



# **i34 BLUE GROWTH**

green innovation for blue growth

## **Deliverable 2.2.**

### **Report on trend analysis and ecosystem mapping**

[July – 2024]

[Version #2]

<b>Project ID</b>	101133055
<b>Project title</b>	I3-4-BLUE-GROWTH: Unlocking the potential of Sustainable Blue Economy
<b>Deliverable title</b>	Report on trend analysis and ecosystem mapping
<b>Deliverable number</b>	2.2.
<b>Deliverable version</b>	2
<b>Date of delivery</b>	
<b>Reviewed by WP leader</b>	
<b>Online access</b>	YES
<b>Diffusion</b>	
<b>Nature of deliverable</b>	Public
<b>Partner responsible</b>	HAMAG-BICRO

<b>Version</b>	<b>Date</b>	<b>Contributors</b>	<b>Description</b>
<b>1</b>	<b>1/7/2024</b>	<b>HAMAG-BICRO</b>	<b>First deliverable's draft</b>
<b>2</b>	<b>15/7/2024</b>	<b>BSSC</b>	<b>BSSC new informations</b>
<b>3</b>	<b>16/7/2024</b>	<b>PMBA</b>	<b>PMBA Revision</b>
<b>4</b>	<b>31/7/2024</b>	<b>HAMAG-BICRO</b>	<b>Final tuning</b>



Funded by the European Union, under **Project ID 101133055**. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Interregional Innovation Investment Instrument. Neither the European Union nor the granting authority can be held responsible for them.

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## TREND ANALYSIS REPORT AND ECOSYSTEM MAPPING

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### Introduction

I3-4-BLUE-GROWTH is a capacity building and investment project preparatory action aimed at promoting interregional cooperation for innovation and investment projects in high-priority and value-added markets of the blue economy sector.

The I3-4-BLUE-GROWTH consortium includes ten organizations from eight European countries, representing various stages of regional development: less developed regions (six partners), regions in transition (two partners), and more developed regions (two partners). The consortium encompasses representatives from all stakeholder groups of the quadruple helix: public administration, technology centres, innovation financing, advisory bodies, and industry clusters.

ANI - National Innovation Agency (Portugal) is a public agency promoting the valorization of knowledge and its transfer to the economic sector through enhanced collaboration between companies and national research entities. ANI's main activities include managing R&D instruments, increasing international program participation, and supporting the National Innovation System. In the project, ANI leads project management, coordinates I3 needs and priority analysis, designs innovative financial instruments, and promotes long-term sustainability and policy recommendations.

Merinova (Finland) is a cluster management company for the EnergyVaasa cluster, focusing on electrical, maritime, and energy technology. It supports business development and technological innovation within the energy sector. Merinova's role includes mapping I3 priorities and stakeholders, developing capacity-building programs, and arranging matchmaking and networking events related to maritime decarbonization and green shipping technologies.

HAMAG-BICRO (Croatia) The Croatian Agency for SMEs, Innovation, and Investments (HAMAG-BICRO) supports SMEs' growth through financial facilitation, innovation promotion, and knowledge commercialization. In the project, HAMAG-BICRO identifies investment projects in sustainable aquaculture, fisheries, and blue biotechnology, contributes to I3 priority analysis, and promotes networking and knowledge exchange.

CTAQUA (Spain) is an aquaculture technology centre that collaborates with public and private entities to advance aquaculture and seafood sectors. It focuses on sustainable aquaculture, animal nutrition, and novel seafood development. CTAQUA's role involves identifying I3 needs in sustainable fisheries and aquaculture, supporting capacity building, promoting internationalization, and facilitating knowledge transfer.

The Agrifood Clust-ER (Italy) is a non-profit association that supports competitiveness in the agrifood sector through collaborative research and technology transfer. It promotes sustainable agrifood models and strengthens the regional innovation system. In the project, Clust-ER Agrifood shares good practices, builds capacity in less developed regions, and participates in I3 priority analysis and value chain mapping.

Pole Mer Bretagne Atlantique (France) PMBA is a maritime innovation cluster promoting collaboration in maritime sectors such as marine energy, biological resources, and maritime safety. It supports innovation and competitiveness in the maritime economy. PMBA coordinates ecosystem building and internationalization activities, and supports the identification of innovation challenges and interregional projects.

DRCT – Regional Government of the Azores (Portugal) promotes the Azores as a knowledge-based society through scientific research and innovation. It supports the integration of research centres into international networks and the promotion of science. In the project, DRCT aids in RIS3 strategy analysis, ecosystem mapping, and development of long-term roadmaps and regional missions.

Unknown Group (Netherlands) is a venture capital and business development firm that supports innovation and market entry for startups globally. It organizes the Get in the Ring startup competition. Unknown Group's role includes designing the I3 open call for investment cases, providing investment readiness advisory, and organizing the Blue Economy Roadshow.

Baltic Sea and Space Cluster (Poland) BSSC is a key cluster focusing on maritime and space technologies, supporting knowledge transfer and business cooperation. It promotes zero-emission ship production and green technologies. BSSC's role involves identifying interregional innovation priorities, fostering cluster cooperation, and supporting SMEs in global competition.

BlueBio Alliance (Portugal) is a non-profit association promoting marine bioresources and blue biotechnology. It represents a wide range of stakeholders from raw material producers to biotech startups. In the project, BBA maps challenges and needs in the blue biotech value chain, supports project advisory and capacity building, and promotes networking and international synergies.

The I3-4-BLUE-GROWTH consortium brings together a diverse group of organizations dedicated to fostering innovation and collaboration in the Blue Economy. By leveraging the strengths and expertise of each partner, the consortium aims to drive sustainable growth, enhance interregional cooperation, and implement smart specialization strategies effectively.

The primary objective of the project is to enhance capacities of less-developed coastal & insular European regions to build and reinforce innovative ecosystems for the development of a sustainable and smart blue economy. The project will focus on two specific value chains (sustainable fisheries, aquaculture and valorisation of blue resources; Renewable Marine Energy and maritime decarbonization) aiming to deepen understanding of the related interregional value chains, transferring knowledge and good practices, and identifying a pipeline of innovative investments to promote sustainable growth of blue economy value chains. The project will equip regional stakeholders and SMEs with technical, business and investment readiness expertise, networking, business matchmaking and brokerage opportunities towards joint interregional innovation investment projects. Based on peer-to-peer knowledge exchange and regional field trips, it will provide them with exemplary best practices and advances in the sector, from both interregional policy, financing and industry perspective.

In this report, external assistance to the project consortium in undertaking Task T2.1, which encompasses the analysis of Research and Innovation Smart Specialisation Strategies (RIS3), ecosystem and initiatives mapping, and trend analysis in interregional cooperation, with a focus on policies, technologies, and best practices.

Specifically, the consortium conducted a comprehensive mapping of Blue Economy representation in specific country level/regional RIS3 strategies and policy trends from two distinct perspectives, each tailored to the national and regional specificities of the project partners.

These perspectives include:

- Interregional Innovation Investment Policies: Evaluating policies that promote cross-border collaboration and investment in the Blue Economy.
- Technologies and Innovative Blue Economy Projects: Identifying and analysing cutting-edge technologies and initiatives within the Blue Economy sector.

HAMAG-BICRO took the lead in coordinating the collection of regional initiatives from across Europe. This collection serves as a showcase of exemplary practices adopted by policymakers to stimulate the Blue Economy sector. The compendium aims to raise awareness about available regional development tools, initiatives, projects, and best practices. Through this effort, the project seeks to enhance peer-to-peer learning and provide insights into opportunities that foster interregional innovation investment projects within the Blue Economy sector.

The collection of best practices will be presented to various project stakeholders and will serve as a foundational input to identify priorities. This will also support the development of a training and capacity-building program aimed at stimulating interregional investment among regional actors and Blue Economy SMEs and startups.

Objective in this task was to provide in-depth analysis and actionable insights that support the strategic goals of the project's stakeholders, thereby contributing to the sustainable growth and innovation in the Blue Economy across Europe. It also had a goal to investigate how Blue Economy Growth Smart Specialization can be used as a tool for economic growth in general.

## Methodology - Understanding the Importance of Interregional Innovation Investment Policies in the Blue Economy

To grasp the significance of Interregional Innovation Investment Policies that promote cross-border collaboration and investment in the Blue Economy, it's essential to analyse trends in the implementation of smart specialization strategies (RIS3) across various regions represented by the project and respective countries. This analysis focuses on specific value chains to understand how these strategies contribute to a sustainable blue economy. Additionally, it identifies relevant stakeholders, innovative initiatives, projects, and technologies within the context of Smart Specialisation for Blue Growth.

### Methodological Framework

The methodology employed in this analysis incorporates various approaches and tools typical of qualitative research methods and evaluation processes. The research began with the formulation of main research questions and the application of methodological triangulation.

Methodological triangulation is a powerful technique used to validate the findings of a study by cross-verifying data from multiple sources. This approach enhances the credibility and reliability of the research outcomes.

In the context of this analysis, methodological triangulation involves the following steps:

#### 1. Data Collection:

**Surveys:** Engaging with project partners from participating regions to gather insights on the implementation of smart specialization strategies.

**Document Analysis:** Reviewing policy documents, strategic plans, and project reports related to Blue Economy initiatives.

**Case Studies:** Detailed examination of specific projects and initiatives that exemplify successful smart specialization in the Blue Economy.

#### 2. Data Sources:

**Primary Sources:** Direct interviews, surveys, and observations.

**Secondary Sources:** Academic articles, policy reports, and official statistics.

**Tertiary Sources:** Summarized and compiled data from multiple secondary sources, such as reviews and meta-analyses.

#### 3. Cross-Verification:

Comparing and contrasting information from different sources to identify consistent patterns and discrepancies.

Using multiple data points to validate findings and ensure robustness.

### **Main Research Questions**

The analysis was guided by several key research questions, including:

- How do smart specialization strategies promote sustainable growth in the Blue Economy?
- What are the specific value chains within the Blue Economy that benefit from these strategies?
- Who are the key stakeholders involved in the implementation of smart specialization strategies?
- What innovative initiatives, projects, and technologies are being developed in this context?

Understanding the landscape of stakeholders and initiatives is crucial for assessing the effectiveness of smart specialization strategies. Key stakeholders typically include these types of institutions with their respective roles:

- **Regional Authorities:** Responsible for the development and implementation of RIS3 strategies.
- **Research Institutions:** Conducting cutting-edge research and development to support innovation.
- **Industry Players:** Companies involved in marine biotechnology, sustainable aquaculture, marine renewable energy, and other blue economy sectors.
- **Non-Governmental Organizations (NGOs):** Advocating for sustainable practices and environmental protection.
- **Funding Bodies:** Organizations providing financial support for innovative projects and infrastructure development.

Innovative initiatives and projects often highlighted in the analysis include those relevant for 2 specific value chains as a focus of the analysis:

- **Marine Renewable Energy Projects:** Development of offshore wind, wave, and tidal energy technologies.
- **Sustainable Aquaculture Practices:** Implementation of integrated multi-trophic aquaculture (IMTA) systems.

- Blue Biotechnology: Research and commercialization of marine-based bioproducts and pharmaceuticals.
- Digital Transformation: Utilization of IoT, AI, and big data for maritime surveillance, resource management, and operational efficiency.

The application of methodological triangulation in this analysis ensures a comprehensive understanding of the impact of smart specialization strategies on the Blue Economy. By validating findings through multiple data sources, the research provides robust insights into how these strategies foster sustainable economic growth, promote innovation, and facilitate cross-border collaboration. The identification of key stakeholders and innovative initiatives further underscores the dynamic and collaborative nature of the Blue Economy, driven by strategic investments and interregional cooperation.

This approach not only highlights the successes achieved during the 2014-2020 programming period but also sets a framework for continued innovation and sustainable development in the 2021-2027 period and beyond.

## Chapter 1: Smart and Sustainable Blue Economy in the context of RIS3

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Utilizing Research and Innovation Smart Specialization Strategies (RIS3) proves invaluable in facilitating the shift towards a sustainable blue economy. These strategies serve as effective instruments in fostering the development of innovation ecosystems geared towards the blue economy within Member States and regions. They achieve this by actively encouraging the exchange of expertise and lessons learned, thereby facilitating the establishment of a cohesive community focused on advancing the blue economy through smart specialization.

Research and Innovation Smart Specialization Strategies (RIS3) refer to targeted approaches that leverage the unique strengths and resources of specific regions or countries to drive innovation and economic growth.

For Finland – Ostrobothnia Region its energy technology, digital solutions, renewable energy, and circular economy initiatives. Vaasa serves as the Nordic energy hub, hosting a high concentration of energy technology companies. The region emphasizes advanced production methods, digitalization, and carbon-neutral strategies. With a strong entrepreneurial spirit and significant investment in research and education, Ostrobothnia leverages collaboration between universities, industry, and the public sector to drive innovation.

In the case of Emilia-Romagna its blue bioeconomy, maritime manufacturing, coastal preservation, and tourism. The region boasts a robust industrial base, innovation ecosystems, and strong collaboration between businesses, research institutions, and public authorities. The South Netherlands region excels in high-tech systems and materials, agri-food, logistics, and life sciences. With a strategic focus on circular economy practices and collaborative networks, the region benefits from advanced manufacturing, sustainable agricultural practices, and excellent logistics infrastructure. Adriatic Croatia leverages its strengths in sustainable tourism, maritime transport, fisheries, aquaculture, and renewable energy potential (sources wind and sun). The region's rich cultural heritage and robust R&D infrastructure could foster innovation and economic growth in the Blue Economy sectors.

Andalusia prioritizes sustainable fisheries, marine renewable energy, coastal tourism, and maritime transport. The region's comprehensive Blue Economy strategy integrates eco-friendly practices, technological innovations, and environmental protection initiatives, supported by a strong focus on R&D in marine sectors.

In France, Bretagne and Pays de la Loire Regions lead in marine renewable energy, maritime industries, sustainable fisheries, and marine research. Bretagne and Pays de la Loire emphasize advanced shipbuilding, marine biotechnology, and sustainable coastal tourism, supported by extensive networks between research institutions, industry, and government.

These unique strengths and resources underpin each region's RIS3 strategy, highlighting their commitment to sustainable development, innovation, and economic growth within their specialized sectors. When applied to the context of transitioning towards a sustainable blue economy, these strategies play a crucial role in steering development efforts in alignment with environmental sustainability goals.

By fostering innovation ecosystems, RIS3 enables the creation of environments where businesses, researchers, and policymakers collaborate to develop solutions tailored to the needs and challenges of the blue economy. These ecosystems provide a fertile ground for the exchange of knowledge and best practices, allowing stakeholders to learn from each other's experiences and successes. As mentioned before, all targeted countries/regions in this report show a high level of dedication to this element, ecosystem strengthening and creation of sustainable partnerships between various stakeholders (for more details please see Chapter 3 and 4).

Moreover, by promoting the formation of a blue economy community within the framework of smart specialization, these strategies facilitate coordination and synergy among diverse actors working towards common goals. This collaborative approach enhances the effectiveness of initiatives aimed at advancing the blue economy, as it brings together stakeholders with varied expertise and perspectives.

Overall, the adoption of RIS3 offers a structured and systematic approach to supporting the transition towards a sustainable blue economy. By harnessing the power of innovation and collaboration, these strategies empower Member States and regions to drive meaningful progress towards a future where economic prosperity is intricately linked with environmental preservation.

The concept of a sustainable and smart Blue Economy encompasses the sustainable use of ocean and marine resources for economic growth, improving livelihoods and jobs, while preserving the health of ocean ecosystems. The term "sustainable" in the Blue Economy context refers to practices that meet current marine and coastal economic needs without compromising the ability of future generations to meet their needs.

This involves balancing ecological, social, and economic objectives and includes:

- Conservation of Marine Biodiversity: Protecting Ocean health and biodiversity through sustainable fishing practices, marine protected areas, and restoration projects.
- Pollution Reduction: Minimizing pollution inputs into marine environments, such as plastic waste, chemical runoff, and carbon emissions.
- Sustainable Energy Production: Developing renewable ocean energy sources such as wave, tidal, and offshore wind energy with minimal environmental impact.
- Climate Change Mitigation and Adaptation: Implementing strategies to reduce the carbon footprint of marine activities and adapt to the impacts of climate change on marine and coastal ecosystems.

- Social Equity and Economic Development: Ensuring that benefits derived from marine resources are equitable and contribute to the socioeconomic development of coastal communities.

"Smart" refers to the incorporation of innovation, technology, and data-driven approaches to maximize efficiency and effectiveness. In the Blue Economy, this can mean:

- Technological Innovation: Utilizing advancement in marine technology, such as automation, robotics, and biotechnology, for better resource management and exploration.
- Data Analytics and AI: Leveraging big data, artificial intelligence, and machine learning to improve the prediction, planning, and management of marine resources.
- Efficient Resource Use: Promoting resource efficiency and circular economy approaches, reducing waste and improving the lifecycle management of materials.
- Collaborative Platforms and Governance: Implementing smart governance frameworks that foster stakeholder collaboration across various sectors and borders to manage marine resources effectively.

