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DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A
ECONOMIC AND SCIENTIFIC POLICY

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Ocean Research in Horizon 2020: The Blue Growth Potential

Study for the ITRE Committee

EN

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POLICY DEPARTMENT A: INDUSTRY, RESEARCH AND ENERGY

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Study

Abstract

This study, provided by the Policy Department A at the request of the ITRE committee, aims to provide a description of the key blue growth sectors of the economy along with the EU potential to exploit them in a sustainable and competitive manner. Apart from the Blue Growth strategy and objectives, it describes its impact on growth and job creation. The report provides an analytical insight as well as policy recommendations on the key issues concerning blue economy and blue growth.

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CONTENTS

LIST OF ABBREVIATIONS

COSME	Competitiveness of Enterprises and small and medium-sized enterprises
EII	European Industrial Initiative
EIP	European Innovation Partnership
EMODNET	European Marine Observation and Data Network
ERA	European Research Area
ESFRI	European Strategic Forum for Research Infrastructure
FAO	Food and Agriculture Organisation
GVA	Gross Value Added
IAOOS	Integrated Atlantic Ocean Observing System
ICZM	Integrated Coastal Zone Management protocol
IMO	International Maritime Organisation
IoT	Internet of Things
JPI	Joint Programming Initiative
JRC	Joint Research Center
JTI	Joint Technology Initiatives
KETs	Key Enabling Technologies
LCE	Low Carbon Energy
MSCA	Marie Sklodowska-Curie Actions
NMP	Nanosciences, Nanotechnologies, Materials and new Production Technologies
MSFD	Marine Strategy Framework Directive
STECF	Scientific, Technical and Economic Committee for Fisheries
SFS	Sustainable Food Security
SRAs	Strategic Research Agendas
UNECE	United Nations Economic Commission for Europe
WTO	World Trade Organisation

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EXECUTIVE SUMMARY

The Blue Growth Strategy[1] aims at creating sustainable growth and employment in the marine and maritime economy to help Europe's economic recovery. The strategy identifies the most prominent sectors of the blue economy in terms of job creation and growth potential and focuses on creating an innovation-friendly environment, promoting measures for the support of SMEs, fostering public-private partnerships, and helping overcome bureaucratic obstacles throughout the innovation process.

The current study aims to provide a description of the blue growth and the potential of the EU to exploit it in a sustainable and competitive manner. The analysis also describes what the impact of the Blue Growth strategy is on growth and jobs creation.

The document is structured in order to provide an overview and general understanding of the blue economy and blue growth, followed by an analysis of the key sectors of the blue economy and their respective potential.

The new Framework Programme for Research and Innovation – Horizon 2020 and the specific research and demonstration activities and support actions in the field of marine and maritime research are also presented.

Finally the study provides analytical insights and policy recommendations on some of the most important issues concerning blue economy and blue growth.

[1] http://ec.europa.eu/maritimeaffairs/policy/blue_growth/index_en.htm.

1. UNDERSTANDING BLUE GROWTH

1.1. Introduction

The present study focuses on the issues of research, knowledge building, applied research, technological development, innovation and marketing, matching the sector developments with the conceptual framework set out in the Horizon 2020 Programme for Research and Innovation. The scope of blue growth is extremely broad and deep, being related to many diverse economic sectors ranging from aquaculture to tourism to biotechnologies to mining to energy. Additional sectors include fisheries, shipbuilding and repair, transport, and oil and gas.

The associated science and technology areas are as diversified and multifaceted and include the most different science and technology fields and research areas[2]. They are profoundly embedded in knowledge, science and technology and innovation and on the approaches to business competitiveness and to addressing societal challenges.

The European Commission's Blue Growth Strategy[3] aims at creating sustainable growth and employment in the marine and maritime economy to help Europe's economic recovery. The Strategy highlights opportunities for growth in other areas such as developing offshore renewable energy technologies, promoting a growing aquaculture sector, or supporting research into the blue biotechnology sector that could become a producer of mass market marine aquatic products. The Strategy was fully endorsed in October 2012 by European Ministers for Maritime Affairs through the Limassol Declaration on a 'Marine and Maritime Agenda' for growth and jobs[4]. As a follow-up to this Strategy, in May 2014, the European Commission published a Communication titled *Innovation in the blue economy: realising the potential of our seas and oceans for jobs and growth*[5].

In this Communication, blue growth acknowledges seas and oceans as the drivers for the European economy, with great potential for innovation and growth offering a potential of 5.4 million jobs and a gross added value of just under EUR 500 billion per year, with potential for further growth in a number of areas, as underlined within the Strategy[6]. The Blue Growth Strategy supports the most prominent sectors of the blue economy, by creating an innovation-friendly environment, supporting SMEs, promoting public–private partnerships, and helping overcome red-tape barriers during the innovation process.

1.2. Key sectors of the Blue Economy in the EU

The Blue Growth study[7] presented an analysis of the job creation potential and the dynamics for research and development (R&D) to deliver technology improvements and innovation. According to this analysis, there are five sectors of the blue economy that seem

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[2] Biotechnologies, pharmaceuticals, engineering, robotics, information and communications technologies, embedded systems, the internet of things, energy and alternative sources, physical sciences, but also economics and economic modelling, monitoring of physical dimensions and of socioeconomic dimensions, as well as financial instruments for innovation, in particular for Small and Medium Sized Enterprises. The analytical methodologies to support the development of the sector and the relevant policies cover most disciplines and also include policy cooperation instruments with sector players and as important, with the countries of the world.

[3] See http://ec.europa.eu/maritimeaffairs/policy/blue_growth/index_en.htm.

[4] Declaration of the European Ministers responsible for the Integrated Maritime Policy and the European Commission, on a Marine and Maritime Agenda for growth and jobs the "Limassol Declaration"' (http://ec.europa.eu/maritimeaffairs/policy/documents/limassol_en.pdf).

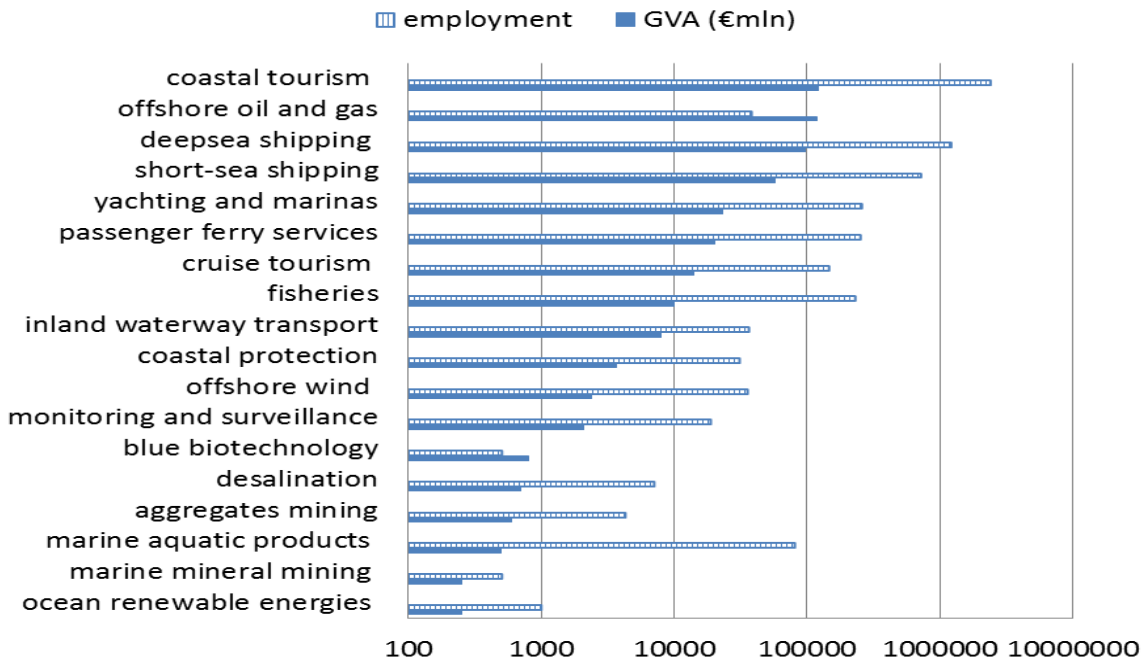
[5] 'Blue Growth opportunities for marine and maritime sustainable growth' (COM(2012) 494 final).

[6] 'Blue Growth opportunities for marine and maritime sustainable growth' (COM(2012) 494 final).

[7] 'Blue Growth Scenarios for Sustainable Growth from the Oceans, Seas and Coasts', Final report, Call for tenders No MARE/2010/01, August 2012.

to have high potential: Blue or Ocean Energy, Aquaculture, Maritime, Coastal and Cruise Tourism, Blue Biotechnology and Seabed Mining (marine and mineral resources.

Figure 1: Employment and economic size of marine and maritime economic activities[8]



1.3. The role of the EU Member States

The EU policy setting gives Member States a great responsibility and an active role in the blue economy, addressing existing issues and barriers to improve the overall blue growth potential and reset focus on its priorities.

The Joint Programming Initiative (JPI) for Healthy and Productive Seas and Oceans[9] kicked off in 2011, bringing together 21 Member States, sharing a common vision and working towards the same objectives. In summary, the Initiative aims to foster enabling cross-cutting technologies; to create the best enabling environment for maximising the development of marine renewable energies; to understand and mitigate the impact of climate change and pressure from human activities on the marine environment to reach Good Environmental Status of our seas by 2020; to develop and sustain infrastructure to support an integrated data and information base enabling industrial development and supporting maritime governance; to develop a research-to-policy mechanism, in particular to support the Marine Strategy Framework Directive (MSFD) and marine spatial planning and management; and to foster the interdisciplinary human capacities necessary to achieve the JPI goals[10].

