outside the direct control of policies – and represent possible future. These background scenarios are further presented in Annex 2. 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. In this chapter, we will capture these variables for each maritime activity by putting specific attention to the aspect of uncertainty.

Bottom-up: Micro-futures as desirable, ambitious but realistic and specific futures

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 emphasis is on the next one or two decades, until 2020/2030, with an occasional outlook on the further future.

The following sections describe the 'micro-future' of 10 promising maritime economic activities, ordered by their development phase. In each of the descriptions we will highlight:

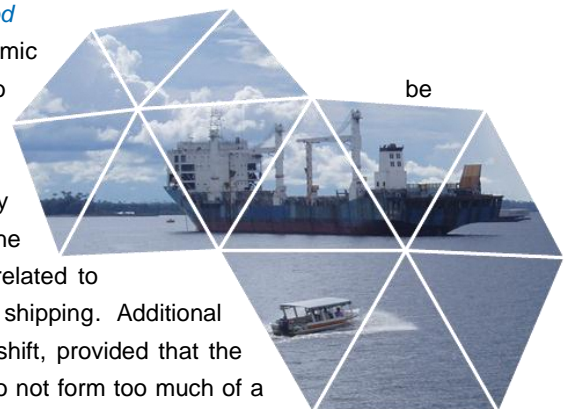
- Potential development: assessment of how the economic activity could develop in terms of focus, size, and impact. Included are the external drivers and the response capacity of the actors;
- Uncertainties: if the potential development were to come true, what would be required from the relevant drivers 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.

2.2 Mature economic activities – the bedrock of Blue Growth

These activities currently provide high amounts of value added and employ substantial numbers of employees. 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. Equally so, on the ability to export and to adopt increasingly sustainable practices.

2.2.1 Short-sea shipping: reaching out to Europe's neighbourhood

The transported volumes grow along with economic development, but at a higher rate - as trade growth tends to factor 1.5 higher than GDP growth. Annual growth is expected in the range of 3-4 percent for the coming decade. Employment is considered to remain relatively stable due to efficiency increases taking place along the value chain. Growth expected in the supply industry is related to technologies addressing the environmental impacts of shipping. 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 SO₂ 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



...'Micro-futures' are desirable, ambitious but realistic – and specific to maritime economic activities

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

power systems. European manufacturers are leading in the development of new propulsion methods. EU supported R&D programs contribute to maintaining this lead position.

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

The European Single Market will contribute to further exports and demand for short-sea shipping. Trade with Neighbourhood countries will increase – as growth in Turkey, Russia, Ukraine and North Africa will spur the demand for short-sea shipping. Congestion of road transport will lead to reduced competitiveness of this alternative, while expectations for rail and inland waterways remain modest. Price competition drives increasing ship size, and there will be diversity in the actor's potential (including terminal operators) to reach economies of scale – big players will be able to invest and adjust faster than small operators.

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

The major impacts of short sea shipping on the environment currently are chemical pollution due to oil spills, discharge of oil and ballast waters 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. 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.

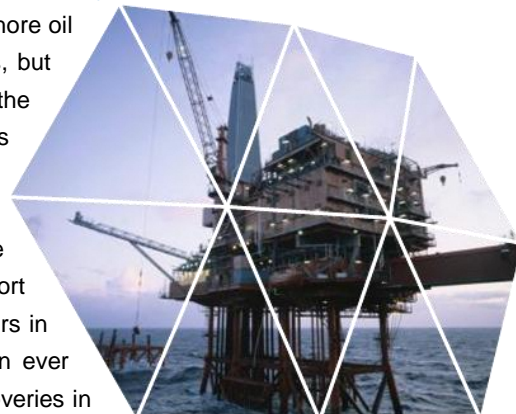
Assumptions about framework conditions

- Lack of capacity in and around secondary ports and their hinterland connections will be addressed;
- Strong enhancements in external infrastructure (ports and hinterland);
- Environmental regulation will be increased gradually, allowing the sector to invest in the necessary adaptation costs.

2.2.2 Offshore oil, gas and methane hydrates: deeper and farther away

...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 global demand for fossil fuels is still growing. Offshore oil extraction is a crucial activity on the European waters, but 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). 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.

This is a large-scale activity with multinational players having a global reach. 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 only 50-60% of fields are being exploited.

Uncertainties stem from financing – as the horizon of financial markets is shorter than payback periods. Environmental impacts can be adverse, as 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;
- Specialised vessels have sufficient access and berthing space in nearby ports;
- No radical changes in the public opinion with regard to this activity (oil spills, climate change impact, etc.).

2.2.3 Coastal tourism: polarisation between places

With more than 2 million European citizens being employed, this 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.



Increased pressure for CO₂ 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.

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.

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

...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 relatively low inflow of young people into these sports. The role of marinas as a potential leverage for coastal economic development has been increasingly debated. Nonetheless, 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.

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). 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.

