BLUEAIR PROJECT

BLUE GROWTH SMART ADRIATIC IONIAN S3

D.T.2.1.1

IDENTIFICATION OF BLUE GROWTH AREAS

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Contents

List of Abbreviations

ADRION (AIR) Adriatic-Ionian (region)

BE Blue Economy

BG Blue Growth

CAGR Compound Annual Growth Rate

CICES Classification of Ecosystem Services

EGD European Green Deal

EC European Commission

EU European Union

EUSAIR EU Strategy for the Adriatic and Ionian Region

GVA Gross Value Added

ICT Information and communications technology

IoT Internet of Things

MPA Marine Protected Areas

MRE Marine Renewable Energy

MSP Maritime Spatial Planning

NACE Statistical classification of economic activities in the European Community

OECD Organisation for Economic Co-operation and Development

PV Photovoltaics

R&D&I Research, Development and Innovation

S3 Smart specialization strategy

SDG Sustainable Development Goals

WP Work Package

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Summary

Background

The **main goal** of **BLUEAIR project** is enhancing *institutional capacities* of ADRION countries/regions in the definition of a common approach towards the implementation of the **S3 policy on Blue Growth** at macro-regional level. Blue Growth can represent a **space of opportunities** in the broader context of the **Blue Economy** where it is possible to achieve innovative growth on the principles of **sustainability** and **protection** of the seas. "EU's Blue Economy encompasses all sectoral and cross sectoral economic activities related to the oceans, seas and coasts, including those in the EU's outermost regions and landlocked countries. This includes the closest direct and indirect support activities necessary for the sustainable functioning and development of these economic sectors within the single market. It comprises emerging sectors and economic value based on natural capital and non-market goods and services"[1].

Objective and Approach

Among other specific objectives, **BLUEAIR project aims to identify Blue Growth areas** of macro regional interest and exploit potentials for transnational cooperation in innovation and **Smart specialisation strategy (S3)** development on Blue Growth in the Adriatic- Ionian Sea area. The BLUEAIR project strategic framework consists of several pillars (strategies or initiatives) directly related to the Blue Growth domain: *EU Blue Economy Report*, *EUSAIR strategy*, *New Industrial Strategy for Europe*, *European Green Deal* and *European Data Strategy* with a clear focus on ADRION countries/regions.

This document – Identification of the Blue Growth Areas, creates important cornerstone and framework for all following activities in relation to Work Package 2 (WP2) - Pilot analysis of existing S3, BG Complementary report for ADRION region, Innovation strategy and action plan for innovation investment in the BG and S3 improvement toolkit. Also, identifies areas of the Blue growth within the document serves as a framework in relation to several WP1 activities (e.g. D.T.1.1.1.- Methodology for BG best practice identification).

Main Findings

There are several promising established Blue Economy sectors within Adriatic-Ionian Sea basin: **Marine living resources**, **Maritime transport**, **Port activities**, **Shipbuilding & repair** and **Coastal tourism**.

Several emerging sectors have a good starting point to mature and develop as promising sectors in Adriatic-Ionian Sea basin and produce positive socio-economic impacts to the region in near future: **Desalination**, **Maritime defence**, **Submarine cables and robots**, and **Blue bioeconomy and biotechnology.**

According to the analysis presented in the document there are **two priority focus areas** important to ADRION region: **Primary focus area and Secondary focus area**.

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[1] European Commission (2019). The EU Blue Economy Report. 2019. Publications Office of the European Union. Luxembourg.

Primary focus area represents groups of established and emerging sectors of Blue Economy sectors, which have direct socio-economic, environmental or other important impact within Adriatic-Ionian Sea basin and strongly rely on first Blue Growth pillar of the EUSAIR strategy. These areas are framed by two groups of **established** sector activities – **Living resources** and **Waterborne transport** groups and two **emerging** sectors – **Bioeconomy & Biotechnology** and **Submarine cables & underwater robots**.

Secondary focus area represents remaining established or emerging sectors or sub-sectors which are relevant to Adriatic-Ionian macroregion, today or in near future. Nevertheless, indirect focus areas are still very much connected to the primary focus areas by technologies, interactions, connections, R&D&I activities, solutions, or other common factors which produce significant present of future impact on Adriatic-Ionian region. Secondary focus area sectors are identified through **Coastal tourism** established sectors and **Shipbuilding activities**. Another identified emerging sector is **Desalination** of sea water.

Based on the presented information, economic indicators and overview of the Blue Growth area as well as strategic determinants of both the EUSAIR strategy and the BLUEAIR project, a functional division of the area is proposed for further analysis and activities within the project. Functional framework is divided into areas for initiatives and interventions:

- **Blue technologies** - framework takes into consideration all marine related technologies that are directly or indirectly related to the projects priority focus areas – primary or secondary and would affect innovation and growth within the sectors and/or solutions to be observed through the project scope, dialogues and interaction with quadruple helix actors. These technologies might be divided in several main groups: Marine technologies, Clean technology (Blue Growth related), Information and Communication Technologies - ICT (Blue Growth related)
- **Fields of activities** (i.e. "Blue sectors" from Blue Economy report) – refer to the Primary focus areas of the established and emerging sectors (see previous paragraph).
- **Blue solutions** - Solutions as overarching topic for delivering marine and maritime services that are not merely of public interest only may be aggregated under three groups: **Maritime surveillance**, **Public services and governance** and **Management of marine ecosystem services**

BLUE TECHNOLOGIES
- Marine technology
- Clean technology (BG related)
- ICT technology (BG related)

FIELDS OF ACTIVITY
- Marine living resources (established)
- Waterborne transport and port activities (established)
- Bioeconomy and Biotechnology (emerging)
- Infrastructure and maritime works (submarine cables, robots, drones) (emerging)

BLUE SOLUTIONS
- Maritime surveillance
- Public services and governance
- Management of marine ecosystem services

1. Introduction

1.1.   BLUEAIR project

The main goal of BLUEAIR project is enhancing institutional capacities of ADRION countries/regions in the definition of a common approach towards the implementation of the S3 policy on Blue Growth at macro-regional level.

Among other specific objectives **BLUEAIR project aims to identify Blue Growth areas** of macro regional interest and exploit potentials for transnational cooperation in innovation and Smart specialisation strategy (S3) development on Blue Growth in the Adriatic- Ionian Sea area.

Blue Growth can represent a space of opportunities in the broader context of the Blue Economy where it is possible to achieve innovative growth on the principles of sustainability and protection of the seas.

The areas of Blue Growth in terms of achieving the goals of innovation policies can be in a form of a *technology, sector, solution* or a combination of them in a particular segment of the Blue Economy that shows significant collaborative potential to stakeholders' strive to identify common challenges, find joint solutions creating synergies for prosperity in the Adriatic-Ionian region.

The **EUSAIR strategy** in its last iteration[2], as a **pivotal document**, defined concrete priorities for the macro region through its four pillars. Through the **Action plan**, these priorities were shaped by a bottom-up approach and extensive consultations into actions/projects that appeared promising to respond to the challenges and opportunities shared by the participating countries.

Although, **one of the pillars is directly related to the Blue Growth domain opening up potentials** of the Adriatic-Ionian macro-region, the opportunities that BLUEAIR can identify may be related through secondary focus to some of the sub-themes in the other three pillars.

BLUEAIR project should therefore explore linkages of Blue growth areas toward other strategies (figure1).

Figure 1. BLUEAIR project Strategic framework
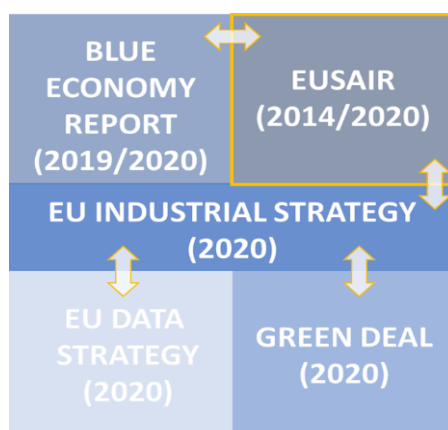
Source: Authors

[2] SWD(2020) 57 final

The European Green Deal[3] **(EGD)** is a new growth strategy aiming to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where economic growth is decoupled from resource use. Further, the EGD is an integral part of the Commission's strategy to implement the United Nations' 2030 Agenda and its seventeen sustainable development goals (SDGs). Several EGD strategies and elements impacts various aspects of the Blue Economy: **The EU Biodiversity Strategy** dealing with conservation of marine ecosystems and the restoration of those degraded, **Farm to Fork strategy** (F2F) aiming at making the food system more sustainable, **Decarbonisation** facilitation through *marine renewable energy, zero-emission maritime transport and ports*[4].

European Data Strategy[5] aims creating a policy environment to make the EU a leader in a data-driven society based on high quality data providing policy makers and citizens base for adequate and informed decisions.

A **New Industrial Strategy for Europe**[6] is a new strategy to help Europe's industry lead the twin transitions towards **climate neutrality** and **digital leadership**. The strategy aims to drive Europe's competitiveness and its strategic autonomy at a time of moving geopolitical plates and increasing global competition.

1.2. Definitions on Blue Economy

Earth's surface is covered with 71% of the ocean, providing humans with the tremendous natural capital, great economic opportunities, and considerable environmental services. Not that long ago, it was considered that oceans' living and non-living natural capital is almost inexhaustible, but in the last 50 years due to the huge economic and oceans' exploitation activities of living and non-living beings and materials, world's oceans were greatly affected by pollution, overfishing, rising sea temperatures and levels, ocean acidification and loss of biodiversity, seabed exploitation, maritime shipping leading to maritime accidents and other environmentally critical activities. From traditional exploitation of living resources (fishing, aquaculture and the processing sector), shipping, fishing and, since the 1960s, offshore oil and gas, new activities are emerging that are reshaping and diversifying maritime industries as new and innovative sectors.

A sustainable **Blue Economy** allows various industries to extract value from the oceans and its coastal regions, where this extraction needs to be balanced with the ocean's sustainability to undergo such activities through the implementation of sustainable practices. Numerous international organisations are involved in addressing challenges of oceans' sustainable usage.

According to **European Commission** - "EU's Blue Economy encompasses all sectoral and cross sectoral economic activities related to the oceans, seas and coasts, including those in the EU's outermost regions and landlocked countries. This includes the closest direct and indirect support activities necessary for the sustainable functioning and development of these economic sectors within the single market. It comprises emerging sectors and economic value based on natural capital and non-market goods and services"[7].

For the **OECD**, "the ocean economy encompasses ocean-based industries (such as shipping, fishing, offshore wind and marine biotechnology), but also the natural assets and ecosystem services that the ocean provides (fish, shipping lanes, CO_2 absorption and the like)"[8].

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[3] COM(2019) 640

[4] COM (2021) 240 final

[5] Commission Communication on "A European Strategy for Data" COM (2020) 66 Final

[6] COM/2020/102 final

[7] European Commission (2019). The EU Blue Economy Report. 2019. Publications Office of the European Union. Luxembourg.

[8] OECD (2016). The Ocean Economy in 2030, OECD Publishing, Paris.

World bank's "the Blue Economy concept seeks to promote economic growth, social inclusion, and the preservation or improvement of livelihoods while at the same time ensuring environmental sustainability of the oceans and coastal areas"[9].

Mentioned definitions are mostly in line and complementing each other.

1.3. Scope of Blue Economy

While definitions are mostly in line and complementing each other, the scope of Blue Economy may vary. OECD[10] is focusing on similar sectors, naming traditional sectors - shipping, fishing and offshore oil and gas, while also detecting new "impressive" offshore wind, tidal and wave energy, oil and gas exploration and production in ultra-deep water and exceptionally harsh environments, offshore aquaculture, seabed mining, cruise tourism, maritime surveillance and marine biotechnology. U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) expands and strengthens the American Blue Economy by leading agency-wide initiatives in the following areas: Marine Transportation, Ocean Exploration, Seafood Competitiveness, Tourism & Recreation and Coastal Resilience[11].

EU's Blue Economy Report[12], aligned with its definition, shifts focus from traditional economic areas – established sectors like living and non-living resources, transport, shipbuilding and tourism to new various emerging and innovative sectors like Blue (ocean) energy (including offshore wind energy and ocean energy), Blue bio economy, Marine minerals, Desalination, Maritime Defence, Research and Infrastructure (Table 1.).

Table 1. List of Blue Economy Report 2021's established and emerging sectors

IDENTIFIED SECTORS BLUE ECONOMY REPORT (2020)	
ESTABLISHED SECTORS	**EMERGING SECTORS**
Marine living resources	Ocean energy
Marine non-living resources	Blue bioeconomy and biotechnology
Marine renewable energy	Marine minerals
Ports activities	Desalination
Shipbuilding and repair	Maritime Defence
Maritime transport	Research and Education
Coastal tourism	Infrastructure and maritime works (Submarine cables, robotics, etc.)

Source: European Commission (2021). The EU Blue Economy Report. 2021. Publications Office of the European Union. Luxembourg.

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[9] World Bank and United Nations Department of Economic and Social Affairs. 2017. The potential of the Blue Economy. Increasing long-term benefits of the sustainable use of marine resources for small island developing states and coastal least developed countries. World Bank, Washington DC:

[10] OECD (n 2)

[11] National Oceanic and Atmospheric Administration (2021). NOAA Blue Economy. Strategic Plan 2021—2025. National Ocean Service website https://oceanservice.noaa.gov/economy/ accessed on 21.01.2021.

[12] European Commission (2021). The EU Blue Economy Report. 2021. Publications Office of the European Union. Luxembourg.

1.4.   The role of Smart Specialisation in the emerging sectors of the Blue Economy

When addressing emerging sectors of the blue economy, there is a challenge regarding the low and inefficient level of information and absence or inconsistent standardised statistical data and indicators, as well as other tools useful for measuring economic impacts. Smart Specialisation's main aim is to strengthen economic competitiveness by adding value to the existing activities, creating opportunities to move up the value chains, creating new solutions and identifying niches able to compete on international markets. This is done through the specific participatory process, including multiple helix approach leading to discovery and promotion of the new and near future perspective market segments and innovation potential. In this way S3s may complement the Blue Economy concepts seeking to highlight new emerging sectors and vice-versa.

1.5.   Blue Growth strategy

The blue economy can be a driver for Europe's welfare and prosperity. In September 2012, the European Commission has launched a Blue growth strategy[13]. It is elaborated in the context of the EU's Integrated Maritime Policy. It focuses upon the potential of the EU's marine and maritime sectors to contribute to sustainable economic development, creation of new jobs and foster innovation. Success in this regard can contribute towards achieving the policy goals set out in the Europe 2020 Strategy[14] for smart, inclusive, and sustainable growth. Strategy outlines guidelines and principles which should be integrated into the relevant EU legislation and policies considering that tailor made regional or local approaches will be needed, due to the diverse characteristics of the EU's various sea-basins. The Europe 2020 Strategy, in its last iteration[15], has identified five sectors that have a high potential for sustainable jobs and growth, such as:

- aquaculture
- coastal tourism
- marine biotechnology
- ocean energy
- seabed mining

Along five potential sectors, the strategy has highlighted important sea basin strategic approach to foster cooperation between countries. It has identified seven sea-basins:

- Adriatic and Ionian Seas
- Arctic Ocean
- Atlantic Ocean
- Baltic Sea
- Black Sea
- Mediterranean Sea
- North Sea

Sea-basin strategies provide a framework for cooperation between the EU member states and their regions and, where appropriate, third non-EU countries sharing the same sea basin. Such strategies strive to identify common challenges, find joint solutions creating synergies for prosperity of the entire region.

1.6.   EUSAIR Strategy for Adriatic and Ionian Sea Basin

In June 2014, the Commission launched the **EU strategy for the Adriatic and Ionian region (EUSAIR)[16]**. It mainly addresses the opportunities of the maritime economy – **Blue Growth, land-sea transport and energy connectivity, protecting the marine environment and sustainable tourism sectors**. The starting point for the EUSAIR was the Maritime strategy for the Adriatic and Ionian Seas[17], adopted by the Commission in late 2012 and now part of the macro-regional strategy.

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[13] COM(2012) 494 final
[14] COM(2010) 2020
[15] SWD(2017) 128 final
[16] SWD(2014) 190 final
[17] COM(2012) 713 final

2. Blue Economy in the EU

2.1. Global Overview

The output of the global ocean economy in general is estimated at EUR 1.3 trillion today with potential to almost double, depending on scenario, by 2030[18]. In other words, many ocean-based sectors or industries may outperform their land base counterparts in terms of value added and employment (Figure 2).

Figure 2. Value added of ocean-based industries in 2010 (left) and in 2030 (right) by industry
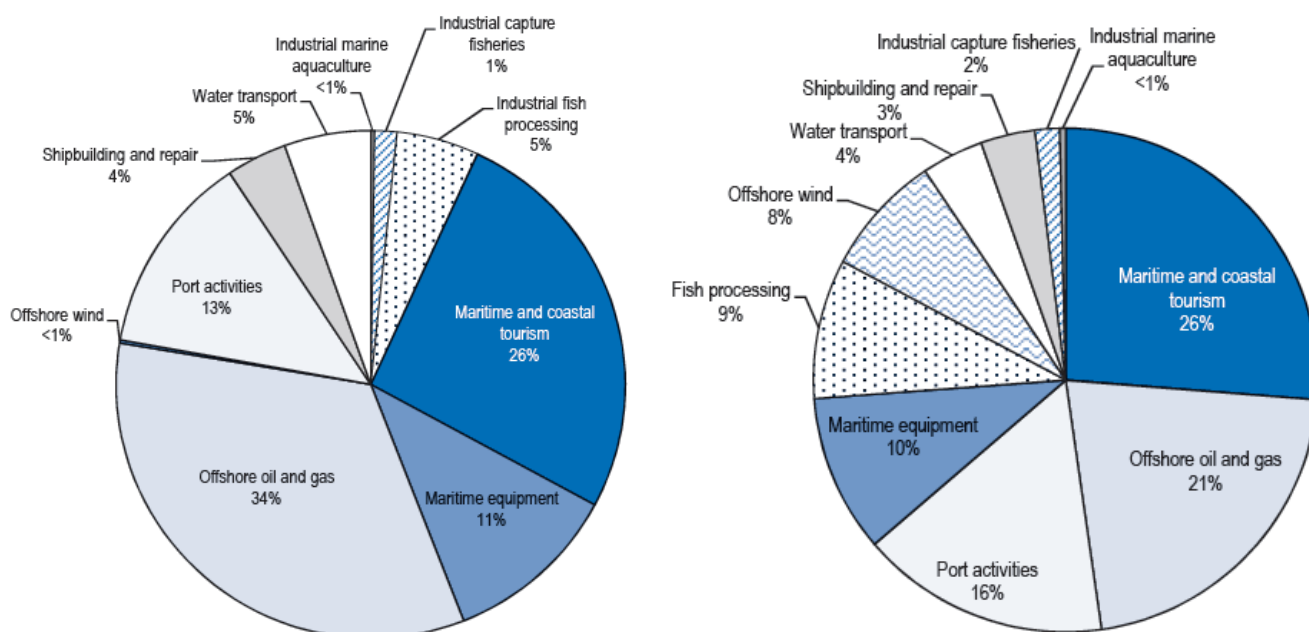
Source: OECD (2016). The Ocean Economy in 2030

2.2. EU Perspective

In the context of the overall EU economy, Blue Economy is evolving rapidly as a source of food, energy, transport or leisure and direct driver for economic prosperity through innovations and new jobs.