1.4. Action at EU level to address specific obstacles/shortcomings

The current state of play at the EU level is clearly defined, however, there is room for more action. There are a number of significant issues that need to be tackled at EU and Member State levels:

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8 'Blue Growth opportunities for marine and maritime sustainable growth' (COM(2012) 494 final).
9 See http://www.jpi-oceans.eu/.
10 JPI Oceans' Vision Document, 2011.

- filling the knowledge and information gaps about European oceans (i.e. seabed resources, marine life, relevant threats, risks and opportunities);
- raising awareness and knowledge sharing on relevant research efforts and increasing the level of interdisciplinary learning to promote technological breakthroughs in blue growth business sectors;
- there is lack of scientists, engineers and skilled workers able to apply new technologies in the marine environment[11].

1.5. Research focus – Horizon 2020

The new Framework Programme Horizon 2020, launched in 2014, focuses on new technologies for economic growth, job creation and sustainable development. Horizon 2020 builds on the 31 projects funded by the Seventh Framework Programme (FP7) under the Oceans of Tomorrow initiative, which received an EU contribution of about EUR 195 million. The Horizon 2020 Blue Growth area has EUR 145 million only for 2014–2015, of which EUR 8 million is for SMEs. There are also other cross-thematic opportunities in the Horizon 2020 Programme in the areas of food security, energy, transport, materials, information technology, and research infrastructures. Furthermore, the JPI for Healthy and Productive Seas and Oceans is a strong coordination instrument of blue growth at Member State level.

1.6. Role of the private sector

The private sector has the responsibility to identify and articulate the actual market research needs. The Commission seeks support and collaborates with several private sector stakeholders for the research and innovation (R&I) agenda under Horizon 2020 and beyond. Currently, there are several sector-specific initiatives such as LeaderSHIP 2020[12], the Waterborne Platform[13], the Aquaculture Platform[14] and the European Sustainable Shipping Forum[15], which engage private sector representatives and key stakeholders.

1.7. International cooperation

There are significant challenges with regards to blue growth research, most of which are global (e.g. ocean acidification) and should be addressed by joint action undertaken at an international level. International cooperation in R&I for sustainable development and growth of the marine and maritime sectors should be further enhanced, as already recognised by the recently signed Galway Statement (May 2014), which officially launched the Canada–EU–USA Atlantic Ocean Research Alliance[16].

1.8. Need for skills

Taking advantage of blue growth opportunities requires an adequately skilled and educated workforce that will have the ability and knowledge to use and apply latest technologies and tools and equipment, filling in a number of gaps such as those in the offshore wind industry.

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[11] 'Innovation in the Blue Economy: realising the potential of our seas and oceans for jobs and growth' (COM(2014) 254 final/2).

[12] LeaderSHIP 2020, 'The Sea – New Opportunities for the Future, February 2013 (http://ec.europa.eu/enterprise/sectors/maritime/files/shipbuilding/leadership2020-final-report_en.pdf).

[13] See http://www.waterborne-tp.org/index.php/.

[14] See http://www.eatip.eu/.

[15] See http://ec.europa.eu/transport/themes/sustainable/news/2013-11-19-essf-composition_en.htm online.

[16] Galway Statement on Atlantic Ocean cooperation launching a European Union - Canada - United States of America Research Alliance. (http://ec.europa.eu/research/iscp/pdf/galway_statement_atlantic_ocean_cooperation.pdf).

Through Horizon 2020, the Marie Skłodowska-Curie Actions are the key support mechanism for human resources in R&I. These Actions focus on enhancing the skills of researchers (combining research excellence with mobility, training and career opportunities) by matching their skills and competences with the actual market/industry needs. The actions promote industry–academia collaboration.

An additional support action concerns the Knowledge Alliances, a scheme promoted under the Erasmus Programme, constituting structured partnerships gathering actors from higher education and business to stimulate innovation in and through higher education[17].

[17] See https://eacea.ec.europa.eu/erasmus-plus/actions/key-action-2-cooperation-for-innovation-and-exchange-good-practices/knowledge-alliances_en.

2. THE BLUE POTENTIAL

There are five value chains, presented in the Blue Growth study (2012)[18], expected that they could deliver sustainable growth and jobs in the blue economy. These are aquaculture, marine tourism, blue biotechnology, ocean energy and seabed mining (ocean minerals).

These sectors need forward-looking policies, to further enhance and exploit the current potential and make them more appealing to private sector investors. The current technological and research state of play for each of the key sectors is presented in the following sections.

2.1. Aquaculture

One of the world's fastest growing sectors, it currently provides the planet with almost half of the fish consumed. EU aquaculture is one of the most competitive blue economy sectors and offers high-quality products according to environmental, animal health and consumer protection standards[19].

Aquaculture production by the 28 EU Member States (EU-28) reached 1.28 million tonnes and EUR 3.51 billion in 2011, according to the Food and Agriculture Organization of the United Nations (FAO). The volume and value of sales reached 1.35 million tonnes and **EUR 4.02 billion**, respectively, in 2011, based on data from the Data Collection Framework (DCF)[20,21]. According to the 'Economic Performance Report on the EU Aquaculture sector'[22], the estimate on the employment of the EU-28 aquaculture sector is **80 to 85 thousand people**[23].

The sector is **dominated by SMEs**; 90 % of the 14 000 aquaculture enterprises are micro-enterprises (with less than 10 employees). They are principally concentrated in Greece, Spain, France, Italy and the United Kingdom, making up 77 % in volume and 76 % in value of EU totals[24,25].

The European Commission adopted the **Common Fisheries Policy (CFP) reform**[26] and has published a set of strategic guidelines with common priorities and general objectives. The key objective is to promote the continuous development of the aquaculture sector, ensuring sustainability, food security and employment. The reform is based on the

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18 'Blue Growth Scenarios for Sustainable Growth from the Oceans, Seas and Coasts', Final report, Call for tenders No MARE/2010/01, August 2012.

19 'Strategic guidelines for the sustainable development of EU aquaculture' (COM(2013) 229 final).

20 Data Collection Framework (DCF) (cf. Council regulation, European Commission (EC) No 199/2008 of 25 February 2008).

21 Scientific, Technical and Economic Committee for Fisheries (STECF), The Economic Performance Report on the EU Aquaculture sector (STECF-13-29), 2013, Publications Office of the European Union, Luxembourg, EUR 26336EN, JRC86671, 383 pp.

22 Scientific, Technical and Economic Committee for Fisheries (STECF), The Economic Performance Report on the EU Aquaculture sector (STECF-13-29), 2013, Publications Office of the European Union, Luxembourg, EUR 26336EN, JRC86671, 383 pp.

23 See http://ec.europa.eu/fisheries/images/aquaculture/aquaculture-infographics_en.pdf online.

24 Information extracted from the infographic published online by DG MARE (http://ec.europa.eu/fisheries/cfp/aquaculture/facts/index_en.htm).

25 Scientific, Technical and Economic Committee for Fisheries (STECF), The Economic Performance Report on the EU Aquaculture sector (STECF-13-29), 2013, Publications Office of the European Union, Luxembourg, EUR 26336EN, JRC86671, 383 pp.

26 See http://ec.europa.eu/fisheries/cfp/index_en.htm.

open method of coordination, agreeing on common priorities and targets[27] and working with multi-annual plans for coordination and best practices exchange[28].

2.2. Maritime and Coastal Tourism

Coastal and maritime tourism is one of five focus areas for delivering sustainable growth and jobs in the blue economy[29]. The European Parliament[30] welcomed this European framework and recommended a series of actions to develop the sector and support sustainable coastal tourism.

The maritime and coastal tourism sector is dominated by small businesses, most of which (around 90 %) employ less than 10 people. It is the largest maritime economic activity currently **employing around 3.2 million people** and generating **EUR 183 billion in gross value added**, more than one third of the overall maritime economy[31].

Blue tourism requires a healthy environment and high-quality services — by specialised and well-trained personnel — to make coastal areas more appealing for nautical tourism sports, and green tourism. Market-led initiatives should target the increase of low-season tourism and reduce the high carbon footprint and environmental impact of coastal tourism[32]. Cross-border coordination would further contribute to the development of high-value tourism areas if it were integrated within the various sea basin strategies (to include actions for promoting cooperation and strategic trans-regional and transnational partnerships, as well as best practice sharing).

As tourism has only recently been included as an 'EU competence', there is little or no regulatory framework. International organisations (e.g. UNECE, IMO) are already responsible for a number of sector-specific issues and regulatory aspects at EU level (e.g. visa regime, Bathing Waters Directive, Water Framework Directive, Port Reception Facilities Directive, MSFD, ICZM[33] and several others)[34].

Coastal and maritime tourism is affected by a number of indirect policy measures, such as information technology connectivity, sustainable transport, safety issues, freedom of movement for workers, and a number of cross-cutting policy aspects such as environmental protection, sustainable development, regional development, skills and training, consumer protection and climate change mitigation that could be addressed by specific regional strategies for EU sea basins at the macro level[35].

Currently, funding opportunities for coastal tourism in the EU are available through the **European Structural and Investment Funds**, **Horizon 2020**, the **Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME) framework programme**, the **Creative Europe programme** and the **LIFE+ programme**. The proposal for the 7th European Environment Action Programme is also linked to coastal and

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[27] Scientific, Technical and Economic Committee for Fisheries (STECF), The Economic Performance Report on the EU Aquaculture sector (STECF-13-29), 2013, Publications Office of the European Union, Luxembourg, EUR 26336EN, JRC86671, 383 pp.

[28] See http://ec.europa.eu/fisheries/cfp/aquaculture/index_en.htm.

[29] 'Blue Growth opportunities for marine and maritime sustainable growth' (COM(2012) 494).

[30] 'Report on Blue Growth: Enhancing sustainable growth in the EU's marine, maritime transport and tourism sectors (2012/2297(INI))', Committee on Transport and Tourism.