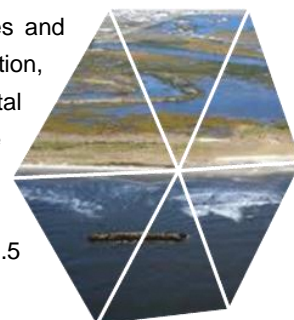
Important for creating synergies will be the ability of key actors to develop an overall vision on value propositions – currently hampered by the large fragmentation of the sector. This fragmentation across sea-basins and proliferation of micro companies also limits innovation (Baltics and North Sea being well-placed). Adjustment and mitigation capacity varies across sea-basins. 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 protection 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 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

2.2.4 Coastal protection: steadily reinforcing Europe and the world

Climate change, resulting in sea level rise, 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. Turnover is expected to increase from € 0.88 billion per year in 2010 to some € 1.5 billion in 2020, followed by further growth afterwards.



Coastal protection is a mature sector, but gradual innovations such as the sand motor, and 'Building with Nature' remain vital. They will increase enthusiasm and support for coastal protection. 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, EU marine contractors will therefore continue to export their services and capture a substantial part of the growth in the rest of the world.

...Important uncertainty is the dependence on public finance

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

Coastal protection activities provide important synergies with ocean renewable energies, e.g. wave energy converters may help to attenuate wave attack and generate electricity. Performing coastal protection works require the involvement of a dredging fleet hosted by nearby ports, creating additional berth demand and associated services. 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;
- Dredging vessels have sufficient access to nearby ports;
- The required sediments remain available;
- Technology keeps in pace with requirements caused by sea level rise;
- Public awareness of the risks of sea-level rise.

2.3 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.

2.3.1 Offshore wind: anywhere the wind blows

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

Off-shore 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. The future of the offshore wind sector is bright. New developments in floating platform construction and improving robustness have lifted previous constraints. Scale effects, combined with raising oil prices and improved public appreciation have provided a more sound economic basis. As a result, the capacity installed is expected to increase from 3.9 MW in 2009, to 40 MW in 2020, and to 150 MW in 2030. The employment will triple from 7,000 fte in 2009 to about 20,000 in 2020. The turnover of the economic activity is expected to triple from € 1.3 billion in 2009 to 4.5 billion in 2020⁹.

Fossil fuel prices will have to show a modest to strong, regular increase. Price level, but especially price volatility has encouraged a strong political will to become less dependent from oil imports. EU environmental regulations are strict and enforced, and on balance they favour offshore wind. By heavy taxation of CO₂-emissions, wind energy has become more competitive; coal is no longer used in newly built power stations, 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 will also restrict large-scale installation of wind energy on land, thus posing restrictions on the construction and operation of these wind farms.

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.

...The EU is leading in technological 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. The key challenge for European enterprises is to use their home market to foster R&D, thus keeping up with the SE Asian competition and continuing to be interesting Joint Venture partners.

Uncertainties come from financing – as the horizon of financial markets is shorter than payback periods (and through the economic and financial crisis even shorter). 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 is in principle assumed to be small. The sector has learned to perform its construction, operation and maintenance in a sustainable way, avoiding intolerable disturbances 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.

⁹ Estimation based on ratio onshore/offshore in energy production applied to total estimated investments of € 27 billion. Source EWEA (2010). "Other estimates suggest that the sector size in the EU is larger, possibly ranging from € 5-10 bn. However, this could not be confirmed by written sources. In addition, this figure is very much dependant on how one defines the value chain, and what counts as direct, indirect and derived employment.

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:

- Infrastructure (physical: grid connection, port facilities) is in place;
- A sound legal framework is in place, providing transparent and simplified permitting procedures and development of educational curricula;
- Environmentally friendly technologies will be available and in use. The balance between positive and negative impacts during the complete device life cycle is favourable;
- Financing will no longer be a problem; 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.

2.3.2 Cruise shipping: cruising along at high speed

This tourism segment already developed since the 1970s, and has become accessible for larger groups since lower cost segments are also accommodated. In North America and the Caribbean, penetration rates are much higher than in Europe, indicating growth and employment potential here.



The worldwide cruise industry forecasts a strong growth trend in demand; the total number of passengers carried worldwide is estimated to reach 29.7 million in 2020 (+61.4% from 2010). Total employment is likely to grow as well, although not at the same rate as passengers carried due to economies of scale. By 2020, employment is expected to reach a level of 400,000, compared to 300,000 in 2010 and 200,000 in 2005.¹⁰

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.

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. Cruise companies 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.

¹⁰ Own estimates, based on data provided by the European Cruise Council (2011).

...By 2020, cruise-related employment is expected to reach 400,000 – compared to 200,000 in 2005.

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

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 CO₂ emissions. In Arctic regions, in particular, cruise tourism not only represents a main source of income but also of pollution in areas that are otherwise pristine. The biggest single threat caused by ship-based activities in these regions comes from the risk of a major oil spill. Other environmental impacts include degradation of regularly-visited sites, air pollution, discharges of sewage and waste water and introduction of non-indigenous species.