To enable successful blue growth, there is a necessity for available data needed for analysis and cumulative knowledge about the sea and its utilization. Therefore, European Commission has published several editions of **EU Blue Economy Report**. Most recent report (2021) still builds on data for 2018 but excluding the United Kingdom from the report and analysis since the UK is no longer a member of the EU (since February 2020). The report covers both established sectors and at emerging activities that offer an insight into the future. As a great analytical asset, the Report is accompanied by the **Blue Economy Indicators** (BEI), an IT interactive tool holding databases needed for analytical breakdowns to guarantee transparency[19]. Blue Economy Indicators are in line with the European Commission's European Data Strategy[20], ensuring better and transparent data usage. According to the Report, EU's Blue economy covers sectoral and cross-sectoral economic activities based on or related to the oceans, seas and coasts:

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[18] OECD (n 2)

[19] The Blue Economy Indicators tool can be accessed through the online dashboard available at: https://blueindicators.ec.europa.eu/ .

[20] Commission Communication on "A European Strategy for Data" COM (2020) 66 Final

- **Marine-based activities**: include the activities undertaken in the ocean, sea and coastal areas
- **Marine-related activities**: activities which use products and/ or produce products and services from the ocean or marine based activities

Major contributor to the EU Blue Economy are the **established sectors**. Due to their nature, in these sectors most complete, accurate, comparable and updated data is available. Each sector is further divided into subsectors where each sub-sector is corresponding with adequate NACE[21] rev. 2 code (Table 2).

Table 2. The Established Blue Economy sectors and their subsectors

Relation to the sea	Sector	Subsector
Marine-Based activities	**Marine living resources**	Primary sector
		Processing of fish products
		Distribution of fish products
	Marine non-living resources	Oil and Gas
		Other minerals
	Marine renewable energy	Offshore wind energy
	Maritime transport	Passenger transport
		Freight transport
		Services and transport
	Coastal tourism	Accommodation
		Transport
		Other Expenditure
Marine-Related activities	**Port activities**	Cargo and warehousing
		Port and water projects
	Shipbuilding and repair	Shipbuilding
		Equipment and machinery

Source: European Commission (2021). The EU Blue Economy Report. 2021

2.3.   Status of Established and Emerging sectors

According to report by the OECD (2016), Europe accounts for 11.6% of the global ocean economy for 2010. **If not otherwise indicated, all data and analyses based on the EU Blue Economy reports would contain data based on the 2019 and 2020 version reports, which includes EU-28 states including the United Kingdom.** Based on the figures for 2018, by EU Blue Economy Report 2020 (EU-28 states, including the UK)[22], seven established sectors of the directly employed close to 5 million people and generated around €750 billion in turnover and €218 billion in gross value added (GVA[23]) in 2018 (Table 3).

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[21] NACE is the "statistical classification of economic activities in the European Community" and is the subject of legislation at the EU level, which imposes the use of the classification uniformly within all the Member States

[22] This report covers periods for the 2009-2018 but includes the United Kingdom as part of the European Union (EU-28)

[23] GVA – gross value added (at factor cost). GVA is conceptually close to GDP (gross domestic product). GVA is defined (ESA 2010, 9.31) as output value at basic prices less intermediate consumption valued at purchasers' prices. GVA is calculated before consumption of fixed capital.

Table 3. EU Blue Economy established sectors, main indicators, 2018 (EU-28)

Indicator	EU Blue Economy 2018
Turnover	€750 billion
Gross value added	€218 billion
Gross profit	€94 billion
Employment	5 million
Net investment in tangible goods	€14 billion
Net investment ratio	22%
Average annual salary	€24,700

Source: European Commission (2020). The EU Blue Economy Report. 2020

Most propulsive Blue economy sectors, regarding employment and GVA evolution in period between 2009-2018 are *Maritime renewable energy* (by far), *Port activities* and *Maritime transport* which all record increase in both employment and GVA percentage figures. *Maritime living resources*, *Shipbuilding & repair* and *Coastal tourism* figures show double figures raise of GVA percentage figures in comparison with 2009 despite single percentage figures downfall in employment. Most enterprising sector is *Marine renewable energy* with its Offshore wind energy subsector which was basically non-existent in 2009 with only 600 jobs and GVA of 79 million €, raising to 4600 jobs and GVA of 1.2 billion € in 2018 (Table 9, Annex).

Only **regressive** traditional sector is *Marine non-living resources* activity that records negative figures in both employment and GVA terms due to continuing low oil-and gas global prices with high operational costs for offshore installations resulting of shifting operations to inland oil and gas installations.

EU Blue Economy encompasses few cross-sectoral economic activities which are based on **relation to the seas** (see figure 4.). Both relations, **sea-based** and **sea-related activities**, are further divided into traditional or established and new, emerging activities. Established sectors are easy to analyse due to structured data collected by the European Commission through Member States and the European System of Statistics (and other related data sources such as Structural Business Statistics, PRODCOM, National accounts and tourism statistics etc.) Each sector mostly has sub-sectors, which are further broken-down into activities (e.g. NACE rev. 2 code). On the other hand, emerging and innovative sectors have a problem with absence of economic indicators (e.g. NACE codes) but more data is becoming available such as output and production capacity in order to find comparable ways of monitoring and measuring these sectors.

Listed below is group of **established sectors** and their present status and outlook via identified trends and drivers within EU's Blue Economy.

2.3.1. Marine living resources

Marine living resources as traditional, established activity includes extraction and commercialization of marine living resources and their conversion into food, bio-based products and bioenergy and finally their distribution through the supply chain.

Sector contribution to the EU Blue Economy (2018): 11.5% of jobs / 9.6% GVA / 9% profits

- The sector employed 573.300 people (-3%) and generated EUR 21 billion (+24%) in GVA and EUR 8.4 billion (+34%) in profits

Subsectors contributions to the EU Blue Economy and comparison 2009-2018):

- *Primary sector*: 218.225 jobs (-10.7%); € 6.3 billion GVA (+33%); € 12.9 billion turnover (+13.6%)
- *Processing of fish products*: 145.270 jobs (+3.4%); € 6 billion GVA (+23.2%); € 35.7 billion turnover (+35.7%)

- *Distribution of fish products*: 209.810 jobs (+1.4%); € 8.6 billion GVA (+17.8%); € 80.4 billion turnover (+24.9%)

Trends and drivers

Economic performance is expected to improve in primary sector as fish stock recovers and capacity continues to adapt while operational costs stay low (low fuel price). Aquaculture sector has very high production standards in different terms (environmental protection, animal health, public health etc.).Large operators base their production on big numbers while few market players concentrate along the distribution chain. Adding value to the product may enable producers in downstream part of the value chain to collect additional value. Certified products with sustainable seafood labels are getting ground as a new market trend.

2.3.2. *Marine non-living resources*

Sector includes exploitation of EU seas and oceans for marine non-living resources, namely offshore oil and gas. Around 80% of EU oil and gas production takes place offshore. Most production takes place in the North Sea and with some extent in the Mediterranean and Black Seas. Besides oil and gas, subsector includes extraction of sand, clay, kaolin and salt extraction from the sea.

Sector contribution to the EU Blue Economy (2018): 1% of jobs / 9% GVA / 16% profits.

- The sector employed 47.000 people (-28%) and generated EUR 19.6 billion (-29%) in GVA and EUR 14.9 billion (-31%) in profits.

Subsectors contributions to the EU Blue Economy and comparison 2009-2018:

- *Oil and gas*: 45.300 jobs (-28.6%); € 19.4 billion GVA (-28.9%); € 42.9 billion turnover (-59.2%)
- *Other minerals*: 1.700 jobs (-21.8%); € 146 million GVA (-19.7%); € 453.5 million turnover (-26%)

Trends and drivers

Oil and gas subsector is in steep decline due to low oil and gas global market price causing decreasing production with high production costs typical for technical demanding offshore operations. Another important factor is clear strategy towards clean energy, in respect with the European *Green Deal*. On the other side, *Other minerals* subsector is forecasted to rise due to increasing demand from construction sector.

2.3.3. *Marine renewable energy (MRE)*

In broader sense, marine renewable energy includes all renewable energy sources that can be generated off the coast such as offshore wind energy, ocean energy and floating solar PV. MRE sector is most important source of green energy. *Fixed offshore wind* is only subsector commercially available and offers available data making it only viable candidate for list of established sectors. Other MRE technologies are at development stage and not yet commercially available (wave energy, tidal energy, salinity gradient energy and ocean thermal energy conversion). Those activities are therefore grouped in emerging sectors.

Sector contribution to the EU Blue Economy (2018): 0.1% of jobs / 0.5% GVA / 0.9% profits.

Subsector contribution to the EU Blue Economy and comparison 2009-2018:

- *Offshore wind energy*: 4.600 jobs (+695%); € 1.1 billion GVA (+1276%); € 4 billion turnover (+1185%)

Trends and drivers

Most installations have been installed in North Sea due to relatively shallow waters. The EU Commission has invested over the years around €300 million in R&D&I mainly focused on cost reduction, performance and reliability. Investment in R&D of offshore wind floating structures for deeper waters has been encouraged.

2.3.4.   Maritime transport

Global maritime transport produces around 3-4% of annual GHG emissions, and it is still considered the most effective way of transport considering pollution per each tonne transported. Despite that fact, there is big potential of reducing GHG footprint by shifting to alternative fuels and improving energy efficiency of ships. Due to expected growth of global and intra-EU trade and rise of cruise and ferry passenger transport, maritime transport has bright future.

Sector contribution to the EU Blue Economy (2018): 62% of jobs / 41% GVA / 34% profits.

- The sector employed 407.800 people (+7%) and generated EUR 35.6 billion (+19%) in GVA and EUR 18.8 billion (+22%) in profits.

Subsectors contributions to the EU Blue Economy and comparison 2009-2018:

- *Passenger transport*: 116.430 jobs (+19%); € 9.7 billion GVA (+56.8%); € 27.4 billion turnover (+42.6%)
- *Freight transport*: 102.200 jobs (-19.3%); € 14.4 billion GVA (-0.4%); € 98.4 billion turnover (+25.6%)
- *Services and transport*: 189.200 jobs (+21.4%); € 11.5 billion GVA (+24.6%); € 47.4 billion turnover (+35.1%)

Trends and drivers

Increasing ship sizes in all freight and passenger segments helps to lower operational costs while also causing noticeable impact on port infrastructure. To achieve ambitious decarbonisation goals of EU Green deal and International Maritime Organisation it requires significant R&D&I push, especially in field of technologies and innovations regarding large scale usage of alternative fuels. In segment of large, deep-sea vessels, several transitional solutions were proposed, such as Liquid Natural Gas (LNG) and biofuels. Alternative fuel in a form of **"green" hydrogen,** produced using renewable energy, may have significant impact in future on lowering GHG footprint[24]. It would require significant changes in ship designs and port distribution infrastructures. Main trend in short-sea segments is development of hybrid and fully electrified power trains and zero-emission applications.

2.3.5.   Coastal tourism

Tourism is by far the biggest sector of all established Blue economy sectors. In recent years, coastal tourism accounts for more than a half (2018, 51.7%) of the EU's touristic accommodation capacities. Due to favourable climatic conditions, coastal tourism activities are mainly concentrated in southern EU member states (Malta, Cyprus, Greece, Croatia, Portugal, Spain) with more than three quarters share compared to rest of EU.

Sector contribution to the EU Blue Economy (2018): 8% of jobs / 16% GVA / 20% profits.

- The sector employed 3.096.700 people (0%) and generated EUR 88.6 billion (+20%) in GVA and EUR 32.3 billion (+44%) in profits.

Subsectors contributions to the EU Blue Economy and comparison 2009-2018:

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[24] EU Blue Economy Report 2020.

- *Accommodation*: 1.224.700 jobs (-13.9%); € 41.1 billion GVA (+10.7%); € 84 billion turnover (+10.8%)
- *Transport*: 453.800 jobs (-6%); € 20.7 billion GVA (+29.5%); € 71.1 billion turnover (+18.8%)
- *Other expenditures*: 1.418.100 jobs (+18.1%); € 26.8 billion GVA (+28.3%); € 94.4 billion turnover (+23.6%)

Trends and drivers

The coastal tourism sector was strongly impacted by global economic crisis in 2009 causing gradual fall in employment until 2015. Since then sector is marked with strong recovery resulting in raising employment numbers to pre-crisis levels. Based on increased numbers, many destinations have negative impacts caused by high intensity of tourists in relation to sea pollution, devastation of coastline and sea floor. COVID-19 outbreak will cause huge negative economic impact due to travel restrictions across the globe. Rapidly growing coastal segment is **cruise tourism** which follows trends in other sectors connected with raising number of cruise ships made in EU (globally, most cruise ships were constructed in EU). Sectors which most benefitted from tourism were manufacturing (€17.4 billion), financial businesses and services (€11.2 billion).

2.3.6. Port activities

Port activities support economic development, trade, tourism, and job creation across EU. More than 90% of Europe's cargo trade in goods passes through more than 1200 seaports and there's also the pass-through of hundreds of millions of passengers boarded on cruisers and ferries. Ports act as multi-activity transport and logistic hubs, supporting other economic activities.

Sector contribution to the EU Blue Economy (2018): 11% of jobs / 16% GVA / 15% profits.

- The sector employed 549.300 people (+20%) and generated EUR 35.2 billion (+24%) in GVA and EUR 14.6 billion (+16%) in profits.

Subsectors contributions to the EU Blue Economy and comparison 2009-2018:

- Cargo and warehousing: 362.400 jobs (+45.9%); € 18.1 billion GVA (+46.9%); € 53.2 billion turnover (+64.9%)
- Port and water projects: 187.000 jobs (-10.3%); € 17.1 billion GVA (+6.5%); € 38.2 billion turnover (+13.6%)

Trends and drivers

Ports across the EU have huge differences in terms of efficiency and productivity. Implementation of new port infrastructure is imperative, due to new trends regarding increasing of ship sizes, especially additional capacity, logistics infrastructure and port superstructures. It is important to maintain excellent infrastructure connections with port hinterland. New trend is **Green Ports,** which describes the actions that ports undertake to transform their processes, structures or policies to lessen their environmental and climate impact[25]. Main green port activities includes: Energy and fuels, Climate mitigation and adaptation, Environmental pollution reduction, Waste and noise management, Maritime and hinterland transport connections, Linkages to circular economy models, Management, policy and finance. Focus point is on energy and fuels topics which cover upgrading port activities and infrastructure concerning new alternative fuels for deep-sea vessels and onshore power supply for hybrid and electric powered short-sea vessels.

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[25] Bergqvist, R. and J. Monios. (2019). Green Ports: Inland and Seaside Sustainable Transportation Strategies. Elsevier

2.3.7. *Shipbuilding and repair*

European shipyards have global market order book share of only 15% but in terms of value that share is at 34%[26]. That is because EU shipyards produce complex and technologically advanced high value-added ships and structures including maritime related hardware with highly skilled workforce.

Sector contribution to the EU Blue Economy (2018): 6% of jobs / 8% GVA / 5% profits.

- The sector employed 318.300 people (-10%) and generated EUR 17.3 billion (+32%) in GVA and EUR 4.7 billion (+126%) in profits.

Subsectors contributions to the EU Blue Economy and comparison 2009-2018:

- Shipbuilding: 269.500 jobs (-12.8%); € 14.2 billion GVA (+32.8%); € 49.1 billion turnover (+13.1%)
- Equipment and machinery: 48.800 jobs (+12.1%); € 3.1 billion GVA (+30%); € 10.1 billion turnover (+14.8%)

Trends and drivers

Trends are in close relation to maritime transport sectors implying need for alternative fuel for deep-sea and short-sea vessels in order to reduce GHG footprint. Besides fuel, trends are pointing to development and construction of new intelligent autonomous ships, fleet monitoring optimization solutions, underwater autonomous vehicles, sensors and related innovative maritime equipment and solutions.

2.3.8. *Groups of Emerging sectors*

Emerging sectors of Blue Economy are represented by new/innovative sectors or by those for which data is emerging and which have significant socio-economic impact on overall Blue economy. However, data gaps are still present so comparison by usual economic indicators cannot be executed. Therefore, alternative indicators have been used for purpose of identification.

2.3.8.1. *Marine renewable energy*

All not yet consolidated offshore technologies are grouped in this emerging sector (Floating offshore wind with anchored floating installations, ocean energy (tidal and wave power), floating solar photovoltaic (FPV) and offshore renewable hydrogen production). Only offshore wind bottom fixed installation represents commercially available subsector and is therefore presented in established sector group.

Floating offshore wind is a growing subsector based on offshore floating structures meant for deeper waters (more than 60 meters), not suitable for shallow type installations typical for the North Sea and Baltics. Currently, total installed capacity on pilot installations equals 45 MW with potential up to 4540 GW[27] out of which around 3000 GW would be located in deep sea locations. Main concerns are focused on enhancement of floating substructure types which are still in pilot and prototype status.

Wave and tidal energy are still in early R&D stage. Several technologies are present to create electricity based on wave energy, tidal stream and range, thermal energy conversion and salinity gradient. Highest resource potential exists along the Atlantic coast and localised areas in the Baltic and Mediterranean seas.

Floating solar photovoltaic energy is based on structures installed on lakes and hydropower reservoirs. Structures are based on floating base with installed solar panels. Main challenges for sea utilisation concern

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[26] Sea Europe (2020). SEA MM Report No 48.
[27] JRC (2020). Technology Development Report LCEO: Wind Energy. Forthcoming

resilience of the structure to the marine harsh environment. Concept is still in R&D phase but offers big potential for various offshore installations or small islands in need of electrical power.

Hydrogen generation offshore production is the main focus of many industries, mainly as alternative fuel for vehicles and vessels. The offshore hydrogen generation has big potential due to advantages of producing large quantities with low cost storage and transport. Many old oil and gas platforms could be re-purposed for renewable hydrogen production. Tidal energy or offshore wind may be coupled with green hydrogen production and subsea storage. Most pilot programmes are ongoing in the North Sea region.

2.3.8.2. Blue Bioeconomy and biotechnology

This emerging sector includes extraction of renewable marine living resources to produce food, feed, pharmaceuticals, cosmetics, bio-based products and energy. Essentially, sector's activities include exploration and exploitation of aquatic organisms, besides traditional fisheries and aquaculture products, in order to develop new innovative products and services. These organisms include three groups: macroalgae (seaweeds), microorganisms (microalgae, bacteria, fungi) and invertebrates (sea stars, sea cucumbers etc.)

The algae subsector is most developed subsector of the Blue Bioeconomy. Algae sector includes microalgae, macroalgae (seaweeds) and cyanobacteria (spirulina). While global algae biomass production (mainly China and Indonesia) is increasing (33 million wet tonnes in 2016) only 0.57% (0.2 million tonnes) was produced in EU (mainly by Norway and Ireland) [28]. Along with economic sectorial benefits, algae have big ecological potential which can contribute to food and ecological sustainability of the seas.

2.3.8.3. Marine minerals

Sector includes marine minerals and metals in or on the seabed (e.g. manganese, copper, cobalt) and chemical elements dissolved in seawater other than marine aggregates (sand, gravel, salt) included as sub-sector in Marine non-living resources. Due to potentially high operational costs seafloor mining must be economically justified. Seabed extraction has to deal with several challenges including mapping of reserves, mining technology and management of the irreversible environmental impacts. No commercial deep seabed-mining projects exist under national jurisdiction of the EU Member states. In 2018, the European Parliament adopted a resolution (2017/2055(INI)) on international oceans governance, regarding moratorium on deep-sea mining until the risks to the environment are fully understood.