[31] 'A European Strategy for more growth and jobs in Coastal and Maritime Tourism' (COM(2014) 86 final).

[32] 'Blue Growth opportunities for marine and maritime sustainable growth' (COM(2012) 494 final).

[33] ICZM Protocol: PROTOCOL ON INTEGRATED COASTAL ZONE MANAGEMENT IN THE MEDITERRANEAN (http://www.pap-thecoastcentre.org/razno/PROTOCOL%20ENG%20IN%20FINAL%20FORMAT.pdf).

[34] 'Study in support of policy measures for maritime and coastal tourism at EU level', Ecorys, 2013.

[35] 'A European Strategy for more growth and jobs in Coastal and Maritime Tourism' (COM(2014) 86 final).

maritime tourism. In addition, the **European Investment Bank** provides SMEs with financing for investments in tourism and/or in convergence regions[36].

2.3. Blue biotechnology

Blue biotechnology is a diverse sector, which encompasses a number of sub-sectors where marine biotechnology applications are used, leveraging resources of marine origin[37]. It is ***one of the key enabling technologies and maritime economic sectors*** [38]. Marine biodiversity and biotechnology research have a huge potential to contribute to new knowledge for *high value products and processes and* ***increase marine resources and biodiversity understanding***[39,40,41].

There aren't any official statistics related to the number of companies, gross value added or employment figures, since blue biotechnology is not considered an 'official sector', creating difficulties in assessing the size and structure as well as respective socioeconomic performance. 'Marine biotechnology accounts for 2-5% of the sector as a whole, leads to an annual turnover in the range of EUR 302 – 754 million. The annual growth rate … revolves around 4-5%, somewhat below that of biotechnology as a whole (6-8%).' On the basis of the same calculations, overall employment in the sector 'is currently expected to be in the range of 11,500-40,000 people.' These are all 'high-end jobs which are the product of considerable public investment in education and training'[42].

A 'strategic approach to research and innovation would provide the scientific and technological bases for substantiating the strategic decisions needed by emerging industrial sectors'[43]. Simplification of procedures and removal of technical and administrative barriers could improve the sector attractiveness for potential interested investors.

The EU appears to be a major player in blue biotechnology, competing with North America and East Asian countries. The main competitive advantages of the EU lie in its R&D activities, access to marine resources and development of infrastructure to support these activities. The United States is taking a lead role in marine algal fuels and Asia is a leading player in bioinformatics[44].

The Horizon 2020 strategy and support programme specifically mentions blue biotechnology and marine biomass as contributors to the economy of the future. 'Very important projects have been funded under FP6 and FP7 with focus on science policy, coordination, infrastructures and support of marine biotechnology; the outcomes of these projects have provided key contributions to developing a European strategy'[45].

2.4. Ocean energy

Ocean energy is one of the pillars of the Blue Growth Strategy[46]. Ocean or blue energy covers all technologies aimed to exploit the renewable energy of seas and oceans other

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36 'A European Strategy for more growth and jobs in Coastal and Maritime Tourism' (COM(2014) 86 final).

37 'Study in support of Impact Assessment work on Blue Biotechnology', Revised Final Report FWC MARE/2012/06 – SC C1/2013/03, July 2014.

38 See http://ec.europa.eu/maritimeaffairs/policy/index_en.htm.

39 'EUROPE 2020 - A strategy for smart, sustainable and inclusive growth' (COM(2010) 2020).

40 'Innovating for Sustainable Growth: A Bioeconomy for Europe' (COM(2012) 60 final).

41 'Blue Growth opportunities for marine and maritime sustainable growth' (COM(2012) 494 final).

42 'Study in support of Impact Assessment work on Blue Biotechnology', Revised Final Report FWC MARE/2012/06 – SC C1/2013/03, July 2014.

43 Blue Growth Communication.

44 Blue Growth Communication.

45 Blue Growth Communication.

46 See http://ec.europa.eu/maritimeaffairs/policy/ocean_energy/index_en.htm.

than offshore wind. The importance of ocean energy is underlined in the Communication on Energy Technologies and Innovation[47] and the Atlantic Action Plan[48], which encourage cross-border cooperation.

Based on the Blue Energy Communication[49], marine renewable energy resources play a key role in Europe's energy portfolio; they also provide the EU with new opportunities to fuel technological innovation, commercial activity and competitiveness. Currently, the EU plans its renewable energy and climate change objectives for after 2020.

The Blue Energy Communication[50] confirms that more than EUR 600 million have been invested by the private sector in the last 7 years, which could be further increased by favourable regulatory and legal conditions[51]. In fact, a clear and stable policy framework facilitates private sector participation and attracts investments

Currently, there are a number of initiatives set out by the Commission, like the European Energy Research Alliance (EERA) Joint Programme[52], the Ocean Energy ERA-NET[53] and Horizon 2020[54], which will all play a central role in promoting cooperation in R&D on the one hand, and help tackle any technical or other issues on the other. The policy document calls for 'a stable and low risk framework of support', 'as it ensures the bankability of projects and thus allows for the growth of installed capacity'[55]. The Commission has recently issued guidance[56] on best practice for renewable energy support schemes based on cost effectiveness but also on need for technological innovation[57,58]. Still, more EU action should be taken to further support the current initiatives both at EU and national levels.

2.5. Seabed mining

The Blue Growth Communication confirms that in the last 10–15 years there has been an annual increase of about 15 % in the price of many non-energy raw materials[59], mainly due to consumer demand in emerging economies. There is a fear that this could lead to supply shortages of several minerals[60].

Latest technological developments, but also the increased concerns over security of supply, have led European companies in the mining industry to consider the sea as a key source of minerals. It is expected that by 2020, around 5 % of the world's minerals (including cobalt, copper and zinc) could come from the ocean floors. This could even rise up to 10 %

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47 'Energy Technologies and Innovation' (COM(2013) 253, 2 May 2013).

48 'Action Plan for a Maritime Strategy in the Atlantic area, Delivering smart, sustainable and inclusive growth' (COM(2013) 279, 13 May 2013).

49 'Blue Energy Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond' (SWD(2014) 12 final, Accompanying the document COM(2014) 8 final).

50 'Blue Energy Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond' (SWD(2014) 12 final, Accompanying the document COM(2014) 8 final).

51 'Blue Energy Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond' (SWD(2014) 12 final, Accompanying the document COM(2014) 8 final).

52 See http://www.eera-set.eu/eera-joint-programmes-jps/.

53 See http://www.oceaneranet.eu/pages/new-page-5.html.

54 See http://ec.europa.eu/programmes/horizon2020/.

55 'Blue Energy Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond' (SWD(2014) 12 final, Accompanying the document COM(2014) 8 final).

56 'European Commission guidance for the design of renewables support schemes' (SWD(2013) 439 final).

57 'Delivering the internal market in electricity and making the most of public intervention' (C(2013) 7243 final).

58 'Delivering the internal market in electricity and making the most of public intervention' (C(2013) 7243 final).

59 WTO, 2010, 'Trade growth to ease in 2011 but despite 2010 record surge, crisis hangover persists', PRESS/628, 7 April 2011.

60 London Metal Exchange (LME) indicates a price increase of about 256 % for the period 2000 to 2010 for non-ferrous base metals. See also COM(2011) 25 final and its accompanying staff working document.

by 2030[61]. Current trends show that the global annual turnover of marine mineral mining will be up to EUR 5 billion in the next decade and up to EUR 10 billion by 2030[62] (starting from very low).

The extraction of dissolved minerals from seawater (e.g. boron or lithium) could become economically feasible in the near future and offer European companies working in this industry the chance to provide high-quality products and services, given their long experience in specialised ships and underwater handling and also leveraging the experience of the offshore oil and gas sector[63].

Several European organisations are engaged in seabed mining activities, as technology providers or as mine operators. The sector is still quite small, but is considered to **have the potential to generate sustainable growth and jobs**.

The main EU policy documents delivered over the last few years emphasise the need to sustain a secure supply of raw materials, increasing the search for alternatives to land-based sources of minerals, proposing three pillars:

1. fair and sustainable supply of raw materials from international markets;
2. fostering sustainable supply within the EU;
3. boosting resource efficiency and promoting recycling.

EU support could include measures to ensure that European companies are not left out of the value chain for marine minerals by competitors and at the same time help ensure that high environmental, legal and security standards are abided by.

As outlined in the stakeholders' consultation (March to June 2014) and according to the United Nations Law of the Sea, 'a country enjoys exclusive sovereign rights to explore its continental shelf and exploit the natural resources, including mineral resources from it. Mining activities in this area are subject to the country's internal legislation'[64].

[61] 'Blue Growth opportunities for marine and maritime sustainable growth' (COM(2012) 494 final).

[62] Based on estimates given by industrial stakeholders in the Blue Growth study (Ecorys, 2012).

[63] 'Blue Growth Scenarios and Drivers for Sustainable Growth from the Oceans, Seas and Coasts', Marine Sub-Function Profile Report Marine Mineral Resources, Ecorys, August 2012.