When these elements are combined, a sustainable and smart Blue Economy can lead to improved marine resource management, innovative industrial growth, and protection of marine ecosystems — all of which are vital for the health of our planet and the well-being of current and future generations.

The latest edition of the EU Blue Economy Report<sup>1</sup> provides extensive analysis of the performance of various blue economy sectors across Europe<sup>2</sup>, utilizing the most recent data available. The EU Blue Economy Report, published annually by the Directorate-General for Maritime Affairs and Fisheries and the Joint Research Centre of the European Commission, provides a comprehensive analysis of the blue economy's scope and size within the EU. The seventh edition presents the latest data from 2021. Combined with the EU Blue Economy Observatory platform, the report offers detailed socio-economic performance indicators by sector, activity, and country, and sheds light on potential economic growth, sustainability transition, and job creation within the blue economy sectors.

Based on the Report the EU's blue economy is performing well overall, with emerging sectors like ocean energy, blue biotechnology, and desalination driving new business opportunities. According to 2021 data from Eurostat:

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<sup>1</sup> The EU blue economy report 2024

<sup>2</sup> The blue economy includes all economic activities related to oceans, seas, and coasts. This encompasses a wide array of sectors such as fisheries, aquaculture, coastal tourism, shipping, ports, and marine renewable energy.

- Employment in the blue economy stands at 3.6 million people, a 17% increase from 2020.
- The sector has a turnover of nearly €624 billion, up 21% from 2020.
- Gross Value Added (GVA) is €171 billion, a 35% increase compared to 2020.

When it comes to key trends the report tracks the evolution of blue economy sectors since 2009, with a focus on socio-economic trends between 2020 and 2021. Despite challenges from the COVID-19 pandemic and rising energy prices due to geopolitical tensions, most sectors showed improved economic performance, with the exception of coastal tourism, which was still recovering in 2021.

From 2015 to 2021, notable increases in nominal GVA were observed in:

- Offshore wind energy: +326%
- Shipbuilding and repair: +54%
- Maritime transport: +29%
- Marine living resources: +27%
- Port activities: +11%

Coastal tourism remains the largest sector, generating 29% of the EU blue economy GVA in 2021, and employing 54% of the workforce. However, it was the most affected by the COVID-19 crisis and had not fully recovered by 2021. Maritime transport is the second-largest sector in terms of turnover, contributing nearly a quarter of the GVA. The marine renewable energy sector, primarily offshore wind, saw gross profits of €2.4 billion and a GVA of €3.3 billion in 2021, marking a 45% increase from 2020. The marine living resources sector, which includes fisheries, aquaculture, and the processing and distribution of fish products, saw a 24% increase in gross profits, valued at €9.7 billion in 2021.

This edition emphasizes the role of blue economy sectors in the energy transition, highlighting the significant economic contributions of blue biotechnology and desalination, alongside a notable growth in marine renewable energy. The EU is a leader in developing energy from waves, tides, and offshore wind, which is crucial for meeting renewable energy targets and climate objectives.

The report also notes fewer positive trends for the EU fishing fleet. Despite a 25% reduction in fuel consumption and CO<sub>2</sub> emissions between 2009 and 2021, fuel efficiency has declined in recent years due to rising fuel prices. The Energy Transition Partnership for the EU fisheries and aquaculture sector, launched in 2023, supports the sector's shift to cleaner energy sources, reducing dependence on fossil fuels.

The report underscores the potential economic impacts of climate change on the blue economy, particularly coastal flooding. If current coastal protection levels are not improved, annual economic damages from coastal flooding could reach between €137 billion and €814 billion by 2100, highlighting the vulnerability of coastal communities in the EU's Outermost Regions.

The report underscores the resilience and growth of sectors like offshore wind energy, blue biotechnology, and desalination, which are driving new business opportunities. For instance, offshore wind energy experienced a remarkable 326% increase in GVA from 2015 to 2021. Despite the COVID-19 pandemic and rising energy prices due to geopolitical tensions, most sectors showed improved economic performance, with coastal tourism being the exception as it continued to recover in 2021.

These findings are highly relevant for the Research and Innovation Smart Specialization Strategies (RIS3) in the regions and countries analyzed, including Finland (Ostrobothnia), Italy (Emilia-Romagna), the Netherlands (South Netherlands), Croatia (Adriatic Croatia), Spain (Andalusia), and France (Bretagne and Pays de la Loire). The report highlights the importance of integrating blue economy sectors into regional development strategies to drive sustainable economic growth, innovation, and job creation. Regions with strong blue economy components, such as marine renewable energy and sustainable fisheries, are well-positioned to leverage these sectors for economic resilience and sustainability.

### Value Chains – focus

The blue economy sector is a major economic driver in Europe, employing nearly 4.5 million people and generating around €650 billion in turnover and €176 billion in gross value added (Eurostat). This sector offers significant opportunities for boosting development, sustainability, and innovation, particularly in less developed regions. Coastal areas, such as the Mediterranean basin, rely heavily on marine resources and activities like fisheries, shipbuilding, and tourism. However, many of these regions face structural challenges, including underdevelopment, lack of innovation, insufficient financial resources for scaling value chains, and high unemployment rates. These issues prevent full exploitation of the blue economy's potential.

The European Green Deal aims to transform the EU economy to achieve carbon neutrality by 2050. It promotes a resource-efficient and competitive economy with zero net greenhouse gas emissions, while protecting natural capital. The blue economy, by leveraging maritime and natural resources, is pivotal in meeting these climate and environmental goals. Climate change poses serious threats to coastal areas, depleting natural habitats, endangering marine ecosystems, and disrupting economic sectors. Investment in innovative sectors, such as AI and robotics, can help manage coastal regions more effectively, ensuring economic growth and job creation.

The EU Communication Transforming the EU's Blue Economy for a Sustainable Future outlines a green transition agenda for the blue economy. In 2022, the European Commission launched the Smart Specialization Platform on Blue Economy, focusing on five key areas to support interregional partnerships and value chains. This platform encourages cooperation among public administration, academia, industry, and civil society.

Maritime renewable energy is a crucial sector within the blue economy. Given the current energy crisis, investing in renewable sources is vital for energy security in

Europe. Coastal regions, particularly in Southern Europe and the Baltics, can benefit significantly from offshore wind energy. The RIS3PEnergy initiative promotes interregional partnerships focusing on renewable energy technologies. The European Commission's Offshore Renewable Energy Strategy aims to increase Europe's offshore wind capacity from 12 GW to 60 GW by 2030 and to 300 GW by 2050, complemented by 40 GW of ocean energy and emerging technologies like floating wind and solar.

EU funding instruments, such as Invest EU, the Connecting Europe Facility (CEF), and the Innovation Fund, along with private investments, support the deployment of renewable technologies and development of associated interregional value chains.

Developing new value chains in the blue circular economy and biotechnology sectors can also drive growth in less developed regions. Reducing the 27,000 tonnes of plastics dumped into European seas each year through bans on single-use plastics and increased use of recyclable materials can decrease water pollution, boost sustainable tourism, and preserve marine biodiversity. Emerging industries include bioplastics production and biowaste valorisation within circular economy principles. Additionally, new value chains focusing on underutilized bioresources like algae and shells are emerging, though their full potential remains untapped.

Based on comprehensive research, industry trends, and climate change considerations, the BlueGrowth project consortium has identified two value chains as the primary focus of the initiative. These value chains have demonstrated the highest potential to significantly advance the digital and green transformation of the Blue Economy, ensuring alignment with both environmental sustainability and technological innovation goals.

These two value chains have been a significant focus of our analysis, revealing a rising trend in their integration into respective RIS3 and other initiatives at the EU, national, and regional levels. Despite this progress, they remain underrepresented, particularly in developing regions. Our findings underscore the need for increased emphasis and support to fully leverage their potential in driving sustainable and innovative growth within the Blue Economy.

## **1. Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources**

Sustainable fisheries and aquaculture represent vital components of the blue economy, focusing on the responsible management and cultivation of aquatic organisms to ensure long-term food security and ecosystem health. The valorization of blue resources involves adding value to marine-based products and by-products through innovative processing techniques and sustainable practices.

Strategies on Sustainable Fisheries in this value chain aim to improve the management of fish stocks, reduce overfishing, and minimize bycatch through advanced monitoring and sustainable fishing practices. Innovations such as selective fishing gear, real-time data collection, and ecosystem-based management approaches are critical.

Aquaculture sector emphasizes the breeding, rearing, and harvesting of aquatic organisms under controlled conditions. Sustainable aquaculture practices include the

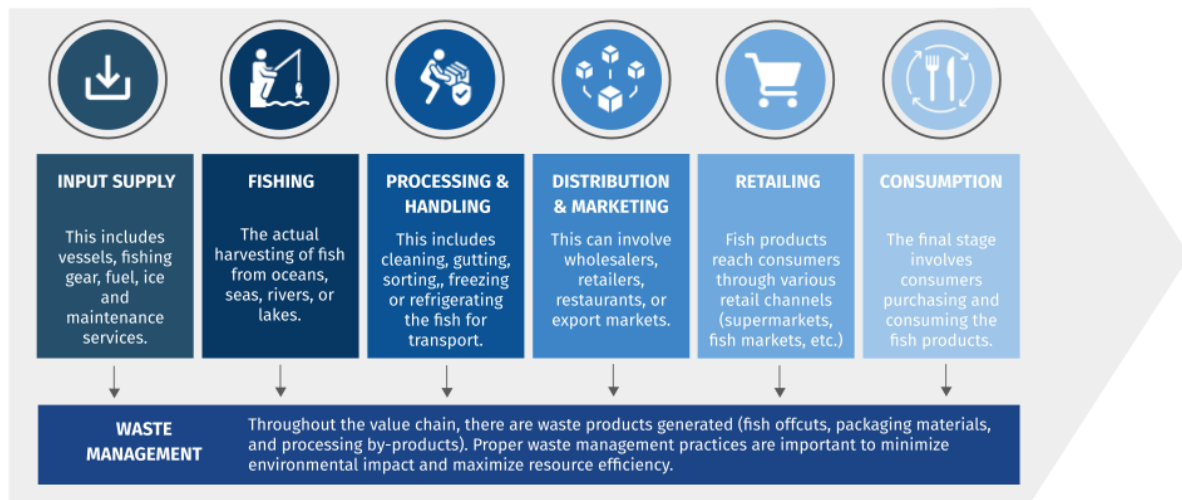
development of environmentally friendly feed, disease management protocols, and techniques to reduce the environmental footprint of aquaculture operations.

Valorization of Blue Resources involves transforming marine resources into high-value products, such as nutraceuticals, pharmaceuticals, and bio-based materials. It includes the sustainable utilization of underused or discarded marine biomass, contributing to a circular economy and reducing waste.

### ***Fisheries value chain***

1. **Input Supply:** This stage involves providing the necessary inputs for fishing operations. This includes vessels, fishing gear (nets, hooks, lines), fuel, ice (for preserving catch), and maintenance services.
2. **Fishing:** The actual harvesting of fish from oceans, seas, rivers, or lakes. This can involve various methods such as trawling, longlining, purse seining, or aquaculture practices such as fish farming.
3. **Processing and Handling:** Once the fish are caught, they need to be processed and handled properly to maintain their quality. This includes cleaning, gutting, sorting, and sometimes freezing or refrigerating the fish for transport.
4. **Distribution and Marketing:** After processing, the fish products are distributed to various markets. This can involve wholesalers, retailers, restaurants, or export markets, depending on the type of fish and the target market. Marketing efforts also play a role in promoting and selling the products.
5. **Retailing:** Fish products reach consumers through various retail channels such as supermarkets, fish markets, online stores, or directly from fishermen through community-supported fisheries (CSFs) or farmers' markets.
6. **Consumption:** The final stage involves consumers purchasing and consuming the fish products. This can be in the form of fresh, frozen, canned, or processed fish products such as fillets, steaks, or canned tuna.
7. **Waste Management:** Throughout the value chain, there are waste products generated, such as fish offcuts, packaging materials, and processing by-products. Proper waste management practices are important to minimize environmental impact and maximize resource efficiency.

## Fisheries Value Chain



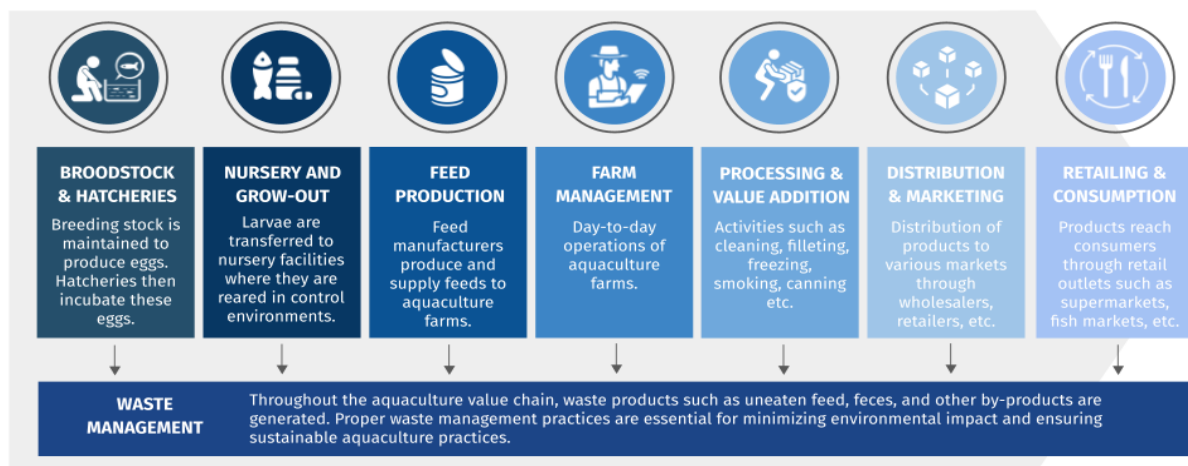
Source: DIH Innovamare, Infographics data archive, 2024

### **Aquaculture value chain**

1. **Broodstock and Hatcheries:** The value chain begins with broodstock management, where high-quality breeding stock is maintained to produce eggs. Hatcheries then incubate these eggs and rear the resulting larvae until they reach a size suitable for stocking into grow-out facilities.
2. **Nursery and Grow-out:** Once the larvae reach a certain stage of development, they are transferred to nursery facilities where they are reared to a larger size in controlled environments. After this stage, the juvenile fish or shellfish are moved to grow-out facilities such as ponds, cages, tanks, or raceways where they are grown to marketable size.
3. **Feed Production:** Aquaculture often requires formulated feeds to supplement natural food sources and ensure optimal growth. Feed ingredients can include fishmeal, fish oil, grains, and other proteins and nutrients. Feed manufacturers produce and supply these feeds to aquaculture farms.
4. **Farm Management:** This stage involves the day-to-day operations of aquaculture farms, including monitoring water quality, feeding, disease control, and harvesting. Efficient farm management practices are crucial for ensuring the health and productivity of the cultured species.
5. **Processing and Value Addition:** After harvesting, aquaculture products may undergo processing to add value and prepare them for the market. Processing activities can include cleaning, filleting, freezing, smoking, canning, or other forms of preservation and packaging.

6. **Distribution and Marketing:** Processed aquaculture products are distributed to various markets through wholesalers, retailers, exporters, and other channels. Marketing efforts play a crucial role in promoting aquaculture products and differentiating them from competing products.
7. **Retailing and Consumption:** Aquaculture products reach consumers through retail outlets such as supermarkets, fish markets, restaurants, and online stores. Consumers purchase and consume these products in various forms, including fresh, frozen, smoked, or processed seafood.
8. **Waste Management:** Throughout the aquaculture value chain, waste products such as uneaten feed, feces, and other by-products are generated. Proper waste management practices are essential for minimizing environmental impact and ensuring sustainable aquaculture practices.