2.3.8.4. Desalination

Desalination is Europe's emerging sector closely related to scarcity of freshwater supply. Besides for drinking water, such produced desalinated water is used in offshore industrial processes and for irrigation purposes. It is projected that many regions in the EU are expected to face severe water shortages by 2050[29]. Most common technologies in use are reverse osmosis (RO) with stake of 85.5% and electrodialysis (ED) with 8% of the total capacity. The desalination process is energy intensive and is expected to increase eight-fold by 2040 due to increased demands for freshwater produced by desalination, which offers big potential for renewable energy driven desalination plants (Figure 3).

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[28] European Commission (2019a). Brief on algae biomass production. ISBN: 978-92-76-12270-8
[29] Bisselink et al. (2018) Impact of a changing climate, land use, and water usage on Europe's water resources: A model simulation study. JRC Technical reports.

Figure 3. Location of Mediterranean desalting facilities.
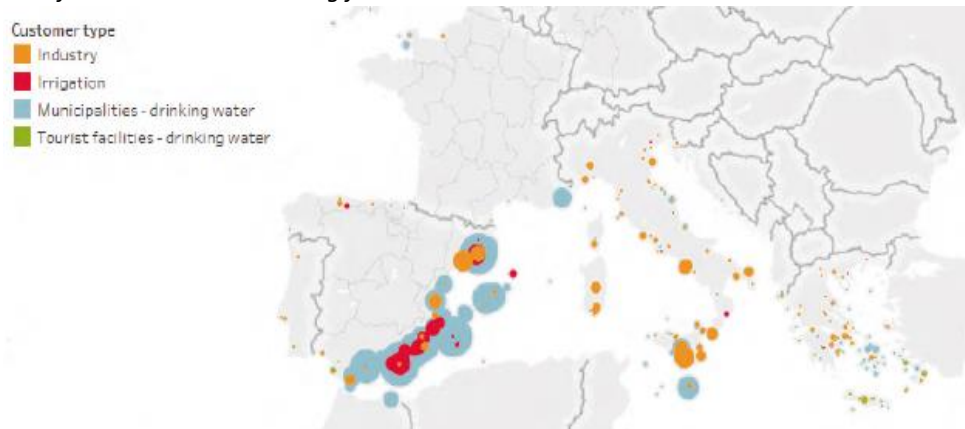
Source: Desaldata

2.3.8.5.   *Maritime defence*

Maritime defence sector with focus on navies is not a new sector but has been included as emerging sector not because of new activities but rather because of the slow emergence of its data. Maritime defence sector is important contributor to the Blue economy.

Importance of the sector lies in the fact that Naval shipbuilding industry is an innovation driven industry and intensive in R&D&I activities (almost double that of the civil sector). Therefore, technology transfers from navies to civil industries have great economic impacts.

Yearly turnover of European naval shipbuilders is more than €10 billion (new vessels) and more than €4 billion for maintenance and repair.

2.3.8.6.   *Research and Education*

Research and innovation is a central driver in relation with the EU Green Deal and sustainable Blue Economy as well. As stated in the EU Blue Economy report 2021 "a forward-looking, mission-oriented and impact-focused research and innovation agenda is a critical lever to drive the transition towards a sustainable Blue Economy. Science and evidence-based policies lead to effective actions. In the context of its commitment to the better regulation[30], the European Commission sources sound scientific evidence from an extensive network of internal services and external partners - starting from the JRC, i.e. the in-house science and knowledge service of the European Commission with the mission to provide independent scientific evidence throughout the policy cycle. In addition, the EU actively promotes cross-disciplinary research and innovation to tackle societal challenges[31]." Based on the new Horizon Europe Framework Programme[32] majority of Horizon 2020 funding dedicated to the Blue Economy was invested in Ocean Observation, followed by Blue Growth and Blue biotechnology. Additionally, funds were allocated to research dedicated to Blue biotechnology beyond algae.

Education and skills are essential for personnel working in the BE industries. There is lack of well-trained professionals and highly-skilled workers. Some identified challenges based on the European Skills Agenda for sustainable competitiveness social fairness and resilience[33] includes: Lack of communication and cooperation

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[30] COM(2019) 178
[31] European Commission (2015). Strengthening Evidence Based Policy Making through Scientific Advice.
[32] https://ec.europa.eu/info/horizon-europe_en , accessed: 05.07.2021.
[33] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1196, accessed: 05.0.2021.

between education and industry; Attractiveness and awareness of career opportunities in the Blue Economy; Ocean literacy culture. As example, 17-32% of offshore renewable energy companies are experiencing skills gaps, while in technical occupations, 9 to 30% are experiencing skills shortages[34]. In the future, Member States will need to provide more education and training schemes targeting the offshore renewable energy sector in line with their expected development targets, as to attract young workers and re/upskill workers to offshore renewable energy jobs.

2.3.8.7. *Infrastructure and maritime works (submarine cables, robots, drones)*

Submarine cables sector is a new perspective emerging sector with great importance as critical infrastructure of strategic importance due to its role in global communications and energy transfers.

Expected duration of submarine cables is around 25 years due to harsh environment. Thus, this economic activity requires significant operational and capital expenses and constant innovation on cables specification (e.g. greater capacity) and upgrading of necessary engineering skills embedded with use of special ships, equipment (ploughing equipment) and submerged vehicles (remotely operated vehicles - ROVs).

Submarine cable network consist of several groups[35]:

- landing points where submarine cables connect with terrestrial power and telecommunication grids;
- telecommunication cables that provide both telecom and data connections;
- power cables for energy transfer;
- scientific cables that transfer data from marine or remote areas for the purpose of scientific research

Out of 378 submarine cables in service, 205 were connected to EU Member States with the length of around 564.000 kilometres.

Maritime technology: robotics, underwater drones, maritime airborne drones are result of emerging digitalisation and technological innovation into maritime sector. Underwater robots are used for various purposes in the maritime domain, such as surveys, scientific research, oil and gas exploration, border surveillance, underwater infrastructure inspection and works, aquafarming etc. in challenging environmental situations. Two of the main types of unmanned water vehicles are Remotely Operated Vehicles (ROV) and Autonomous Underwater Vehicles (AUV). Other types of robotics used in the maritime environment are for example the Remotely Piloted Aircraft System (RPAS), very often used in surveillance operations.

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[34] COM/2020/741 final.
[35] EU Blue Economy Report 2020

3. EU Blue Economy's Sectors Related to Adriatic-Ionian Sea Basin

Eight established Blue Ecomony sectors have significant relevance across the EU (Table 4.), but some sectors have higher relevancy in specific sea basins or even geographic areas within the same sea basins. This is due to different geographic positions, climate, sea basin depth, biodiversity, geological compositions, ocean or sea conditions, transport routes etc. **Analysis is based on the EU Blue Economy Report 2020 including the United Kingdom.**

The aim is to provide an estimation of each established sector, mainly in terms of GVA and employment, in order to determine relevant currently and future impact on Adriatic-Ionian Sea basin (Figure 4.).

Table 4. EU Member States participating in the different sea basins (EU-28)

Northern Waters			Mediterranean				Black Sea
Atlantic	North Sea	Baltic Sea	Mediterranean	West MED	East MED	Adriatic-Ionian	
ES	BE	DE	CY	ES	CY	EL	BG
FR	DE	DK	EL	FR	EL	HR	RO
IE	NL	EE	ES	IT		IT	
PT	UK	FI	FR	MT		SI	
UK	DK	LT	HR	PT			
	SE	LV	IT				
	FR	PL	MT				
		SE	SI				

Source: Commission Services

Regarding countries which belong to two sea basins (e.g. Italy belongs to West Mediterranean and Adriatic-Ionian Sea basins), specific proportions were calculated[36] for each year in the time series (2009 – 2017).

Figure 4. EU regions belonging to Adriatic-Ionian Sea Basin

Source: European Commission, based on NUTS 2016, level 3. Administrative boundaries

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[36] For instance, in 2016 in Italy, total employment of the NUTS 3 regions participating in the Adriatic – Ionian strategy amounted to 7.3 million people, while all NUTS 3 coastal regions had a total employment of 13.7 million; that is 53.4% of employees. Similarly, the GDP of NUTS 3 regions in the Adriatic Ionian amounted to €450 billion while the GDP of all NUTS 3 coastal regions in Italy amounted to €860 billion; that is 51.9%. The average of both values, i.e. 52.6%, was used to estimate how much of the employment and GVA from the Italian Blue Economy is generated in the regions participating in the Adriatic – Ionian strategy.

3.1. Employment

In 2017, **employment** in Adriatic-Ionian Sea basin has reached 851.900 people which is 19% with respect to the EU total Blue economy (4.475.800 employees) (Figure 5).

Figure 5. Employment by sea basin (thousands employees)
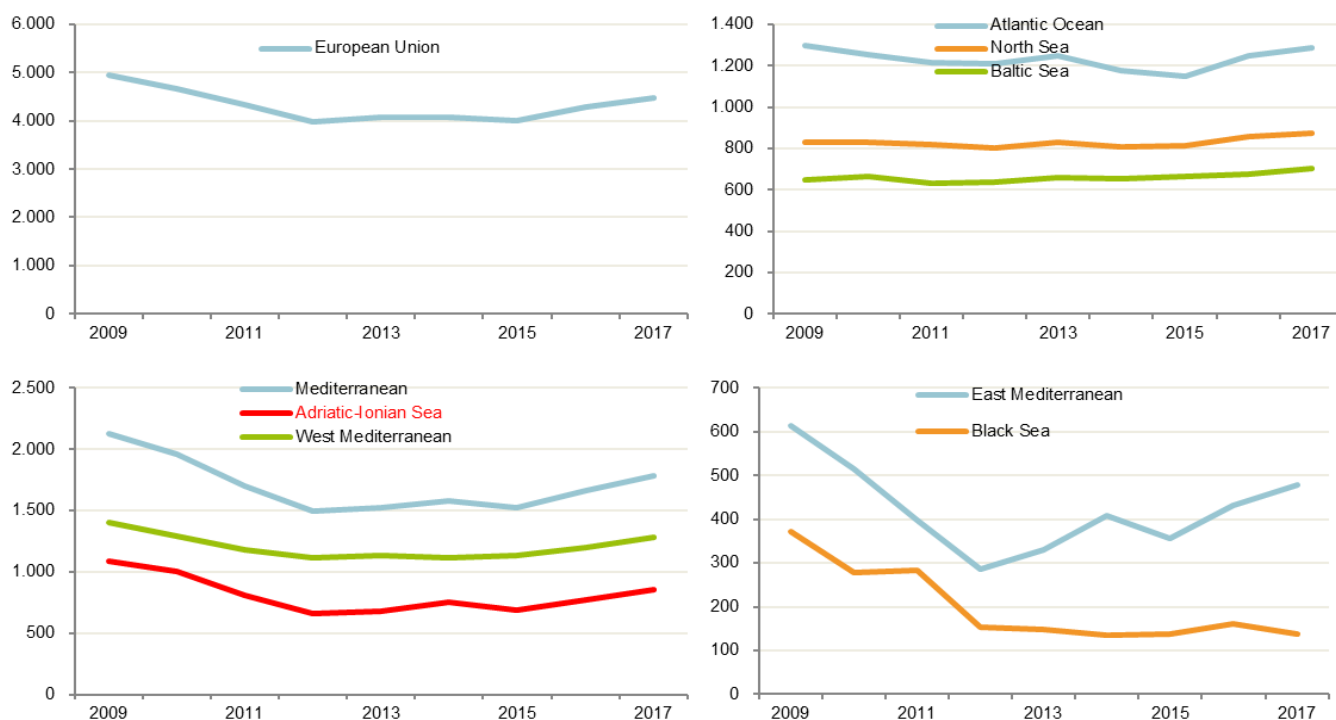
Source: European Commission: The EU Blue Economy Report.

In Adriatic-Ionian Sea basin, almost two thirds of 618.300 people are employed in Coastal tourism sector (72.6%) or 24% out of EU total Coastal tourism employees. Living resources sector comes second with 87.100 employees (10.2%) or 15.3% in EU Living resources sector with notable Maritime transport with 63.600 employees (7.5%) or 15.6% with respect to the EU total Maritime transport sector. Non-living resources record minimum employment (2.500 people) and Marine renewable energy records no employees (Figure 6).

Figure 6. Employment by sector for Adriatic-Ionian Sea Basin, 2017 (thousands employees)
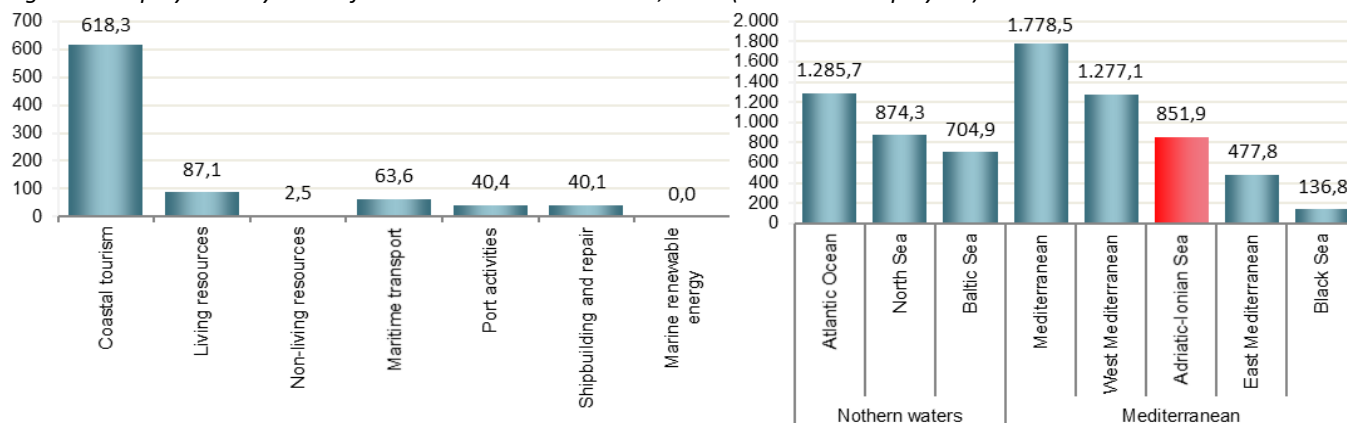
Source: European Commission: The EU Blue Economy Report.

3.2. Gross Value Added (GVA)

Regarding **GVA** figures, Adriatic-Ionian Sea basin has reached 22,6 € billions, which is 11% of the total EU Blue Economy (GVA 205.6 € billions) (Figure 7).

Figure 7. GVA by Sea Basin (€ billion)
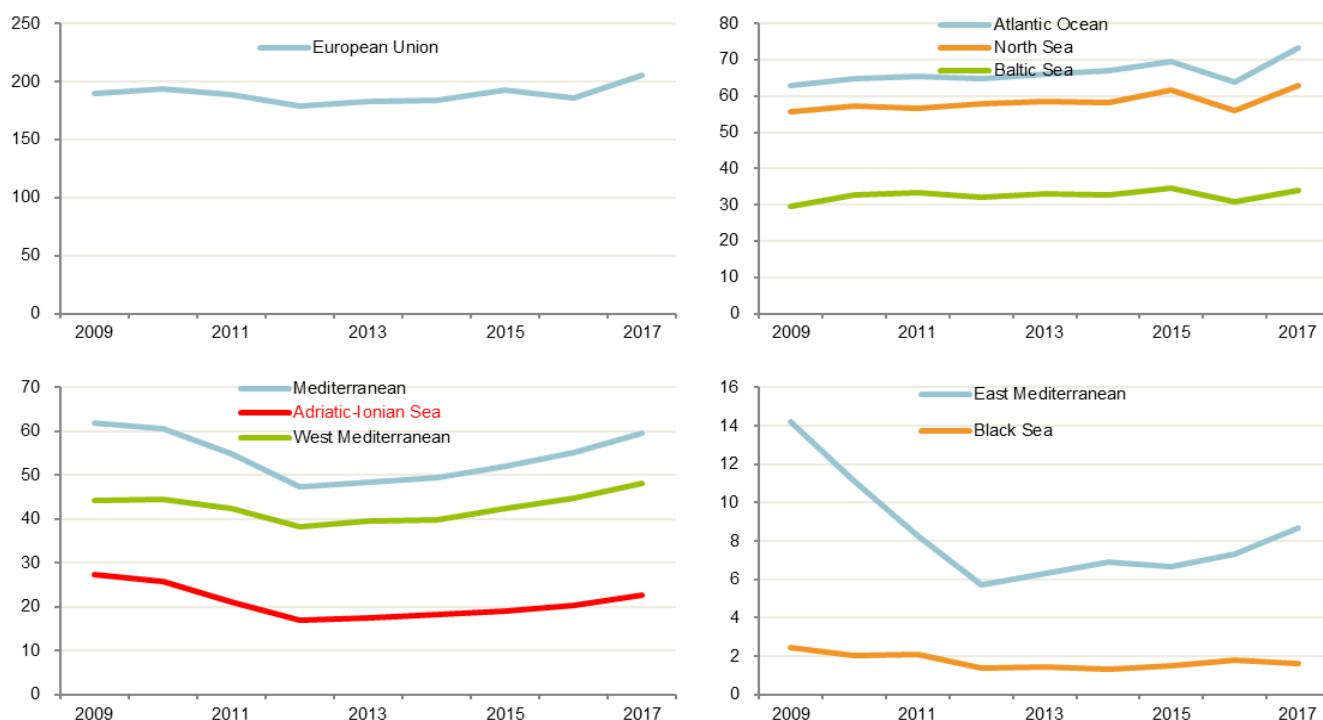
Source: European Commission: The EU Blue Economy Report.

In Adriatic-Ionian Sea basin, GVA is dominated by **Coastal tourism** sector with 12.3 € billion (54.4%) or 16.2% out of EU total Coastal tourism GVA. Maritime transport sector comes second with GVA 3.8 € billions (16.8%) or 10.8% in EU sector level, with Port activities GVA 2.2 € billion (9.7%) or 6.3% with respect ot the EU total Port activities sector. Non-living resources record minimum GVA activity with only 0.4 € billions and Marine renewable energy records no activity in Adriatic-Ioninan Sea basin (Figure 8).

Figure 8. GVA by sector for Adriatic-Ionian Sea Basin, 2017 (€ billion)

Source: European Commission: The EU Blue Economy Report.