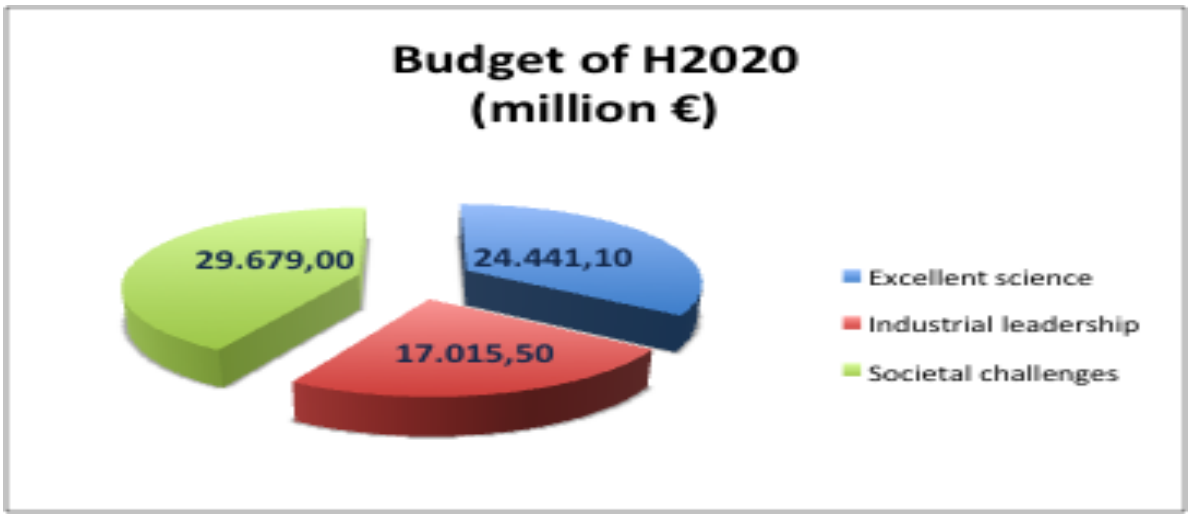
[64] http://ec.europa.eu/dgs/maritimeaffairs_fisheries/consultations/seabed-mining/index_en.htm/.

3. EU CAPACITY TO EXPLOIT THIS POTENTIAL: THE SCENARIOS AND RESEARCH AND INNOVATION POLICY FRAMEWORK

3.1. Overview[65]

The new Framework Programme for Research and Innovation (2014–2020), Horizon 2020, aims to support objectives and activities, which cannot be efficiently realised by EU Member States, contributing to the achievement of the objectives of the Europe 2020 strategy, providing a strategic framework for R&I. The EU R&I policy aims at being an instrument to leverage private and public investments for economic growth, job creation, social inclusion and addressing societal challenges.

Figure 2: H2020 Budget



3.2. Blue Growth in Horizon 2020[66]

This report will present how Blue Growth objectives are included and targeted by R&I activities. Blue Growth in Horizon 2020 is a set of vertically and horizontally integrated R&I policy measures to support the realisation of the potential of seas and oceans. Its support policies are based on the exploitation of technological progress offshore and in coastal areas. These policies target specific priority domains of the Blue Growth agenda, inter alia: "*valorising the diversity of marine life; sustainable harvesting of the deep-sea resources; new offshore challenge; sea and ocean observation technologies; and the socio-economic dimension*"[67].

[65] REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing Horizon 2020 – the Framework Programme for Research and Innovation (2014–2020) and repealing Decision No 1982/2006/EC.

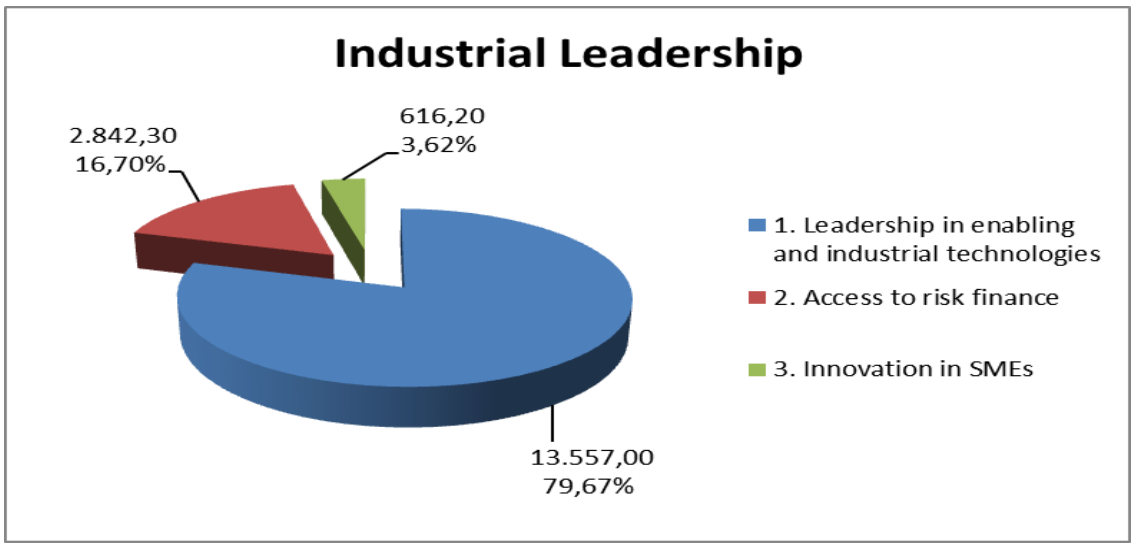
[66] Call for Blue Growth: Unlocking the potential of Seas and Oceans – H2020-BG-2014/2015. HORIZON 2020 WORK PROGRAMME 2014 – 2015. 9. Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy.

[67] Call for Blue Growth: Unlocking the potential of Seas and Oceans - H2020-BG-2014/2015.

It must be underlined that there is a significant number of other horizontal areas, which address directly and indirectly blue growth related issues. The three integrated pillars of Horizon 2020[68] all directly or indirectly concern Blue Growth:

The priority "**Excellent Science**" directly targets the science base and the consolidation of the European Research Area (ERA) to increase the EU's research system's competitiveness. This priority has four objectives: «(a) "The European Research Council (ERC)" shall provide attractive and flexible funding to enable talented and creative individual researchers and their teams»; «(b) "Future and emerging technologies (FET)" shall support collaborative research in order to extend Europe's capacity for advanced and paradigm-changing innovation»; «(c) "Marie Skłodowska-Curie actions" shall provide excellent and innovative research training as well as attractive career and knowledge-exchange opportunities through cross-border and cross-sector mobility of researchers».

Figure 3: Priority Excellent Science – Areas and Resources Allocation



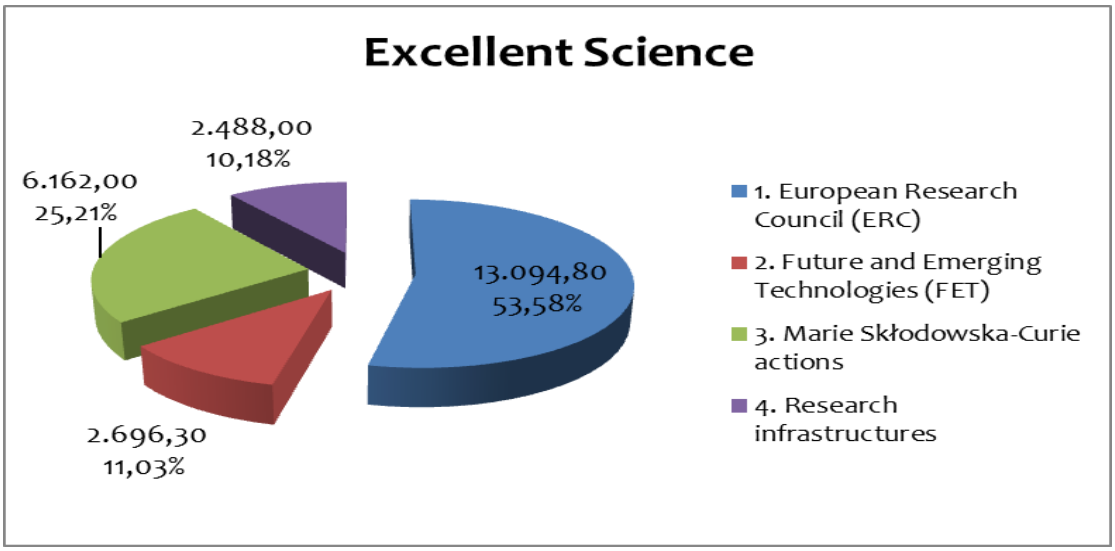
The fourth objective "Research infrastructures" shall «develop and support excellent European research infrastructures and assist them to contribute to the ERA by fostering their innovation potential, attracting world-level researchers and training human capital, and complement this with the related Union policy and international cooperation» and is of particular importance to the development of the blue economy.

The priority "**Industrial leadership**" in particular supports the competitiveness of enterprises, and in particular of SMEs, and has three specific objectives: '(a) "Leadership in enabling and industrial technologies" shall provide dedicated support for research, development and demonstration and, where appropriate, for standardisation and certification, on information and communications technology (ICT), nanotechnology, advanced materials, biotechnology, advanced manufacturing and processing and space'; '(b) "Access to risk finance" shall aim to overcome deficits in the availability of debt and equity finance for R&D and innovation-driven companies and projects at all stages of development, together with the equity instrument of the Programme for the

[68] REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC. Annex I. L347/123.

Competitiveness of Enterprises and small and medium-sized enterprises (COSME) (2014-2020). It shall support the development of Union-level venture capital'; '(c) "Innovation in SMEs" shall provide SME-tailored support to stimulate all forms of innovation in SMEs, targeting those with the potential to grow and internationalise across the single market and beyond.' Within industrial leadership, priorities (a) and (c) are particularly relevant for the blue economy.

Figure 4: Priority Industrial Leadership – Areas and Resources allocation



The priority '**Societal challenges'** addresses the objectives and societal challenges identified by the Europe 2020 strategy that aim at stimulating[69] 'the critical mass of research and innovation efforts needed to achieve the Union's policy goals' addressing a number of specific objectives:

(a) health, demographic change and well-being;

(b) food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy;

(c) secure, clean and efficient energy;

(d) smart, green and integrated transport;

(e) climate action, environment, resource efficiency and raw materials;

(f) Europe in a changing world - Inclusive, innovative and reflective societies;

(g) Secure societies - Protecting freedom and security of Europe and its citizens.

Blue Growth in Horizon 2020 has a broader scope and wider targets, covering the exploitation of marine life, the new off shore challenge, the exploitation of deep sea sources and deep sea mining, ocean observatories, systems and technologies and horizontal aspects.