## Aquaculture Value Chain



Source: DIH Innovamare, Infographics data archive, 2024

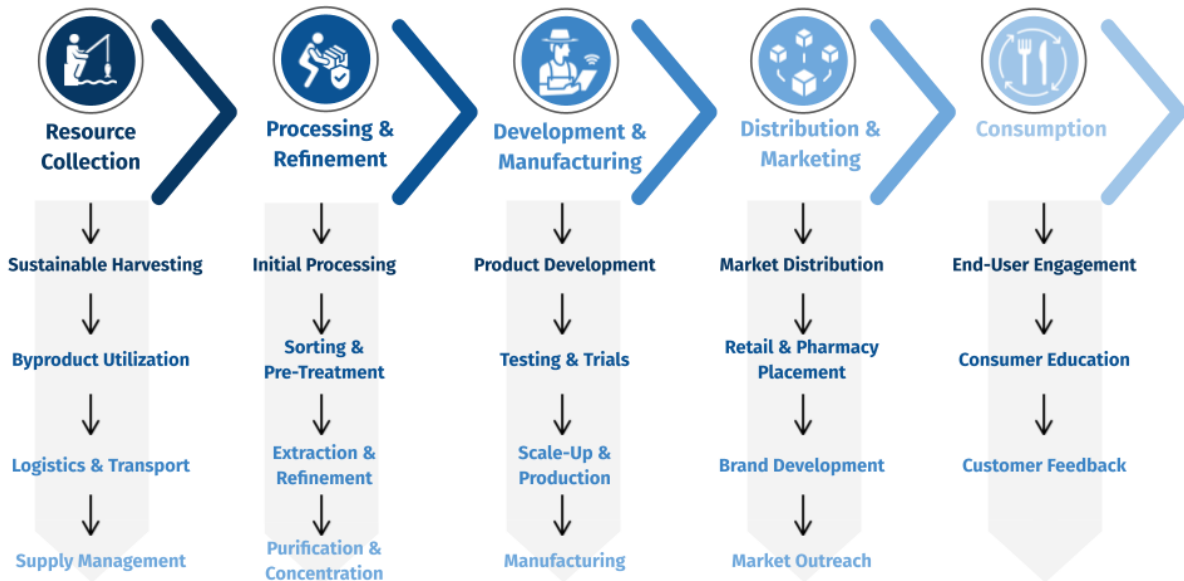
### Valorization of Blue Resources<sup>3</sup>

1. **Input Supply:** Resource Collection: Sustainable Harvesting - Obtaining marine resources like fish, algae, and other organisms through sustainable fishing and aquaculture practices; Byproduct Utilization - Collection of byproducts from seafood processing facilities, which are typically discarded, for additional uses; Supply Chain Logistics and Transport Ensuring cold chain integrity and efficient logistics to transport raw materials to processing facilities while maintaining

<sup>3</sup> This involves transforming marine resources into high-value products, such as nutraceuticals, pharmaceuticals, and bio-based materials. It includes the sustainable utilization of underused or discarded marine biomass, contributing to a circular economy and reducing waste

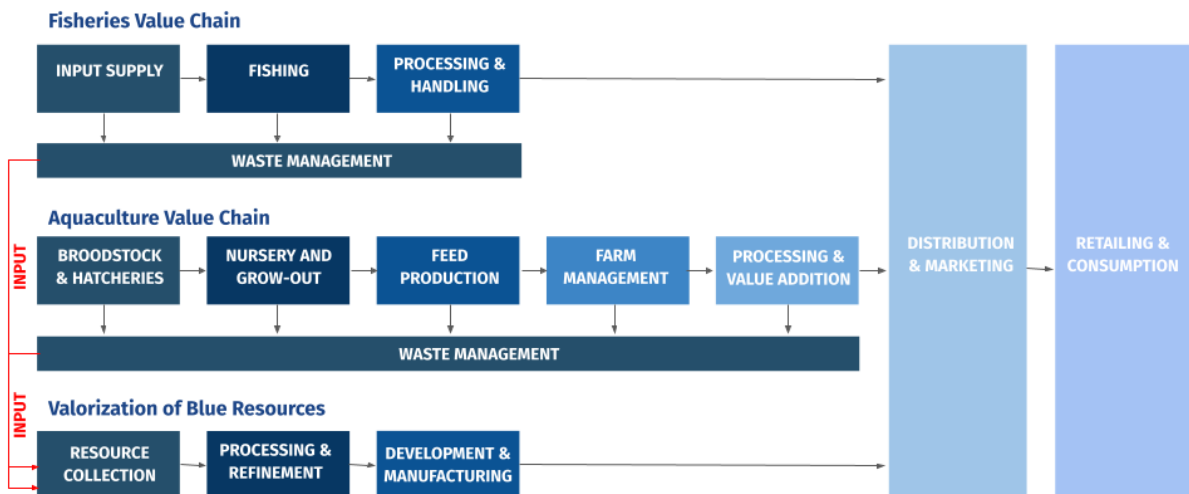
- quality; Supply Management - Coordination with suppliers to ensure a steady and sustainable supply of marine resources.
2. Processing and Refinement: Initial Processing - Sorting and Pre-Treatment, sorting biomaterials based on quality and intended use, and pre-treatment processes such as cleaning and drying; Extraction and Refinement - Bioactive Compound Extraction, using various extraction methods to obtain bioactive compounds from marine resources; Purification and Concentration - Purifying extracted compounds and concentrating them to enhance their value and efficacy for different applications.
  3. Development and Manufacturing: Product Formulation - Product Development: Combining extracted bioactive compounds with other ingredients to create nutraceuticals, pharmaceuticals, and bio-based materials; Testing and Trials - Conducting lab testing and clinical trials to ensure product safety and efficacy; Scale-Up and Production; Scaling Up - Transition from lab-scale processes to large-scale production while maintaining product quality; Manufacturing - Producing the final products in compliance with regulatory standards and good manufacturing practices (GMP).
  4. Distribution and Marketing: Market Distribution - Logistics: Efficient distribution channels to bring finished products to market, again maintaining any necessary cold chain requirements; Retail and Pharmacy Placement - Securing placement in retail outlets, pharmacies, or direct online distribution channels; Marketing and Sales - Brand Development: Establishing a brand that communicates the sustainable and high-value nature of the products; Market Outreach - Engaging in marketing efforts to educate consumers and create demand for these specialty products.
  5. Consumption: End-User Engagement - Consumer Education: Informing consumers about the benefits and sustainable attributes of the products to promote responsible consumption; Customer Feedback - Collecting consumer feedback for continuous

## Valorization of Blue Resources



Source: DIH Innovamare, Infographics data archive, 2024

## Interrelated Value Chains



Source: DIH Innovamare, Infographics data archive, 2024

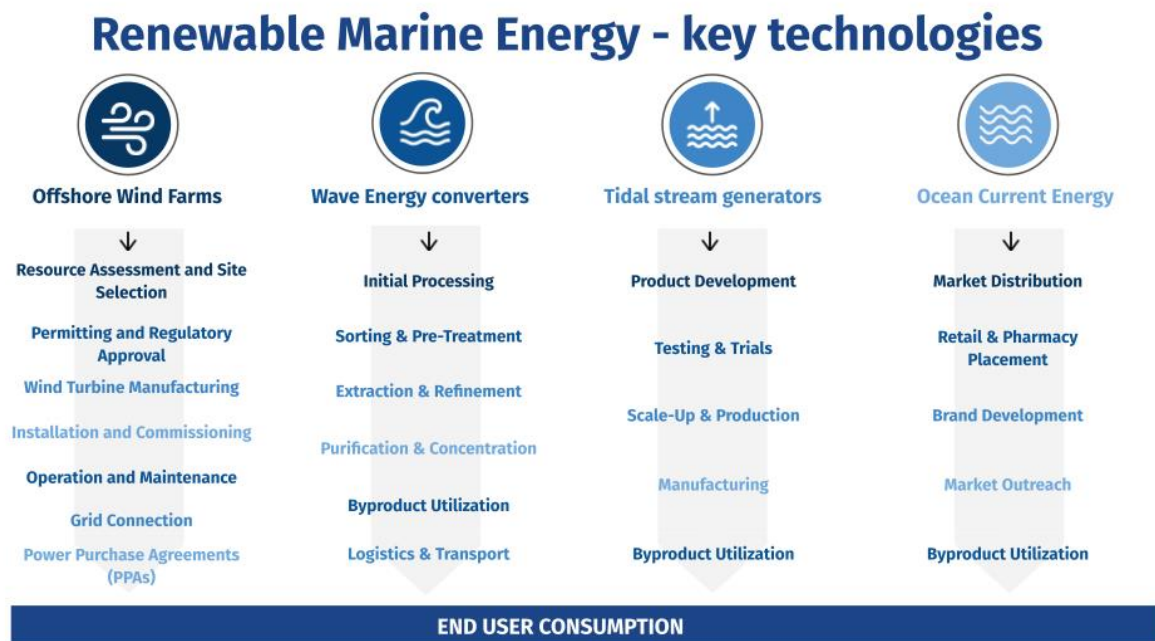
## 2. Renewable Marine Energy and Maritime Decarbonization

The shift towards renewable marine energy and maritime decarbonization is crucial for reducing greenhouse gas emissions and mitigating climate change. This value chain

focuses on harnessing renewable energy sources from the ocean and implementing measures to decrease the carbon footprint of maritime activities.

Renewable Marine Energy term encompasses energy generated from ocean-based sources such as wind, waves, tides, and thermal gradients. Key technologies include offshore wind turbines, wave energy converters, tidal stream generators, and ocean thermal energy conversion systems. Advancements in these technologies can provide sustainable and reliable energy, reducing dependence on fossil fuels.

Maritime Decarbonization strategies aim to lower the carbon emissions of the shipping and maritime industries. This involves the development and adoption of low-emission fuels (e.g., biofuels, hydrogen, ammonia), energy-efficient ship designs, and innovative propulsion systems. Additionally, implementing energy management systems and optimizing shipping routes contribute to significant emission reductions.



Source: DIH Innovamare, Infographics data archive, 2024

### Offshore Wind Farms

1. Resource Assessment and Site Selection: Identify suitable offshore locations with high wind energy potential through resource assessments and environmental impact studies.
2. Permitting and Regulatory Approval: Obtain necessary permits and approvals from regulatory bodies for the construction and operation of offshore wind farms.
3. Wind Turbine Manufacturing: Manufacture wind turbine components including towers, blades, nacelles, and foundations.
4. Installation and Commissioning: Transport and install wind turbine components offshore, including foundation installation, turbine assembly, and commissioning.

5. Operation and Maintenance: Conduct regular maintenance and repairs of offshore wind turbines to ensure optimal performance and longevity.
6. Grid Connection: Establish connections to the onshore power grid for electricity transmission from offshore wind farms to consumers.
7. Power Purchase Agreements (PPAs): Negotiate agreements with utilities or power purchasers for the sale of electricity generated by offshore wind farms.
8. End User Consumption: Consumers receive electricity generated by offshore wind farms through the grid, powering homes, businesses, and industries.

### **Wave Energy**

1. Technology Development: Research and develop wave energy conversion technologies to capture energy from ocean waves.
2. Prototype Testing: Test prototype wave energy devices in controlled environments such as wave tanks or small-scale ocean deployments.

Pilot Projects: Deploy larger-scale wave energy devices in real-world conditions to demonstrate feasibility and performance.

3. Installation and Maintenance: Install wave energy devices offshore and conduct regular maintenance to ensure optimal performance and reliability.
4. Grid Connection: Establish connections to the onshore power grid for electricity transmission from wave energy devices to consumers.
5. PPAs: Negotiate agreements with utilities or power purchasers for the sale of electricity generated by wave energy devices.
6. End User Consumption: Consumers receive electricity generated by wave energy devices through the grid, powering homes, businesses, and industries.

### **Tidal Energy**

1. Resource Assessment and Site Selection: Identify suitable locations with strong tidal currents for tidal energy development through resource assessments and environmental studies.
2. Technology Development: Research and develop tidal energy conversion technologies such as tidal turbines or tidal barrages.
3. Installation and Maintenance: Install tidal energy devices in tidal currents and conduct regular maintenance to ensure optimal performance.
4. Grid Connection: Establish connections to the onshore power grid for electricity transmission from tidal energy devices to consumers.
5. PPAs: Negotiate agreements with utilities or power purchasers for the sale of electricity generated by tidal energy devices.
6. End User Consumption: Consumers receive electricity generated by tidal energy devices through the grid, powering homes, businesses, and industries.

## **Ocean Current Energy**

1. Resource Assessment and Site Selection: Identify suitable locations with strong ocean currents for ocean current energy development through resource assessments and environmental studies.
2. Technology Development: Research and develop ocean current energy conversion technologies such as underwater turbines or underwater kites.
3. Installation and Maintenance: Install Ocean current energy devices in ocean currents and conduct regular maintenance to ensure optimal performance.
4. Grid Connection: Establish connections to the onshore power grid for electricity transmission from ocean current energy devices to consumers.
5. PPAs: Negotiate agreements with utilities or power purchasers for the sale of electricity generated by ocean current energy devices.
6. End User Consumption: Consumers receive electricity generated by ocean current energy devices through the grid, powering homes, businesses, and industries.

## **Maritime decarbonization**

1. Fuel Production and Supply:
  - Research and Development: Invest in research and development of alternative fuels such as biofuels, hydrogen, ammonia, and synthetic fuels.
  - Production Facilities: Establish production facilities for manufacturing alternative fuels at scale, including refineries, hydrogen electrolysis plants, and biofuel production facilities.
  - Supply Chain Management: Develop supply chains for sourcing feedstocks, processing fuels, and distributing them to ports and vessels.
2. Vessel Technology and Design:
  - Design and Engineering: Develop and optimize vessel designs for improved energy efficiency and compatibility with alternative fuels.
  - Newbuild Construction: Construct new vessels with advanced propulsion systems, fuel storage, and emission control technologies.
  - Retrofitting: Retrofit existing vessels with energy-saving technologies, exhaust gas cleaning systems (scrubbers), and alternative fuel conversion kits.
3. Port Infrastructure and Operations:

- Shore Power: Invest in shore power infrastructure to enable vessels to plug into clean electricity while docked, reducing emissions from auxiliary engines.
- LNG Bunkering: Develop liquefied natural gas (LNG) bunkering infrastructure at ports to support vessels using LNG as a transitional fuel.
- Alternative Fuel Infrastructure: Establish infrastructure for bunkering alternative fuels such as hydrogen, ammonia, and biofuels.
- Logistics and Supply Chain Management: Optimize port operations and logistics to support the efficient handling and distribution of alternative fuels.

#### 4. Regulatory Framework and Policy Support:

- Emissions Regulations: Implement and enforce international and national regulations to limit greenhouse gas emissions from maritime transport.
- Incentive Programs: Introduce financial incentives, subsidies, tax breaks, and grants to support the adoption of low-carbon technologies and fuels.
- Research Funding: Allocate funding for research and development projects aimed at advancing maritime decarbonization technologies.
- Collaboration and Partnerships: Foster collaboration among governments, industry stakeholders, research institutions, and non-governmental organizations to drive innovation and policy development.

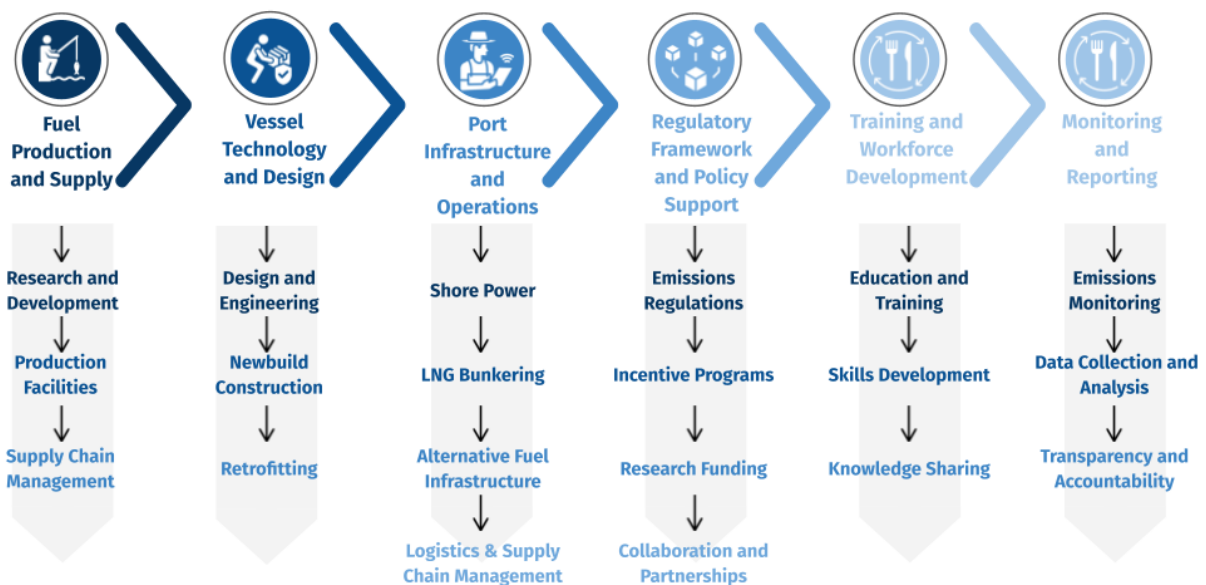
#### 5. Training and Workforce Development:

- Education and Training: Provide training programs and educational resources to maritime professionals on new technologies, safety protocols, and operational best practices.
- Skills Development: Invest in workforce development initiatives to ensure that maritime personnel have the skills and knowledge needed to operate and maintain low-carbon vessels and infrastructure.
- Knowledge Sharing: Facilitate knowledge sharing and collaboration within the maritime industry to disseminate best practices and lessons learned from decarbonization efforts.