...Synergies emerge through shared use of port facilities.

The cruise sector has important synergies with other shipping functions as it 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;
- Harmonisation of (environmental) regulations geographically (sea basins) as well as across tourism sectors, creating a level playing field for cruise to compete against other segments of the tourism industry;
- Clear implementation regimes for new legislation, allowing the shipbuilding industry to adapt timely and gain competitive power against Asian yards and suppliers.

2.3.3 Maritime monitoring and surveillance

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. 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.). 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).



...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. Further environmental awareness policies will need to be increasingly monitored and enforced, while modern public procurement policies are expected to further drive demand. Environmental monitoring in particular 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.

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 amongst public actors. 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.

An important uncertainty is the dependence of maritime monitoring and surveillance on public spending, mostly by Member States. Further integration and data-sharing data across sectors and across Member States (eventually leading to a European system of data sharing), may have a positive impact in this respect as it is expected to lead to higher efficiency and improved cost-effectiveness of maritime surveillance. 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.

This activity provides potential for strong and positive environmental impacts, as it facilitates sustainable practices within other maritime functions. It also leads to spin-off 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 project)
- 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.

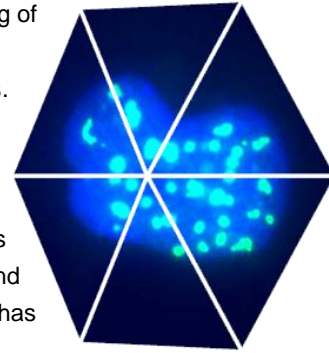
2.4 Pre-development stage: investing in the jobs for tomorrow

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?

2.4.1 Blue biotechnology: a bright future for high-value applications

'Blue biotechnology'¹¹ comprises all activities associated to the farming of aquatic organisms and to the development of new usages of marine resources, notably the use of wild and farmed aquatic living resources.

At this moment in time, blue biotechnology still has limited economic performance, as it is R&D centred. However, an early estimate of the global market for marine biotechnology products and processes is \$2.4 billion (1/3 in the USA and 2/3 elsewhere) with an upward trend (Lloyd-Evans L 2005a). While still small in size the economic activity has already shown recent growth and its future is assessed positive.



By 2030, blue biotechnology including the algae sector will have seen significantly grown, 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, it will become a provider for mass product markets, with two more major applications: green chemistry and energy (2025-2030).

Groundbreaking photo-bioreactor designs and extraction processes will allow micro-algae production to scale up within viable economic conditions. Popular food products are omega-3 and omega-6 fatty acids. Macro-algae farms are developed along the coast, sharing space with other sectors on multi-purpose platforms combining several activities such as integrated multi-trophic aquaculture¹², and other activities (wind, coastal protection). Furthermore, high value marine products are expected to have a wide range of applications that reach the market: new medical molecules, bio-plastics, enzymes or biocides are the main ones.

Uncertainties come from the access to finance, not only for Research but mostly for Development. Besides, the technological and intellectual race with key competitors, such as the USA and Japan today, and China and India tomorrow will impose further uncertainties. Large-scale pollution, climatic events and acidification are threats to algae aquaculture, but the activity itself could also help to counter such threats – e.g. through carbon storage. 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.

Blue biotechnology provides 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. 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).

¹¹ Blue biotechnology here covers the economic activities "Algae Aquaculture" as well as "High value use of marine resources".

¹² Multi-trophic aquaculture is based on interlinked productions of fish, seaweed and shellfish.

...Blue biotechnology is expected to grow through a three-stage progression.

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

Unlocking the metal fixing 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).

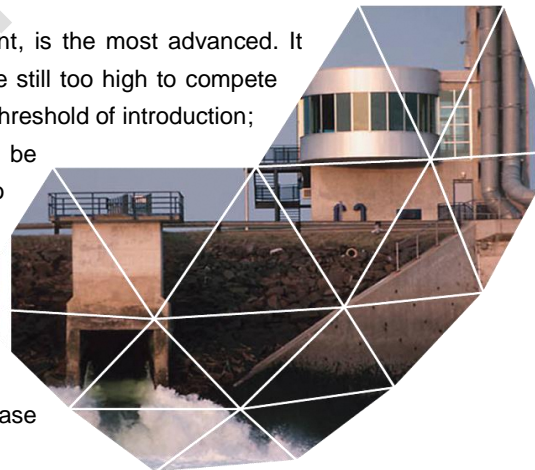
Assumptions about framework conditions being fulfilled:

- 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).

2.4.2 Blue energy: tidal current as the next wave

'Blue energy' or Ocean renewable energy consists of a package of four different offshore energy segments¹³:

- 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.



¹³ the observations that follow are based on literature and interviews, as reported in the Economic activity Profile document

...Immediately following tidal current will be tidal wave...