[69] REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing Horizon 2020 – the Framework Programme for Research and Innovation (2014–2020) and repealing Decision No 1982/2006/EC. Annex I. L347/124.

Figure 5: Priority Societal Challenges – Areas and Resources Allocation

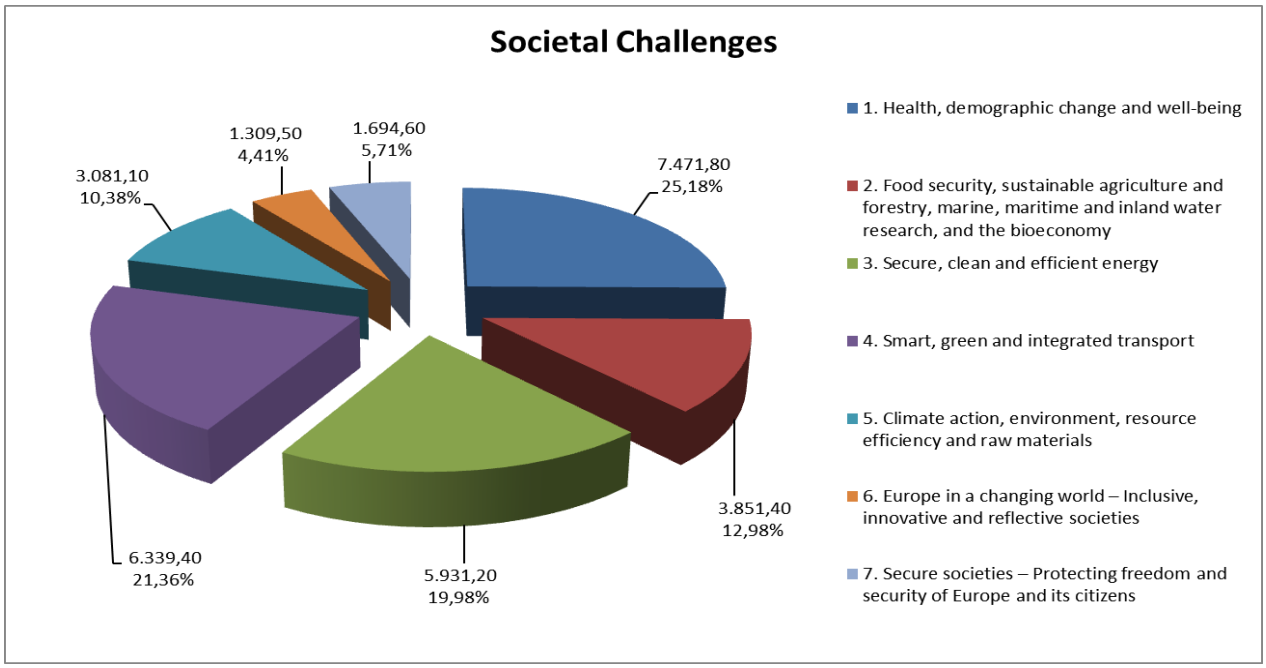
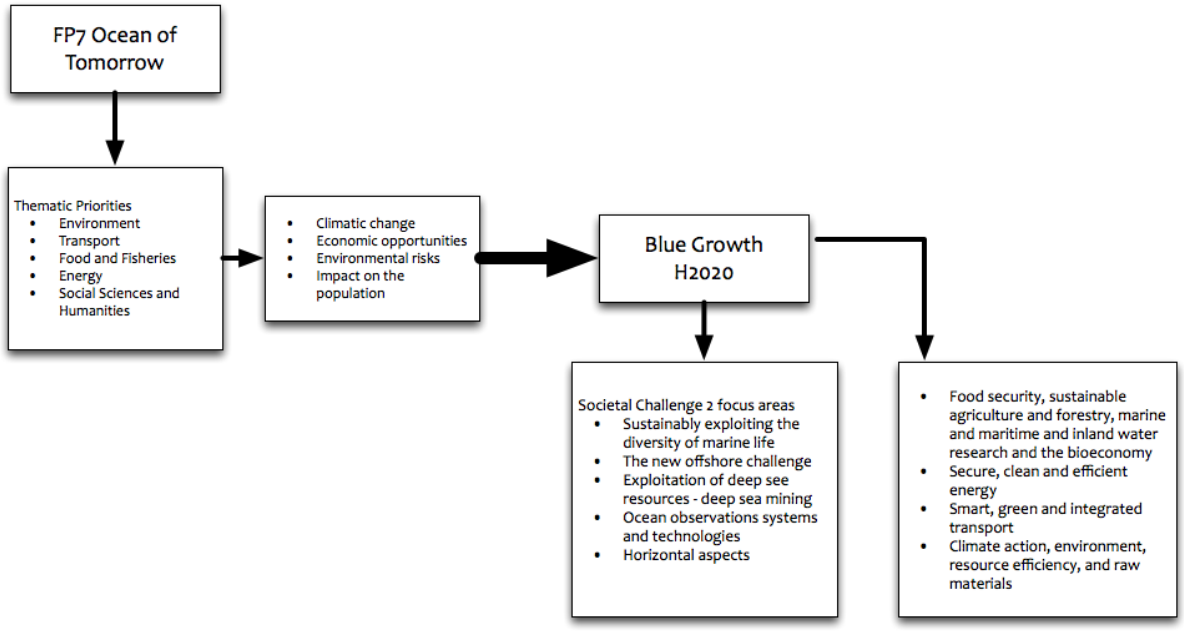


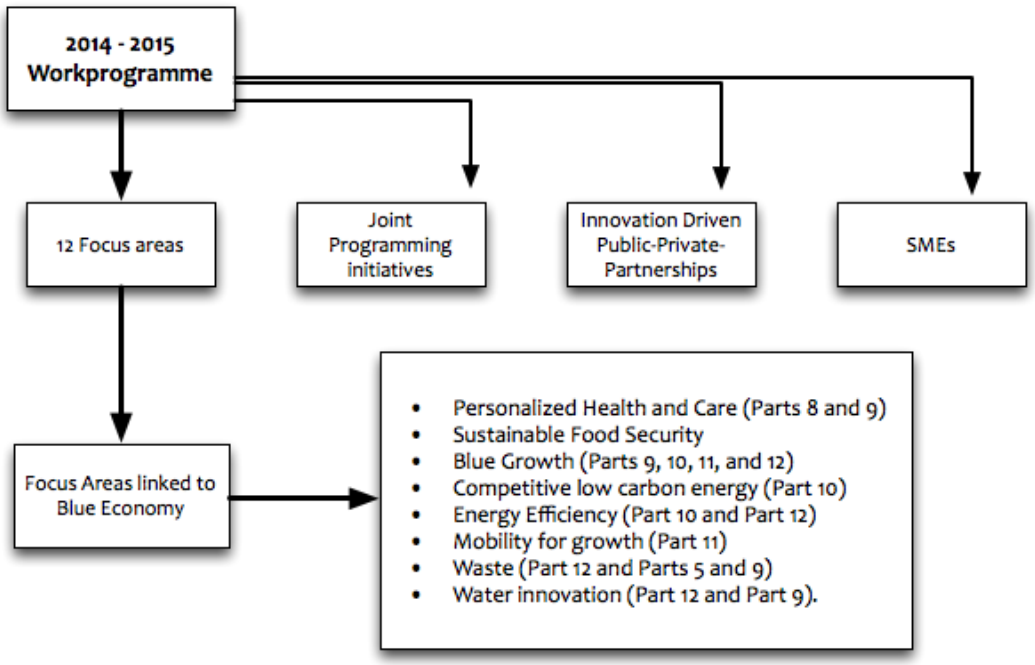
Figure 6: From FP7 Ocean of Tomorrow to H2020 Blue Growth[70,71]



[70] "The ocean of tomorrow" FP7 – OCEAN – 2010 Description of topics Info - day – 16 September 2009. http://ec.europa.eu/research/agriculture/ocean/presentations_speeches/hall%20presentation.pdf.

[71] HORIZON 2020 WORK PROGRAMME 2014 – 2015. 9. Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy.

Figure 7: Specific overview of the 2014 – 2015 Workprogramme[72]



3.2.1. European research infrastructures (4)[73]

Horizon 2020 identifies research infrastructures as facilities, resources and services that are used by research to conduct their activities of knowledge building and innovation. In many cases they host activities beyond research, such as education, and they 'play an increasing role in the advancement of knowledge and technology and their exploitation'. They also have the ability to assemble a critical mass of activities, people and knowledge, and are capable of hosting or supporting local or distributed research activities and projects. There are numerous calls relevant to the European research infrastructures, which are related to the blue economy and the blue growth.

The funding supports trans-national and virtual access activities by European researchers, and the cooperation between research infrastructures[74], scientific communities, industries and other stakeholders. They combine networking activities; trans-national access or virtual access; and joint research activities[75]. These calls mobilise consortia of several research infrastructures as well as stakeholders from different Member States, Associated Countries[76] and third countries.

Research and supported activities include:

- energy: support the precompetitive research in wind turbines, ocean energy converters and electrical subsystems for grid integration;
- research infrastructures for ocean drilling;

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[72] Own elaboration based on HORIZON 2020 WORK PROGRAMME 2014 – 2015. Table of Contents and 1. General Introduction.

[73] HORIZON 2020 WORK PROGRAMME 2014 – 2015. 4. European research infrastructures (including e-Infrastructures). European Commission Decision C (2014) 4995 of 22 July 2014.

[74] Call - Integrating and opening research infrastructures of European interest - H2020-INFRAIA-2014/2015

[75] Call - Support to innovation, human resources, policy and international cooperation - H2020-INFRASUPP-2014/2015.

[76] Associated Countries are countries, which are allowed to have a share in Framework Programme-funded activities. Horizon 2020 explicitly specifies them.