#### 6. Monitoring and Reporting:

- Emissions Monitoring: Develop monitoring systems and methodologies to accurately measure and report greenhouse gas emissions from maritime transport.
- Data Collection and Analysis: Collect and analyze data on fuel consumption, emissions, and operational performance to track progress towards decarbonization goals.
- Transparency and Accountability: Promote transparency and accountability through public reporting of emissions data and progress towards decarbonization targets.

## Maritime decarbonization



Source: DIH Innovamare, Infographics data archive, 2024

## Chapter 2: Main Findings

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### **F14: DETERMINATION OF EU TO INVEST IN INNOVATIONS IN BLUE ECONOMY - European Union's Approach to Smart Specialization in the Blue Economy**

The European Union (EU) is demonstrating strategic and integrated approach to fostering a sustainable blue economy through the implementation of Smart Specialization Strategies (RIS3). These strategies are designed to leverage the unique strengths and resources of different regions, promoting innovation and economic growth within the blue economy sectors. The overarching goals of the EU's approach include enhancing environmental sustainability, boosting economic development, and ensuring social inclusiveness.

The concept of Blue Growth recognizes that maritime economic activities cannot be fully captured through a traditional sectoral approach. These activities, whether maritime or non-maritime, are not necessarily defined by industrial classification. Blue Growth is a long-term strategy aimed at promoting sustainable growth across marine and maritime sectors. Oceans and seas are crucial drivers of the European economy, offering substantial potential for innovation and economic development. This strategy contributes to the Europe 2020 goals of smart, sustainable, and inclusive growth.

The EU's Blue Economy includes all sectoral and cross-sectoral economic activities related to oceans, seas, and coasts, even extending to the EU's outermost regions and landlocked countries. It encompasses both direct and indirect support activities essential for the sustainable development of these sectors within the single market. This economy involves emerging sectors and economic value derived from natural capital and non-market goods and services, providing approximately 5.4 million jobs and generating nearly €500 billion in gross added value annually. The strategy highlights areas with potential for further growth.

Smart Specialisation supports policymakers, regional and national authorities, and other stakeholders involved in research and innovation. It bridges blue growth investment platforms and regional innovation initiatives, identifying economic activities in emerging blue economy sectors like marine renewable energy, biotechnology, desalination, deep-seabed mining, and coastal and environmental protection. However, these sectors often lack comprehensive data and standardised indicators to measure economic and innovation impacts effectively.

The Smart Specialisation approach strengthens economic competitiveness through inclusive, participatory processes, promoting previously untapped innovation potential. It fosters knowledge exchange among stakeholders to support smart, sustainable, and socially effective regional choices. This framework identifies blue-growth niches of innovation, aiding in economic activity identification. In order to assist the regions in developing and upgrading their RIS3 EU has set up The European Commission's Smart Specialisation Platform (S3P). It supports regions in developing RIS3

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<sup>4</sup> In this chapter each "F" stands for "Finding" and the associated number relates to number of analyses finding.

strategies by providing online tools like Eye@RIS35. This tool offers data on innovation priorities from EU Member States, regions, and some non-EU countries, aiding investment prioritization and collaboration.

Data comes from public managers and EU staff, based on approved RIS3 documents. For non-EU countries, existing innovation strategies are used. This tool encourages authorities to update their RIS3 priorities through ongoing stakeholder processes. Non-EU data remains broad, offering a general view of research and innovation priorities.

In support of the EU Blue Economy Annual Report, the Smart Specialisation platform analyses policy activity, project interventions, industrial advancements, and research activity in emerging blue economy sectors. This analysis focuses on regional and member state levels, identifying technological stages, key actors, business volumes, international projection, related strategies, funding, and indicators. The geographic scope includes EU regions, with attention to regional, interregional, member state, and macro-regional contexts linked to sea basins.

Examples of EU Regions Specialised in Blue Economy:

1. Brittany (France): Focus on marine biotechnology, especially macro and micro-algae, invertebrates, bacteria, and viruses, with applications in food, health, cosmetics, biofuels, and green chemistry. The strategy connects research and business models in fisheries and fish farms.
2. Azores (Portugal): Strengthening research in deep-seabed mining and biotechnology, aiming to become an intercontinental platform for ocean knowledge, and ensuring sustainable exploitation of marine resources.
3. Ida-Viru (Estonia): Specialisation in tourism, health services, wind energy, fish farming, and boat building, aligned with Estonia's national Smart Specialisation framework.
4. Schleswig-Holstein (Germany): Identified maritime economy as a key domain through inclusive dialogue, focusing on maritime technologies, specialised ship construction, offshore energy, and maritime biotechnology.
5. Canary Islands (Spain): Emphasizes the role of universities in innovation, with a focus on tourism, shipbuilding, and ocean energy, leveraging international partnerships for research and industry collaboration.
6. Ireland: Reorganised administrative structures to support Smart Specialisation, establishing a marine coordination group and a network of brokers to engage local entrepreneurs and economic actors.
7. Portugal Centro (Portugal): Focus on value chains associated with marine resources, conservation, sustainable monitoring, and development of new products and services. Utilizes a regional innovation hub to combine expertise from various entities.

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<sup>5</sup> <https://s3platform.jrc.ec.europa.eu/map>

8. Galicia (Spain): Prioritizes valorisation of the sea through innovation in high-tech and services, improving commercialisation of sea-related products and services.

9. The Marine Renewable Energy (MRE) partnership, led by Scotland and the Basque Country, involves 15 EU regions. It aims to support European companies in improving competitiveness in marine renewable energy markets (offshore wind, wave, and tidal energies) through cross-sectoral and cross-regional collaboration. The partnership focuses on technological challenges like increased water depths, corrosion, and logistics for offshore wind, and device survivability for ocean energy. It also enhances understanding of industry needs, helping policymakers design effective responses. The MRE partnership's work includes pilot projects like North Sea Solutions for Innovation in Corrosion for Energy (NeSSIE)<sup>6</sup>, focusing on anti-corrosion technologies, and a new Pilot Action on sensing and remote monitoring in MRE facilities.

10. Pomerania (Poland) - In the Pomeranian Voivodeship, in 2015, in the process of entrepreneurial discovery, by decision of the Board of the Pomeranian Voivodeship, 4 ISP areas (Intelligent Specializations of Pomerania – Pomeranian Smart Specialization) were selected: ISP 1 - Offshore and port and logistics technologies; ISP 2 - Interactive technologies in an information-saturated environment; ISP 3 – Green energy - Eco-efficient technologies; ISP 4 – Common Health - Medical technologies for the health of humans, animals and the environment as one common ecosystem.

Overall, the Blue Growth strategy and Smart Specialisation approach aim to foster innovation and sustainable development across Europe's marine and maritime sectors, driving economic growth and achieving the EU's strategic goals.

## **F2: THERE ARE SIGNIFICANT ADVANCEMENTS IN THE EU'S APPROACH TO FOSTERING INNOVATION, INTERREGIONAL COOPERATION, AND SMART SPECIALIZATION STRATEGIES WITHIN THE BLUE ECONOMY**

The evolution of the Blue Economy from 2019 to 2024 reveals significant shifts in focus, scope, and strategic initiatives. These changes reflect advancements in technology, the impact of global challenges, and an increased emphasis on sustainability and innovation.

### *Focus and Scope*

In 2019, the Blue Economy Report placed a strong emphasis on the development of emerging sectors, particularly marine renewable energy. The report included detailed analyses of innovation activities and underscored the importance of smart specialization in fostering regional growth and technological advancements. The scope of the 2019 report covered a broad range of maritime sectors, including fisheries, aquaculture, coastal tourism, shipping, ports, and marine renewable energy. It particularly highlighted the contributions of these sectors towards the Europe 2020 strategy goals of smart, sustainable, and inclusive growth.

By 2024, the Blue Economy Report had expanded its focus to encompass a broader emphasis on innovation and sustainability within the Blue Economy. This newer report

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<sup>6</sup> <https://www.s3vanguardinitiative.eu/pilot-projects/north-sea-solutions-innovation-corrosion-energy>

dives into the economic performances of various sectors in the aftermath of the COVID-19 pandemic and considers the impacts of geopolitical tensions. There is a pronounced focus on energy transition and climate impact. The scope remains comprehensive, covering established sectors such as fisheries, aquaculture, coastal tourism, shipping, and ports. However, the 2024 report places a more significant emphasis on blue biotechnology, desalination, and the digital transformation of maritime activities. This shift reflects a growing recognition of the potential of these newer areas to drive sustainable growth and innovation.

### *Key Data and Economic Performance*

The 2019 report highlighted job creation within emerging Blue Economy sectors and the potential for growth in marine renewable energy. It emphasized the establishment of innovation ecosystems through smart specialization as a critical driver of economic development.

In contrast, the 2024 report provides a more data-driven approach, offering detailed metrics on employment and economic performance. By 2024, the Blue Economy employed 3.6 million people, marking a 17% increase compared to 2020. The sector generated a turnover of nearly €624 billion, a 21% increase from 2020, and achieved a Gross Value Added (GVA) of €171 billion, a 35% increase. Significant growth was observed in offshore wind energy, which saw a 326% increase in GVA, alongside substantial growth in shipbuilding and repair (54%), maritime transport (29%), marine living resources (27%), and port activities (11%). These figures underscore the resilience and adaptability of the Blue Economy in the face of global challenges.

### *Emerging Sectors and Innovation*

In 2019, marine renewable energy was identified as a pilot emerging sector with detailed indicators for measuring innovation activities. The report stressed the importance of creating regional innovation hubs through smart specialization, facilitating networking among EU regions.

The 2024 report continues to highlight the significance of marine renewable energy, but it also brings added focus to blue biotechnology and desalination. The report underscores the EU's leadership in developing energy from waves, tides, and offshore wind, illustrating the continued importance of marine renewable energy. Additionally, the 2024 report places a strong emphasis on the role of digital innovation in transforming traditional maritime sectors, focusing on Industry 4.0 technologies. This reflects a broader understanding of innovation that includes not only new technological advancements but also the integration of digital transformation in existing sectors.

### ***Environmental Sustainability and Climate Impact***

The 2019 report was centred on the sustainable growth of maritime sectors and their contributions to the Europe 2020 strategy goals. It encouraged regions to identify and invest in niche areas of blue growth to enhance economic competitiveness.

By 2024, the focus had expanded to include a detailed analysis of the energy transition within the Blue Economy. This includes the adoption of renewable energy

sources and the shift towards cleaner energy solutions in fisheries and aquaculture. The 2024 report introduces a new section on the impact of climate change, utilizing tools like the Large-scale Integrated Sea-level and Coastal Assessment Tool (LISCoAsT)<sup>7</sup> to assess potential damages from coastal flooding. This section highlights the need for enhanced coastal protection and provides a more comprehensive view of how climate impacts the Blue Economy.

### **Policy and Strategic Recommendations**

In 2019, policy recommendations were centred around fostering innovation ecosystems through smart specialization and enhancing regional cooperation to support emerging sectors like marine renewable energy.

The 2024 report offers comprehensive policy recommendations to support energy transition, enhance sustainability, and mitigate climate impacts. It includes insights into the effectiveness of EU-led initiatives and partnerships aimed at driving innovation and growth within the Blue Economy. These strategic initiatives are designed to ensure that the Blue Economy continues to be a significant contributor to the EU's economic growth and environmental goals.

The 2024 Blue Economy Report builds on the foundation laid by the 2019 report, providing a more comprehensive and data-driven approach to assessing the economic, environmental, and innovation impacts within the Blue Economy. The focus has evolved from merely identifying emerging sectors to implementing strategic initiatives that drive sustainability and innovation across maritime sectors. Detailed economic performance metrics and sectoral growth analysis in the 2024 report highlight the resilience and adaptability of the Blue Economy in the face of global challenges. By expanding its scope to include digital transformation and placing a stronger emphasis on climate impact and sustainability, the 2024 report underscores the EU's commitment to a green transition. The strategic recommendations provided aim to ensure that the Blue Economy continues to be a significant contributor to the EU's economic growth and environmental goals, fostering a sustainable and inclusive future.

This comparison highlights the evolution of the EU's approach to Blue Growth, showcasing advancements in data analysis, sectoral growth, and the integration of sustainability and innovation in blue economy strategies.

### **F3: ENHANCING THE BLUE ECONOMY ON THE EU LEVEL - THE EU'S STRATEGIC APPROACH TO INNOVATION, SUSTAINABILITY AND DIGITAL TRANSFORMATION OF BLUE ECONOMY**

*Key Elements of the detected EU's Approach proving strong determination to strategically enhance Blue Economy:*

#### 1. Regional Focus and Customization

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<sup>7</sup> <https://data.jrc.ec.europa.eu/collection/LISCOAST>

- Tailored Strategies: Smart Specialization Strategies (RIS3) are designed to harness local strengths and opportunities, enabling regions to leverage their unique marine and coastal resources for sustainable economic growth.
- Collaboration and Knowledge Sharing: The EU promotes inter-regional collaboration and knowledge exchange, fostering a community dedicated to innovation and best practices in the blue economy.

## 2. Innovation Ecosystems

- Public-Private Partnerships: Encouraging collaboration between businesses, research institutions, and public authorities to address sector-specific challenges and opportunities.
- Research and Development: Investing significantly in R&D to drive advancements in sustainable fisheries, aquaculture, marine biotechnology, and renewable marine energy.

## 3. Sustainability and Environmental Protection

- Eco-friendly Practices: Developing sustainable practices across all blue economy sectors, including fishing, aquaculture, and marine biodiversity protection.
- Circular Economy: Promoting the valorization of marine biomass and innovative waste reduction techniques to foster a circular economy.

### ***Initiatives for Digital and Green Transformation***

#### 1. Digitalization of the Blue Economy

- Smart Technologies: Integrating IoT, AI, and big data analytics to improve maritime surveillance, resource management, and operational efficiency.
- Blue Cloud: Creating a digital platform for marine research and innovation, supporting data sharing and analysis to enhance sustainable management practices<sup>8</sup>.

#### 2. Green Transformation Initiatives

- Offshore Renewable Energy: Investing in wind, wave, and tidal energy to reduce fossil fuel reliance and combat climate change.
- Maritime Decarbonization: Developing and adopting alternative fuels and energy-efficient technologies in shipping and port operations.

#### 3. Funding and Support Programs

- European Maritime and Fisheries Fund (EMFF): Providing financial support for sustainable fishing, aquaculture, and marine conservation projects.
- Horizon Europe: Funding projects aimed at advancing marine technologies, sustainable practices, and innovative solutions within the blue economy.

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<sup>8</sup> <https://www.embrc.eu/collaborative-projects/blue-cloud-2026-federated-european-fair-and-open-research-ecosystem-oceans>

#### **F4: SHIFT TOWARDS A MORE DATA-DRIVEN, DIGITALLY INTEGRATED, AND ENVIRONMENTALLY FOCUSED APPROACH IN THE EU'S SMART SPECIALISATION STRATEGIES**

The EU's approach to smart specialization in the blue economy is comprehensive and multifaceted, focusing on regional strengths, innovation ecosystems, and sustainability. Through various initiatives and funding programs, the EU is driving the digital and green transformation of the blue economy sectors, ensuring that economic growth is aligned with environmental protection and social inclusiveness. This strategic approach aims to position the EU as a leader in sustainable marine and coastal development, contributing to global efforts to address environmental and economic challenges.

The European Union's approach to Smart Specialisation Strategies (RIS3) in the Blue Economy has evolved significantly from the 2014-2020 programming period to the 2021-2027 period, reflecting broader goals of innovation, sustainability, and digital transformation.

During the 2014-2020 programming period, the EU's RIS3 strategies were tailored to capitalize on regional strengths, focusing on key areas such as marine renewable energy, sustainable fisheries, and coastal tourism. These strategies emphasized localization and prioritization, ensuring that each region could leverage its unique marine and coastal resources to foster sustainable economic activities. Moreover, there was a strong emphasis on participation and collaboration, engaging stakeholders from the public and private sectors, academia, and civil society. This collaborative environment was crucial in driving innovation and fostering a sense of shared responsibility for regional development.

A critical component of these strategies was the development of innovation ecosystems. Public-private partnerships were heavily promoted, strengthening the collaboration between businesses, research institutions, and public authorities. Significant investments were made in research and development (R&D) to advance technological innovations in marine biotechnology, aquaculture, and other marine sectors. These efforts were aimed at creating a robust foundation for sustainable growth, leveraging scientific advancements to enhance the competitiveness of the Blue Economy.