Tidal current energy is the next most advanced segment. The yearly installed capacity for tidal current energy will 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 future¹⁴. Employment will increase accordingly, from 1000 fte in 2010 to potentially 20,000 fte in 2035. The turnover has increased from € 4 million in 2005 to € 37 million in 2010, and will grow further to € 360 million in 2015¹⁵. Immediately following is wave energy. In the longer run, all options should be kept open, but OTEC and forward osmosis still need time and technological development to prove them. 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.

...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 demonstration.

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

- combining OTEC with Sea Water Air Conditioning (SWAC);
- application of OTEC-technology in the production of LNG;
- combining OTEC with production of drinking water and extraction of minerals;
- combining OTEC on floating installations with reducing the problem of the plastic pulp in the oceans.

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;
- Infrastructure (physical: grid connections, 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.

2.4.3 Marine mineral mining: the EU as a player on the ocean floor?

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.

...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

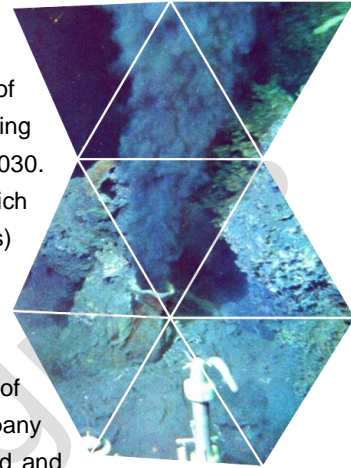
¹⁴ Source: Renewable UK (2011)

¹⁵ Source: Douglas-Westwood (2010)

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 sulphides: deposits which are the result of hot fluids being discharged through fractures (vents) between tectonic plates¹⁶. 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.¹⁷. The mining company has thereto designed and built a dedicated ship from the German Harren & Partners Company. 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.¹⁸ 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.¹⁹ 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.

¹⁶ Halfar, J. and Fujita, Rodney M. (2002) "Precautionary management of deep-sea mining", *Marine Policy*, v.26, 2, p.103-106

¹⁷ 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.

¹⁸ Bertram et al. (2011) "Metalliferous Sediments in the Atlantis II Deep – Assessing the Geological and Economic Resource Potential and Legal Constraints. Kiel Working Paper No. 1688, March.

¹⁹ World Ocean Outlook, Chapter 7 "Marine minerals and energy", p. 151.

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.

2.5 Conclusions

Global Blue Growth economic and jobs potential is strong

There is a true strong Blue Growth potential. The economic activities presented provide clear economic and employment prospects. However, there are marked differences as to whether these are likely to emerge in the short-term or in the longer term.

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).

Economic activities which are in a *growing phase* will need to provide the jobs in the next few years. EU players are leading in the business through several large multinational companies (e.g. offshore wind) or by a strong command over the supply chain (e.g. cruise tourism). Not all economic activities in this phase are covered equally well by Europe. The potential for desalination as an economic activity, for instance, is limited for European actors who face major competition from Korean, Japanese and Chinese players.

Mature economic activities have had time to establish a solid industry structure. Mature economic activities are dominated by large-scale operators (e.g. Oil & gas, Coastal protection) or consist of a mix of fragmented operators with some large players supplemented by a large number of small operators (Short-sea shipping, Coastal tourism).

Blue Growth trajectories will depend on the global context

The potential of the reviewed Blue growth 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.

Yet many of the uncertainties relate to the outside (exogenous) variables, as they have been analysed through the background scenarios. Blue Growth prospects appear to profit most from a 'sustainable world' scenario – as stable economic growth combined with a growing environmental

awareness provide an excellent context for the majority of economic activities analysed, particularly for blue biotechnology, offshore wind, and blue energy. A 'pursued growth' scenario will also provide opportunities, especially for the mature and growing functions such as shipping, tourism, cruising, oil & gas exploitation and marine mineral mining. Prospects are however less bright in the 'Fragile recovery and especially the 'Boom and bust' scenarios. Within these scenarios, Blue Growth is expected not to necessarily develop differently, but above all more slowly – due to a short-term horizon of all actors, more risk-averseness and restricted public and private investment budgets. It is especially in these scenarios that additional policy support is likely to be welcomed needed – for Blue Growth to take off.

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 now 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.

EU companies are leading in marine energy and mineral innovation

Within the above context, the EU is clearly in a leading position when it comes to innovation in all energy-related economic activities, both renewable and non-renewable: it has generated around half of the reviewed patents in Oil & gas, offshore wind, and Marine mineral resources, while 1/4 of the reviewed patents in Ocean renewable energy sources. A strong performance can also be recorded in the algae field (algae aquaculture).

Strong marine scientific and academic competencies, but major knowledge transfer gaps

In general, the EU has strong marine scientific and academic competencies, as demonstrated by high numbers of publications and citations. It has a share of 4 out of 10 authors or higher in publication related to most maritime economic activities, from energy and raw materials to the domain of living resources.