BLUEAIR is implemented through the financial support of the ADRION programme
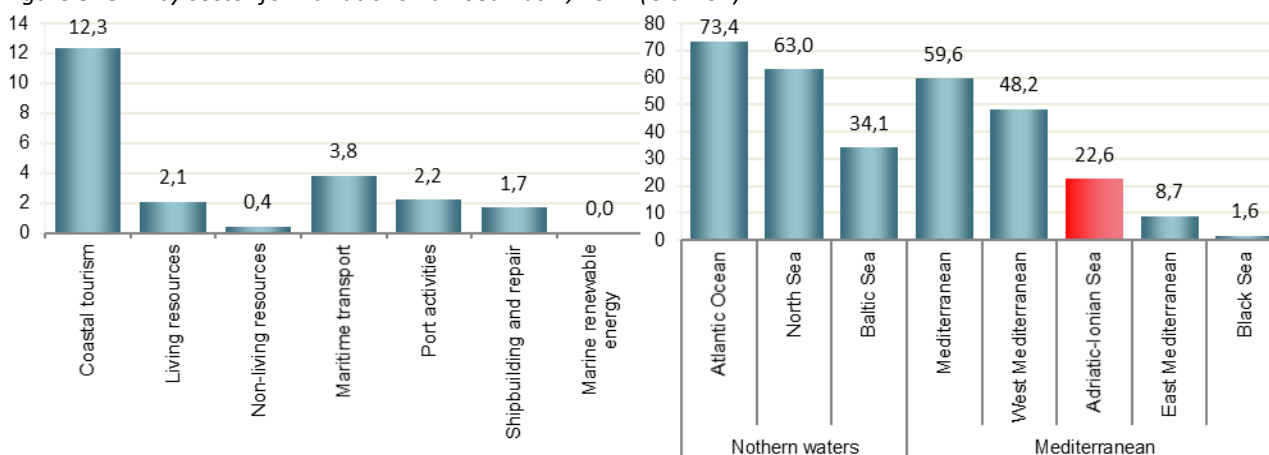
3.3. Apparent labour productivity

Considering two economic indicators (employment and GVA) **apparent labour productivity**[37] or "per capita productivity" may indicate which are the leading sectors and gives an idea of the productivity of the labour production factor (Figure 9.).

Highest apparent labour productivity in EU region is recorded in Non-living resources sector related to extraction of oil and gas activities, especially in the Baltics, North Sea and Atlantic Ocean.

Marine renewable energy related to wind energy is second highest apparent labour productivity sector again in the Baltics, North Sea, and the Atlantic Ocean sea basins.

Among Top 3 sectors in **Adriatic-Ionian Sea basin**, the **Non-living resources** is the most significant sector due to oil and gas extraction activities, fallowed with Maritime transport and Port activities.

On the opposite side, Coastal tourism has lowest labour productivity due to its service-oriented nature and high number of touristic workers. Besides that, Coastal tourism with Living resources sector labour productivity in Adriatic-Ionian Sea basin are seeded below the total Blue economy EU average.

Marine renewable resources have top labour productivity figures in the Baltics. North Seas, Atlantic Ocean and West Mediterranean while in Adriatic-Ionian Sea basin that sector has no recorded activity.

Figure 9. Apparent productivity of established sectors in eight EU sea basins (2017).
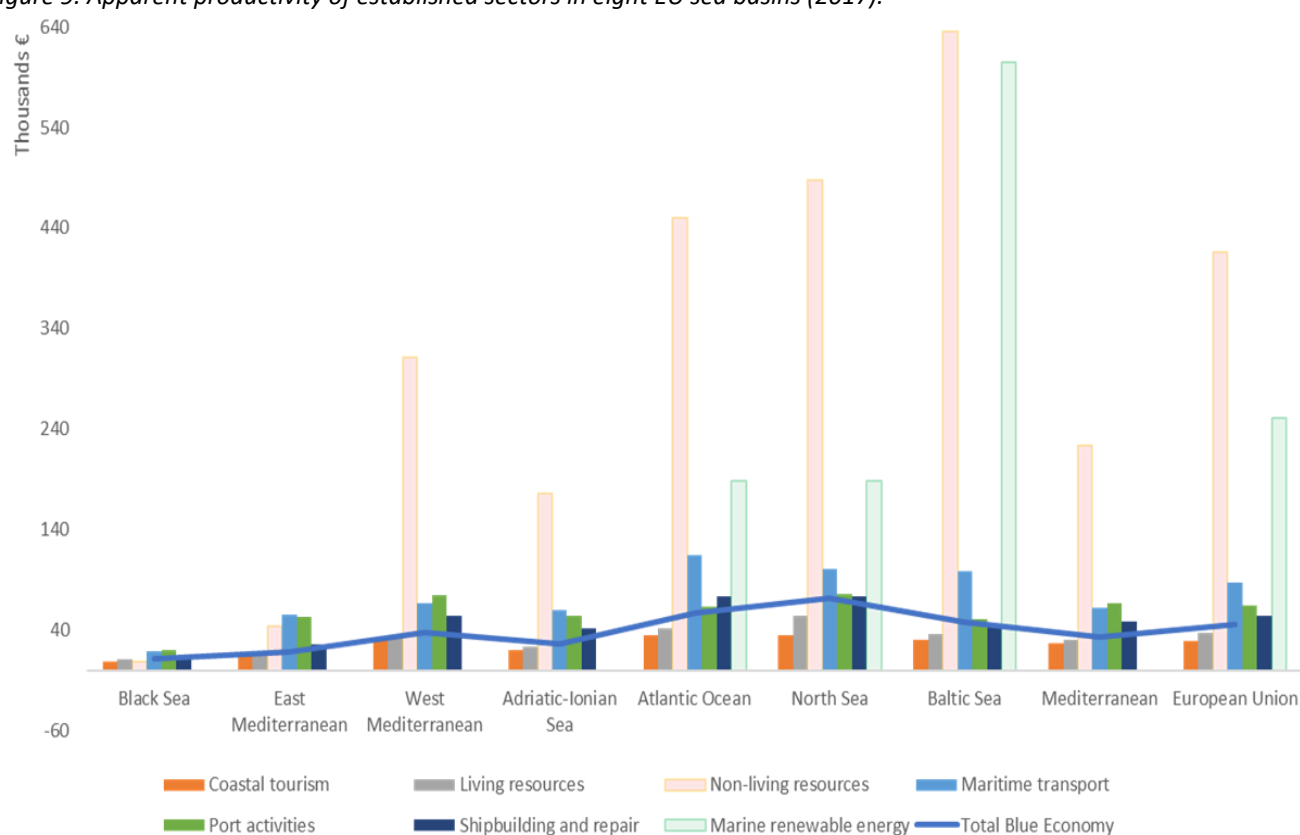
Source: Authors, based on European Commission: The EU Blue Economy Report data

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[37] Apparent labour productivity is defined as value added at factor costs divided by the number of persons employed. (Eurostat; Statistics explained)

3.4. Promising established and emerging EU Blue Economy sectors in Adriatic-Ionian Sea basin

According to current data (employment, GVA) and estimates of future trends, five established sectors have strong socio-economic impact in Adriatic-Ionian region (Table 5).

Table 5. Overview of sectors evolution, Employment and GVA, 2009-2017

Sector	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR[38] 2009-2017
Total EU BE jobs (thousands)	4.952,78	4.673,15	4.330,24	3.990,60	4.085,04	4.072,15	4.005,87	4.294,06	4.475,83	*-1,12%*
Total AIR jobs	1.086,94	1.005,20	803,76	659,10	675,04	756,74	691,52	772,04	851,89	**-2,67%**
Coastal tourism	839,53	767,64	575,08	434,63	458,05	524,94	456,15	537,32	618,25	-3,34%
Living resources	91,57	92,41	91,26	91,90	88,24	84,32	84,84	89,10	87,07	-0,56%
Non-living resources	13,51	11,58	10,83	12,11	10,98	11,60	11,77	4,84	2,50	-17,09%
Maritime transport	54,80	51,26	50,68	49,39	47,39	61,12	61,39	61,29	63,62	1,67%
Port activities	35,43	33,96	33,13	31,70	32,12	38,96	40,99	41,43	40,37	1,48%
Shipbuilding and repair	52,11	48,36	42,77	39,38	38,25	35,79	36,38	38,06	40,09	-2,87%
Marine renewable energy	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0
Sector	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR 2009-2017
Total BE GVA (million €)	189,81	193,47	188,33	178,93	182,81	183,61	193,04	185,50	205,64	*0,89%*
Total AIR GVA	27,51	25,84	21,07	17,08	17,46	18,25	19,13	20,34	22,58	**-2,17%**
Coastal tourism	18,43	16,72	12,41	9,12	9,68	9,57	9,19	10,05	12,32	-4,38%
Living resources	1,62	1,59	1,68	1,45	1,46	1,49	1,74	2,19	2,08	2,82%
Non-living resources	1,20	1,18	1,14	1,00	0,79	0,73	0,83	0,77	0,44	-10,55%
Maritime transport	3,03	3,28	2,83	2,80	2,84	3,39	3,99	3,72	3,85	2,7%
Port activities	1,50	1,61	1,53	1,56	1,59	1,82	2,10	2,19	2,21	4,40%
Shipbuilding and repair	1,73	1,47	1,48	1,15	1,11	1,24	1,28	1,43	1,68	-0,33%
Marine renewable energy	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,0

Source: Blue economy indicators, https://blueindicators.ec.europa.eu/ accessed on 21.01.2021

Five promising established Blue Economy sectors within Adriatic-Ionian Sea basin are:

- **Marine living resources** – sector with constant and second highest employment and raising GVA of CAGR 2.82% in period 2009-2017.
- **Maritime transport** - sector with positive raising trend and third highest employment and raising GVA of CAGR 2.7% in period 2009-2017.
- **Port activities** – sector with constant slowly rising trend in employment and exceptional raising GVA trend of CAGR 4.4% in period 2009-2017
- **Shipbuilding and repair** – despite decreasing employment trend, GVA is experiencing positive trend especially from 2013, almost recovering to 2009 pre-crisis levels.

[38] CAGR - Compound annual growth rate

- **Coastal tourism** – still biggest sector considering employment figures (72.6%) strongly affected by the global financial crisis but recovering concerning employment and GVA with positive trend in the last several years.
  Sector may experience another strong downfall affected by global pandemia.

Two remaining established EU Blue Economy sectors have currently **decreasing importance or no impact** in Adriatic-Ionian region:

- **Marine non-living resources** – sub-sector activities in relation to *Oil and gas* takes 97.4%, with majority of activity in *Extraction of natural gas* (77.9%), while remaining *Other minerals* subsector has only a stake of 2.6% in *Extraction of salt* activity (Table 6).
  Sector has biggest negative trend regarding employment of CAGR -17.09% (almost 11.000 lost jobs) betweek 2009-2017. GVA figures also shows constant downfall of CAGR -10.55% in period between 2009-2017.

Table 6. Marine non-living sector brake-down (GVA, € million, 2017, Adriatic-Ionian Sea basin EU Member states-Italy[39], Slovenia, Croatia, Greece)

Sector	Subsector	Activity	2017 (€ million)	% over selected activities
Marine non-living resources	TOTAL		**441.1**	**100%**
	Oil and gas		**429.7**	**97.4%**
		Extraction of crude petroleum	11.2	2.5%
		Extraction of natural gas	343.7	77.9%
		Support activities for petroleum and natural gas extraction	74.8	17.0%
	Other minerals		**11.5**	**2.6%**
		Operation of gravel and sand pits; mining of clays and kaolin	-	-
		Extraction of salt	11.5	2.6%
		Support activities for other mining and quarrying	-	-

Source: Authors, based on European Commission: The EU Blue Economy Report data

- **Marine renewable energy** (Off-shore wind energy, with bottom-fixed foundation to the seabed) – no activities in terms of GVA and employment recorded in Adriatic-Ionian Sea basin mostly due to unfavourable geographic conditions of non-shallow sea.

Several **emerging sectors have a good starting point to mature and develop as promising sectors** in Adriatic-Ionian Sea basin and produce positive socio-economic impacts to the region in near future. Due to its composition, the emerging sectors of Blue Economy are represented by new/innovative sectors or by those which data is emerging and which have significant socio-economic impact. Unfortunately, due to the lack of data, special attention and foresight analysis should be considered.

- **Desalination** – small scale desalination plants are already active in Italy and Greece in supporting activities of producing drinking water for coastal municipalities or coastal industries (see Figure 3).
- **Maritime defence** – naval shipyards are active in Italy, Croatia and Greece with limited but slowly emerging data showing positive direct and indirect socio-economic impacts in terms of employment, GVA and novel innovative solutions.
- **Submarine cables and robots** – several, mostly telecommunication cables were laid between Italy, Croatia and Greece creating submerged network between states (Figure 10). Submerged cable laying

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[39] 52.6%, was used to estimate how much of the employment and GVA from the Italian Blue Economy is generated in the regions participating in the Adriatic – Ionian strategy.

activities have big potential due to their expected duration of around 25 years and necessary engineering skills embedded with use of special ships and submerged vehicles.

Figure 10. Submarine cable map in Adriatic-Ionian sea basin
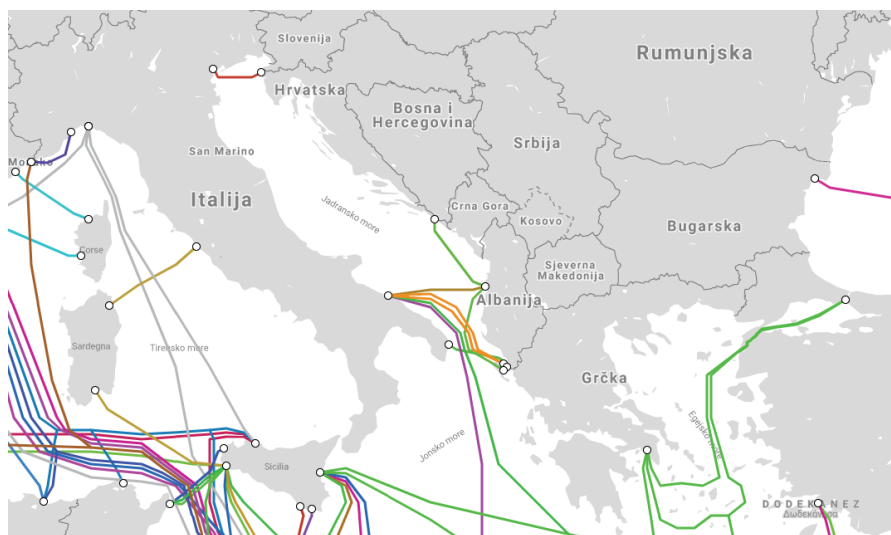
Source: TeleGeography; Submarine Cable Map: https://www.submarinecablemap.com/

- **Blue bioeconomy and biotechnology** – sector is active in Adriatic-Ionian Sea basin mostly in early R&D pre-commercial status. More data is needed for complex analysis.

Remaining **two emerging sectors have insignificant or no present socio-economic impact** due to currently unfavourable geographical factors or activities in those sectors are still in early pre-commercial status (early TRL[40]):

- **Marine renewable energy** (floating offshore wind, wave and tidal energy etc.) – most ongoing current pilot operations are stationed in the Baltics, Northern Sea and along the Atlantic ocean due to favourable geographic conditions. Potentially promising activity for Adriatic-Ionian region is *floating offshore wind,* an alternative to offshore wind with bottom-fixed foundation to the seabed, in order to overcome sea depth current obstacle. Therefore, it is worth to pay attention and monitor development of that activity in relation to ADRION region.
- **Marine minerals** – deep-sea mining for high value metals and minerals is still not active in Adriatic-Ionian Sea basin.

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[40] Technology Readiness Levels (TRLs) are indicators of the maturity level of particular technologies. This measurement system provides a common understanding of technology status and addresses the entire innovation chain. There are nine technology readiness levels; TRL 1 being the lowest and TRL 9 the highest.

4. Proposal for scope of BLUEAIR project research areas

In order to identify Blue Growth sectors of the macro regional interest and exploit potential for transnational cooperation according to BLUEAIR specific objectives, there is a need to take into account European Commissions' intention of supporting the development of marine-related economic and innovation activities through several initiatives on EU and regional level covering the "Blue" tag. In 2019, DG MARE and the JRC presented the Blue Economy Report which focuses on boosting the "blue" economy andsustainable use of ocean resources for economic growth through entrepreneurship, investment, and research and innovation. On the regional levels, regarding Adriatic-Ionian Sea basin, blue economy is driven through EUSAIR macro-regional strategy adopted by the European Commission and endorsed by the European Council in 2014. One of four thematic priorities/pillars representing key challenges as well as key opportunities in the region is Blue Growth Pillar covering research promotion, innovation and business opportunities in blue economy sectors, adaptation to sustainable seafood production and consumption and improving sea basin governance. Considering a wider Blue Economy domain on EU level enhanced with recently identified emerging novel sectors (together with data-backed established sectors), a scope of BLUEAIR project sectors may be enriched to provide more focused and updated project framework.

4.1. Transition map from Blue Economy to EUSAIR

To be able to understand complex thematic interactions, Sankey diagram is presented, linking Blue Economy established and emerging sectors to potential EUSAIR pillars and following EUSAIR areas of interventions (Indicative actions) (Figure 11, for more detailed figure see the Annex).

Figure 11. Transition map (Linkage thickness represent GVA relations in absolute values)
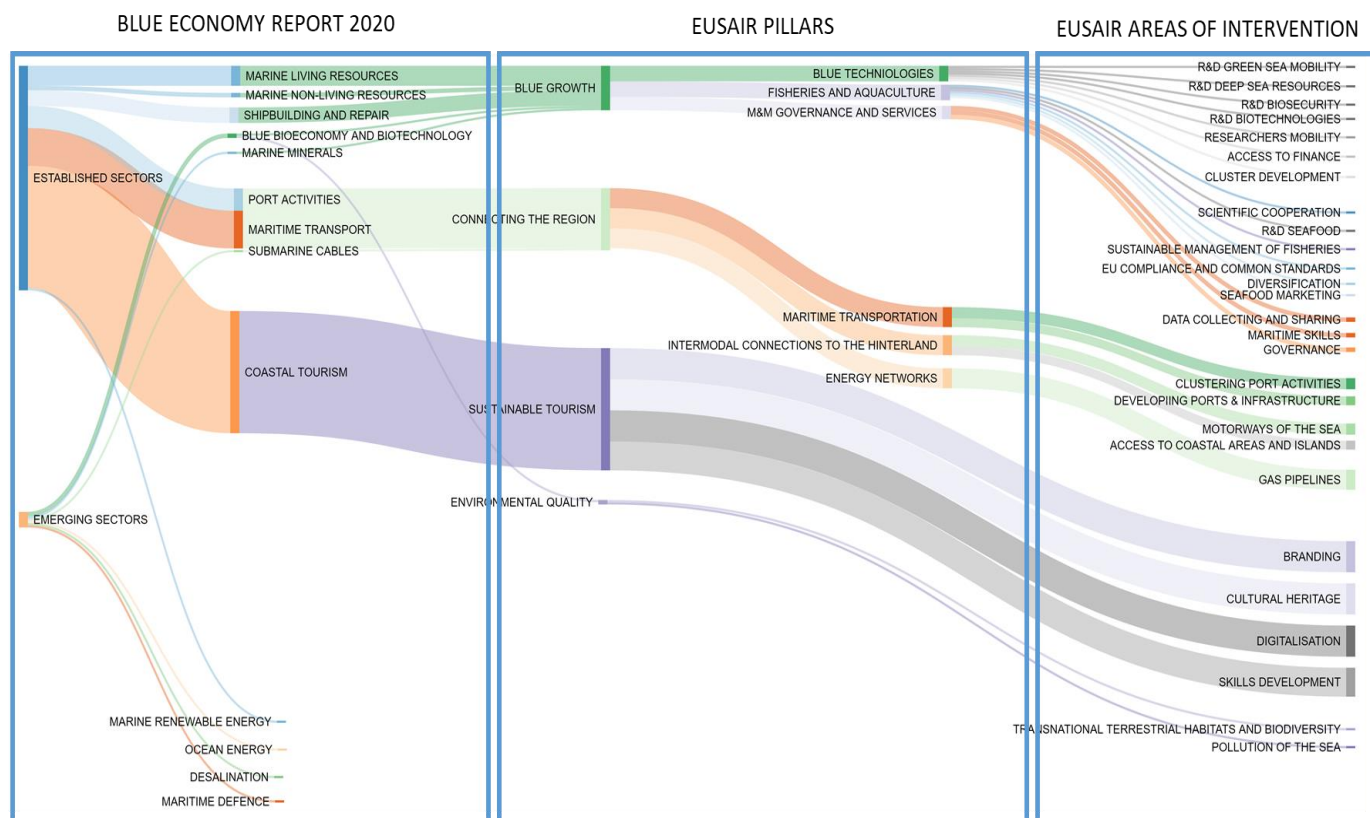
Source: Authors

Transition map illustrates **connection** between Blue economy sectors[41] and four pillars of the EUSAIR macro regional strategy. Furthermore, as it is already mentioned, thickness of the linkages represents GVA (gross value added). Nonetheless, one should bear in mind that GVA relates to whole sectors as defined in Blue economy report 2020, hence not to the proposed areas of intervention, as they refer to particular activities (for example, R&D or marketing as particular activities within sectors such as fisheries or tourism).