- supporting research infrastructures in aquaculture;
- research infrastructures for terrestrial research in the Arctic linking with marine and atmospheric networks;
- infrastructures for integrated and sustained coastal observation to harmonise observation.

3.2.2. Leadership in enabling and industrial technologies (5)[77]

Enabling and industrial technologies R&I aim at reinforcing Europe's leadership in competitive key enabling technologies, ICT and space with a particular focus on boosting competitiveness, creating jobs and supporting growth. The emphasis is on R&D and innovation of industrial applications alongside industrial roadmaps and involving industrial players and SMEs. The expected outcomes need to be close to the market, with clear avenues of exploitation. Key enabling technologies are expected to deal with major societal challenges. The bio-based industries Joint Technology Initiative (JTI) is relevant to blue growth areas and blue economy-related fields, in particular low-carbon energy and energy efficiency.

3.2.3. Information and Communication Technologies (5i)[78]

Horizon 2020 aims at a systemic integration of components into cyber-physical systems. The funded activities range from technology-driven R&D to application-driven R&I. There are two principal areas related to blue growth:

- ICT 1 – 2014: Smart Cyber-Physical Systems — i.e. next generation embedded ICT systems interconnected through the IoT. These systems are employed, among others, in transport and logistics systems and process industry, which belong to the blue economy field.
- ICT 30 – 2015: Internet of Things and Platforms for Connected Smart Objects, where IoT of connected devices and objects is for support of smart environments, businesses, services and persons.

Figure 8: Blue Growth and ICT

[77] HORIZON 2020 WORK PROGRAMME 2014 – 2015. 5. Leadership in enabling and industrial technologies. European Commission C(2014)4995 of 22 July 2014.

[78] HORIZON 2020 WORK PROGRAMME 2014 – 2015. 5. Leadership in enabling and industrial technologies. i. Information and Communication Technologies. European Commission C(2014)4995 of 22 July 2014.

3.2.4. Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing (5ii)[79]

Several of the blue economy sectors concern material and manufacturing processes, with the application of horizontal technologies. Deep-sea technologies and in particular high-performance material, are one of the key areas of Blue Growth. The field of Materials for severe operating conditions (NMP 19 – 2015) targets also transport and deep-sea technologies. The overall allocation for the family of calls for 2015 is EUR 148.37 million.

3.2.5. Marine and maritime and inland water research and the bioeconomy (9)[80]

Horizon 2020 embeds this research field in the wider context of Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy. One of the purposes of this societal challenge is the sustainable optimisation of biological resources. The Framework Programme provides an important support to bilateral agreements and dialogues and international cooperation initiatives such as the EU-China dialogue on R&I, the dialogue on Food, Agriculture and Biotechnology, the Transatlantic Research Alliance, the International Knowledge-Based Bioeconomy (KBBE) Forum between the EU, Australia, Canada and New Zealand, the EU-Africa dialogue on R&I.

The workprogramme 2014-2015 is composed of three calls and supports Sustainable Food Security[81] focusing on safe and nutritious food and on food processing. The 2014 work programme focuses on the blue economy aquaculture and on the understanding of the drivers of food security, including the sea-related value chains.

The priorities of the call are the gradual elimination of discards in European fisheries. Furthermore it involves tackling disease related challenges and threats in aquaculture, the Implementation of an Ecosystem-based approach for European aquaculture and Innovative solutions for sustainable novel food processing.[82]

The call for Blue Growth: Unlocking the potential of Seas and Oceans[83] intends to realise the potential of seas and oceans from the most divergent points of views: Food Security, Secure, clean and efficient energy, Smart, green and integrated transport, and Climate action, environment, resource efficiency and raw materials[84].

As already mentioned, the Blue Growth area addresses five priorities: diversity of marine life, sustainable harvesting of deep sea resources, new off-shore challenge, sea and ocean observation technologies and the socioeconomic dimension. The purpose of the blue growth area is to improve 'the understanding of the complex interrelations between various maritime activities, technologies, including space enabled applications, and the marine environment to help boost the marine and maritime economy by accelerating its potential through R&I.' The blue growth R&I area has a high cross-cutting nature, addressing issues on energy, transport, resource efficiency and raw materials, as well as industrial technologies. It is also relevant to health, demographic change and wellbeing as well as to

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[79] HORIZON 2020 WORK PROGRAMME 2014 – 2015. 5. Leadership in enabling and industrial technologies. ii. Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing. Technologies. European Commission C(2014)4995 of 22 July 2014.

[80] HORIZON 2020 WORK PROGRAMME 2014 – 2015. 9. Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy. European Commission Decision C (2014)4995 of 22 July 2014.

[81] Call for Sustainable Food Security - H2020-SFS-2014/2015.

[82] Respectively SFS-9-2014, SFS-10-2014/2015, SFS-11-2014/2015, SFS-17-2014.

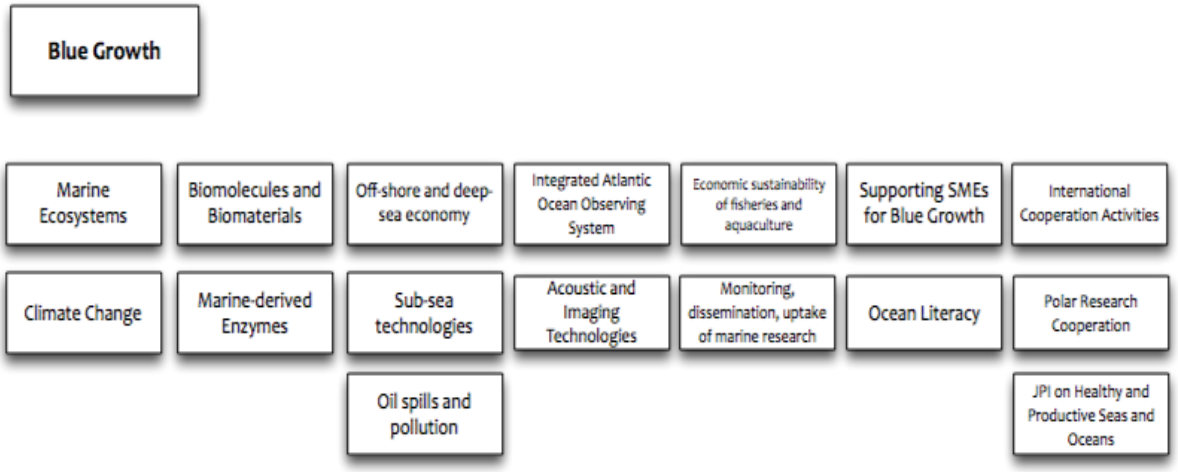
[83] Call for Blue Growth: Unlocking the potential of Seas and Oceans - H2020-BG-2014/2015.

[84] Respectively Part 9, Part 10, Part 11, Part 12.

inclusive, innovative and secure societies, and needs to be supported by international cooperation to address global issues.

The calls cover: marine ecosystems, climate change and fisheries and aquaculture, biomolecules and industrial biomaterials, marine-derived enzymes, technological and operational challenges of the future innovative offshore and deep sea economy, sub-sea technologies for example for remotely operated vehicles and robots, response capacities to oil spills and marine pollutions, the deployment of the Integrated Atlantic Ocean Observing System (IAOOS) for a better management and sustainable exploitation of the maritime resources, acoustic and imaging technologies to monitor the state of marine ecosystems, tools and methods to assess the economic sustainability of European fisheries and aquaculture, monitoring, dissemination and uptake of marine and maritime research, supporting SMEs efforts for the development of innovative solutions for blue growth, ocean literacy – engaging with society – social innovation and international cooperation initiatives: Atlantic Ocean Cooperation Research Alliance; European polar research cooperation; implementation of the Joint Programming Initiative on 'Healthy and Productive Seas and Oceans'[85].

Figure 9: The Blue Growth Areas



3.2.6. Secure, clean and efficient energy (10)[86]

A secure, clean and efficient energy production and supply are essential for the sustainable development of the EU in its global context. The work programme addresses 'Energy Efficiency' and 'Competitive Low-Carbon Energy', which are directly related to blue growth. The area competitive low-carbon energy[87] aims at supporting the development of affordable, cost-effective and resource-efficient energy technology solutions targets renewable electricity and in particular on blue growth's wind and ocean energy. The programme develops along a sequence of research and innovation findings, from basic research, technology development, technology demonstration and supply-side market readiness, demand-side market up-take. One specific call (LCE-5) is in support of the development of innovation and technologies for the deployment of off-shore grids linking off-shore wind parks and on-shore grids.

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[85] Respectively BG-1-2014/2015 to BG-16-2014/2015.

[86] HORIZON 2020 WORK PROGRAMME 2014 – 2015. 10. Secure, clean and efficient energy. European Commission Decision C (2014) 4995 of 22 July 2014.

[87] Call – Competitive Low-Carbon Energy. H2020-LCE-2014/2015.

3.2.7. Smart, green and integrated transport (11)[88]

Another element of blue growth is to support transport, shipping and logistics activities. Part of the blue economy is shipbuilding, ship repair and transport. This blue economy relevant activity covers three calls for proposals and in particular mobility for growth. The area[89] addresses four related challenges: waterborne, logistics, intelligent transport systems, and infrastructures.

The calls target energy efficient and very-low emission vessel, safer and more efficient waterborne operations through new technologies and smarter traffic management, system modelling and life-cycle cost and performance optimisation for waterborne assets, synergies alongside the supply chain, including e-commerce, to support and streamline logistics processes, common communication and navigation platforms for logistics applications, architectures and open systems for information sharing, connectivity and information sharing for intelligent mobility based on GNSS-based location, of cloud computing and big data processing, smarter design, construction and maintenance of infrastructures and next generation transport infrastructure[90].