However, the discrepancies between patent and publication patterns point to an emerging conclusion which is supported by experts consulted: the EU has excellent academic and scientific capacities in the different maritime fields, but considerably less commercial implementation power to embark on these. Especially activities in the (pre-) developmental stage tend to be carried out by small companies, spin-offs or suppliers which can be strapped for cash, wary to share knowledge, and with limited control over 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 strategic response capacity, and its ability to bring promising and sustainable maritime innovations fast and decisively to the global market place. This requires clearly a favourable policy context.

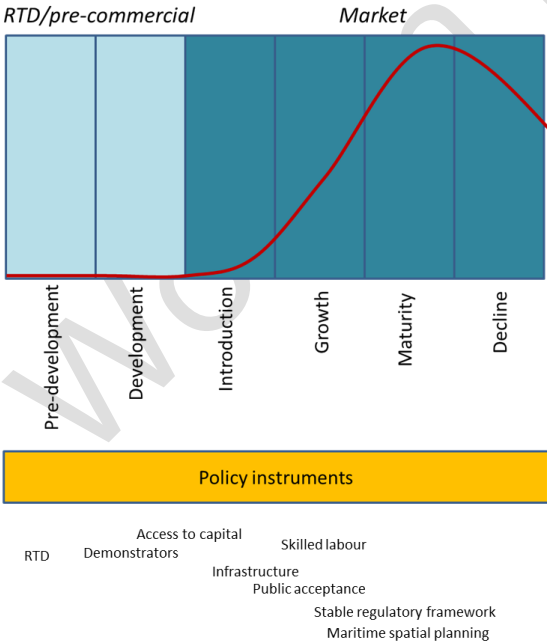
3 Exploration of policy initiatives

3.1 Europe 2020 as a strategic framework

Note: This Chapter is in an early stage of development. The focus of the study-team will be to expand it in the coming weeks. The proposed strategy is to discuss the main strategy with the project Steering Committee on 12th December 2011; to subsequently link policy ideas with existing policy initiatives, and to present a further developed version to the One day stakeholder meeting on 26th January 2012, after which the more robust policy ideas can be further elaborated as part of the Third Interim and Final Reports.

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 options 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 3: Policy 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.

As an elaboration of Europe 2020, a Blue Growth strategic framework is proposed which promotes future maritime economic and employment opportunities through the lens of smart, sustainable and inclusive policy actions.

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 carefully predefined 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.

A sustainable policy response favours those maritime economic activities which contribute to the overall quality of the oceans, seas and energies. 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.

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.

3.2 Smart responses: making combinations and building critical mass

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

Policy rationale

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.

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.

Policy options

1. Promoting the use of risk capital, e.g. by making private investments in Blue Growth fiscally attractive;
2. Promoting the interest of venture capitalists, as part of cluster strategies;
3. Promote access to existing funding, e.g. through the new Structural Funds programmes;
4. Promoting the use of public loan schemes, e.g. by developing maritime investment funds or by linking them to existing initiatives (e.g. regional investment banks);
5. Explore the role of the EIB – in particular the RTD related facilities

3.2.2 A fresh approach to maritime R&D

Policy rationale

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 for 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.).

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.

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.

Policy options

1. Increase the visibility of research to mobilise the private sector,
2. Promote more informal exchange between science and the business world. A dedicated EIT KIC (Knowledge and Innovation Community) could help in this respect;
3. Specific maritime R&D programmes, taking full account of the characteristics and limitations of actors. The development of the “Oceans of tomorrow” as a strategic plan with Member States and JPI Oceans is welcomed. It is crucial to provide the opportunities for synergies in public research funding programmes (FP7) to materialize. This requires a degree of openness in the programming phase, allowing for bottom-up processes, e.g. through brainstorming on potentials for synergies prior to the selection of themes and projects;
4. Encouragement of Member States to use Structural Funds – also for R&D purposes;
5. Research and development can be stimulated through tax incentives to attract private resources also from political foundations and think tanks, e.g. US Foundation scheme;
6. Increased attention to pre-market demonstrators directed at convincing potential investors of the validity of new technologies.

3.2.3 Smart Infrastructure – essential for upscaling

Policy rationale

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.

Policy options

1. Support investment schemes for port development, not only in the EU, but also in Neighbourhood countries such as Turkey, Russia, the Ukraine and North Africa – as it is in these regions that major investments are yet to be made;
2. Invest in high-voltage power grid infrastructure, including cross-border connections, e.g. through the Cohesion Fund, TEN-T and EIB loans.

3.2.4 Cluster support – helping to build critical mass

Policy rationale

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.

Policy options

1. Positive growth potentials could be achieved by clusters gaining greater visibility amongst politicians and the general public, in particular for emerging industries (and less for established ones, such as Oil & Gas). Identifying cross-national and cross-sectorial potential of clusters along value chains and aligned to EU priorities within the Europe 2020 strategy is seen as important element of future policy orientation;

2. Supporting local and regional authorities to develop their own maritime cluster policies, and build exchange of experience across European clusters;
3. Explore the links with the European Network of Maritime Clusters.