It is indicative that most EU Blue Report established and emerging sectors are compatible to EUSAIR pillars and may be aligned to one another by creating relations in terms of GVA values. Several EU Blue Economy sectors have none or very insignificant linkages with EUSAIR pillars, mostly those identified as emerging sectors, also due to non-existent data sources (Marine renewable energy, Ocean energy, Desalination, Maritime defence).

4.2. Transition map from Blue Economy to BLUEAIR

Another approach significant to selecting focus areas of the BLUEAIR project scope is creating linkages and establishing connections of established and emerging Blue economy sectors over EUSAIR pillars creating potential areas of BLUEAIR project scope by grouping sectors into several socio-economic or environmental impact groups. Transition map illustrates links between established and emerging sectors of Blue Economy report (2020) and EUSAIR pillars, and towards further division on two priority focus areas – BE Primary focus area and Secondary Focus Area specific for Adriatic-Ionian Sea basin. (Figure 12, for more detailed figure see the Annex).

Figure 12. Transition map to BLUEAIR potential areas
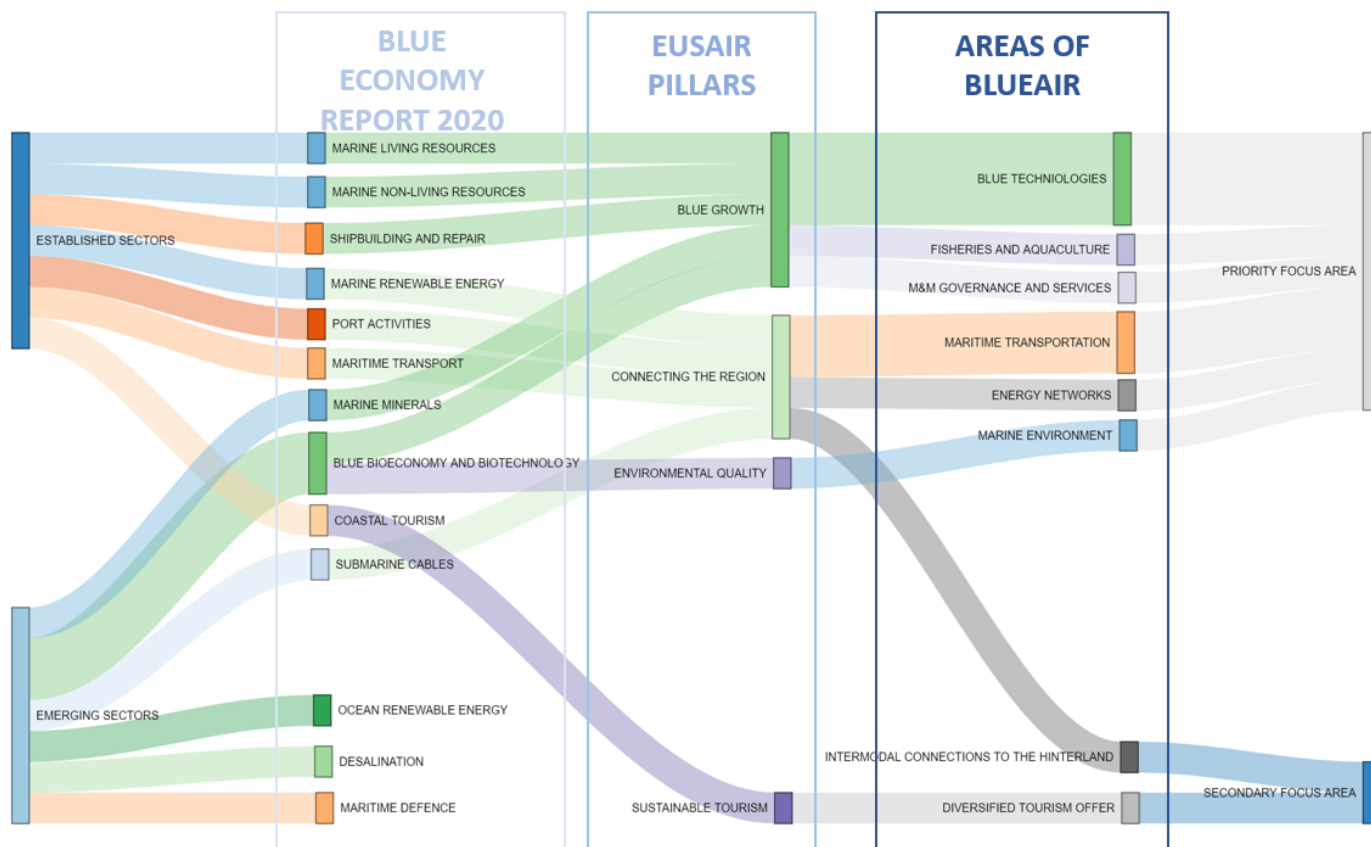
Source: Authors

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[41] As defined in Blue economy report 2020

4.3.   Blue economy priority focus areas

Primary focus area represents groups of established and emerging sectors of Blue Economy sectors, which have direct socio-economic, environmental or other important impact within Adriatic-Ionian Sea basin and strongly rely on first Blue Growth pillar of the EUSAIR strategy. That impact may already have influence on the region with positive or negative trends with recorded data over the years or may cause significant impacts in near future. Primary focus area constitutes a basis and main direction in finding common thematic, economic, and technological areas in Blue economy of the AIR macro-region and its Blue Growth Innovation strategy and Action plan.

Table 7. Priority focus areas

PRIMARY FOCUS AREA		SECONDARY FOCUS AREA	
ESTABLISHED SECTORS	**EMERGING SECTORS**	**ESTABLISHED SECTORS**	**EMERGING SECTORS**
Living resources • Fisheries • Aquaculture	• Blue bioeconomy & biotechnology	• Coastal tourism	• Desalination
Waterborne transport • Transport • Port activities	• Submarine cables and underwater robots	• Shipbuilding and repair*	

Note: * observed through their technological contribution within Blue technology area
Source: Authors

These areas are framed by two groups of established sectors – Living resources and Waterborne transport groups and two emerging sectors – Bioeconomy & Biotechnology and Submarine cables & underwater robots. Living resources group holds two important activities - *Fisheries* and *Aquaculture* while Waterborne transport group consists of *Transport* and *Port activity* sectors related to both seas and inland waters. Waterborne transport holds its name because it includes both sea and inland water transport activities. (Table 7).

Secondary focus area represents remaining established or emerging sectors or sub-sectors which are relevant to Adriatic-Ionian macroregion, today or in near future. Those secondary or indirect sectors are mostly aligned to remaining EUSAIR pillars (Connecting the region; Environmental Quality and Sustainable tourism). Nevertheless, indirect focus areas are still very much connected to the primary focus areas by technologies, interactions, connections, R&D&I activities, solutions, or other common factors, which produce significant future impact on Adriatic-Ionian region.

Secondary focus area sectors are identified through *Coastal tourism* established sector and *Shipbuilding* activities. Another identified emerging sector is *Desalination* of sea water.

Non-focus area sectors include remaining Blue Economy Report sectors which are not relevant in Adriatic-Ionian Sea basin in terms of non-existing present activity or with low future potential (e.g. Marine renewable energy and Marine minerals) or their economic activities are rapidly decreasing (e.g. Marine Non-living resources).

Few sectors (e.g. *Shipbuilding & Repair, Maritime defence and Research & Education*) will be analysed and observed through their **research and technological contribution** rather than sectorial within Adriatic-Ionian region due to their significant impact on technological advancements and spill over effect to other sectors and activities.

4.4. Blue growth area framework proposal for the BLUEAIR project

Based on the presented information, economic indicators and overview of the Blue Growth area as well as strategic determinants of both the EUSAIR strategy and the BLUEAIR project, a **functional division** of the area is proposed for further analysis and activities within the project.

In terms of harmonizing the scope of the Blue Growth areas which allows a sufficient and non-limiting aspect to search for and identify common interests in terms of development and innovation in the Blue Growth areas, the functional division follows the logic of the Blue Growth pillar.

Functional framework is divided into **areas for initiatives and interventions**:

1. Blue technologies
2. Fields of activities (i.e. "Blue sectors" from Blue Economy report)
3. Blue solutions

Framework is based on actual (established/traditional) and identified (emerging) sectors, activities, technologies or solutions, but allows structural changes (possible new or changed initiatives or strategies) in a form of insertion of additional technologies, new emerging sectors or novel solutions which make it futureproof.

As mentioned, each framework area is functioally related with EUSAIR Blue Growth pillar and its thee sub-topics: Blue technologies, Fisheries and Aquaculture and Maritime and marine governance and services, but expanded with wider scope of martime related activities in line with AIR region and recent EU initiatives backed by measurable data on annual basis.

4.4.1. Blue Technologies

Oceans and seas are one of key drivers for EU economy boosting innovations and growth. Innovations in maritime activities require more advanced technologies and structures to ensure more demanding development across maritime sectors like waterborne mobility, living resources and food supply, marine renewable energy, sustainable tourism and other marine related solutions.

On EU level, maritime technology related sector has a turnover of € 91 billion with more than 500.000 directly employed people, most of which are highly skilled and contributes significantly to regional development in around 200 regions in 18 countries[42].

Some marine technologies may affect only one sector, but some technologies may affect multiple sectors. On some points, technologies are often an integration of multiple technologies. For example, the implementation of waterborne autonomous underwater vehicles (AUV) or remotely operated vehicles (ROV) requires the application and successful integration of several technologies like **sensors, communications, robotics, propulsion, navigation etc.**

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[42] Joint SEAEurope and IndustriALL Europe Position, February 2016

Through the BLUEAIR project and its implementation phases project partners **should focus their work under „BLUE" technology scope** and consider technologies as enablers for solutions and value chains within sectors. That framework takes into consideration all marine related technologies that are directly or indirectly related to the projects priority focus areas – primary or secondary and would affect innovation and growth within the sectors and/or solutions to be observed through the project scope, dialogues and interaction with quadruple helix actors. These technologies might be divided in several main groups:

- Marine technologies
- Clean technology (Blue Growth related)
- Information and Communication Technologies - ICT (Blue Growth related)

First group - marine technologies, consists of various marine related technologies in general terms associated with different marine sectors and/or activities with direct or indirect technological impacts. WEGEMT, an European Association of 40 Universities in 17 countries, defines marine technology as "Technologies for the safe use, exploitation, protection of, and intervention in, the marine environment; involving Naval Architecture, Marine Engineering, Ship Design, Building and Operations, Oil & Gas Exploration, Exploitation and Production, Hydrodynamics, Navigation, Sea Surface and Sub-Surface Support, Underwater Technology and Engineering, Marine (renewable and non-renewable) Resources, Transport Logistics and Economics, Inland, Coastal, Short Sea and Deep Sea Shipping, Protection of the Marine Environment, Leisure, Safety."

Other two groups represent technologies that are a complementing link between Blue Pillar and the strategic directions of industrial development towards **digitized and green solutions** in accordance with the EU's Industrial strategy. This primarily refers to **data technologies, communications & connectivity and unmanned and autonomous systems** as well as those clean technologies associated with **marine renewable energy**, **waterborne mobility** and **pollution control**.

Three general technology groups create **technology framework** or knowledge related ecosystem of the project scope. Knowledge ecosystem focuses on generating new knowledge and technologies based on R&D activities related to basic/fundamental research within scientific organisations and applied research with experimental development more related to business activities and entities directed at producing new products or processes or improving existing products or processes.

Marine technologies, according to the Global Marine Technology Report 2030[43]**,** that combine good technical feasibility on a commercial basis, potential marketability, and their transformational impact on the respective sectors directly or in indirect way are presented below.

It must be emphasized that list of technologies is not definitive but rather points to the present and near future direction that might possibly be taken for development and implementation by the established or emerging sectors within the project scope. Some technologies, due to the specific characteristics of technology, apply to one specific sector, while others may apply to two or even all of them.

- **Propulsion and powering –** global trend show that demand for large size ships is growing. Efficiency of ships has improved but simultaneously increasing power demands for the propulsion and power generation which raises concern for effects/consequences over future fossil-fuel dependency and CO_2 footprint. Development and application of relevant propulsion and powering technologies may be

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[43] Lloyd's Register, QinetiQ and the University of Southampton, *Global Marine Technology Trends 2030* (2015) Southampton, GB. University of Southampton

focused on environmental but also commercial challenges. More efficient engines for main propulsion, alternative propulsion configurations like hybrid propulsion systems, or even new solutions such as hull air lubrication. Use of such technologies would depend on ship segments and deep-sea or short-sea application.

- **Smart ship –** Smart ships are not discrete technology, but rather full scope of interrelated technologies (sensors, robotics, Big data, advanced materials, communications, etc.) Smart ships projected timeline predict several transition phases for traditional ship types – digital ship phase towards intelligent ship by exploitation of real-time big data, communications any analytics to create proactive decision making in the design, operation and ship maintenance. Final phase is step towards autonomous ships by exploitation of sensors and robotics to replace human operators or even whole crews (fully autonomous ships).

- **Shipbuilding –** Shipbuilding itself is an activity consisting of ship design and construction using various technologies during the process. Most distinctive technology with great potential in shipbuilding is additive manufacturing allowing manufacturing objects with complex geometry or honeycombs for example. Adaptable hull forms are another promising technology to better handle loading conditions and speed profiles together with ballast free ship designs.

- **Robotics –** Robots can perform different operations on different levels of autonomy. Robots are great assets exploiting work in harsh working conditions. In marine shipping, remote-controlled robots are a promising alternative. Robotic technology is relying on other technologies like sensors and remote controls, communications etc.

- **Autonomous systems –** use of autonomous systems in the marine domain may include increased use of interconnected intelligent systems in order to enable use of fully autonomous surface and underwater vessels. It can be used in various sectors using long endurance sensing, data gathering to vast range of organisations, such as coastguards, research bodies, and weather and climate bureaus. Due to their cost efficiency and wide range of applications various industries would utilise such systems (oil and gas sub-sector, pharmaceutical companies, aquaculture etc.)

- **Advanced materials –** advanced materials include all materials engineered to deliver special physical or functional properties. Main industry trend are advanced materials produced in nanoscale /referred as nano-materials). Such materials may provide new functionalities in marine applications like environmental sensing, self-cleaning, shape modification, multi-functional materials improving ship performance. New materials may actively reduce the noise and vibration released from machinery. Bio-inspired materials may be applied in marine industry, for instance special bio-inspired materials applied on the hulls in order to repel formation of algae (anti-fouling coatings) on the hull of the ship. Self-repairing, self-healing materials in case damage occurs may reduce the need for maintenance.

- **Sensors –** sensor technology is rapidly evolving creating new fields of application. Main trends are miniaturisation coupled with low-power, low-cost requirements, standardisation, low power transmission and energy consumption. In marine domain sensors would enable better situational awareness and vessel management. Wireless sensor technology enables remote data collection. Micro and nano-mechanical sensors would also contribute to new monitoring and sensing capabilities. Marine capable sensors would require specific characteristics like self-calibration, fault tolerance, wireless capabilities, robustness, ultra-low energy consumption etc. As the maritime data network would be vital, great importance is needed in terms of cybersecurity activity in order to protect vital data from unauthorised access.

- **Sustainable energy generation –** Oceans and seas can be harnessed to generate electricity to power households, transport and industries. Energy is transformed from ocean waves, winds, solar energy tides, salinity and temperature differences conversion. Produced energy can be stored in batteries or transported to the shore by underwater cables. Part of produced electrical energy can be used to generate and produce hydrogen from sea water. Biggest benefit of the sustainable energy generated

in the ocean space on such offshore energy generation installations is minimal carbon footprint, so the impact on the environment will be relatively small.

- **Advanced Manufacturing -**Advanced manufacturing is closely related with other technologies such as additive manufacturing in conjunction with robotic systems. Automation and embedded intelligent systems would result in increased productivity, safety and quality. Augmented and virtual reality techniques would reduce product development time. Advanced manufacturing would enable the production processes of components and products on or near the point of use. In relation to marine activities, advanced manufacturing on-site (on-vessel) facilities may provide significant reduction of logistic costs and even provide necessary components or product when needed independently of traditional supply chains.

Clean technologies (Cleantech) – *Cleantech*, also referred to as clean technology, and often used interchangeably with the term *Greentech*, refers to methods of reducing the negative environmental impact of otherwise conventional technologies.

Cleantech points out to a wide variety of environmentally-friendly practices and technologies in domains from solar and wind energy production to process improvements that can increase efficiencies in supply chains and production lines. Recently in last decades, *cleantech* term is used more explicit with environmental connotation like "green technology" or "eco-friendly technology"[44].

The **goal** of using clean technologies is to **protect the environment, repair damage done to the environment in the past, conserve natural resources and preserve the Earth's natural resources**[45].

According to Roland Berger and German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)[46], *cleantech and environmental technology* are **cross-sector industry**, which are then broken down into six **lead markets -** *Environmentally friendly power generation, storage and distribution; Energy efficiency; Material efficiency; Sustainable mobility;* and finally *Waste management and recycling*.

This breakdown creates a **framework** for analysing the environmental technology and resource efficiency industry. Each lead market has two subdivisions – market segments and technology lines. **Market segments** form groups of **technology lines,** which include products, processes and services. The technologies under these lead markets provide solutions to help preserve ecosystems, but also help to meet fundamental human needs. This approach complements large share of 17 Sustainable Development Goals (SDGs) documented in the UN'S 2030 Agenda, which are closely related to the environmental technology and resource efficiency. Many of the SDGs goals can be met only with the use of products, processes and services from the cleantech industry. Examples include clean water and proper sanitation, affordable and clean energy, sustainable cities and communities, sustainable consumption and production, measures to mitigate climate change and steps to protect both **marine life** and terrestrial life[47].