Sustainability and environmental protection were also key objectives during the 2014-2020 period. The EU promoted eco-friendly practices and the adoption of circular economy principles, focusing on the valorization of marine biomass and the reduction of waste through innovative processing techniques. These measures were designed to enhance economic competitiveness while ensuring the protection of marine ecosystems, aligning with broader environmental goals.

The 2021-2027 programming period builds on these foundations but with a more comprehensive and integrated approach. Enhanced governance and monitoring mechanisms have been introduced, including the implementation of good governance criteria and the use of big data and analytical tools to monitor and evaluate RIS3 strategies. This period also sees an increased emphasis on digital

transformation, integrating technologies such as IoT, AI, and big data analytics in maritime activities to improve efficiency and sustainability.

Furthermore, there is a broader focus on emerging sectors like blue biotechnology and desalination, recognizing their potential to drive sustainable growth. The detailed analysis of energy transition within the Blue Economy, including the adoption of renewable energy sources and cleaner technologies in fisheries and aquaculture, reflects the EU's commitment to achieving its climate goals. The introduction of tools like the Large-scale Integrated Sea-level and Coastal Assessment Tool (LISCoAsT) to assess and mitigate climate impacts highlights the increased focus on climate adaptation and resilience.

In summary, the transition from 2014-2020 to 2021-2027 showcases a strategic evolution towards a more data-driven, digitally integrated, and environmentally focused approach. The EU's Smart Specialisation Strategies have adapted to include more rigorous governance, broader sectoral focus, and a stronger emphasis on sustainability and climate action, ensuring that the Blue Economy continues to contribute significantly to regional development and economic growth in the EU.

## **F5: RISING TREND OF BLUE ECONOMY SECTORS REPRESENTED IN RIS3 AND RELATED VALUE CHAINS IN ANALYSED COUNTRIES**

### **F5.1: Leadership of Developed Innovators<sup>9</sup> in the Blue Economy Trend**

The finding that "more developed, moderate and strong innovators are leaders in this rising trend" highlights the crucial role that developed regions and countries play in driving the Blue Economy forward. This trend is particularly significant within the context of Smart Specialisation Strategies (RIS3), which focus on leveraging regional strengths to promote innovation and economic growth.

Positive Correlation between Blue Economy Leadership and Regional Competitiveness Index (RCI) and European Innovation Scoreboard (EIS) indicates that regions with higher competitiveness and innovation capabilities are better positioned to capitalize on emerging Blue Economy opportunities. This is reflected in their proactive adoption of specific value chains in RIS3 strategies.

#### *Encompassing Blue Economy and Specific Value Chains in RIS3 Strategies*

1. **Marine Renewable Energy:** Regions that are strong innovators have invested significantly in marine renewable energy technologies, such as offshore wind, wave, and tidal energy. These areas have robust research institutions and public-private partnerships that drive technological advancements and commercialization efforts.

Example: The UK and Germany are leaders in offshore wind energy, supported by strong policy frameworks and substantial investments in R&D and infrastructure.

2. **Sustainable Aquaculture and Fisheries:** Developed regions have also focused on sustainable aquaculture practices and advanced fisheries management. Innovations

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<sup>9</sup> Merge of the two separate indicators in the regional level: development index and innovation scoreboard – more developed / strong innovators = developed innovators

include integrated multi-trophic aquaculture (IMTA) and land-based recirculating aquaculture systems (RAS), which enhance sustainability and efficiency.

Example: Norway and Denmark have pioneered in developing sustainable aquaculture technologies, benefiting from their strong innovation ecosystems and supportive regulatory environments.

### Importance of Innovation Ecosystems

Innovation Ecosystems: Developed regions benefit from well-established innovation ecosystems that facilitate collaboration between universities, research centres, industries, and government bodies. These ecosystems are crucial for fostering innovation and translating research into marketable products and services.

Example: Finland's approach to smart specialization in the Ostrobothnia region, where extensive collaboration between businesses, educational institutions, and public entities drives innovation in energy technologies and digital solutions for the maritime sector.

### Strategic Policy Frameworks

Smart Specialisation Strategies (RIS3) aim to identify and invest in niche areas of competitive strength. Developed regions have effectively used RIS3 to focus on the Blue Economy, integrating regional strengths into broader economic and innovation policies.

These strategies ensure that innovation efforts are aligned with regional capabilities and market needs, promoting sustainable economic growth and regional development.

The leadership of more developed, moderate, and strong innovators in the Blue Economy trend underscores the importance of robust regional innovation systems and strategic policy frameworks. The positive correlation between RCI, EIS, and the rising trend in the Blue Economy reflects how regions with higher competitiveness and innovation capacities can effectively leverage these strengths to drive forward the Blue Economy, particularly through targeted value chains in RIS3 strategies such as marine renewable energy and sustainable aquaculture. This holistic and strategic approach enables these regions to not only enhance their economic growth but also contribute significantly to global sustainability goals.

Country	NUTS regions	Dominant industries (percentage of GDP) in 2022.	EU Regional Competitiveness Index (RCI)	European innovation scoreboard (EIS)	Innovation Group
Poland		Services (58.16%) Industry (28.09%) Agriculture (2.84%)	-	68.09	Emerging Innovator
NUTS 1	PL6: Makroregion północny	Services (58.11%) Industry (28.12%) Agriculture (2.87%)	-	68.06	Emerging Innovator



NUTS 2	PL63: Pomorskie	Manufacturing: 29% Services: 57% Construction: 7%	90.4	72.50	Emerging Innovator
Portugal		Services (66.09%) Industry (18.62%) Agriculture (1.85%)	-	92.88	Moderate Innovator
NUTS 1	PT2: Região Autónoma dos Açores and Continente	Tourism and Hospitality: 10% Manufacturing: 16% Agriculture and Fishing: 3%	-	60.30	Emerging Innovator
NUTS 2	PT20: Região Autónoma dos Açores	Tourism and Hospitality: 15% Agriculture and Fishing: 8% Services: 50%	-	-	-
NUTS 2	PT11: Norte and Centro	Manufacturing: 20% Services: 55% Agriculture: 5%	89	93.10	Moderate Innovator
France		Services (70.32%) Industry (17.38%) Agriculture (1.8%)	-	114.21	Strong Innovator
NUTS 1	FRH: Bretagne	Agriculture and Agri-food: 10% Services: 60% Manufacturing: 20%	100.4	112.10	Strong Innovator
Italy		Services (64.3%) Industry (23.82%) Agriculture (1.82%)	-	97.99	Moderate Innovator
NUTS 1	ITH: Nord-Est	Manufacturing: 28% Services: 57% Agriculture: 4%	-	-	-
NUTS 2	ITH5: Emilia-Romagna	Manufacturing: 30% Agriculture: 6% Services: 55%	93.6	109.80	Strong Innovator
Spain		Services (67.9%) Industry (20.79%) Agriculture (2.34%)	-	96.80	Moderate Innovator
NUTS 1	ES6: Sur	Tourism: 15% Agriculture: 7% Services: 58%	-	-	-
NUTS 2	ES61: Andalucía	Agriculture: 10% Tourism: 12% Services: 55%	74.9	77.10	Moderate Innovator
Finland		Services (59.46%) Industry (25.09%) Agriculture (2.38%)	-	145.63	Innovation Leader
NUTS 1	FI1: Manner-Suomi	Manufacturing: 28% Services: 65% Forestry and Paper: 5%	-	-	-

NUTS 2	FI19: Länsi-Suomi	Manufacturing: 30% Services: 60% Agriculture: 3%	112.9	131.80	Innovation Leader
Netherlands		Services (68.68%) Industry (19.51%) Agriculture (1.5%)	-	139.56	Innovation Leader
NUTS 1	NL3: West-Nederland	Services: 70% Trade and Transportation: 15% Agriculture: 5%	-	-	-
NUTS 2	NL33: Zuid-Holland	Trade: 20% Services: 60% Manufacturing: 10%	142.5	142.20	Innovation Leader
Croatia		Services (61.31%) Industry (19.51%) Agriculture (2.48%)	-	75.44	Emerging Innovator
NUTS 1	HR0: Hrvatska	Tourism: 20% Manufacturing: 25% Services: 50%	-	-	-
NUTS 2	HR05: Grad Zagreb	Services: 60% Trade: 20% Manufacturing: 10%	90	115.50	Strong Innovator
		Source: <a href="https://www.statista.com">statista.com</a>	Source: RCI	Source: EIS	

### F5.2: Countries with higher representation of maritime industries in the GDP showing more dedication to integration of blue economy into their RIS3

Situation Analysis of Two Value Chains in Various Regions in comparison to representation of maritime related industries in their overall economic development trends is showing correlation between the factors.

Country	Sector	Key Points
Poland	Offshore Wind Energy	Significant growth with projects like Bałtyk I, II, and III. Potential up to 11 GW by 2040. Up to 10,000 jobs projected.
	Shipbuilding and Repair	Concentrated in Gdańsk and Gdynia. Employs around 15,000 people. Major contributor to exports.
	Maritime Transport	Port of Gdańsk handled over 50 million tons of cargo in 2023. Integral to Poland's trade.
	Coastal Tourism	Major economic driver, attracting millions of visitors. Part of the service sector, contributing 66.4% to GDP.
	IT Sector	Growing rapidly in Gdańsk. Employs over 20,000 people. Significant part of the service sector.

	Marine Living Resources	Includes fisheries and aquaculture. Employs around 3,000 people. Contributes 1.9% to GDP.
	Valorization of Blue Resources	Emerging sector involving innovative uses of marine resources. Contributes to both industrial and service sectors.
Portugal	Offshore Wind Energy	Pioneering projects like WindFloat Atlantic. Planned expansion to 10 GW by 2030. Renewable energy sector contributes around 2-3% of GDP.
	Shipbuilding and Repair	Viana do Castelo is a key hub. Expected growth in jobs due to offshore wind projects. Contributes approximately 13% to GDP.
	Maritime Transport	Crucial for trade, supports offshore wind sector. Contributes about 4-5% to GDP.
	Coastal Tourism	Significant part of the economy, contributing 15.8% to GDP in 2022. Expected to exceed 21% by 2033.
	IT Sector	Supports innovation in marine and renewable energy projects. Contributes about 5% to GDP.
	Marine Living Resources	Fisheries and aquaculture employ around 30,000 people. Agriculture, forestry, and fishing contribute about 2% to GDP.
	Valorization of Blue Resources	Blue biotechnology involves marine organisms for commercial applications. Emerging sector with potential economic impact.
France	Offshore Wind Energy	Growing sector with significant job creation expected.
	Shipbuilding and Repair	Employs approximately 20,000 people. Significant part of regional economy.
	Maritime Transport	Several thousand jobs in passenger and freight transport. Important for trade and logistics.
	Coastal Tourism	Major employer with tens of thousands of jobs. Attracts millions of visitors annually.
	IT Sector	Substantial number of tech-related jobs. Increasing contribution to GDP.
	Marine Living Resources	Fisheries employ several thousand people. Aquaculture focuses on sustainable practices.

	Valorization of Blue Resources	Emerging sector creating specialized jobs in biotechnology and resource optimization.
Italy	Offshore Wind Energy	Romagna 1 Offshore Wind Project, 200 MW, costing around \$442.6 million.
	Shipbuilding and Repair	Italian shipbuilding responsible for 36% of world's cruise ships in 2022. Significant industry with advanced technology.
	Maritime Transport	26 ports/harbors/marinas, 1 national port (Ravenna).
	Coastal Tourism	130 km of coastline, tourism contributes 11% to regional GDP. Over 320,000 beds and 3000 hotels.
	IT Sector	Strong investment in innovation and digitalization. High rankings in digital economy indexes.
	Marine Living Resources	Small-scale fisheries with 609 vessels and 4500 workers. 45% of national aquaculture production.
	Valorization of Blue Resources	Emphasis on sustainable aquaculture practices, marine research, and collaboration for innovative solutions.
Spain	Offshore Wind Energy	Emerging key player. Recent investments with significant regional renewable energy impact.
	Shipbuilding and Repair	Vital industry in Cadiz and Huelva. Thousands employed, significant GDP contribution. Modernization and eco-friendly tech focus.
	Maritime Transport	Crucial hubs in the Mediterranean. Thousands employed, substantial GDP contribution.
	Coastal Tourism	Major economic sector. Tens of thousands employed, millions of visitors annually. Focus on sustainable practices.
	IT Sector	Growing sector with thousands employed. Increasing GDP contribution with digitalization efforts.
	Marine Living Resources	Significant industry with thousands employed in fisheries and aquaculture. Emphasis on sustainability.
	Valorization of Blue Resources	Promoting sustainable development through marine research, conservation, and innovation.
Finland	Offshore Wind Energy	One offshore wind farm (Tahkoluoto) with 44.3 MW capacity. Supported by Finnish Wind Power Association.

	Shipbuilding and Repair	Key sector in Turku with significant economic impact. Advanced technological capabilities and sustainability focus.
	Maritime Transport	Major contributor to foreign trade. High percentage of goods transported by sea.
	Coastal Tourism	Vital part of the economy with extensive coastline and numerous islands.
	IT Sector	Expanding sector with substantial employment. Significant contributor to national exports and GDP.
	Marine Living Resources	Prominent industries with thousands employed. Focus on sustainable practices and equipment modernization.
	Valorization of Blue Resources	Various initiatives promoting marine research, conservation, and innovative resource use.
Netherlands	Offshore Wind Energy	Strong sector with 3,000 employees and significant investments. Key export sector for technology and services.
	Shipbuilding and Repair	Employs around 12,000 people. High investment due to modernization and new ship orders.
	Maritime Transport	Critical role with 50,000 employees. Major hub at Port of Rotterdam.
	Coastal Tourism	Significant sector with 25,000 employees. Generates billions in revenue annually.
	IT Sector	Growing sector with 60,000 employees. High investment in technology and innovation.
	Marine Living Resources	Sustainable practices with a focus on fisheries and aquaculture.
	Valorization of Blue Resources	Emerging sector with investments in sustainable marine resource use.
Croatia	Offshore Wind Energy	Nascent stage with few companies exploring projects. Limited employment currently.
	Shipbuilding and Repair	Declining sector with around 10,000 employees. Export value around €1 billion annually.
	Maritime Transport	Increasing passenger transport, decline in freight transport. Several major companies including Jadrolinija.

	Coastal Tourism	Major sector with 150,000 employees. Significant contributor to GDP.
	IT Sector	Growing sector with around 30,000 employees. Rapidly increasing software and services exports.
	Marine Living Resources	Fisheries and aquaculture have upward trends. Significant seafood export value.
	Valorization of Blue Resources	Supported by EU funds for research and development. Emerging sector with potential growth.

### Sustainable Seafood, Aquaculture, and Valorization of Blue Resources

Coastal regions in Europe are crucial for providing food not only to local communities but also to the broader European population. The EU ranks as the fifth-largest producer of fisheries and aquaculture globally, contributing about 3% to the world's production. Of this, 78% comes from fisheries and 22% from aquaculture (FAO, 2019). However, despite this significant production, Europe still heavily relies on seafood imports, with the total value reaching \$54.8 billion in 2020, continuing a trend that peaked at \$58.0 billion in 2018.

This dependency underscores the need for the EU to bolster internal seafood security by fully harnessing its marine resources. Promoting sustainable production and consumption models is essential to compete internationally. Aquaculture holds substantial potential for economic development and job creation in many EU coastal communities. Under initiatives like the European Green Deal and the Farm-to-Fork Strategy, aquaculture and seafood production can become pivotal sectors for decarbonization, climate change mitigation, ecosystem preservation, and the adoption of circular economy models. These efforts also aim to diversify consumer diets with healthy and sustainable options, including 'superfoods' like algae and sea urchins.

The valorization of bioresources and blue biomass presents significant opportunities. For instance, algal biomass is a promising feedstock for producing value-added products such as food, feed, and biofuels. To realize this potential, strategic and long-term interregional cooperation is necessary to identify and scale investment projects, enhancing local development and economic conditions through the green transition. Innovation in supply chains and the elimination of inefficiencies in aquaculture sustainability are critical. Encouraging new business models and supporting innovative SMEs and startups in underdeveloped coastal regions are vital. Establishing advisory services for sustainable fishing and aquaculture will also promote the sector's greening.

### Marine Renewable Energies (MRE) and Maritime Decarbonization

Marine renewable energies and maritime decarbonization are vital for regional growth, offering numerous opportunities for new value chains and fostering collaboration and innovation.

## Marine Renewable Energies (MRE)

Seas and oceans hold immense potential for generating clean, renewable energy. Coastal regions, rich in sun and wind, can harness these resources through strategic investments and planning, significantly benefiting local economies. Large-scale exploitation of renewable energy from sun, wind, waves, and tides can generate jobs and boost economic development in less developed coastal areas while supporting decarbonization.