3.2.8. Climate action, environment, resource efficiency and raw materials (12)[91]

This part is related to the sustainable supply and efficient use of raw materials in view of growing demand. It is particularly connected to the deep sea activities of blue growth: off-shore and deep-sea economy, sub-sea technologies, and pollution prevention.

Actions under this call[92] aim to improve understanding of the complex interactions of ecosystems and the different drivers of changes in the environment to understand restoration mechanisms and improving sustainable and efficient access to raw materials.

- The areas of R&I are: the economics of climate change and linkages with sustainable development in sea and oceans and coastal areas; R&I for climate action, climate change mitigation options, earth-system modelling and climate services; biodiversity and ecosystem services: drivers of change and causalities; ecosystem restoration; consolidating the ERA on biodiversity and ecosystem services; R&I for the management of natural resources[93].
- New solutions for sustainable production of raw materials: Deep mining on continent and/or in sea-bed; new sustainable exploration technologies and geomodels; strategic international dialogues and cooperation on raw materials with technologically advanced countries; and strategic international dialogues and cooperation with raw materials producing countries and industry; coordinating European Observation networks to reinforce the knowledge base for climate, natural resources and raw materials[94].

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88 HORIZON 2020 WORK PROGRAMME 2014 – 2015. 11. Smart, green and integrated transport. European Commission Decision C(2014)4995 of 22 July 2014.

89 CALL 'MOBILITY FOR GROWTH' H2020-MG-2014/2015.

90 Respectively MG.4.1-2014, MG.4.2-2014, MG.4.3-2015, MG.6.1-2014, MG.6.3-2015, MG.7.1-2014, MG.8.1-2014, and MG.8.2-2014.

91 HORIZON 2020 WORK PROGRAMME 2014 – 2015. 12. Climate action, environment, resource efficiency and raw materials. European Commission Decision C (2014)4995 of 22 July 2014.

92 Call – Growing a Low Carbon, Resource Efficient Economy with a Sustainable Supply of Raw Materials H2020-SC5-2014/2015.

93 Respectively SC5-3-2014, SC5-5-2014/2015, SC5-6-2014, SC5-7-2015, SC5-9-2014, SC5-10-2014/2015

94 SC5-11-2014/2015.

4. OVERALL REMARKS

4.1. Underexplored marine biodiversity and marine renewable energy

Policy making purposes require the assessment of the **potential of blue growth, in particular that of marine biodiversity and of marine renewable energy**. In fact, it has been recognised that blue biotechnology is a sector mainly science driven, with still limited economic effects. But its future economic potential is considered limitless considering the ability to generate a wide range of application, such as new medical molecules, bio-plastics, enzymes and biocides.

The high level of capacities of its science and technology sector places Europe in an excellent position to take advantage of the opportunities of **marine biotechnology**. Leading commercial players from the cosmetic, pharmaceutical and chemical industries have the potential to turn the results of research into business opportunities. One of the key success factors is the availability of innovation financing, as well as an appropriate regulatory framework.

Even if the technologies for **ocean renewable energy** are still at an early stage of development, Europe is very well placed due to an advanced R&D. The most promising prospects are in the exploitation of **tidal current energy** and **wave energy**. The key to success for these rests on the rapid development of technological solutions and on successful demonstration projects. Naturally, the levels of energy raw materials have a significant impact on the speed of development of this sector.

4.2. Importance of blue growth strategy by the EU and Member States

In general, it has been recognised that there are gaps in and limits to the **availability of updated data** on oceans and seas, i.e. seabed resources, marine life, relevant threats, risks and opportunities. These data are necessary for policy support, but also as a concrete evidence base for business decisions. There is also limited awareness of the importance of marine and maritime science, causing low interdisciplinary learning and limiting the progress towards technological breakthroughs, as well as a shortage in scientific, engineering and technical skills.

The current policy setting, in particular as concerns Horizon 2020 and the R&I design, specifically focuses on measures that address the above issues. The Blue Growth agenda places a particular emphasis on **sea and ocean observation and monitoring**, in particular promoting infrastructures and the creation or development of observatories such as the IAOOS for a better management and sustainable exploitation of the maritime resources (call BG-8-2014) and Coordinating European Observation Networks to reinforce the knowledge base for climate, natural resources and raw materials (SC5-11-2014/2015).

Seas and oceans have a global nature and require **involvement at country and regional levels**. Horizon 2020 is shaped to give an active role to Member States in promoting the potential of the blue economy. Policies, and in particular R&I policies at national and regional levels aim at enhancing the awareness and addressing existing issues to put in place a set of coordinated actions to exploit the broad range of opportunities provided by the blue growth potential.

Member States, in turn, have put in place initiatives to address the blue growth related skills shortage, for example encouraging clusters of industry and education institutions. There are a number of integrated maritime policy initiatives to address the data[95] and planning issues (European Marine Observation and Data Network (EMODnet), Maritime

[95] http://www.emodnet.eu/.

Spatial Planning Directive[96] etc.), showing an increased activity of Member States in blue economy sectors.

One founding element of the EU Blue Growth Strategy is the JPI for Healthy and Productive Seas and Oceans[97] launched in 2011. It gathers 21 Member States sharing a common vision and working towards the same objectives. This JPI is responsible for blue growth priority streamlining and to promote actions in line with the R&I agenda of the Horizon 2020 Programme. 'Cooperation in research is also stimulated through other programmes and initiatives, such as: European Innovation Partnerships (EIPs), JTIs, the European Strategy Forum on Research Infrastructures (ESFRI), and the ERA-NET projects'[98].

4.3. Member State strategies for addressing Commission communication objectives

Even though **Commission communications** are not binding legal documents and Member State initiatives are of their own accord, they still appear to be closely following the Commission communications, using them as a guideline for national strategies and blue economy-related initiatives.

The Sea Basin Strategies[99] on Maritime Policy and the respective Action Plans include specific measures relevant to the EU communications' objectives, for example the CFP, the MSFD and the Maritime Spatial Planning Directive, but also addressing all key sectors of the blue economy (marine biotechnology, mining for minerals, coastal tourism, offshore renewable energy and aquaculture).

4.4. Private Sector contribution

The role of the **private sector** in the blue economy is central for the definition and specification of the R&I requirements. Horizon 2020 involves private stakeholders in the formulation of the R&I agenda. There are several sector-specific initiatives such as LeaderSHIP 2020[100], the Waterborne Platform[101], the Aquaculture Platform[102] and the European Sustainable Shipping Forum[103], which engage private sector representatives and key stakeholders.

Aquaculture is one of the most competitive blue economy sectors in Europe. However, the EU aquaculture sector has to face fierce foreign competition with a huge pressure on market prices, with high labour and capital costs as well as administrative burdens that slow down investments in the sector, hindering the full potential of the EU aquaculture sector. Other issues emerging from the uneven EU regulation constitute a hampering element. That is a scenario of an expanding market for farmed fish and shellfish.

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[96] L 257/135, DIRECTIVE 2014/89/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, of 23 July 2014 establishing a framework for maritime spatial planning.

[97] See http://www.jpi-oceans.eu/.

[98] See http://www.jpi-oceans.eu/european.

[99] See http://ec.europa.eu/maritimeaffairs/policy/sea_basins/index_en.htm.

[100] LeaderSHIP 2020, 'The Sea – New Opportunities for the Future', February 2013 (http://ec.europa.eu/enterprise/sectors/maritime/files/shipbuilding/leadership2020-final-report_en.pdf).

[101] See http://www.waterborne-tp.org/index.php/.

[102] See http://www.eatip.eu/.

[103] See http://ec.europa.eu/transport/themes/sustainable/news/2013-11-19-essf-composition_en.htm.

The trends in **ocean energy** deployment appear modest compared to the offshore wind sector; however, the recent ocean industry 'Vision Paper'[104] indicates a clear outline of needs and vision of the industry.

In **Blue Energy**[105] there is already a significant investment by the private sector over the last decade, and this investment is set to be increased further. It might be useful to increase investor awareness, involving national authorities, development banks, private financiers and project developers. A European Industrial Initiative (EII) could be developed based on the outcomes of the Ocean Energy Forum. Several EIIs have already been established under the SET-Plan[106]. EIIs are public–private partnerships that bring together industry, researchers, Member States and the Commission to set out and achieve clear and shared objectives over a specific time frame. Building large-scale public–private partnerships could be an effective means of sharing risk and leveraging private investment.

4.5. Drivers for a rapid industrial exploitation of ocean resources

The drivers for a rapid industrial **exploitation of ocean resources** are an increased availability of technologies and the relevant resources to develop marketable solutions, but also to address the lack of knowledge by key players. To address the latter point, the European Commission has created EMODnet, to unlock fragmented and hidden marine data resources and to make these available to individuals and organisations (public and private), and to facilitate investment in sustainable coastal and offshore activities through improved access to quality-assured, standardised and harmonised marine data. EMODnet is an initiative of the European Commission Directorate-General for Maritime Affairs and Fisheries (DG MARE) as part of its Marine Knowledge 2020 strategy[107]. Another key driver is a clear and uniform regulatory framework.

4.6. International cooperation in Research and Innovation

International cooperation in the blue economy is one of the key elements of the R&I policy. Most blue growth challenges are global and need to be addressed by joint action undertaken at an international level. International cooperation in R&I for sustainable development and growth of the marine and maritime sectors should be further enhanced, as already recognised by the recently signed Galway Statement (May 2014). The Statement officially launched the Canada–EU–USA Atlantic Ocean Research Alliance[108].

4.7. Coordination between Member States

Organisation of the coordination between Member States is increasingly based on the open method of coordination, in particular in the fisheries area, through the CFP reform. One coordination instrument concerns the sea basin regional strategies, which define a tailor-made strategy for each region[109].

4.8. Joint Programming Initiative on Oceans' efficiency

The mentioned **Joint Programming Initiative on Oceans** is an additional instrument, besides the R&I support instruments, which the Framework Programme puts in place to

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[104] http://www.oceanenergy-europe.eu/index.php/communication/publications.