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[44] Investopedia – What is Cleantech?, https://www.investopedia.com/terms/c/cleantech.asp, retrieved on 16.02.2021.
[45] ibid
[46] Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (2018): GreenTech made in Germany 2018-Environmental Technology Atlas for Germany, Berlin, https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/greentech_2018_en_bf.pdf , retrieved on 16.02.2021.
[47] ibid

Although, all six cleantech lead markets have direct or indirect connection with the Blue Growth and project's proposed areas, several lead markets including their affected market segments and technology line show bigger impact than others in relation to Blue growth domain:

- **Environmentally friendly power generation, storage and distribution -** Technologies that support the withdrawal from fossil fuels and promote the use of renewable energy sources to minimize resource consumption and harmful emissions in fossil-based power generation.
- **Renewable energy** – Photovoltaics, Solar thermal energy, Solar thermal power plants, Wind power (onshore), Wind power (offshore), Geothermal power, Hydropower
- **Energy efficiency -** is a key tool to reduce greenhouse gas emissions in a way to add as much value as possible with as little energy as possible.
- **Cross-sector components** - auxiliary production processes like electric drive systems, compressors, compressed air and vacuum technology, pump systems, process control instrumentation, ventilators, heat exchangers measurement and control instrumentation
- **Material efficiency-** efficiency in processing of extracted raw materials. It encompasses technologies and methods that reduce the consumption of non-energy resources and minerals.
- **Renewable resources** – Aim is introducing renewable resources in fostering the sustainable use of recourse. It encompasses Bioenergy for heat and power generation, Feedstock for the chemical industry, Bioplastics, Composite materials, Natural cosmetics, Natural insulating materials, Oils/fats and paints/varnishes from renewable resources
- **Protection of environmental goods -** renaturation of sites affected by raw material extraction. Examples of technology lines are Soil and noise protection, Groundwater protection, water conservation, air pollution, Nature and landscape conservation
- **Sustainable mobility –**In relation to digitalization of transport sector, new technologies provides opportunities for shaping new business models in line with the environmental protection goals.
- **Alternative drive technologies –** segment comprises electric, hybrid and fuel cell drive systems as alternatives to conventional combustion engines
- **Renewable fuels (eFuels[48]) –** segment comprises alternatives to oil-based fuels. Bioethanol, Biodiesel, Biomethane, Hydrogen from renewable resources, Biokerosene
- **Technologies to increase efficiency -** products and technologies needed to provide better efficiency for combustion engines. Efficiency gains in combustion engines, Lightweight engineering technologies
- **Transportation infrastructure and traffic management -** innovative measures and technologies that may reduce mobility-related emissions. Essential topics are Smart transportation concepts. Important technology lines include transport infrastructure, Traffic control systems, Filling station infrastructure for alternative drive systems
- **Sustainable water management** – reliable water supply not only depends on quantity, but also of quality. Therefore, climate change in not the only problem but pollution of water resources sometimes exceeds the problem of water supply.
- **Wastewater cleaning** - technology lines includes Sewage sludge treatment, Energy management in wastewater treatment plants and Recovery of materials in wastewater
- **Wastewater treatment methods** - technology and activities related to the segment

On top of defined six lead cleantech markets, **digitalization** plays very important role in cleantech, driving big investments into "green" products, processes and services in order to reduce environmental pollution. There are five digital systems identified to bear big impact potential for cleantech industry – connected energy, building information networks, Industry 4.0, urban connected mobility and smart grids.

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[48] https://www.efuel-alliance.eu/en/efuels, accessed: 16.02.2021.

BLUEAIR is implemented through the financial support of the ADRION programme
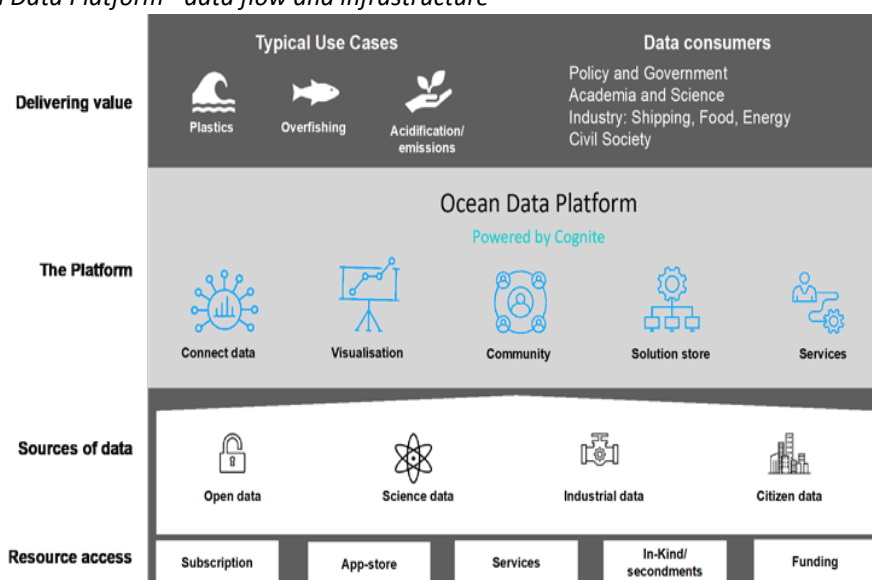
Information and Communication Technologies (ICT) – Although ICT is increasingly used in industry and transport, the blue economy and the maritime sector can also benefit from embracing of the most promising technological solutions for the blue economy. Today, digitalisation and innovation in ICT are major drivers in all traditional and emerging areas of the blue economy, including maritime surveillance and security, as modern ships and ports become cyber-physical systems.

The European Research Consortium for Informatics and Mathematics (ERCIM)[49] has identified some of the most important ICT fields of applications in the blue growth field, which includes (but is not limited to):

- machine learning and artificial intelligence,
- cyber-physical systems (ships and ports),
- IoT / M2M communication,
- space communications and observations,
- large data infrastructures,
- unmanned and autonomous systems.

The oceans, seas, and coasts are home to diverse marine ecosystems, provide a wealth of resources, influence climate, and offer many economic opportunities. A thorough understanding of the natural dynamics and effects is needed in order to develop sustainable management strategies and conservation of these ecosystems. To support the required research and innovations, new "blue data space" and data platforms are developing that offers seamless access to marine data as well as computing and required services. Such emerging platforms as examples are Blue-Cloud platform and Ocean Data Platform (ODP)[50]. The data moving through the platforms are drawn from a variety of sources including traditional, open, institutional ocean and data from industry, independent scientists, and even private citizens (Figure 13).

Figure 13. The Ocean Data Platform - data flow and infrastructure

Source: www.oceandata.earth

Among many ICT technologies related to maritime sector three technology groups are standing out:

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[49] https://ercim-news.ercim.eu/en123/special/blue-growth-introduction-to-the-special-theme, accessed: 16.02.2021
[50] https://www2.blue-cloud.org/ , https://www.oceandata.earth/, accessed: 16.02.2021.

- **Communications and connectivity** – crucial technology in maritime industry especially for situational awareness and information exchange. Maritime communications allow for emergency calls, geo-positioning, weather updates, marine-life tracking etc. Diversity and capability of communication technologies will enable the acquisition and connection of data from different sources, especially sensors, enabling the use of other technologies, especially big data analytics. Future marine communications including safeguarding of threats and cybersecurity will be driven by the increasing need for huge data transfers between ships, offshore platforms, wind farms and on the opposite side onshore installations for optimal operational efficiency, safety, and security. Transformation will increase its speed by adopting and integrating new technologies based on 5G, WiFi and new satellite generations notably in the workflow processes like real-time decision making in ship management, physical onboard surveys, remote regulatory compliance etc.

- **Big data analytics** – huge amount of data is created nowadays produced by different sources and various formats like world meteorological and oceanographic data, traffic data, material and machinery performance data, cargo related data, passengers' and crews' personal data etc. Such data is very difficult to analyse using traditional methods often missing to identify complex interconnections between different databases and formats. Therefore, big data analytics involves deploying many algorithms and use of powerful machine learning and analytics to identify the correlation between data and applying intuitive conversions offering confidence-ranked response. Big data analytics would improve the understanding of the patterns of trends and optimise operational efficiency, maximise asset utilisation and prioritise resource allocation. One of the important challenges is upgrading the IT infrastructure to retrieve, store and process real-time data and maintain security levels from rising threats from cyber-attacks. Data storage would be supported by new communication technologies.

- **Unmanned and autonomous systems** – systems that operate remotely and autonomously emerge as technology in many areas of the blue economy serving in solutions both on land and at sea, on the surface (both at sea and on land) and underwater for the purpose of various operations or data collection. Operations in which the technology is particularly promising are cost reductions, easier use and greater comfort for health and safety risks, especially those in harsh conditions. In addition to satellite communication and data collection systems, they are also complemented by the emergence of autonomous and unmanned systems on the surface and underwater in the area of maritime surveillance. Data from satellite observation systems can be usefully combined with information collected at sea level and thus significantly increase their accuracy.

4.4.2. Fields of Activity

Primary focus area of the proposed BLUAIR scope is centred around established (or traditional) and emerging (new) sectors based on EU related Blue economy and selected in accordance with relation in Adriatic-Ionian region.

Primary focus area with corresponding sectors creates **business ecosystem** of the project scope. Business ecosystem focuses on economic activities and creation of new or improved products, processes, services, and business models based on constant innovative business activities and use of new technologies.

Established sectors have direct socio-economic, environmental, or other important impact within Adriatic-Ionian Sea basin and strongly rely on first Blue Growth pillar of the EUSAIR strategy. That present impact has positive or negative future trends.

Established sector activities are framed by two groups – **Living resources** and **Waterborne mobility.**

Living resources group consists of two important parts: **Fisheries** and **Aquaculture.** Both parts of a Living resources are defined by common subsectors, namely – Primary sector, along with Processing of fish products and Distribution of fish and seafood products. Each subsector has defined economic activities easily tracked by their corresponding NACE codes. (Table 8).

Table 8. Brake down of primary focus area

Sector	Subsector	Activities (NACE rev.2)
Marine living resources	Primary sector	A3010 – Capture **fisheries**
		A0320 – **Aquaculture** sector
	Processing of fish products	C1020 – Processing and preserving of fish, crustaceans, and molluscs
		C1041 – Manufacture of oils and fats
		C1084 – Prepared meals and dishes
		C1089 – Other food products
	Distribution of fish products	G4638 – Wholesale of other food, including fish, crustaceans, and molluscs
		G4723 – Retail sale of fish, crustaceans, and molluscs in specialised stores
Maritime transport	Passenger transport	H5010 – Sea and coastal passenger water transport (water transport)
		H5030 – Inland passenger water transport
	Freight transport	H5020 – Sea and coastal freight water transport
		H5040 – Inland freight water transport
	Services and transport	N7734 – Renting and leasing of water transport equipment
		H5229 – Other transportation support activities
Port activities	Cargo and warehousing	H5224 – Cargo handling (port services)
		H5210 – Warehousing and storage
	Port and water projects	H5222 – Service activities incidental to water transportation
		F4291 – Construction of water projects

Source: European Commission (2020). The EU Blue Economy Report. 2020

Waterborne mobility group as a general mobility overlay constitutes of **Maritime transport** and **Port activities** groups <u>related to both seas and inland waters</u>. It must be noted that Maritime transport has particular activities contained in NACE codes which reflect sea/coastal and additional inland transport activities. Similar with previous group, waterborne mobility group is defined by common subsectors, Maritime transport related – Passenger transport, Freight transport and Services for transport plus Port activities related – Cargo & warehousing and Port & water projects. Again, specific activities are tracked by corresponding NACE codes (Table 8). It must be noted that Shipbuilding sector will be observed through its technological contribution rather than as independent sector.

Emerging sectors are represented by new/innovative sectors or by those for which data is emerging and which have significant socio-economic impact to overall Blue economy. However, data gaps are still present so comparison by usual economic indicators cannot be executed. Therefore, NACE codes are not used but alternative indicators have been used instead.

Emerging sectors consist of **Bioeconomy & biotechnology** and **Infrastructure and maritime works (submarine cables, robots, drones)** sectors.

Bioeconomy & biotechnology - This emerging sector includes extraction and exploitation of renewable marine living resources to develop new innovative products and services (food, feed, pharmaceuticals, cosmetics, bio-based products and energy). These organisms are divided into three groups: macroalgae (seaweeds), microorganisms (microalgae, bacteria, fungi) and invertebrates (sea stars, sea cucumbers etc.)

The algae subsector is most developed subsector of the Blue Bioeconomy. Currently, there are 15,000 chemical compounds identified in different species of algae, which have great potential for pharmaceutical, energy and materials markets. Along with economic sectorial benefits, algae have big ecological potential which can contribute to food and ecological sustainability seas. Some examples of environmental benefits are wastewater treatment that is deposited into the sea may help mitigate the global waste production, reducing of depleting natural fish supplies and limiting the damage on fragile ecosystems, creation of fresh water supply as important by-product of algae production. As many of the technologies involved have been proven at a pilot scale, there is already a substantial potential for easier business upscaling.

Infrastructure and maritime works (submarine cables, robots, drones) sector- *Submarine cables* sector is new emerging sector with great importance as critical infrastructure of strategic importance due to its role in global communications and energy transfers. Submerged cables laying activities have big potential due to their expected duration of around 25 years and necessary engineering skills embedded with use of special ships and submerged vehicles.

Subsectors' *underwater robots* are used for various purposes in the maritime domain, such as surveys, scientific research, oil and gas exploration, border surveillance, underwater infrastructure inspection and works, aquafarming etc. in challenging environmental situations. Two of the main types of unmanned water vehicles are Remotely Operated Vehicles (ROV) and Autonomous Underwater Vehicles (AUV). Other types of robotics used in the maritime environment are for example the Remotely Piloted Aircraft System (RPAS), very often used in surveillance operations.

4.4.3. Blue Solutions

Solutions as overarching topic for delivering marine and maritime services that are not merely of public interest only may be aggregated under three groups:

- Maritime surveillance
- Public services and governance
- Management of marine ecosystem services

Maritime surveillance is the effective understanding of all activities carried out at sea that could impact the security, safety, economy, or environment of the European Union and its Member States. It is essential for creating **maritime awareness** ('knowing what is happening at sea'). It may comprise activities and solutions related to the needs of a wide range of maritime policies - irregular migration/border control, maritime security, fisheries control, anti-piracy, oil pollution, smuggling – but also develop novel methods for addressing existing capability gaps, such as the tracking of small boats.

Currently, EU and national authorities responsible for different aspects of maritime surveillance – such as border control, safety and security, fisheries control, customs, environment or defence – collect data separately and often do not share them between each other. The Common Information Sharing Environment

for the EU maritime domain (CISE), currently under development, will ensure effective data exchange between maritime authorities across sectors and across borders so that information is available for their missions at sea[51].

Integrated maritime surveillance is about providing authorities interested or active in maritime surveillance with ways to exchange information and data. Sharing data will make surveillance cheaper and more effective. A better management of safety, security and marine activities, requires a maritime surveillance system implemented both at national and transnational level to tackle these dimensions while also contributing to the European Green Deal objectives, as part of the European efforts to implement the United Nation's 2030 Agenda for Sustainable Development and its goals. Sharing and management of information and data between different stakeholders through digital transformation, is the way to success for developing and upgrading efficiency of existing systems.

Public services and governance are activities related to the **maritime space**, **spatial planning** and **legislation** for several purposes like environmental protection, fisheries, transport, border control, customs and defence, costal management and other support to policy instruments implementation related to Blue sectors. Public services and governance are closely related to EUSAIR Pillar 1 - Topic 3 of the same name with the specific objective to improve Adriatic-Ionian Sea basin governance and services by enhancing administrative and institutional capacities.

Most recent EUSAIR effort by EC (DG REGIO and DG NEAR) is aimed to adaption of the EUSAIR flagships initiative, which includes development activities for improving marine and maritime governance and Blue growth services in form of:

- research platforms and trans-regional cooperation between communities in order to combat marine litter pollution, develop fish tourism and ichthyotourism and bolster creation of start-ups and local employment and promotion of partnership work;
- Governance of maritime space for a sustainable and transparent use of maritime and marine resources which will include supporting the implementation of the new Directive on Maritime Spatial Planning; adopting clearer legal frameworks for development of Allocated Zones for Aquaculture (AZAs), marine protected areas (MPAs), exploiting deep-sea water and marine mineral resources;
- Improving maritime professional skills and expertise

Maritime spatial planning (MSP) is a legislative framework the European Parliament and the Council have adopted in 2014 upon identifying a need to manage joined waters more coherently due to competition for maritime space. Planned benefits of the maritime spatial planning are aimed at:

- Reduction of conflicts between sectors and creating synergies between different activities;
- Encouraging investments by implementing transparent and clearer rules;
- Increasing cross-border cooperation in various sectors like energy grids, submarine cables, pipelines, shipping lines and other activities and to develop coherent networks of protected areas;
- Protecting the environment through early identification of impacts and opportunities for multiple use of space.

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[51] EC, Integrated maritime surveillance https://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/ , retrieved on 16.02.2021.

Management of marine ecosystem services – Ecosystem services by definition are "the benefits people obtain from ecosystems"[52]. In relation to the maritime activities, the Blue economy comprises of economic activities that directly or indirectly use living or non-living resources from the sea. Marine ecosystem can provide a higher amount of services when is healthy, creating more benefits for people. Knowing how to assess the economic value of the ecosystem services in relation to Blue economy activities may be of big importance. This value can indicate a sum that can be at stake when the ecosystem is endangered.

According to the World Economic Forum[53] the top most likely risks were related to environmental hazards and directly linked to ecosystem services: 1) extreme weather, 2) climate action failure, 3) natural disasters, 4) biodiversity loss and 5) human-made environmental disasters.

Maintaining stable and healthy marine habitats with sustainable resources is essential for sustainability and productivity of the Blue economy sectors.

Common International Classification of Ecosystem Services (CICES) grouped such services into three general sections[54]:

- **Provisioning services** — benefits obtained directly from the ecosystem, so called ecosystem goods (e.g. sea food, water purity, raw minerals, biogenic minerals, energy in a form of biomass fuels etc.);
- **Regulating and maintenance services** — benefits obtained from the regulation of ecosystem processes (e.g. climate regulation, carbon sequestration, coastal protection, waste decomposition and detoxification, water purification, flood protection etc.) and
- **Cultural services** – non-material benefits obtained directly from the ecosystem (e.g. aesthetic, recreational, psychological and spiritual benefits, science and education, etc.)

Each section and corresponding **category** are in certain interaction with affected proposed project's sectors or subsector:

- Provisioning services section
- **Food provision** – direct and indirect dependency through fisheries, aquaculture production
- **Water storage and provision** – direct dependency through water for human consumption
- **Biotic materials and biofuels** – direct and indirect dependency through biomass or biotic element for non-food purpose
- Regulating and maintenance services section
- **Water purification** – direct or indirect dependency through bio and physiochemical processes for waste and pollutant removal
- **Air quality regulation** – direct and indirect dependency through air pollutants concentration in the lower atmosphere
- **Coastal protection** – direct and indirect dependency through erosion prevention, protection against floods
- **Climate regulation** – direct and indirect dependency through greenhouse gases, uptake, storage and sequestration of CO_2
- **Weather regulation** – direct and indirect dependency through influence on local weather conditions as thermo-regulation and humidity

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[52] Millennium Ecosystem Assessment (MEA)

[53] World Economic Forum – The Global Risk Report 2020, https://www.weforum.org/reports/the-global-risks-report-2020 , retrieved on 16.02.2021.

[54] Common International Classification of Ecosystem Services (CICES) - Towards a common classification of ecosystem services, https://cices.eu/ retrieved on 16.02.2021

- **Ocean nourishment** – direct and indirect dependency through nutrient regulation and soil formation
- **Life cycle maintenance** – direct and indirect dependency through biological and physical support habitat maintenance
- **Biological regulation** – direct and indirect dependency through biological control of pests that may affect commercial activities and human health
- Cultural services section
- **Recreation and tourism** – indirect dependency through fish caching for non-commercial purposes

Ecosystems are extremely complex interacting living and non-living systems. Such a complexity is translated into the interaction between ecosystem services and the Blue Economy. Marine ecosystem services and Blue economy have clear interaction. Some Blue economy activities may directly arise from marine ecosystem services like food provisioning services which support fisheries and aquaculture activities, and others indirectly like life cycle maintenance which supports marine living resources. It is known that one maritime ecosystem service may support several economic activities, so for example services of Water purification support Blue Economy sectors such as Marine living resources, Blue bioeconomy and Coastal tourism.