Europe leads globally in offshore wind energy, with over 90% of the world's installed capacity. From a few demonstration plants in the early 2000s, the EU now has 14.6 GW of installed offshore wind capacity across 11 countries. However, challenges like local opposition to visible offshore wind farms and high maintenance costs remain. Interregional collaboration on technology development and demonstration projects can make ocean-based renewable energy more widespread, cost-competitive, and environmentally sustainable. Engaging local communities to address psychological barriers is also necessary for the successful deployment of energy infrastructures.

## Maritime Decarbonization

Maritime transport is crucial for the global economy and plays a significant role in reducing carbon emissions and combating climate change. Shipping is the most carbon-efficient mode of transport, with international maritime shipping accounting for less than 3% of annual global greenhouse gas emissions. Maritime transport is vital for the EU economy and trade, facilitating around 80% of worldwide goods transportation and one-third of intra-EU trade. In 2019, approximately 420 million passengers travelled via EU ports (Eurostat).

The COVID-19 crisis significantly impacted maritime transport, with a 10.2% reduction in ship calls at EU ports in 2020 compared to 2019. The most affected segments were cruise ships (-85%), passenger ships (-39%), and vehicle carriers (-23%). The 'Fit for 55' initiative aims to foster sustainable investments in the maritime sector and increase demand for renewable and low-carbon fuels. Identifying and funding projects in sustainable, low-carbon ports is essential for transitioning to decarbonized marine transport.

Creating networks of interregional sustainable maritime transport hubs can revitalize tourism and shipping, benefiting regions hardest hit by the pandemic. Promoting modern propulsion technologies, renewable fuels, zero-emission technologies like batteries and fuel cells, environmentally sound ship recycling, and quiet vessel programs in sensitive areas are crucial actions for future adoption.

This detailed analysis per participating country/region presented in Chapter 3, highlights the current status and ongoing efforts in each region concerning the two value chains, illustrating how smart specialization strategies are being applied to promote sustainable blue economy initiatives. Here is the short overview specifically focused on 2 value chains while rest of the analysis per country/region is available in next chapter.

*Poland (NUTS 1: PL6 - Makroregion północny, NUTS 2: PL63 - Pomorskie)*

**Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:** In the Pomorskie region, significant efforts are underway to modernize fishing practices and promote sustainable aquaculture. The Baltic Sea's proximity supports fisheries, with initiatives aimed at reducing overfishing and improving stock management. The valorization of blue resources focuses on utilizing fish by-products for high-value products like omega-3 supplements and cosmetics, driving both economic growth and environmental sustainability.

**Renewable Marine Energy and Maritime Decarbonization:** The northern macro-region is investing in offshore wind energy, with several projects planned or under development in the Baltic Sea. These initiatives are part of Poland's broader strategy to increase renewable energy sources, which also includes exploring wave and tidal energy potential. Maritime decarbonization efforts include transitioning to low-emission fuels and enhancing energy efficiency in port operations.

*Portugal* (NUTS 1: PT2 - Região Autónoma dos Açores and Continente; NUTS 2: PT20 - Região Autónoma dos Açores, PT11 - Norte, and Centro)

**Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:** The Azores are a critical area for sustainable fisheries, emphasizing traditional fishing methods that protect marine biodiversity. The region is also developing aquaculture, particularly for species like sea bass and sea bream, using sustainable practices. Valorization projects in Portugal focus on converting marine biomass into bioactive compounds for pharmaceuticals and nutraceuticals.

**Renewable Marine Energy and Maritime Decarbonization:** Portugal is a leader in wave and tidal energy research, with several pilot projects in the Azores and mainland coastal areas. The country aims to harness its extensive maritime resources to generate renewable energy. Efforts in maritime decarbonization include the use of alternative fuels and implementing green port initiatives to reduce emissions from shipping and port activities.

*France* (NUTS 1: FRH - Bretagne and NUTS 2: FRH0 - Bretagne)

**Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:** Brittany is renowned for its rich marine resources and strong fisheries sector. Sustainable fishing practices are well-established, focusing on preserving fish stocks and marine ecosystems. The region also excels in aquaculture, particularly shellfish farming. Valorization efforts include developing high-value products from seaweed and fish by-products, promoting a circular economy.

**Renewable Marine Energy and Maritime Decarbonization:** Brittany is at the forefront of marine renewable energy, with significant investments in offshore wind and tidal energy projects. The region's coastline is ideal for such developments, contributing to France's renewable energy targets. Maritime decarbonization strategies include upgrading vessels to reduce emissions and implementing energy-efficient technologies in ports.

*Italy* (NUTS 1: ITH - Nord-Est and NUTS 2: ITH5 - Emilia-Romagna)

**Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:** Emilia-Romagna has a well-developed fisheries sector, with a focus on sustainable practices to protect the Adriatic Sea's resources. Aquaculture is also significant, with innovative techniques to reduce environmental impacts. Valorization projects include using fish waste for biofuel production and high-value bioproducts.

**Renewable Marine Energy and Maritime Decarbonization:** While Italy's primary renewable energy focus has been on solar and wind, there is growing interest in marine energy, particularly in the Adriatic Sea. Efforts to decarbonize maritime activities include enhancing port infrastructure to support low-emission technologies and promoting the use of cleaner fuels in shipping.

*Spain* (NUTS 1: ES6 - Sur and NUTS 2: ES61 - Andalucía)

**Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:** Andalucía's coastal areas support diverse fisheries and aquaculture activities. The region emphasizes sustainable fishing practices and the development of aquaculture to meet increasing seafood demand. Valorization initiatives are focused on converting marine resources into pharmaceuticals, nutraceuticals, and other high-value products.

**Renewable Marine Energy and Maritime Decarbonization:** Southern Spain is exploring the potential for offshore wind and wave energy, leveraging its extensive coastline. Maritime decarbonization efforts include the adoption of LNG and other alternative fuels, as well as improving energy efficiency in port operations and logistics.

*Finland* (NUTS 1: FI1 - Manner-Suomi and NUTS 2: FI19 - Länsi-Suomi)

**Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:** Finland prioritizes sustainable fisheries in the Baltic Sea, focusing on reducing environmental impacts and maintaining fish stock health. Aquaculture development is also a priority, with innovative practices to minimize ecological footprints. Valorization projects include converting fish by-products into biofuels and other valuable materials.

**Renewable Marine Energy and Maritime Decarbonization:** Finland is actively developing offshore wind energy in the Baltic Sea. The country is also exploring wave and tidal energy potential. Maritime decarbonization efforts are robust, with initiatives to improve energy efficiency in shipping and transition to alternative fuels such as biofuels and hydrogen.

*Netherlands* (NUTS 1: NL3 - West-Nederland and NUTS 2: NL33 - Zuid-Holland)

**Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:**The Netherlands has a well-established fisheries sector, with strong emphasis on sustainability and innovation. Aquaculture is expanding, particularly in Zuid-Holland, with a focus on environmentally friendly practices. Valorization efforts include using seaweed and fish by-products for bioplastics and other high-value products.

**Renewable Marine Energy and Maritime Decarbonization:** The Netherlands is a pioneer in offshore wind energy, with significant projects in the North Sea. The country is also exploring wave energy potential. Maritime decarbonization strategies include

implementing LNG as a shipping fuel, developing hydrogen-powered vessels, and enhancing port sustainability through green initiatives.

*Croatia* (NUTS 1: HR0 - Hrvatska and NUTS 2: HR05 - Grad Zagreb)

**Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:** Croatia's fisheries sector is vital to its economy, with efforts to implement sustainable practices in the Adriatic Sea. Aquaculture is growing, with a focus on species like tuna and sea bass. Valorization projects are developing to utilize marine resources for pharmaceuticals and cosmetics, promoting a blue bioeconomy.

**Renewable Marine Energy and Maritime Decarbonization:** Croatia is exploring the potential for renewable marine energy, including offshore wind and wave energy. Maritime decarbonization efforts include transitioning to alternative fuels and enhancing the energy efficiency of maritime operations and infrastructure, particularly in major ports like Rijeka and Split.

## Chapter 3: Ecosystem mapping

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In the context of this report, an "ecosystem" refers to the interconnected network of organizations, stakeholders, technologies, policies, and practices that collectively contribute to the development and growth of specific sectors of the Blue Economy.

Key Components of an Ecosystem:

1. **Stakeholders:** Research Institutions, such as universities and specialized research centres conducting studies and innovations; Businesses, such as companies ranging from startups to large enterprises involved in developing and deploying technologies; Government Agencies such as public bodies providing regulations, funding, and strategic direction; Non-Governmental Organizations (NGOs) representing groups advocating for sustainable practices and supporting initiatives.
2. **Technologies:** Innovative Tools and Systems such as Equipment and software like autonomous underwater vehicles (AUVs), renewable energy technologies, and advanced monitoring systems; Digital Infrastructure such as Platforms such as digital twins, blockchain for logistics, and real-time data analytics.
3. **Policies and Regulations:** Environmental Standards such as Regulations to ensure sustainable practices and minimal ecological impact; Funding Programs such as Initiatives like the European Maritime and Fisheries Fund (EMFF) and Horizon 2020 providing financial support for research and development.
4. **Practices:** Sustainable Practices such as Methods and technologies promoting environmental sustainability, such as Recirculating Aquaculture Systems (RAS) and Integrated Multi-Trophic Aquaculture (IMTA); Collaborations such as Cross-border and inter-sectoral partnerships enhancing knowledge sharing and innovation.

### 3.1 Blue Growth Ecosystem Stakeholders

During the methodology application presented in the introduction of this report, it became evident that key stakeholders in the blue growth ecosystem related to this project consistently emerged across various analyses and were cross-referenced by multiple sources and perspectives. These stakeholders are numerous, and this report cannot comprehensively cover them all. However, based on the provided input, the main stakeholders have been identified and highlighted.

Future deliverables in this project will delve deeper into the ecosystem's specific components, engaging in stakeholder workshops, analyses, and discussions. This ongoing work will provide a more comprehensive understanding of this ecosystem component (Stakeholders) and is focused on the other 3 components of the Blue Growth Ecosystem: Technologies, Policies and Regulation and Practices. For now, under Ecosystem component 1: Stakeholders, this report offers a brief overview of the major players.

#### **Main Blue Ecosystems on the EU level**

The European Union supports several initiatives aimed at connecting diverse stakeholders to foster green and digital transformation in traditional blue economy sectors and the development of new ones. Projects like the Blue Economy Window, the European Maritime and Fisheries Fund (EMFF), and the BlueInvest platform bring together entrepreneurs, researchers, policymakers, and investors. These initiatives focus on innovative solutions for sustainable fisheries, aquaculture, marine biotechnology, renewable ocean energy, and maritime surveillance. They emphasize collaboration, technology adoption, and investment to enhance sustainability, economic growth, and digitalization in the maritime sector.

There are many success stories on the EU level on how Ecosystems can function in the pursue of transformation and innovation. For the purpose of this report here are the most successful ones from the perspective of report topic and relevant findings:

**BlueBioValue** based in Portugal, is an exemplary blue economy ecosystem because it focuses on scaling up marine bio-based projects that promote sustainability and innovation. By supporting initiatives that replace high carbon emission solutions with low or negative ones, BlueBioValue contributes significantly to ocean conservation, renewable resources, and decarbonizing industries. Its comprehensive programs, including acceleration and ideation, empower startups to develop eco-friendly technologies, addressing global challenges such as climate change, resource scarcity, and pollution. This holistic approach ensures a balanced and sustainable utilization of ocean resources, fostering a healthier planet.

BlueBioValue operates on an international scale, welcoming participants from various countries to join its programs. This inclusivity fosters a diverse network of innovative minds and solutions from around the globe, enhancing the ecosystem's impact on the blue economy by leveraging a wide range of perspectives and expertise.

BlueBioValue focuses on several main topics within the blue economy ecosystem:

1. **Feeding a Growing Population & Sustainable Food Systems:** Developing marine bio-based solutions to enhance food security.
2. **Enhancing Health & Well-being:** Using marine resources for health innovations.
3. **Climate Change Mitigation & Adaptation:** Promoting low-carbon and renewable solutions.
4. **Resource Scarcity & Ecosystem Preservation:** Sustainable utilization of ocean resources.
5. **Circular Bioeconomy Growth:** Encouraging renewable and recyclable marine-based products.
6. **Reducing Plastic Production & Pollution:** Developing alternatives to traditional plastics and reducing marine pollution.

**The SUBMARINER Network** is an international collaborative platform focused on innovative and sustainable use of marine resources in the Baltic Sea Region. It brings together a diverse group of stakeholders, including authorities, research institutions, civil society, and private companies, to promote blue growth and ecological balance. The network supports the EU Green Deal and the UN Sustainable Development Goals through various transnational projects and initiatives, fostering a sustainable blue economy.

The SUBMARINER Network's key strengths include its comprehensive and multidisciplinary approach, fostering collaboration among diverse stakeholders such as authorities, research institutions, civil society, and private companies. It integrates local perspectives into transnational frameworks, addressing critical issues like overfishing, plastic pollution, and climate change. The network supports innovative projects that align with the EU Green Deal and the UN Sustainable Development Goals, promoting sustainable blue growth. This holistic and inclusive approach makes it a prime example of an effective and impactful blue economy ecosystem.

**Maritime Digital Hub** Limited is a UK-based non-profit bridging technology and the maritime industry for digital transformation. Formed by experts from both sectors, it collaborates with maritime clusters and local authorities. It provides workshops, events, research, and partnerships aligned with the Maritime 2050 agenda. Key partnerships include the Liverpool City Region, EM3 Local Enterprise Partnership, and Aerospace Cornwall Programme. Services include networking events, round tables, publications, and online forums. Funded by member contributions and donations, it offers discounted event participation for members.

**DIH Oceanopolis**, established in 2018 in Norway, assists SMEs and the public sector in adopting AI, HPCs, and cybersecurity. It offers access to labs, strategic partnerships with academic and public institutions, and services in AI, HPC, cybersecurity, and digital competence. Key partners include Norwegian clusters, universities, and regional institutions. Services also include workshops, digital maturity assessments, and investment support. Funded by the EU's DIHelp program and regional plans, it collaborates with clusters and business associations for cost-effective operations.

**OceanACT**, launched in 2021 in Portugal, focuses on developing and managing marine testing infrastructures for innovative blue economy technologies. It aims to attract investment and create skilled jobs by improving technology testing and shortening time-to-market for sustainable products. The consortium includes +ATLANTIC, CEIIA, Fórum Oceano, INESC TEC, and WavEC. Services cover technology testing, environmental impact assessment, simulations, data processing, and training. The business model involves three phases: Installation, Investment, and Consolidation, targeting financial autonomy by 2025 through service revenues.

**Piraeus Blue Growth DIH** was founded in 2014 in Greece, Piraeus Blue Growth DIH aims to inspire young entrepreneurs to innovate in marine and freshwater resources. It promotes new technologies and sustainable business ideas, contributing to local skill development and economic transformation. Partnerships include regional organizations, research and technology entities, and business associations. Services include training on advanced ICT equipment, technical guidance, personalized consulting, and support for business ventures. Funded by the Blue Growth initiative and regional sponsors, it integrates into the Piraeus Blue Growth Strategy.

**Lighthouse Digital Innovation Hub** established in 2017 in Lithuania, supports companies in Klaipėda with digital innovation for improved business processes. It connects public and private sectors, focusing on maritime, IT, construction, biotechnology, and energy. Services include expert advice, thematic events, co-working spaces, access to finance, mentoring, strategic planning, and prototyping. Partnerships span local authorities, universities, research institutions, and private companies. Funded by Horizon 2020, European Social Fund, and national sources, it aims to enhance regional digital innovation.

**One Sea - Autonomous Maritime Ecosystem**, founded in 2015 in Finland, aims to develop a secure, highly automated maritime logistics system. Managed by DIMECC, it collaborates with industry leaders and ICT companies to create a digital maritime ecosystem. Services include strategic development, collaborative research, product testing, market intelligence, and digital skill education. Key partners include ABB, Cargotec, Ericsson, Kongsberg, Wärtsilä, and Finnish maritime associations. Funded by partner membership fees and Business Finland, One Sea focuses on commercializing autonomous maritime services.

**Ocean Data Factory (ODF)** is Sweden's national marine data lab, promoting sustainable ocean data innovation. Founded in 2019 and funded by Vinnova, it collaborates with universities, research institutes, and private companies. ODF focuses on AI, machine learning, and neural networks for ocean data. Services include data-driven innovation cycles, workshops, hackathons, and structured decision-making support. Partnerships include the University of Gothenburg, Chalmers, RISE, and SMHI. Future sustainability aims involve securing DIH project funding and developing market services for long-term financial viability.