3.2.5 *High-skilled labour: engineers wanted*

Policy rationale

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 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.

Policy options

1. Increase awareness of the opportunities created by Blue Growth on the labour market;
2. Specific attention to maritime skills development and training, e.g. within the context of ESF programmes;
3. Specific attention to mobility of highly skilled maritime workers, e.g. through Marie-Curie and similar programmes.

3.2.6 *Standards*

Policy rationale

New regulations are affecting in particular the mature functions including short-sea 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.

Policy options

1. Greater harmonisation of standards, e.g. in marine data mining, will help EU Member States to foster blue growth potentials. This however, can on the one hand drive the sector; on the other hand it can also hamper market growth, since buyers are waiting for entire clarity on future standards.

3.3 Promoting a sustainable approach to the maritime economy

3.3.1 *Promote integrated maritime planning at the level of sea-basins*

Policy rationale

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.

Policy options

1. Intensifying of integrated maritime planning at the level of sea-basins²⁰

3.3.2 Promote experience with new maritime spatial concepts

Policy rationale

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?²¹ 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.

Policy options

1. Promote the exchange on new maritime spatial concepts, including leading experts, activity-based stakeholders and citizens
2. Promote pilots and demonstrators.

3.3.3 Promoting local, integrated development strategies

Policy rationale

Various Blue Growth activities are hampered by fragmented, bureaucratic and/or non-cooperative local public actors. Indeed, several of the (mature) economic activities rely strongly on local planning and good local governance. Coastal protection measures as well as port extensions require local permissions at the least, and are often delayed due to stringent local planning regulations and procedures. Sustainable coastline tourism requires a cooperative and transparent local government, and so does the installation of desalination plants or ocean renewable energy facilities.

Policy options

1. Optimise opportunities for promoting local development strategies under the new Structural Funds as well as the EMFF²².

3.3.4 Integrated environmental regulations

Policy rationale

Evidently, environmental regulations and their correct implementation (e.g. the ICZM and Flood directive) 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 short-sea shipping and oil & gas exploration, but provide strong opportunities for environmental monitoring and coastal protection.

²⁰ See the ongoing consultation in this domain: http://ec.europa.eu/fisheries/partners/consultations/msp/index_en.htm; <http://climate-l.iisd.org/news/european-commission-launches-consultation-on-maritime-spatial-planning/>; <http://ec.europa.eu/environment/consultations/iczm.htm>

²¹ See for example DNV (2011) "Technology Outlook 2020", p. 84 and further

²² The EMFF adopted by the European Commission:

<http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/1495&format=HTML&aged=0&language=EN&guiLanguage=en>

Policy options

1. Build on the Maritime Spatial Framework Directive.

3.3.5 Promoting sustainable maritime business models

Policy rationale

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 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.

Policy options

1. Exchange with existing maritime platforms on how to develop effective initiatives.

3.4 Inclusiveness: Blue Growth benefits for all

3.4.1 Promoting public awareness

Policy rationale

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.

Policy options

1. Exchange of good practices on involvement of local communities in maritime development;
2. Support to public-private dialogues on Blue Growth perspectives at local levels.

3.4.2 Low-skilled labour: local initiatives

Policy rationale

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.

Policy options

1. Exchange with existing maritime platforms and Member States on how to develop effective initiatives.

3.4.3 Integrated approach to health and safety standards

Policy rationale

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.

Policy options

1. Comparison of health and safety standards within the EU, including their rationale, effectiveness;
2. Exchange with existing maritime platforms and Member States on how to come to an integrated approach to health and safety standards;
3. Exchange of good practices and effective initiatives.

Work in progress

Annexes

The following annexes are included

- Annex 1: Literature
- Annex 2: Current size of maritime functions and economic activities
- Annex 3: Policy grid (measures relevant for selected maritime economic activities)

Work in progress

Annex 1: Current economic size of maritime functions and economic activities

	Current size		Sources	Comments
Function / activities	Value added (€ bn)	Employment (*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 Growing aquatic products	3.3	64	Eurostat database (2011), Framian 2007	Production data 2007, employment data 2005
2.4 High value use of marine resources (health, cosmetics, well-being, etc.)	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 (see annex 3 on this specific sub-function)	
3. Energy and raw materials				
3.1 Oil, gas and methane hydrates	107-133	25-50	Eurostat database (2011) + own estimate for offshore share	Data appear unreliable; probably much larger
3.2 Offshore wind energy	1.3	7	EWEA (2010), Euroobserver (2010)	Share based on MW installed offshore compared to onshore
3.3 Ocean renewable energy resources (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 (see annex 3)	