Main human pressure on marine ecosystem services include several activities:

- Input or spread of non-indigenous species,
- Over-exploitation and over-extraction of marine resources or mortality/injury to wild species,
- Input of nutrients and organic matter,
- Physical loss or disturbance to seabed,
- Changes to hydrological conditions,
- Input of contaminants, litter and hazardous substances,
- Input of anthropogenic sound and other forms of energy.

In order to be able to successfully manage the marine ecosystem services, it is necessary to measure and monitor, using comprehensive and quantitative methods, the health of marine natural capital and its ecosystems services supporting the Blue Economy activities. The economic value of such goods and services goes beyond the actual use of nature associated with physical use but also includes option values associated with goods/services potentially used in future and non-use values associated with irreplaceable environmental assets.

Therefore, the 7th Environment Action Program (7th EAP) and the EU Biodiversity Strategy 2020 include objectives to develop natural capital accounting (NCA) in the EU, with a focus on ecosystems and their services. Natural capital accounting (NCA) is still in an experimental status with methods and metrics still evolving. It is foreseen that ecosystem accounting complements the system of national accounts (SNA), where the role of natural capital is completely absent.

The purpose of ecosystem valuation is to help answer clearly defined policy questions and to help visualise and quantify (in monetary or non-monetary terms) the diverse direct and indirect contributions of ecosystems to human well-being.

ANNEX

Table 9. Overview of sectors evolution, Employment and GVA, 2009-2018

Sector	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Δ 2018-2009
Total BE jobs	**4.952,8**	**4.673,1**	**4.330,2**	**3.990,6**	**4.085,0**	**4.072,1**	**4.005,9**	**4.294,1**	**4.475,8**	**4.997,1**	**0,9**
Marine living resources	591,6	591,3	572,4	578,2	563,2	562,0	561,3	570,5	570,9	573,3	-3,1
Marine non-living resources	65,6	67,8	63,8	66,1	62,0	63,9	65,1	55,3	46,7	47,0	-28,4
Marine renewable energy	0,6	0,9	1,3	1,3	2,6	2,5	4,0	3,6	4,0	4,6	693,3
Port activities	456,8	452,2	433,3	464,4	464,0	503,8	522,7	575,5	549,3	549,3	20,3
Shipbuilding and repair	352,5	315,9	301,6	297,8	297,5	303,6	307,1	319,4	317,3	318,3	-9,7
Maritime transport	380,5	376,7	384,7	379,5	377,5	397,7	407,3	387,2	407,8	407,8	7,2
Coastal tourism	3.105,2	2.868,3	2.573,2	2.203,3	2.318,3	2.238,6	2.138,4	2.382,5	2.579,7	3.096,7	-0,3
Sector	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Δ 2018 - 2009**
Total BE GVA (million €)	**189.815**	**193.469**	**188.327**	**178.931**	**182.812**	**183.606**	**193.037**	**185.502**	**205.642**	**218.275**	**15,0**
Marine living resources	16.949	17.123	17.706	17.972	17.528	18.466	19.497	21.076	21.100	20.966	23,7
Marine non-living resources	27.490	28.335	28.050	27.968	26.087	24.187	23.351	15.639	19.435	19.565	-28,8
Marine renewable energy	79	173	278	333	461	573	965	949	1.015	1.089	1276,3
Port activities	28.387	28.432	31.850	29.291	29.839	31.563	34.594	34.582	35.205	35.205	24,0
Shipbuilding and repair	13.062	14.092	13.857	13.843	13.498	14.733	14.539	15.298	17.135	17.276	32,3
Maritime transport	29.867	33.262	29.871	30.602	32.144	32.450	37.018	30.382	35.599	35.599	19,2
Coastal tourism	73.981	72.052	66.717	58.922	63.255	61.634	63.073	67.576	76.152	88.575	19,7

Source: Blue economy indicators, https://blueindicators.ec.europa.eu/ accessed on 21.01.2021

Table 10. Overview and interlinks between Blue Economy Report sectors and EUSAIR pillars

ESTABLISHED SECTORS						
Relation to the sea	**Sector**	**Subsector**	**Activity (NACE rev.2)**	**Description**	**INTERACTIONS WITH OTHER SECTORS**	**RELATION TO THE ADRIATIC-IONIAN SEA BASIN** insignificant/medium/strong
Marine-Based activities	Marine living resources	Primary sector	A03.11 Marine fishing (SSCF Capture fisheries) A03.12 Freshwater fishing (Capture fisheries LSF) A03.13* (Capture fisheries DWF) A03.21 Marine aquaculture A03.22 Freshwater aquaculture A03.23* (Shellfish aquaculture)	Sector encompasses the harvesting of renewable biological resources (primary sector), their conversion into food, feed, bio-based products and bioenergy (processing) and their distribution along the supply chain. In broader terms, these activities form an integral part of the EU Blue bioeconomy, which includes any economic activity associated with the use of renewable aquatic biological biomass	Maritime transport Marine non-living resources Marine renewable energy Port activities Coastal tourism Offshore wind farms	STRONG
		Processing of fish products	C10.20 Processing and preserving of fish, crustaceans and molluscs C10.41 Manufacture of oils and fats C10.85 Manufacture of prepared meals and dishes C10.89 Manufacture of other food products n.e.c.			STRONG
		Distribution of fish products	G46.38 - Wholesale of other food, including fish, crustaceans and molluscs G47.23 - Retail sale of fish, crustaceans and molluscs in specialised stores			STRONG
	Marine non-living resources	Oil and Gas	B06.10 Extraction of crude petroleum B06.20 Extraction of natural gas B09.10 Support activities for petroleum and natural gas extraction	Extraction of crude petroleum, Extraction of natural gas and Support activities for petroleum and natural gas extraction; Operation of gravel and sand pits; mining of clays and kaolin, Extraction of salt	Marine living resources Coastal tourism Maritime transport Port activities Shipbuilding and repair Marine renewable energy (wind farms)	MEDIUM (decreasing)
		Other minerals	B08.12 Operation of gravel and sand pits; mining of clays and kaolin B08.93 Extraction of salt B09.90 Support activities for other mining and quarrying			INSIGNIFICANT
	Marine renewable energy	Offshore wind energy	D35.11 Production of electricity D35.12 Transmission of electricity	Offshore wind energy is currently the only commercial deployment of a marine renewable energy; Sector currently only comprises Fixed offshore wind.	Marine living resources Coastal tourism Maritime transport	INSIGNIFICANT
	Maritime transport	Passanger transport	H50.10 Sea and coastal passenger water transport H50.30 Inland passenger water transport	Shipping is the most carbon-efficient mode of transportation. Achieving decarbonisation will require a combination of technological and operational innovations and the large-scale use of alternative fuels. The development of hybrid or fully electrified power trains will enable innovative vessels layouts, further energy efficiency, the integration of renewables as well as zero-emission applications in short-sea segments.	Marine living resources Marine renewable energy Port activities	STRONG
		Freight transport	H50.20 Sea and coastal freight water transport H50.40 Inland freight water transport			STRONG
		Services and transport	H52.29 Other transportation support activities N77.34 Renting and leasing of water transport equipment			STRONG
	Coastal tourism	Accommodation	I55.10 Hotels and similar accommodation I55.20 Holidays and other short-stay accommodation I55.30 Camping grounds, recreational vehicle parks and trailer parks i55.90 Other accommodation	Coastal tourism includes beach-based tourism and recreational activities, e.g. swimming, sunbathing, and ther activities for which proximity to the sea is an advantage, such as coastal walks and wildlife watching. Maritime tourism covers water-based activities and nautical sports, such as sailing, scuba-diving and cruising. The increasing number of tourists have led to concerns around the sustainable development of coastal areas, especially those characterised by high-density building and expanding environmental footprints. The cruise industry is an important and growing segment within Coastal tourism.	Marine living resources Marine non-living resources Marine renewable energy Port activities Maritime transport	STRONG
		Transport	G47.30 Retail sale of automotive fuel in specialised stores H49.10 Passanger rail transport, interurban H49.31 Urban and suburban passenger land transport H51.10 Passanger air transport			STRONG
		Other Expenditure	G47.60 Retail sale of cultural and recreational goods in specialised stores G47.70 Retail sale of other goods in specialised stores I56.00 Food and beverage service activities			STRONG
Marine-Related activities	Port activities	Cargo and warehousing	H52.10 Warehousing and storage H52.24 Cargo handling	Ports, as multi-activity transport and logistic nodes, also play a crucial role in the development of maritime sectors. Many ports across the EU, known as "Green Ports" are reducing their environmental and climate impact while also enabling green shipping fleets.	Marine living resources Maritime transport Marine non-living resources Marine renewable energy Coastal tourism Maritime defence	STRONG
		Port and water projects	F42.91 Construction of water projects H52.22 Service activities incidental to water transportation			STRONG
	Shipbuilding and repair	Shipbuilding	C30.11 Building of ships and floating structures C30.12 Building of pleasure and sporting boats C33.15 Repair and maintenance of ships and boats	The EU specialises in segments of shipbuilding with high level of technology and added value, such as cruise ships, offshore support vessels, fishing, ferries, research vessels, dredgers, mega-yachts, etc. The EU is also a global leader in the production of high-tech, advanced maritime equipment and systems. This specialisation and leadership position is a direct result of the sector's continuous investments in research and innovation as well as in a highly skilled workforce.	Marine living resources Maritime transport Marine non-living resources Marine renewable energy Coastal tourism Maritime defence Port activities Offshore wind farms	STRONG
		Equipment and machinery	C13.92 Manufacture of made-up textile articles, except apparel C13.94 Manufacture of cordage, rope, twine and netting C25.99 Manufacture of other fabricated metal products n.e.c. C26.51 Manufacture of instruments and appliances for measuring, testing and navigation C28.11 Manufacture of engines and turbines, except aircraft, vehicle and cycle engines C32.30 Manufacture of sports goods			STRONG

BLUEAIR is implemented through the financial support of the ADRION programme

EMERGING SECTORS						
Relation to the sea	Sector	Subsector	Activities (Comments)	Description	INTERACTIONS WITH OTHER SECTORS	RELATION TO THE ADRIATIC-IONIAN SEA BASIN insignificant/promising
Marine-Based activities	Marine renewable energy	Floating offshore wind / Wave and tidal energy / Floating solar photovoltaic energy / Hydrogen generation offshore	Emerging sectors can be those which are new/innovative, but can also be those for which data is emerging. As more data is becoming available so that measuring more niche activities is becoming somewhat less complex. However, it is worth mentioning that data gaps still exist and that a straightforward evacuation of these sectors, as seen for the established ones is not yet entirely possible. The market and supply chains of these technologies are not yet consolidated.	Offshore wind (anchored floating devices), ocean energy (tidal and wave power), floating solar photovoltaic (FPV), and renewable hydrogen production offshore	Marine renewable energy (bottom fixed foundations)	INSIGNIFICANT
	Marine minerals	n(a		Activity includes rare raw minerals and metals other than marine agregates (e.g. sand and gravel) mentioned in established sector. Icludes five classes of mineral deposites: Marine placers, Phosphorites, Seafloor massive sulphides, Cobalt-rich ferromanganese crusts and polymetallic nodules	Shipbuilding and repair	INSIGNIFICANT
	Desalination	n/a		Desalination is a common technology and an alternative for water supply that can alleviate the growing pressure on freshwater resources.	Marine renewable energy	PROMISING
Marine-Related activities	Maritime defence	n/a		Includes navies and their impact on national economies.	Shipbuilding and repair	PROMISING
	Submarine cables	n/a		Submarine cable networks ensure that data, telecommunication, and power transmission connections are possible within the EU and between the EU and third countries.	Marine renewable energy	PROMISING
	Blue bioeconomy and biotechnology	The algae sector		Sector includes the non-traditionally exploited groups of marine organisms and their commercial biomass applications. These organisms comprise macroalgae (seaweeds), microorganisms (microalgae, bacteria and fungi) and invertebrates (e.g., sea stars, sea cucumbers, sea urchins).	Marine living resources	PROMISING

Pillar	Topics	Indicative Actions	TITLE OF A FLAGSHIP 2020	PLAGSHIP SUBSTANCE (Blue economy related)	BLUE ECONOMY PRIORITY FOCUS AREA
Blue Growth	Blue technologies	**R&D&I platforms on green sea mobility, deep sea resources, biosecurity and bio-technologies** The most promising themes are green sea mobility, deep sea resources (including the development of unmanned marine vehicles), bio-security and blue bio-technologies. **Macro-regional cluster development** Support the establishment of trans-boundary clusters on promising sectors such as green shipbuilding and new materials in order to enhance exploitation of emerging technologies and internationalisation of SMEs. **Researchers mobility** Promotion of "brain circulation" amongst research institutes/academies and companies as a condition for developing macro-regional cooperation in the field of blue technologies **Improving access to finance and promoting start-ups** Improving access to funding and promoting start-ups for development and testing prototypes or ideas and supporting business spin-offs from scientific research	FOSTERING QUADRUPLE HELIX TIES IN THE FIELDS OF MARINE TECHNOLOGIES AND BLUE BIO-TECHNOLOGIES FOR ADVANCING INNOVATION, BUSINESS DEVELOPMENT AND BUSINESS ADAPTATION IN BLUE BIO-ECONOMY	Blue technoligies; "brain circulation"; networking capacities; skilled human capital; know-how transfers EU-IPA countries; research, private, public cooperation; innovative products and services; technology transfers; compliance/adaptation of non-EU countries, trade and investment barriers removal; internationalization; access to finance; clustering; blue skills promotion; creation of databanks; marine bio-discoveries; novel eco-friendly products serving circular economy; decatbonization of fishing fleets; "one-stop-shops" operation support for SMEs	**PRIMARY** Oil and gas Other sea minerals Cargo and warehousing Port and water projects Shipbuilding Equipment amd machinery Passenger transport Freight transport Services for transport Blue bioeconomy and biotechnology
	Fisheries and aquaculture	**Scientific cooperation on fisheries and fish stocks** Supporting regular assessment of shared fish stocks in the Adriatic and Ionian Seas and evaluating main elements for sustainable management of fisheries **Sustainable management of fisheries** Multiannual fishery management plans are crucial for sustainable fisheries. Economic **EU compliance and common standards and practices** To develop and apply common standards and practices. Compliance with the EU acquis in these sectors and alignment to common standards are needed for sustainable fishery management and sustainable aquaculture **Diversification and profitability of fisheries and aquaculture** Sustainable and profitable fisheries and aquaculture require strengthened stakeholder involvement in the overall management, as well as improved and diversified activities. With regard to aquaculture, this may also imply developing tools for proper site management, environmental monitoring and improving quality schemes. **R&D platform for seafood** Actions include research aiming at improving productivity, quality and environmental sustainability of aquaculture (including offshore aquaculture), as well as at increase the industry's ability to respond to market needs and to diversify its offer (new species) **Developing skills** Action focuses on promoting and strengthening networks of academies and training institutes aiming to develop specific educational and (joint) training programs for fishermen and aquaculture farmers on innovative fishing and aquaculture techniques and safety at work **Marketing of seafood products** Quality and origin of seafood products are critical to creating added value throughout the fisheries and aquaculture value chains in the Region (labelling, traceability and certification).	PROMOTING SUSTAINABILITY, DIVERSIFICATION AND COMPETITIVENESS IN THE FISHERIES AND AQUACULTURE SECTORS THROUGH EDUCATION, RESEARCH & DEVELOPMENT, ADMINISTRATIVE, TECHNOLOGICAL AND MARKETING ACTIONS, INCLUDING THE PROMOTION OF INITIATIVES ON MARKETING STANDARDS AND HEALTHY NUTRITIONAL HABITS	Increasing competitiveness of coastal comunities; compliance of non-EU countries with EU Acquis; combining fisheries with tourism activities; management and sustainable exploration of fish stock; data collection; fish stock assessment; elimination of destructive fishing practices; upgrading fishermen skills; introduction of new spicies; alternative raw materials for feed production; new farming technologies; advances processing technologies; innovative traceability; strategy for small scale fisheries; fisheries management; monitoring network for alien spicies; enhanced habitat features (artificial reefs); aquaculture legal framework; farming technology methodology; initiatives on marketing standards and healthy nutritional habits; certification; harmonization of legislation	**PRIMARY** Primary sector Processing of fish products Distribution of fish products Cargo and warehousing Port and water projects Shipbuilding Equipment and machinery Blue bioeconomy and biotechnology
	Maritime and marine governance and services	**Governance of maritime space** Framework for a sustainable and transparent use of maritime and marine resources. This will include supporting the implementation of the new Directive on Maritime Spatial Planning **Institutional capacity to harmonise standards and regulations** Development of common understandings and harmonised standards and regulations as well as sharing of best practices **Data and knowledge sharing** Sharing data and knowledge among public bodies in the Region can increase the efficiency of the public administration **Maritime skills** Improving the levels of skills in the Region, e.g. by strengthening networks of academics, training organisations and professional organisations in the maritime sector. **Citizen and business awareness and involvement** Promoting citizen and business awareness regarding blue economy, new technologies, fisheries and aquaculture.	BOLSTERING CAPACITY BUILDING AND EFFICIENT COORDINATION OF PLANNING AND LOCAL DEVELOPMENT ACTIVITIES FOR IMPROVING MARINE AND MARITIME GOVERNANCE AND BLUE GROWTH SERVICES	Competition for maritime space regarding renewable energy equipment, aquaculture; harmonization of standards; removal of barriers and obstacles; complience/adaptation of non-EU countries with EU Acquis; improved skills and soft skills; network strenghtening; marine litter pollution; developement of fishtourism and ichthyotourism; maritime space for a sustainable and transparent use of resources; exploring deep-sea water and marine mineral resources	**PRIMARY** Primary sector Processing of fish products Distribution of fish products Port and water projects Shipbuilding Equipment and machinery