### Participating regions

Poland: Pomerania Region

Business Support Organizations and Agencies:

In the Pomerania region, key organizations include the Regional Pomeranian Chamber of Commerce, promoting regional business activities, the Pomeranian Science-Technological Park in Gdynia supporting technological innovation, and the Gdansk Science and Technology Park facilitating research and development. The Gdansk Business Incubator STARTER provides incubation services for startups, the Kwidzyn Industrial and Technological Park supports industrial and technological businesses, and the Slupsk Technology Incubator facilitates innovation in Słupsk. The Pomeranian Digital Innovation Hub promotes digital innovation in the region. Baltic Sea and Space Cluster (Poland) BSSC is a key cluster focusing on maritime and space technologies, supporting knowledge transfer and business cooperation

#### Research Institutions:

Gdynia Maritime University and Gdańsk University of Technology are significant contributors, with the latter having numerous international agreements fostering research and development in marine technologies.

#### Successful Companies in Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:

Mirko Fisheries Company and LOSOS SP. Z O.O. are leading companies in this sector. Mirko Fisheries Company specializes in herring products, while LOSOS SP. Z O.O. processes and preserves fish, seafood, and snails.

#### Successful Companies in Renewable Marine Energy and Maritime Decarbonization:

PKN Orlen and Polenergia S.A. are key players in this sector. PKN Orlen is partnering in Baltic Power, Poland's first offshore wind farm, and Polenergia S.A. is developing offshore wind projects with Norwegian partner Equinor.

#### Portugal: Norte and Centro Regions

##### Norte Region

#### Business Support Organizations and Agencies:

In the Norte region, AEP Chamber of Commerce and Industry supports business activities in Porto, while Blue Bioeconomy CoLAB focuses on the Blue Economy, including sustainable fisheries and renewable marine energy.

#### Research Institutions:

INESC TEC and the Network of Parks, C&T and Incubators are key research institutions. INESC TEC specializes in systems and computer engineering research, and the Network of Parks, C&T and Incubators facilitates innovation through parks and incubators.

#### Incubators and Funds:

iMan Norte Hub promotes digital transformation in manufacturing, supporting the region's innovation ecosystem.

#### Successful Companies in Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:

Aquacria Piscícolas, S.A., Mar Cabo Frozen Products Ltd, ALGAPlus, and CorPower Ocean are notable companies in this sector. Aquacria Piscícolas, S.A. is a fisheries and aquaculture farm, Mar Cabo Frozen Products Ltd is a seller of frozen fish and aquaculture products, ALGAPlus produces and commercializes algae and derivatives, and CorPower Ocean develops renewable ocean energy technologies.

## Centro Region

### Business Support Organizations and Agencies:

In the Centro region, CEC/CCIC supports business in Coimbra, the Central Region Business Incubators Network supports startups and business innovation, and the Incubator of Maritime Industries supports maritime industry startups in Figueira da Foz. BLC3 is a technology and innovation campus in Oliveira do Hospital, and PTCentroDIH is the Digital Innovation Hub of the Centro Region.

## Portugal: Azores Autonomous Region

### Business Support Organizations and Agencies:

In the Azores, CCIPD is the main chamber of commerce supporting economic activities, the Regional Directorate for Science and Technology promotes scientific research and technology, TERINOV is a Science and Technology Park on Terceira Island, Startup Azores supports startups and investment, and the Azores Digital Innovation Hub promotes digital innovation in the region.

### Successful Companies in Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:

Grupo Vidinha, Lurdes Narciso, LDA, and SeaExpert Azores are leading companies in this sector. Grupo Vidinha is a prominent fisheries company with a strong market presence, Lurdes Narciso, LDA is a major player in the Portuguese fisheries sector, and SeaExpert Azores provides expertise in marine resources.

### Successful Companies in Renewable Marine Energy and Maritime Decarbonization:

Graciollica, LDA and EDA Renovaveis, S.A. are notable companies in this sector. Graciollica, LDA operates a hybrid power plant on Graciosa Island, and EDA Renovaveis, S.A. is developing renewable energy projects including a geothermal plant on Terceira Island.

## Spain: NUTS 1 (ES6: Sur) and NUTS 2 (ES61: Andalucía)

### Business Support Organizations and Agencies:

In Spain, Agencia IDEA provides support and funding for innovation and business development, while Centro Tecnológico de Acuicultura (CTAQUA) is dedicated to aquaculture innovation. The Campus de Excelencia Internacional del Mar (CEIMAR) promotes marine science and technology research, and Fundación Biodiversidad supports marine biodiversity conservation and sustainable use of marine resources.

### Successful Companies in Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:

Pescanova, Cupimar, and Lubimar are prominent companies in this sector. Pescanova focuses on sustainable fishing and aquaculture, Cupimar specializes in sustainable farming of clams and other shellfish, and Lubimar focuses on sustainable farming of sea bass and sea bream.

Successful Companies in Renewable Marine Energy and Maritime Decarbonization:

Acciona, Endesa, and Navantia are key players in this sector. Acciona is involved in developing offshore wind farms, Endesa invests in renewable energy projects including marine energy, and Navantia develops eco-friendly vessels and technologies for maritime decarbonization.

France: NUTS 1 (FRH: Bretagne)

Business Support Organizations and Agencies:

In Brittany, Pôle Mer Bretagne Atlantique promotes innovation in maritime activities, Technopôle Brest-Iroise supports innovative projects in marine sciences and technologies, and Campus Mondial de la Mer fosters research, innovation, and development in marine science and technology.

Incubators and Funds:

The Blue Economy Window Call for Proposals provides financial support for innovative projects in the blue economy, targeting SMEs and startups.

Successful Companies in Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:

Glacialis, MerAlliance, and Aquastream are leading companies in this sector. Glacialis specializes in sustainable fishing and valorization of by-products, MerAlliance focuses on sustainable sourcing and processing of fish, and Aquastream develops sustainable fish farming systems.

Successful Companies in Renewable Marine Energy and Maritime Decarbonization:

Sabella, Naval Group, and Éoliennes Flottantes du Golfe du Lion (EFGL) are prominent companies in this sector. Sabella develops tidal stream turbines, Naval Group works on green technologies for ships and maritime decarbonization, and EFGL develops floating offshore wind farms.

Italy: Emilia-Romagna Region

Business Support Organizations and Agencies:

In Emilia-Romagna, the Regional Union of Chambers of Commerce supports economic activities, ART-ER fosters regional sustainable growth through innovation and internationalization, and Creative Hub Bologna supports creative industries and innovation. Technopolis Modena promotes technological innovation, Technopolis Reggio Emilia supports research and innovation, Romagna Tech Innovation Incubator facilitates technological startups in Forlì, Ravenna Technopolis supports scientific and technological projects, and Emilia Romagna Regional Ecosystem of Digital Innovation promotes digital innovation in Bologna.

Successful Companies in Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:

Rizzoli Emanuelli, S.p.A, Ittigel S.r.l, and Eurofishmarket are notable companies in this sector. Rizzoli Emanuelli, S.p.A is an award-winning fisheries company, Ittigel S.r.l produces and markets seafood products, and Eurofishmarket engages in seafood trading and market analysis.

Successful Companies in Renewable Marine Energy and Maritime Decarbonization:

Qint'x Holding and AGNES Holding S.r.l are key players in this sector. Qint'x Holding develops floating offshore wind parks, and AGNES Holding S.r.l collaborates on renewable energy projects in the Adriatic Sea.

Netherlands: NUTS 1 (NL3: West-Nederland) and NUTS 2 (NL33: Zuid-Holland)

Business Support Organizations and Agencies:

The Netherlands hosts several key business support organizations, including the Rotterdam Maritime Capital of Europe, which spearheads innovation in the maritime sector through initiatives like Maritime Delta and PortXL. Maritime Delta connects companies, research institutions, and government bodies, while PortXL is a maritime accelerator that scales up startups. Additionally, InnovationQuarter acts as the regional economic development agency for Zuid-Holland, investing in innovative companies and stimulating economic growth. RDM Rotterdam is a vital campus and innovation hub, fostering collaboration between businesses and educational institutions with a focus on maritime and sustainable innovations.

Research Institutions:

Deltares and TU Delft are prominent research institutions contributing significantly to the blue growth ecosystem. Deltares specializes in applied research in water and subsurface fields, while TU Delft excels in research and development related to maritime technology and sustainable energy.

Incubators and Funds:

BlueCity serves as a crucial incubator for circular economy startups, supporting numerous ventures in sustainable aquaculture and blue resource valorization.

Non-Governmental Organizations (NGOs):

The Hague Security Delta (HSD) is an essential player focusing on security and cybersecurity related to the maritime industry, thereby contributing to the broader blue growth ecosystem.

Successful Companies in Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:

Koppert Biological Systems, BlueCity, and Zeeland Aquaculture are leading companies in this sector. Koppert Biological Systems is a global leader in biological crop protection and sustainable growing systems, BlueCity supports startups in

sustainable aquaculture and blue resource valorization, and Zeeland Aquaculture is notable for its sustainable farming of shellfish using innovative methods.

Successful Companies in Renewable Marine Energy and Maritime Decarbonization:

TenneT, the Port of Rotterdam, and Van Oord are key players in this sector. TenneT is an electricity transmission system operator integrating renewable energy sources, the Port of Rotterdam is advanced in sustainability initiatives and maritime decarbonization efforts, and Van Oord specializes in dredging, marine engineering, and offshore wind projects.

Finland: Ostrobothnia Region

Business Support Organizations and Agencies:

In Ostrobothnia, the Ostrobothnia Chamber of Commerce promotes regional business activities, while the Regional Council of Ostrobothnia is responsible for maintaining the regional innovation and research network. Innovation and Entrepreneurship InnoLab of the University of Vaasa is a multidisciplinary open research platform focusing on open and user innovation, entrepreneurship, and public sector innovation. Additionally, the Wartsila Sustainable Technology Hub is a center for research, product development, and production aimed at driving decarbonization in the marine and energy sectors.

Successful Companies in Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:

Relevant companies in this sector are united under the Ostrobothnian Fisheries Association, which comprises a total of 36 fishery associations across four fisheries regions.

Successful Companies in Renewable Marine Energy and Maritime Decarbonization:

Key players include ABB Finland, Citec (Cyient), Mervento, and Veo. These companies are part of the renowned EnergyVasa energy technology hub, which is the largest in the Nordic countries and a world leader in smart electrical solutions, sustainable energy, flexible power generation, and digitalization.

Croatia: National Level

Business Support Organizations and Agencies:

At the national level in Croatia, the Croatian Chamber of Economy (HGK) operates a Centre for Innovations and EU Projects, supported by a network of regional chambers of economy. The Croatian Agency for SMEs, Innovation and Investments (HAMAG-BICRO) provides funding and support for innovation and business development. Zagreb Innovation Centre (ZICER) offers incubation services, while Technology Park Split is the largest technology park in Croatia. The European Digital Innovation Hub Adria (EDIH Adria) and Blue European Digital Innovation Hub (BlueDIH) promote digital and green transformation for a sustainable blue economy.

Successful Companies in Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources:

Leading companies include Cromaris d.d., a leader in the fisheries sector known for quality and sustainable practices,

Successful Companies in Renewable Marine Energy and Maritime Decarbonization:

While companies in this sector are practically non-existent in Croatia, the Institute for Applied Ecology (OIKON) possesses extensive experience in environmental protection and relevant technologies. Additionally, several software companies could provide valuable technological support for projects directed towards renewable marine energy and maritime decarbonization in the future.

## 3.2 Country overview - Representation of Blue Economy in RIS3 and relevant Value chains

POLAND

### **A) NATIONAL LEVEL**

At the national level Poland adopted a practice of regular upgrading of initial RIS3 strategies instead of enacting completely new documents. In this sense, the initial document covering the period between 2014-2020 received upgrades in 2020., 2021. and 2023. respectively. This document still seems to be in force and no separate strategy for the 2021-2027 has been received.

The first version of the national RIS3 (2014) featured five thematic areas (1. Healthy Society, 2. Agrifood, Forestry-Timber and Environmental Bioeconomy, 3. Sustainable Energy, 4. Natural Resources and Waste Management and 5. Innovative Technologies and Industrial Processes). Out of these, of relevance to the Blue Economy could be the areas 2 (it includes the sphere of producing high-quality organic healthy food, potentially marine-based), 3 (it includes high efficiency, low-emission, and integrated energy production – e.g. from marine renewable sources as well as environmentally friendly transport solutions – e. g. in marine transport) and 5 (it includes the sphere of developing biosensors and smart sensor networks – e.g. for underwater use for monitoring purposes, smart grids and geo-information technologies – which could be equally used for maritime environmental monitoring and surveillance, as well as automation and robotization of technological processes – it could include the development of underwater robots and similar robotic-like appliances).

By 2020., the structure of the strategy was partially changed, and it included 14 distinct thematic areas. Out of these 14 of particular importance to the Blue Economy is the last one - Innovative marine technologies for specialized vessels, marine and offshore structures and logistics based on marine and inland transport. Concrete sectors within this area were further distributed among Polish territorial units (regions) according to specific preconditions available in each region: offshore, port and logistics technologies (Pomerania), maritime activities and logistics (West Pomerania), water management (Warmia-Masuria), transport, logistics and trade on water and inland routes (Kuyavia-Pomerania).

Following the upgrades of the strategy in 2021.-2023. the descriptions of each thematic area were greatly expanded, and lower-level areas were also added. Given that one thematic area was excluded, the previous 14th thematic area was renamed to Maritime Technologies and became the 13th, with relevant lower-level areas. These lower-level areas include sectors such as specialized vessels, marine and coastal structures, logistics based on sea and inland transport and the dredging industry. The shipbuilding and maritime technology industry in Poland has generally shown great production flexibility in recent years, resulting from the ability to quickly adapt to changing market realities. Shipowners focus their orders on environmentally friendly, economical, power-driven vessels with the lowest possible emission of CO2 and other harmful substances, while the demand for zero-emission ships is also growing.

In the Pomeranian Voivodeship, the Pomeranian Smart Specialization areas were verified in the first half of 2024. It is the result of extensive consultations with the regional economic and scientific community, supported by the results of public surveys addressed to entities interested in innovation, numerous meetings, conversations, conferences and workshops with experts.

Concrete areas with corresponding sectors are the following:

## **ISP 1 – Offshore and port and logistics technologies**

### **1. Universal structures and technologies for the exploitation of sea resources, including:**

- a) floating or stationary structures of components of offshore wind farms, mining platforms, floating platforms, including aquaculture installations;
- b) devices and structures in energy conversion systems conducive to the protection of the natural environment, in particular absorbers used to obtain energy from sea waves and active shore protection;
- c) use of offshore structures and emerging infrastructure for the development of aquaculture and disposal of aquaculture waste;
- d) facilities for transshipment of large-scale marine structures;
- e) technologies and devices with increased energy efficiency for offshore shipbuilding and transport services, including ship bunkering installations for alternative fuels;
- f) technologies and devices for: searching, estimating and obtaining biological and raw material resources of the sea;
- g) hyperbaric technologies.

### **2. Vehicles and vessels used in the marine environment and coastal, including:**

- a) unmanned maritime, land and air vehicles for monitoring and inspection, operation of offshore facilities, marine hydrotechnical facilities, the state of the natural environment or assessment of marine resources;
- b) vessels with reduced impact on the natural environment, including for tourism and recreation purposes.

### **3. Technical solutions reducing the negative impact on the natural marine environment and the coastal zone, including:**

- a) systems for purifying water from petroleum and biological pollutants;
- (b) systems for monitoring the state of the marine environment and the coastal zone;
- c) devices and technologies for the treatment of low-salinity ballast water;
- d) technologies and devices for purification and economic use of sludge;

e) devices, techniques and technologies for environmental protection, limiting anthropopressure on the marine environment and cleaning the marine environment, including

in ports and shipyards;

f) methods of processing waste and pollution from ports, shipyards and shipping.

4. Innovative ways and technologies of using unique natural compounds produced by marine organisms, incl

a) technologies and devices for the use of unique natural compounds produced by marine organisms as ingredients of medicines, cosmetics or substances and products for the food industry;

b) technologies, devices and methods for breeding marine organisms;

c) safe, durable and environmentally neutral technologies for protecting underwater infrastructure.

**5. Technologies, devices and processes to improve the safety and efficiency of transport and logistics services in ports and their hinterland and foreland, including:**

a) means of transport (water and land), drives and reloading equipment;

b) technologies for buildings related to transport and logistics services using renewable energy sources;

c) navigation organization and safety systems;

d) systems for spatially efficient parking of motor vehicles in the port area;

e) intermodal transport technologies to/from seaports;

f) systems optimizing communication systems in relation to/from the port and integrating cargo and passenger traffic management;

g) systems and technologies increasing the security of ports and port infrastructure and its facilities;

h) technologies for managing the storage and circulation of goods in warehouses and logistics centres.