	Current size		Sources	Comments
Function / activities	Value added (€ bn)	Employment (*1000)		
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 mineral resources	<0.25	<0.5	No data, own estimate based on literature (see annex 3)	
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.
4.3 Cruise including port cities	14.1	143	European Cruise Council (2010)	Based on expenditure data for 2009
4.4 Working	4,108	75.1 mln	Eurostat database (2011)	GVA in coastal regions (NUTS 3), 2008 data
4.5 Living	n/a	177 mln	Eurostat database (2011)	Population in coastal regions (NUTS-3), 2008 data
5. Coastal protection				
5.1 Protection against flooding and erosion	1.0-5.4	10-50	Eurostat (2004), IPCC (2009), EC (2004), Hinkel (2010) (GVA), own estimate (employment)	2008 data
5.2 Preventing salt water intrusion	<0.25	<0.5	no data, own estimate based on literature (see annex 3)	Sub-function is strongly linked to 5.1
5.3 Protection of habitats	<0.25	<0.5	no data, own estimate based on literature (see annex 3)	Sub-function is strongly linked to 5.1
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)	Figures include only direct costs related to transport related activities. Based on fleet size & investment & operating costs
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: Blue Growth: General background scenarios

1. Intended use of the General Scenarios

The general scenarios that we present here are foresights, not forecasts:

“Nobody can predict, therefore one should not try. The only relevant discussions about the future are those where we succeed in shifting from the question whether something will happen to the question: What will we do if it happens?”

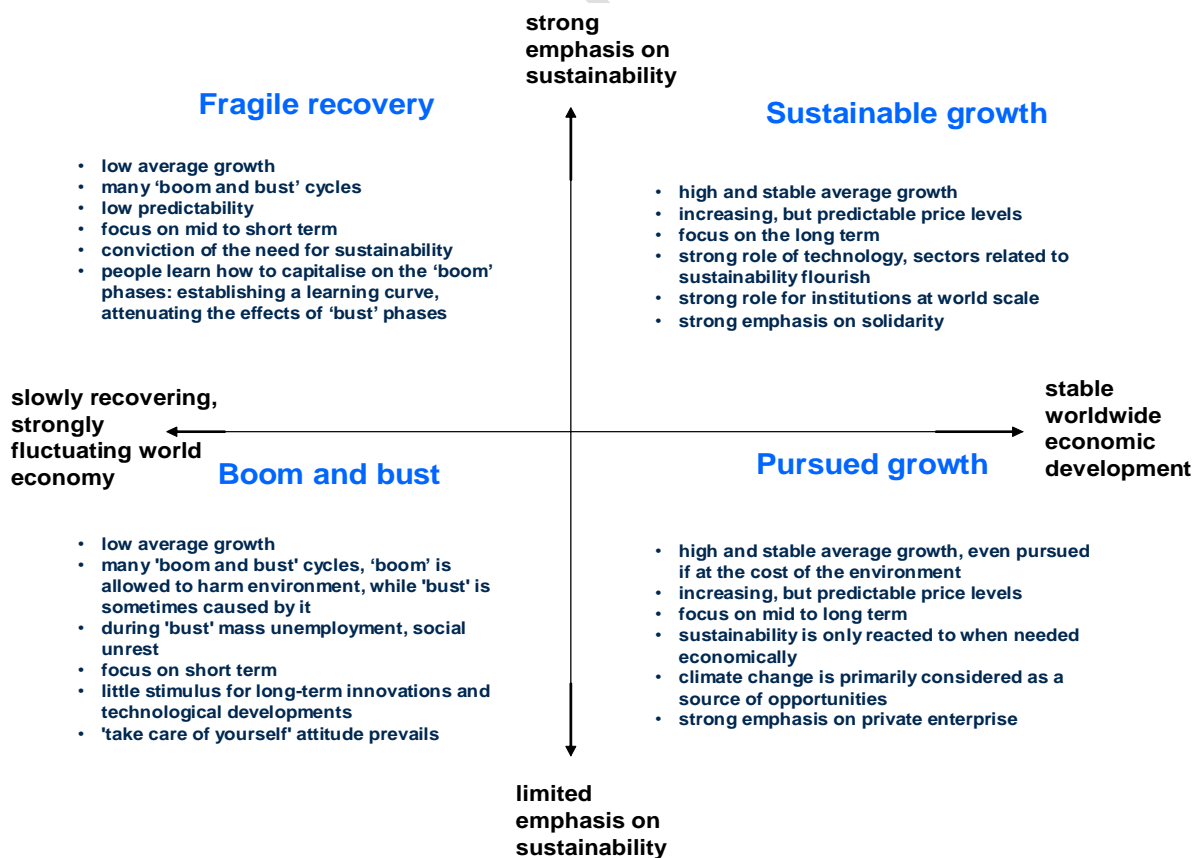
Arie de Geus, Former Head of Planning, Shell

The general scenarios serve a twofold reason:

- They will help to improve the 13 microfutures scenarios by discussing their potential in the four different futures.
- Findings will be used to improve the robustness of policy options, by examining and discussing their effects in the four general scenarios.

2. The scenario matrix

Based on an analysis of the Blue Growth subfunctions²³, 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.



²³ Cf. Blue Growth Second Interim Report, chapter 3.1.

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

3. *Short descriptions*

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 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 led 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.