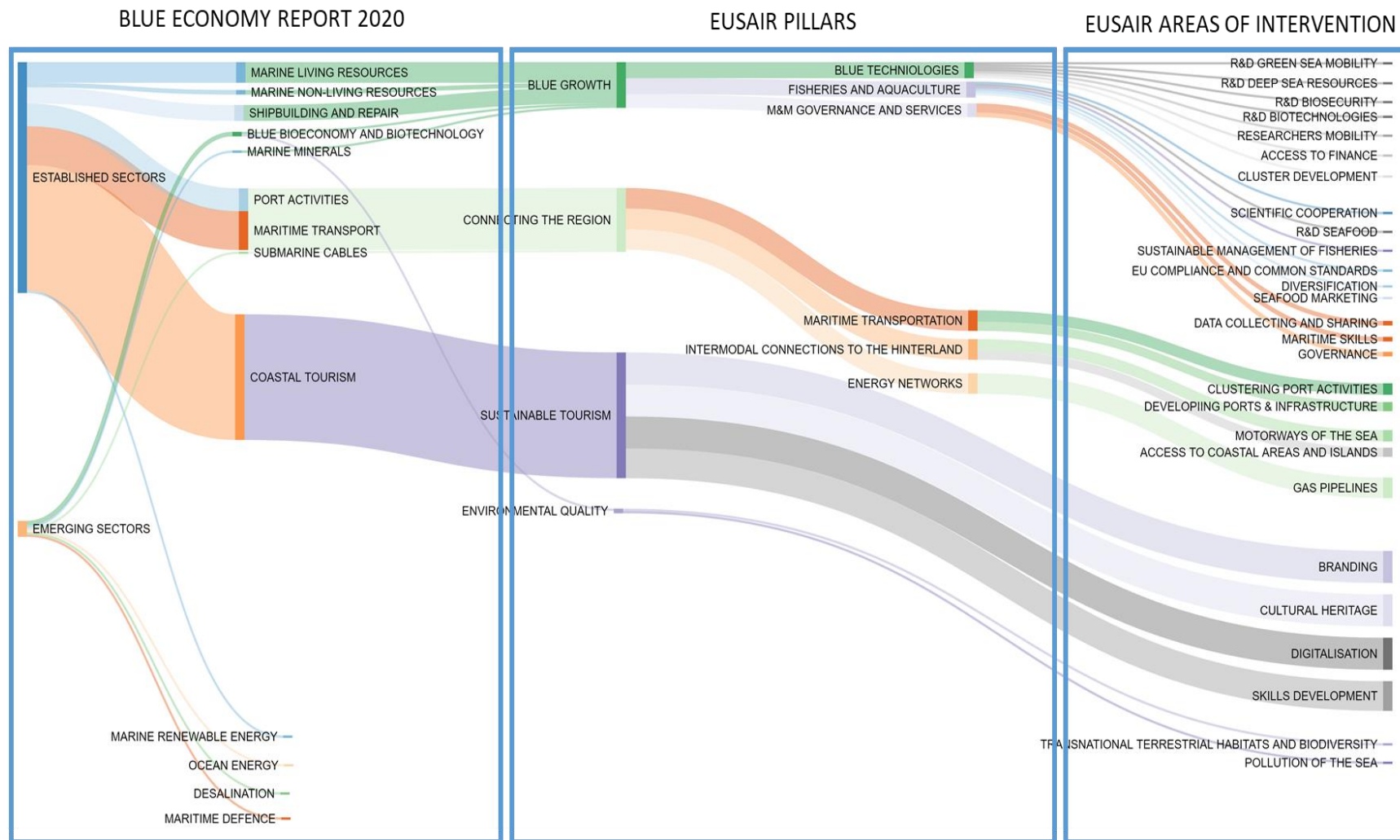|					PRIMARY / SECONDARY
Connecting the region	Maritime transport	**Clustering port activities /services** Harmonising the ports processes through a common ITS (Intelligent Transport **Improving and harmonising traffic monitoring and management** Strengthening and securing frequent exchange of information between coastal countries through the development of a Common Adriatic-Ionian Vessel Traffic Monitoring and Information System. Improving safety and security of maritime traffic in the region **Developing ports, optimising port interfaces, infrastructures and procedures / operations** In order to boost maritime transport, short-sea shipping capacity and cross-border ferry connectivity. Development of combined infrastructure (trade, procedures, movement of goods information systems, structures, vehicles and operations), improving links to the mainland and emphasising the supply chain of goods.	THE ADRIATIC-IONIAN MULTI-MODAL CORRIDORS	More connected, greener and low-carbon Europe; maritime connections between the coasts of the Adriatic and Ionian Seas alongside the TEN-T network and intermodal connections between the seaports and the hinterland of the Region; development of ICT and other innovative solutions to promote environmental-friendly transports (e.g. green ports, cycling routes developments); A-I Cycle Route; green/smart port hubs; onshore power supply (OPS); technology testing in ports; mapping of local and MR needs; zero emission infrastructure; interoperability among ports; ICT sollutions; enhance connectivity to islands boosting short sea shipping green solutions; circular economy projects; hybrid ships; environment-friendly solutions for greener, safer and efficient transport systems	**PRIMARY** Distribution of fish products Cargo and warehousing Port and water projects Shipbuilding Equipment and machinery Passenger transport Freight transport Services for transport Transport (coastal tourism)
	Intermodal connections to the hinterland	**Developing the Western Balkans comprehensive network** Need to prioritise investments on the defined SEETO comprehensive network (railway, inland waterways, nodes and hubs, notably with the motorways of the sea), aimed at promoting sustainable transport in the Region, and to prepare their integration in the Trans-European Network – Transport (TEN-T) network. **Improving the accessibility of the coastal areas and islands** Addressing tourism seasonality. Exploring new coordinated and market-based options, optimising use of freight and passenger routes and involving private and public stakeholders. **Developing motorways of the sea** Intermodal transport requires integrated management of the whole logistic chain. Essential elements are, inter alia, improved road and rail infrastructure linking ports with the hinterland and improved infrastructure within a port and ITS solutions. **Railway reform** Measures to expedite progress in railway reform, e.g. transparent non-discriminatory access to rail terminals, in particular in sea and inland ports, introducing a concession approach for infrastructure, with direct cost-oriented track access charges, performance schemes and management contracts for authorised applicants **Development of air transport** Establishing a dialogue amongst stakeholders on regional flight connections aiming to develop better links within the Region **Cross-border facilitation** Physical and non-physical investments on specific transport axes.			**SECONDARY** Cargo and warehousing Port and water projects Passenger transport Fraight transport Services for transport Transport (Coastal tourism)
	Energy networks	**Cross border electricity interconnections** **Gas ring** Objective is to enhance security of supply and to promote market integration through diversification of sources and routes to connect gas supply sources. Promoting more secure gas supply. **Support the establishment of a well-functioning electricity market** Energy needs an integrated and well-functioning market. Providing correct transmission capacities to the market, irrespective of the market concept applied. **Remove barriers for cross-border investments** Regulatory measures will be enforced in order to remove some of the barriers to cross-border investment; these may involve permitting procedures, information for decision makers, cost benefit analysis, incentives for projects with a cross-border impact and others.	POWER NETWORKS AND MARKET FOR A GREEN ADRIATIC-IONIAN REGION INTEGRATED NATURAL GAS CORRIDORS AND MARKET FOR A GREEN ADRIATIC-IONIAN REGION DEVELOPMENT AND OPERATION OF LOGISTICS FOR DIRECT LNG USE AS A CLEAN FUEL FOR THE ADRIATIC-IONIAN REGION	Digitalisation of the power system, smart grids, deployement of renewable energy sources Natural gas would be the fuel of choice in the energy transition; New gas pipelines, gas storage, LNG regasification terminals Construction and management of an LNG infrastructure in key harbours; network of LNG refuelling stations for road transport; pilot project to promote marine and road truck engine conversion to the LNG use as a fuel	**SECONDARY** Oil and gas Offshore wind energy

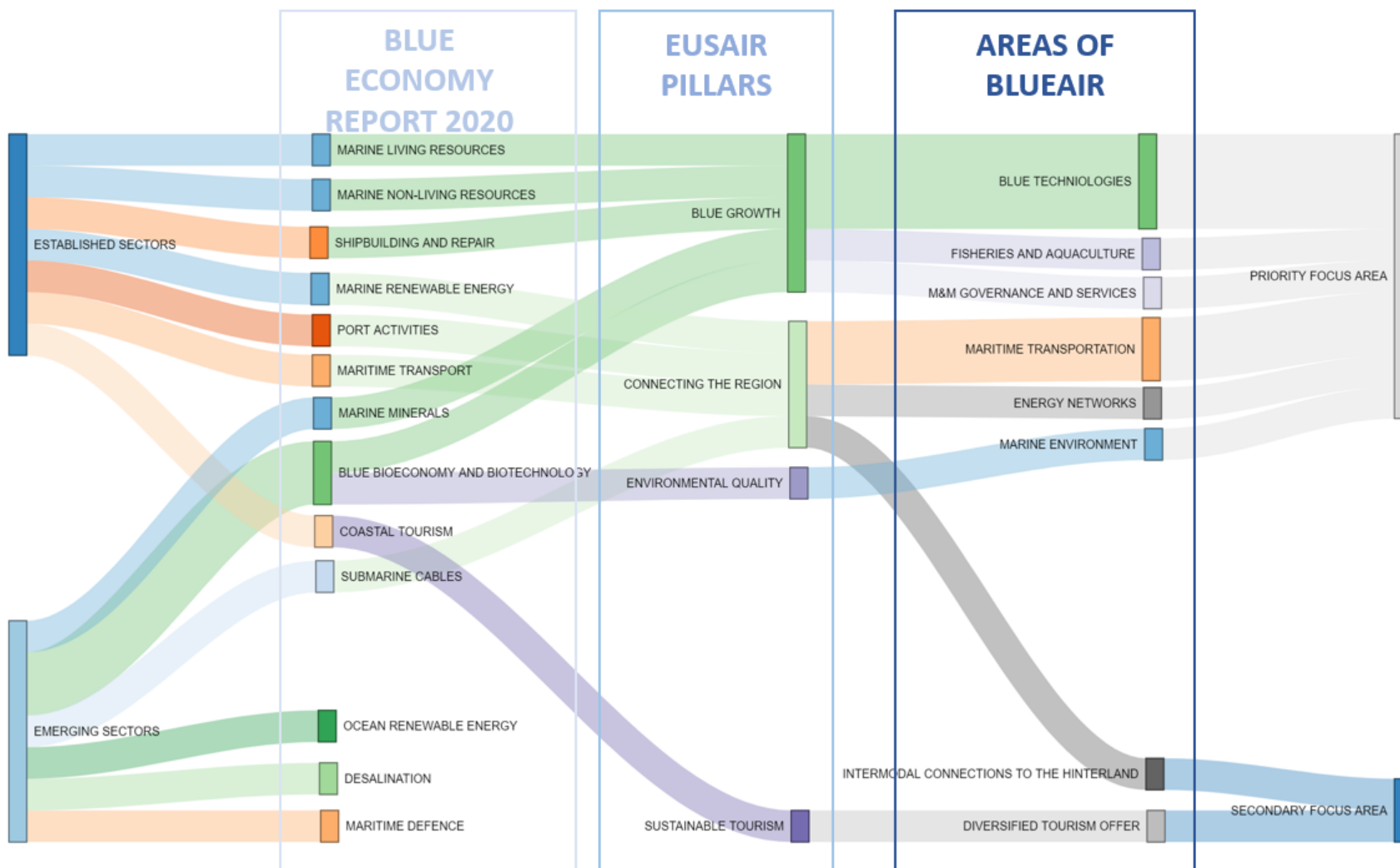| Environmental quality	The marine environment - A) Threat to coastal and marine biodiversity	**Increasing marine knowledge** Basis for actions related to Maritime Spatial Planning (MSP), Integrated Coastal Management (ICM) and implementation of the Marine Framework Strategy Directive. inventory of marine biodiversity and detailed habitat mapping; monitoring diversity descriptors; common infrastructure platform in terms of data collection, marine research, lab analysis through common survey programs, research vessels and laboratories; develop a Web-GIS Observatory Network	PROMOTION OF SUSTAINABLE GROWTH OF THE AI REGION BY IMPLEMENTING ICZM AND MSP ALSO TO CONTRIBUTE CRF ON ICZM OF BARCELONA CONVEN-TION AND THE MONITORING AND MANAGEMENT OF MARINE PROTECTED AREA	Maritime Spatial Planning; Integrated Coastal Management; decreasing of marine pollution (marine litter, micro plastics); protection of biodiversity; improving water quality; defining gaps in marine and coastal knowledge	**SECONDARY** Blue bioeconomy and biotechnology Primary sector Oil and gas Other minerals Offshore wind energyPassenger transport Freight transport Port and water projects Marine ecosystem services
		Enhancing the network of Marine Protected Areas By possible designation of new areas in coordination with the process of designation of various programs, strategies and directives.			
		Exchanging best practices among managing authorities of Marine Protected Areas Aiming to achieve and/or to maintain the Good Ecological Status of marine waters and to preserve biodiversity also by integrating a fishing component in each MPA (e.g. Fishing Protected Areas)			
		Implementing Maritime Spatial Planning (MSP) and Integrated Coastal Management (ICM) By ensuring coordination of different projects/initiatives with the frameworks provided by the Maritime Spatial Planning Directive and the Priority Action Plan of UNEP/MAP			
	The marine environment - B) Pollution of the sea	**Implementing a life cycle approach to marine litter** Establishing a coordinated monitoring system and database on marine litter and marine pollution	DEVELOPMENT AND IMPLEMENTATION OF ADRIATIC-IONIAN SUB/REGIONAL OIL SPILL CONTINGENCY PLAN	Response to marine pollution incidents	
		Supporting Clean-up programmes for both floating and sunken litter Integrating these activities with recycling programmes, and investing in necessary infrastructure.			
		Drafting and implementation of a joint contingency plan for oil spill and other large-scale pollution events Implementation of measures to enable joint contingency planning and coordinated emergency response.			
		Identifying hotspots Identifying hotspots and investing in reducing emissions of pollutants by realising a Hot Spot Inventory and aiming to depollute the sea.			
		Ensure prioritisation of investments to reflect the contribution to pollution of the sea Aligning existing funding instruments to support investment in waste management, waste water treatment and environmentally-friendly agricultural practices.			
		Address diffuse sources Address diffuse sources (e.g. nitrates from agriculture) by decreasing fertiliser use and by enhancing the recycling of nutrients			
	Transnational terrestrial habitats and biodiversity	**Development of joint management plans for cross-border habitats and ecosystems** Transnational plan to deal with landscape fragmentation through Green Infrastructure investment and to enhance the NATURA 2000 network. It should also enhance the Emerald network of protected areas, and strengthen ecosystem resilience in preparation for potential impacts of climate change	PROTECTION AND ENHANCEMENT OF NATURAL TERRESTRIAL HABITATS AND ECOSYSTEMS	Protection and enhancement of natural terrestrial habitats and ecosystems; ecological connectivity of blue and green corridors/infrastructure; conservation and restoration of large carnivore populations; protecting natural terrestrial habitats and ecosystems	**NON-FOCUS AREA**
		Joint population level management plans for large carnivores Developing GIS database of large carnivore habitats, and identifying needs for developing green infrastructure. Increase awareness of benefits to be reaped from healthy carnivore populations, notably for species preservation and for marketing areas for eco-tourism.			
		Harmonisation and enforcement of national laws With respect to length and timing of hunting season, list of species which can be hunted, designation of 'no hunting' areas.			
		Protection and restoration of coastal wetland areas and karst fields Activities to restore wetland areas including restoration of water flows and vegetation, investments in green infrastructure and removal of grey infrastructure; clean-up of sites and investment in waste water treatment.			
		Awareness-raising activities on the implementation and financial aspects of environmentally friendly farming practices e.g. organic farming, agri-environmental measures			

Sustainable tourism	Diversified tourism offer (products and services)	**Brand-building of the Adriatic- Ionian tourist products/ services** Gradual establishment of an Adriatic-Ionian brand which would posit the Region as one destination in the eyes of visitors, residents and stakeholders.			**SECONDARY** Primary sector Processing of fish products Distribution of fish products Port and water projects Shipbuilding Equipment and machinery Passenger transport Freight transport Services for transport Accomodation Transport Other expenditure
		Initiative to improve quality for sustainable tourism offer Improving the quality of the existing offer and delivering new services and products of enhanced quality should be at the basis of sustainable tourism offer. In this context, a tourism offer addressing specific target of tourists, such as: seniors, youth or people with disabilities, would be of interest.			
		Diversification of the cruise and nautical sectors and enhancement of the yachting sector By exploring alternative routes and/or business model, linking better the cruise offer to local people and products, unsustainable congestion can be better tackled and the full potential could be better exploited, with more lasting economic benefits for local economies.			
		Sustainable tourism R&D platform on new products and services Focuses on joining forces in the Region among university departments, research centres, innovation and technology transfer networks, together with the business community for development and marketing of new products and services, development of clusters and smart specialisation strategies.	RESEARCH & DEVELOPMENT FOR IMPROVEMENT OF SME'S PERFORMANCE AND GROWTH-DIVERSIFICATION	Harmonized methodological framework for the survey on cultural tourism demand; cultural resources, local economy and society, establishing new cultural tourism products	
		Sustainable and thematic tourist routes Action focuses on development and branding of macro-regional tourism routes, through mapping and further promoting existing routes. In addition, one should also explore creation of new routes building on the assets and diversity of the Adriatic-Ionian Region. This will include developing strategies for attracting new niche markets, especially for cultural, luxury and business tourism.	DEVELOPMENT OF SUSTAINABLE AND THEMATIC CULTURAL ROUTES/ CONNECTING CULTURAL ROUTES IN EUSAIR	Development of cycling, walking/hiking and sailing routes that would better connect all EUSAIR Cultural routes; sustainable tourism valorization of coastal and underwater cultural heritage	
		Fostering Adriatic-Ionian cultural heritage In order to diversify the Region's profile in the eyes of its visitors and to extend the tourism inflows beyond the summer season, the rich cultural background and assets should be further exploited by strengthening cultural cooperation.			
		Improving accessibility for Adriatic -Ionian tourism products and services This action is expected to adjust tourism products and services in the Region to the needs of both residents and visitors with special access needs (i.e. senior groups, young people and schools, disabled people, families with low income).			
		Upgrade of the Adriatic Ionian tourism products The Region has a unique variety of products - especially in agriculture and food processing sector - generated through processes that are unique in the world. Labelling and upgrading local products at macro-regional level is likely to result in stronger affiliation with the Region.			
	Sustainable and responsible tourism management (innovation and quality)	**Network of Sustainable Tourism businesses and clusters** Stimulating innovation through interaction between different tourism actors and creation of strong synergies with complementary sectors along the value chain applying the Smart Specialisation approach through adapting the Entrepreneurial discovery process	DEVELOPMENT OF THE NETWORK OF SUSTAINABLE TOURISM BUSINESSES AND CLUSTERS	Networks of creative industries, networks promoting and sharing best practices in environmental quality management and tourism clusters for the implementation/adoption of the EU Eco-Management and Audit Scheme (EMAS), ETIS and other Green (sustainable) Certification Schemes	**NON-FOCUS AREA**
		Facilitating access to finance for new innovative tourism start-ups Facilitated access to information on funding possibilities for innovative sustainable tourism start-ups, and for SMEs and university spin-offs capitalising on new research results and bringing new products and services into the sector.			
		Promoting the Region in world markets Improving the promotion of destinations in international key markets is needed for increased tourist flows.			
		Expanding the tourist season to all year-round Action will seek to alleviate seasonality in the Adriatic Ionian, and expand the tourist season.	EXPANDING THE TOURIST SEASON TO ALL-YEAR ROUND	Cruise destination management	
		Training in vocational and entrepreneurial skills in tourism Action will focus on the need for training for SMEs (including e-training), the creation of an Adriatic-Ionian Observatory on Sustainable Tourism skills, and training for tourism entrepreneurship.	TRAINING AND SKILLS IN THE FIELD OF TOURISM BUSINESSES (VOCATIONAL AND ENTREPRENEURIAL SKILLS)	Responsible tourism destination management	
		Adriatic Ionian cooperation for facilitating tourist circulation Common procedures on visas, and nautical licenses valid for visitors wishing to visit a range of Adriatic and Ionian attractions, revising the legislative regime for skippers and recreational boating and establishing stable and simplified legislative and fiscal framework are some of the actions needed for considerably increasing the tourism inflows.			
		Adriatic-Ionian Charter for sustainable and responsible tourism Establishment of an Adriatic-Ionian Charter to encourage sustainable and responsible tourism practices in the Region. It would promote the use of indicators to measure sustainable development at destination level			

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Figure 11. Transition map (Linkage thickness represent GVA relations in absolute values)

Source: Authors

Figure 12. Transition map to BLUEAIR potential areas

Source: Authors