[105] 'Blue Energy Action needed to deliver on the potential of ocean energy European seas and oceans by 2020 and beyond', EU, 2014.

[106] http://ec.europa.eu/energy/technology/set_plan/set_plan_en.htm.

[107] See http://www.emodnet.eu.

[108] Galway Statement on Atlantic Ocean cooperation launching a European Union - Canada - United States of America Research Alliance (http://ec.europa.eu/research/iscp/pdf/galway_statement_atlantic_ocean_cooperation.pdf).

[109] See http://ec.europa.eu/maritimeaffairs/policy/sea_basins/index_en.htm.

foster the cooperation of Member States to develop common innovation visions and Strategic Research Agendas (SRAs) to address specific societal challenges. The JPI is in charge of a number of activities, which include:

- fostering enabling cross-cutting marine technologies across the maritime sectors;
- fostering the marine bioeconomy in relation to new products, services and jobs;
- creating the best enabling environment to maximise the development of marine renewable energies;
- developing the necessary knowledge and technologies to conquer the new deep sea frontier;
- understanding and mitigating impact of climate change and pressure from human activities on the marine environment, to reach Good Environmental Status of our seas by 2020;
- improving the understanding of marine ecosystems and their processes, in particular the delivery of ecosystem services and the impacts of human activities;
- understanding climate change impact on coastal areas and the design of marine and maritime structures and activities, to optimise mitigation and significantly reduce costly damages;
- developing and sustaining infrastructure to support an integrated data and information base enabling industrial development and supporting maritime governance;
- developing a research-to-policy mechanism, in particular to support the MSFD and marine spatial planning and management;
- to foster the interdisciplinary human capacities necessary to achieve the JPI goals[110].

4.9. How is EU innovation policy being implemented in this domain of activities?

The main EU research and Innovation policy instrument demonstrates a well-developed, integrated approach, providing horizontal and vertical measures. It provides an effective framework developed top down, which is extremely favourable to enable the bottom up proposition of research and innovation activities, which favour the development of Blue Growth and the Blue Economy. The science and technology coverage of Blue Growth is complete, including both direct measures and indirect technology support.

4.10. Measures to improve skills and accelerate access to finance

There are measures in place to **improve skills and accelerate access to finance**, and they include a specific SME instrument. Furthermore, 'the **European Investment Bank** provides SMEs with financing for investments in tourism and/or in convergence regions'[111]. Horizon 2020 has a specific three-stage instrument to support innovation processes in SMEs: the equity instrument of the COSME programme.

4.11. Leading Member States in the blue economy

The Member States that are in the lead in terms of the sectors of the blue economy are, according to the latest available data:

[110] JPI Oceans' Vision Document, 2011.

[111] JPI Oceans' Vision Document, 2011.

Aquaculture	Blue Energy	Coastal & Maritime Tourism	Blue Biotechnology	Seabed Mining	Shipbuilding and Ship repair	Fisheries	Offshore oil and gas
France, UK, Spain, Italy, Greece	UK, Spain, Sweden, Denmark, France, Ireland, Portugal	UK, France, Spain, Portugal, Netherlands, Italy, Greece, Cyprus, Germany, Poland, Denmark, Sweden, Bulgaria, Romania	Ireland, Norway, UK, France, Germany	UK, France, Germany	Germany, Italy, Netherlands, Romania, Turkey	Spain, Denmark, UK, France, Netherlands	UK, Denmark, Netherlands, Italy

4.11.1. How to anticipate and facilitate the emergence of value chains based on sea resources?

Based on the job-creation potential analysis performed for the Blue Growth Study[112], and also considering the potential for research and development to deliver technology improvements and innovation and the need for action at EU level, aquaculture, marine tourism, blue biotechnology, ocean energy and seabed mining are considered the most promising value chains that could deliver sustainable growth and jobs in the blue economy.

The latest Europe 2020 Flagship initiatives focus on and "allow for an assessment of functions across sectors and world-wide, and point out where synergies and supply chain risks can occur"[113].

To facilitate the development of the emerging value chains it is essential that all relevant players at all levels of activity are identified and supported accordingly. This should start with the framework conditions and should also involve any 'backward links' like R&D and design departments, suppliers of equipment and resources as much as any 'forward links' like, distribution and sales[114]. "This is important since large parts of the economic activities take place not in core sectors themselves, but in adjacent economic activities"[115].

4.12. Smart specialisation – Horizon 2020: How is better integration of industrial and regional marine and maritime policies ensured?

Smart specialisation[116] is 'a new innovation policy concept designed to promote the efficient and effective use of public investment in research. Its goal is to boost regional innovation in order to achieve economic growth and prosperity, by enabling regions to focus on their strengths. Smart specialisation understands that spreading investment too thinly across several frontier technology fields risks limiting the impact in any one area. A smart specialisation strategy needs to be built on a sound analysis of regional assets and technology. It should also include an analysis of potential partners in other regions and

[112] Blue Growth Scenarios for Sustainable Growth from the Oceans, Seas and Coasts, Final report, Call for tenders No. MARE/2010/01, August 2012.

[113] Blue Growth, Scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts, Ecorys(2012)

[114] Blue Growth, Scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts, Ecorys(2012)

[115] Blue Growth, Scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts, Ecorys(2012)

[116] See http://ec.europa.eu/research/regions/index_en.cfm?pg=smart_specialisation.

avoid unnecessary duplication. Smart specialisation needs to be based on a strong partnership between businesses, public entities and knowledge institutions – such partnerships are recognised as essential for success.'

4.13. Effectiveness of the measures to support the development of global and new marine value chains

For these sectors but also for other sectors promoting the blue economy, it is essential that there are forward-looking policies, seeking to further enhance and exploit the current potential and make them more appealing to private sector investors. In the Europe 2020 Flagship initiatives, a **growing policy attention is being paid to value chains**; they allow for an assessment of functions across sectors and worldwide, and point out where synergies and supply chain risks can occur. With reference to the maritime functions, the most important value chains were analysed. The core activities for each function or maritime economic activity are surrounded by both upstream and downstream activities. Upstream of the value chain are suppliers of equipment and resources, who may also have their suppliers. Downstream are processing sectors and, subsequently, distribution and sales. For example, shipbuilding has not been treated as an independent sector, but depending on the type of ships incorporated as part of a range of value chains, notably those in short-sea shipping, offshore, cruise shipping, dredging and surveillance[117].

4.14. General policy aspects and recommendations

1) The Blue Growth Strategy is well embedded into the Horizon 2020 Framework Programme, which integrates the specific Blue Growth policy development lines with the complementary scientific and technological areas required.

2) The provisions of Horizon 2020 set up and implement information for policy design, evaluation, monitoring and assessment, and are adequate and appropriate.

3) Horizon 2020 provides an extremely articulate and complex policy framework to support blue growth through R&I to produce scientific, technological, innovation and market competitiveness, as well as societal impacts at the EU and global level. The Blue Growth programme should define targets it aims to meet in terms of science, knowledge and technology, sector, market performance and sea basins.

4) The beneficiaries of the policy support should be classified according to the principal target of their R&I project. Within the framework of needs developed in 1 they should provide quantitative data and qualitative information considering the knowledge creation separately from the innovation aspects:

    a. the academic and research players should define their targets of knowledge creation, scientific output and scientific resources training, as well as the response to overall societal needs;

    b. the business players should define their technological, functional and market targets, as well as the outcomes in terms of economic performance, competitiveness growth and value creation, and consider the wider societal challenges affected.

5) The Blue Growth policy should provide clear rules on how the Blue Growth Strategy should tailor scientific, functional and sectorial needs to the specific characteristics of any given geographical area or sea basin relevant for a blue growth development policy

[117] 'Blue Growth, Scenarios and Drivers for Sustainable Growth from the Oceans, Seas and Coasts', Ecorys, August 2012.

and embed the concept of smart specialisation to provide a regional focus of R&I policy, which the EU Framework Programme at the moment does not have.

6) The FP is appropriately evaluated in its interim and final stages, as well as after its completion. The specific evaluation instruments, specifying approaches and timelines, should be integrated to appropriately take into account the blue growth aspects.

7) The Blue Growth policy subvention rules should clearly specify the requirements to define the impacts of R&I projects on blue growth and how the outcomes should be defined, measured and assessed to determine the actual impacts on the blue growth dimensions.

8) The Blue Growth programme should include:

    a. a target framework for the coordination measures and the JPI, specifying the expected socioeconomic and societal outcomes;

    b. a comprehensive set of rules to measure and assess the immediate and long-term impact of all coordination measures, in particular of the JPI on Oceans, in terms of scientific, technological, market, social and societal dimensions. The set-up of the JPI on Oceans should include specific evaluation and monitoring instruments to assess the overall performance.

9) The Blue Growth programme should put in place appropriate evaluation, monitoring and impact assessment mechanisms to help develop specific value chains in the sectors.

10) The Blue Growth programme should put in place appropriate evaluation, monitoring and impact assessment mechanisms to verify whether blue economy SMEs are capable of building up the necessary critical mass to withstand global competition and whether they are capable of accessing the appropriate business networks.

11) The Blue Growth programme promotes dialogue and coordination among countries and regions, also considering their seas and oceanic basins. The programme set-up and rules should make sure that appropriate evidence is collected on this multi-level dialogue and on the associated actions in the field.

12) The Blue Growth programme should define how the different dimensions (i.e. EU, global, national, regional and basin) are taken into account when defining the relevant policy targets and designing approaches to evaluation, monitoring and impact assessment.

13) To adequately assess the effects of smart specialisation, the Blue Growth programme and the related technological work programmes of Horizon 2020 should define the links to the regional/basin dimensions.

14) Horizon 2020 should establish a specific segment for researcher capacity building and training, which should take into account the specific skills required for blue growth.

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NOTES

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