Use of the seas and oceans

A.o.: Flourishing deep and short sea shipping, enhanced port facilities and capacities, strongly increasing tourism sector (coastal and cruise), high investment levels in technologies for exploitation of marine biodiversity, increased role of the seas and oceans in human food production, gradual shift towards sea-based renewables, intensified monitoring activities, intensified international coordination of the use of marine space.

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 economical 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.

Use of the seas and oceans

A.o.: Flourishing deep and short sea shipping, enhanced port facilities and capacities, strongly increasing coastal tourism in northern Europe due to climate change effects, strong cruise shipping sector, high investment levels in technology, increased role of the seas and oceans in traditional human food production, persisting extraction of oil, gas and minerals from deep seas, also in the Arctic, intensified monitoring activities.

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.

Use of the seas and oceans

A.o.: Fluctuating transport volumes result in obsolete fleets and port facilities, ad-hoc measures prevail, stable coastal tourism in northern Europe due to climate change effects, declined cruise shipping sector, almost no investments in developing technologies, increased role of the seas and oceans in traditional but non-sustainable human food production, persisting extraction of oil, gas and minerals from deep seas, also in the Arctic, extended monitoring activities.

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.

Use of the seas and oceans

A.o.: Fluctuating transport volumes result in obsolete fleets and port facilities, ad-hoc measures prevail, declined 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, extraction of minerals from deep seas is slow to develop.

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.

<p>Environment and climate</p>	<p>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.</p>	<p>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.</p>	<p>Environment and climate change are of secondary importance, receiving attention only for the most acute problems during 'boom' phases.</p>	<p>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.</p>
<p>International relations</p>	<p>Strongly developed and aimed at long-term coordination and cooperation. World governance is the lubricant of development.</p>	<p>Strongly developed and aimed at long-term coordination and cooperation, but only if related to direct national interests. More bilateral agreements than in A.</p>	<p>Of opportunistic nature, aimed at serving short-term national interests, thereby adding to the overall volatile character of the economy.</p>	<p>Opportunistic and guided by available funding, but rooted in a shared vision on future desired state.</p>
<p>Role of public authorities</p>	<p>Play a strong role in the fields of planning, national and international coordination and in presiding over conflicts. Strong position of global organisations.</p>	<p>Play a strong role in the fields of planning, national and international coordination and in presiding over conflicts. Strong position of national authorities.</p>	<p>Weak and unreliable, due to limited resources and capacity to anticipate. Unrest during 'bust' phases causes frequent government changes.</p>	<p>Considered instrumental in preventing the worst excesses of boom and bust, trying to keep course in difficult circumstances. Hampered by limited resources.</p>

Annex 3A: Policy options and their applicability by maritime activity

Maritime Economic activity		Smart growth				Sustainable growth		Inclusive growth	
		Access to finance	Maritime R&D	Infrastructure	Cluster support	Skills	Integrated maritime planning at sea-level basins	Standards & Regulation	Public awareness
Mature economic activities	Short-sea shipping			++				++	
	Offshore oil, gas & methane hydrates		+	+				++	++
	Coastal Tourism	+		+		+	+		
	Coastal Protection		+	+			+	++	+
Growth-stage	Offshore Wind			++		+	++		++
	Cruise Shipping			++			++	+	+
	Maritime Monitoring & Surveillance		+	+				++	
Pre-development stage	Blue Biotechnology	++	++		+	++			+
	Blue energy	++	++	++	+				+
	Marine mineral mining	++	++		+				++

Annex 3B: Policy options and their applicability by maritime activity – including characterisation

Maritime Economic activity		Smart growth					Sustainable growth		Inclusive growth
		Access to finance	Maritime R&D	Infrastructure	Cluster support	Skills	Integrated maritime planning at sea-level basins	Standards & Regulation	Public awareness
Mature economic activities	Short-sea shipping			External infra (outside EU)				Environmental regulations	
	Offshore oil, gas & methane hydrates		Techniques for depletion	Access to ports				Renewable energy & health policies	Public opinion (e.g. oil spills)
	Coastal Tourism	Access to loans		Access to sust. transport		Limited attractiveness	Long-term visions		
	Coastal Protection		Technology keeps up pace	Access to ports				Integrated coastal protection frame	Public awareness of sea-level rise
Growth-stage	Offshore Wind			Energy grids/connections/Ports		Technical staff for servicing	Timely reservation of suitable areas	Sound legal framework	Public acceptance of large operations
	Cruise Shipping			Ports and birthing capacity				Harmonisation of regulations	Public acceptance
	Maritime Monitoring & Surveillance		EU RTD framework					Harmonisation of standards	
Pre-development stage	Blue Biotechnology	Access to risk capital	Technological breakthroughs		Needed to attract investors	High-skilled researchers			Public acceptance
	Blue energy	Access to capital for pilots	Technological breakthroughs	Energy grids & connections	Other energy functions				Public acceptance
	Marine mineral mining	Access to private capital			Integrator function				Public acceptance

Work in progress