**6. Smart Sea Technologies, including:**

a) IT and ICT systems and technologies for monitoring, simulating, optimizing, integrating, controlling and managing means of transport in motion (land, water and air), as well as transport infrastructure;

b) technologies and systems supporting the development of control and management centres and security of offshore and port and logistics infrastructure;

c) maritime cybersecurity systems, including those based on modern quantum technologies, in particular for critical infrastructure;

d) Internet of Things (IoT) technologies for shipbuilding, port and logistics infrastructure and monitoring the marine environment.

For each thematic area a separate document was also published, specifying **certain examples of good practice – these success stories represent several already implemented state-of-the-art projects**, often unique in their features, which could serve as an indicator for the future development directions.

With regard to **Marine Technologies**, the implemented success stories were oriented towards design, construction and conversion of specialized vessels and their specialized equipment, design, construction and reconstruction of marine and coastal structures, as well as processes and devices used for logistics based on sea and inland transport.

#### ***Example 1: Development of a new product: "Airboat" type boat***

The aim of the project was to establish cooperation with a scientific unit and jointly develop a design project and bring it to the form of a finished product that can be placed on the market. The key activity carried out as part of the project was the conduct of industrial research and development work by the Institute of Aviation. **The project was characterized by a high level of innovation - there was no Airboat manufacturer in Poland before. There were no engines available on the market with parameters that would allow for use in Airboats.**

The result of the R&D work is a prototype with all the features of the new product, tested for the correctness of the technical solutions used and the functional parameters obtained. The prototype was tested in real conditions using feedback from target users. The result is a product ready to be put into production and placed on the market, i.e. **an unsinkable flat-bottomed boat powered by a propeller (Airboat), able to move on water, land and ice without the risk of damage to the engine or hull. The boat will be manufactured at the Applicant's headquarters using its existing machinery. The main advantages of the new product over similar devices are the mobility of the boat, the ability to quickly reach hard-to-reach areas, precision of control and a relatively low price.**

#### ***Example 2: Development of an autonomous/remotely controlled floating platform dedicated to hydrographic measurements in limited water areas***

The subject of the project was the **development of an autonomous/remotely controlled multi-task surface platform for operations in limited water areas, i.e. in port areas, roadsteads, anchorages, lagoons, bays and lakes, rivers and other confined areas.** As part of the project, requirements regarding the hull structure and type of drive were developed, and then **an unmanned catamaran was made of light, durable material, with a two-hull system (4 m long and 2 m wide) and with a small draft from 20 cm in the bow part to 50 cm in the stern - engine part.** It is equipped with two Torqeedo Cruise 4.0 RL electric motors operating independently of each other with a power of 4kW each, which ensure **appropriate speed and manoeuvrability.** The unit is equipped with 16 LiFePo4 batteries with a voltage of 3.2V each, placed in two

independent battery panels. The battery bank is additionally charged by 2 photovoltaic panels. This energy ensures the system's operation for approximately 12 hours. **The platform is characterized by multi-variant functionality implemented by installing a wide range of measuring equipment.** The navigation sensors are mounted on an automatically foldable mast, which ensures safe transport of the unit and access to the measurement area. The data is transmitted to the coast station.

The result of the project is the implementation of a **fully functional HydroDron-1 prototype into production, which allowed Marine Technology to start providing services using a multi-task autonomous/remotely controlled surface platform (ASV) and to offer the production of platforms upon request of external customers. The platform has the ability to perform measurement missions in limited water areas.** In autonomous mode or in remote control mode, especially useful in difficult navigation situations, it follows the planned trajectory. The sensors equipped with the HydroDron include a 3D radar, a LIDAR system, and laser rangefinders, cameras, echo sounders and 3D sonar, integrated with on-board industrial computers. **The innovation of HydroDron lies in the ability to work in water areas that are inaccessible or difficult to access for larger crewed units, the use of which is impossible or unprofitable. The HydroDron platform is characterized by mobility,** i.e. it can be transported on a car trailer or on a larger surface vessel.

### ***Example 3: Development of a new hub: Baltic ZEV HUB***

Baltic Sea and Space cluster was establishing the Baltic ZEV HUB, a sustainable and efficient network for the development of innovative zero-emission ships and related technologies that brings together relevant and active stakeholders.

This platform is ready for production of the zero emission vessels for ferry connection, offshore and seaports service. The platform is accelerating the transition to sustainable maritime solutions by fostering innovation, providing a space for collaborative forums, sharing knowledge, and promoting zero-emission vessel state-of-the-art technologies. The HUB connects NGOs, public, private and academic sector interested in technology transfer, development and commercialisation of new electric vessels, known as zero-emission vessels (ZEV).

**CRIST Shipyard is a coordinator of the Baltic ZEV HUB.** CRIST is a leading shipyard on the European market. CRIST's specialty is shipbuilding and marine constructions. It is one of the leaders in the offshore and hybrid/electric ships industry. He successfully implements more and more advanced projects. CRIST has delivered vessels such as "Electra" (the first electric ferry in Europe), Heavy Maintenance Vessel "VIDAR", Heavy Lift Jack – Up Vessel "INNOVATION" and Jack-up Barge "THOR". CRIST has been combining innovation with experience for over 3 decades.

### ***Example 4: Development of a new green hub: BSSC Green Tech HUB***

The idea of the GreenTech Hub is based on a preliminary analysis of the demand for such solutions in the coastal municipalities and small ports of the Baltic Sea region. It focuses on identifying hybrid solutions resulting from the needs of local clusters, Polish coastal municipalities and small ports.

The BSSC Green Tech HUB members have potential and are ready to install diversified sources of renewable energy in Poland such as wind, solar, biotechnological and hydrogen energy, as well as energy from sea currents, The hub can to store this energy. The Hub members cooperate with a member of the BSS Cluster, **Technology Group ASE is a coordinator of the BSSC Green Tech HUB**. The ASE Group has an experience in production of industrial installations and possesses technology that allows to build stationary energy and mobile storage and energy batteries systems on seaports OPS. The management of energy obtained from so many sources will allow for software using artificial intelligence, which will distribute the stored energy to local consumers.

Within this BSSC Green Tech HUB there is also an idea for ecological food production, aquaponics farms. On the basis of nitrogen, which is produced from fish excrements, 100 percent ecological plants will be grown, among other vegetables and fruit. The HUB is ready to create demonstration installations.

With regard to the presence of specific value chains, Renewable Marine Energy was partially addressed in this way within the national RIS3.

As could be seen earlier, the trend of the diversification of the sectors over time can clearly be observed. In particular, after the 2021-2023 upgrade, a whole new area – New technologies in the dredging industry with relevant lower-level areas was added. In comparison with the other strategies analysed, the Polish national RIS3 is a well-developed and wide-ranging document, with numerous Blue Economy sectors included.

Beyond the RIS3, the “Sustainable Development Strategy for Poland up to 2025” (Polska 2025) is the main framework, elaborated by the Polish Government. It is a multidimensional strategy and the focal point for other plans, programmes and strategies. Due to its long-term perspective, sustainable development is perceived of as a process that allows for a gradual balancing of growth, social cohesion and environmental protection. The overall strategy aims at not disturbing the country's efforts to catch-up with the industrialised countries. Insofar, Polska 2025 has an open character – like a compass for the state and society – and is not narrowly concentrated upon some quantified objectives. The general goal of this strategy, developed with the help of the UN and the OECD, is to ensure the continued resilience of Polish economy with its relevant sectors, and also to make it the 7th largest economy of the EU. Poland's national approach to the Blue Economy focuses on sustainable development and innovation, aiming to harness the economic potential of its maritime sectors. This vision is aligned with broader EU goals for climate neutrality, sustainability, and technological advancement. Key areas of focus include renewable energy, particularly offshore wind energy, maritime transport modernization, and sustainable fisheries and aquaculture.

## **B) REGIONAL LEVEL – POMERANIA REGION**

**Brochure entitled Pomorskie Smart Specialisations (PSS)** published in 2020., specifies **4 distinct thematic priority areas (PSS 1-4) for smart specialisation** of the region: 1.

**Offshore, Port and Logistics Technologies, 2. Interactive Technologies in an Information-Saturated Environment, 3. Eco-Effective Technologies in the Generation, Transmission, Distribution and Consumption of Energy and Fuels and in Construction** as well as **4. Medical Technologies in the Area of Civilisation and Aging-Associated Diseases**. Tracking the changes over time was not possible since the partner provided this brochure only.

**In the Pomeranian Voivodeship, the Pomeranian Smart Specialization areas were verified in the first half of 2024. It is the result of extensive consultations with the regional economic and scientific community, supported by the results of public surveys addressed to entities interested in innovation, numerous meetings, conversations, conferences and workshops with experts.**

Of primary interest to this report is the PSS1. Its main objective is to significantly strengthen international competitiveness and accelerate the rate of growth of maritime economy enterprises in Pomorskie through research and development work and the resulting innovative products, services and technologies in the area of environmentally sound exploration and use of marine resources. In order to achieve it, **7 priority areas were defined:**

innovative specialist, manned and unmanned vessels, vehicles and transport devices to support the economic use of the sea and coastal areas and technical devices that are part of their specialist equipment

innovative technologies and structures together with technical devices that are part of their specialist equipment for the exploration of the resources of the sea and its hinterland

studying and monitoring the marine environment for the purposes of a sustainable and environmentally sound use of marine resources

technologies to clean the marine environment and reduce and eliminate pollution generated in the process of economic exploitation of marine resources

technologies and devices for the exploration of marine resources, including minerals and unique biological substances, innovative methods for farming biological organisms in the marine environment and for economic exploitation

innovative solutions and technologies to improve effectiveness and safety and reduce energy consumption in logistics processes related to sea transport

technologies supporting innovative solutions which make active, health and spa tourism more attractive and unique, in particular if it comes with a strong export potential, using floating vehicles and all types of structures that use the region's coastal location.

In addition, **3 thematic groups** (Trade education, Energy mix, New Technologies) and **5** rather similar **scopes of PSS1** were identified: 1. Universal Solutions and Technologies to Explore Marine Resources, 2. Vehicles and Vessels used in the Marine and Coastal

Environment, 3. Devices, Techniques and Systems for Monitoring and Clearing up the Maritime Environment and its Hinterland, 4. Innovative Ways and Technologies for Utilising Unique Natural Compounds Produced by Marine Organisms and 5. Technologies, Devices and Processes to Improve the Safety and Efficiency of Transport and Logistics Services in Ports, their Hinterlands and Forelands.

**Gdańsk Entrepreneurship Foundation and STARTER Gdańsk Business Incubator** were assigned the role of **leaders** in the implementation of PSS1.

Other PSSs do not cover the topics related to the Blue Economy. **The partial exception is PSS2 and PSS3**, which has the sector of **Offshore Wind Energy and Interactive Technologies in An Information-Saturated Environment amongst its thematic groups**.

**ISP 2 - Interactive technologies in an information-saturated environment (BSSC – in seaports, shipbuilding industry, seafarers training, seaport and maritime industry safety and security)**

**1. Multimodal human-machine interfaces (BSSC – in seaports, shipbuilding industry, seafarers training, seaport and maritime industry safety and security) , including:**

- a) control, communication and human-machine cooperation techniques;
- b) development of wearable systems and exoskeletons;
- c) virtual (VR) and augmented reality (AR) systems, including the so-called Metaverse;
- d) digital replicas of physical objects, processes and systems (Digital Twin/Data Twin).

**2. Smart Spaces and Smart Systems (BSSC – in seaports, shipbuilding industry, seafarers training, seaport and maritime industry safety and security), including:**

- a) intelligent technologies and systems for automation, diagnosis, decision-making, management and monitoring of processes, facilities or environments (production plant, home, hospital, car, city, port, etc.), including: using technologies for storing and processing data close to the source where it is generated, edge computing and cloud solutions (cloud computing and management);
- b) embedded systems for smart spaces, including: in the field of remote management and optimization of power consumption and operating efficiency of devices and systems;
- c) technologies for the Internet of Things (IoT), including: intelligent network components, sensors and solutions creating new generation services and networks;
- d) design of semiconductor systems (including logic, memory), as well as design and production of equipment and materials for the production of semiconductor systems;
- e) software and electronics solutions with a reduced environmental footprint, including work on software optimization in the field of minimizing energy consumption (green software), optimization of processes related to data collection, processing and analysis, and electronics solutions based on the sustainable development paradigm (sustainable electronics );
- f) unmanned vehicles (including USV, UAV, UGV, UUV, etc.), along with devices, components, systems and software, including algorithms providing intelligence, enabling their effective use in dedicated work environments.

**3. Space and satellite engineering (BSSC - technologies supporting monitoring of the marine environment, fisheries, maritime transport, seaport security), including:**

- a) software, electronic circuits and systems related to the **development and application of satellite observation and navigation systems**, as well as the management of space and satellite systems;
- b) development and use of space and satellite technologies, including satellite data, in security, telecommunications, environmental monitoring and maritime industry;
- (c) components for space and satellite technologies, including rocket technologies, for control, navigation, data processing, safe and reliable communications, on-board subsystems and propulsion units.

**4. Artificial Intelligence and advanced data processing and cybersecurity (BSSC - application in maritime transport management, production of fish farms and seafood, fisheries, port security and maritime logistics), including:**

- a) methods of artificial intelligence, machine learning, using distributed systems, parallel processing;
- b) effective methods of collecting, compressing, verifying, as well as processing (data mining, big data, small data, cloud computing) and analysis of data, including: using data centers and advanced virtual databases;
- c) technologies for data transmission (including through telecommunications networks);
- d) innovative solutions for the digital transformation of society, counteracting digital exclusion, data privacy and unique identification of people, ships, products, processes and operations;
- e) solutions and technologies ensuring the security of infrastructure and data storage, processing, transmission and transmission, including encryption and cryptography.

The **Offshore Wind Energy** sector is related to the **3rd priority research area of PSS3 – ISP 3 – Green energy - Eco-efficient technologies.**

**PSS3 - Renewable energy sources (RES), distributed generation and prosumer energy, including:**

- a) development and implementation of new technologies for the production of biofuels and biocomponents that do not compete with food production (second and third generation);
- b) new technologies and systems for the generation, storage and consumption of electricity, heat or cold in renewable energy sources (including: energy from waste and biomass, hybrid power plants);
- c) using waste heat to produce energy;

d) systems enabling and optimizing the cooperation of many distributed energy sources (balancing areas within "energy islands", energy cooperatives and communities, energy clusters) and energy monitoring and management technologies);

e) the use of other fuels improving the broadly understood efficiency or ecological effect of existing distributed energy sources;

f) development and improvement of tools for forecasting energy production and consumption from renewable energy;

g) hydrogen technologies and fuel cells

## **2. Energy storage in the seaports and marinas, and shipbuilding and shiprepairing, fish production industry, including:**

a) research and implementation of innovative materials and technologies for energy storage systems and the use of building infrastructure **in the seaports and marinas** for energy storage purposes;

b) improving the efficiency and durability of energy storage systems **in the seaports**;

(c) energy storage management systems **in the seaports and marinas and maritime industries**;

d) integration and management of energy storage systems **in the seaports**, power or heating networks and renewable energy sources;

e) systems for managing transport charging points using energy storage facilities, including mobile storage facilities **in the seaports and marinas**.

## **3. Alternatively powered means of transport, including:**

a) technologies, products and solutions for electric and hybrid vessels and seaport equipment and vehicles.

(b) energy distribution and management systems for electric transport and seaport terminals, fishing industry;

c) systems and devices for bidirectional energy flow between the electric vehicle and the power grid.

## **4. Technologies in nuclear energy (BSSC - used to power ships and in the sea ports), including:**

a) nuclear reactor technologies - design, construction and operation of nuclear reactors, nuclear fuel and its cycle, reactor cooling systems;

b) nuclear safety - risk and safety assessment of nuclear reactors, radiation-resistant materials, reactor control and monitoring technologies, design and construction of nuclear power plants;

- c) fuel management and waste - storage and disposal of radioactive waste, recovery and recycling of nuclear fuel;
- d) energy applications - use of nuclear energy to produce electricity, new concepts of reactors and energy systems based on nuclear energy.

Similarly to the previously analysed strategies of other partner countries, the themes of the two value chains (a) Sustainable Fisheries, Aquaculture and Valorization of Blue Resources and b) Renewable Marine Energy and Maritime Decarbonisation) were **partially addressed (in particular, this regards Renewable Marine Energy), although it was done in a different form**. The general impression is that the Polish stakeholders are **much more focused on the development of transport, logistical and other highly technological solutions within the relevant Blue Economy sectors**, while **Fisheries, Aquaculture and valorization of other living blue resources are rather scarcely present or fully absent** from their RIS3 strategies.

The correlation between the presence of the Blue Economy sectors and the general direction of development is clearly visible in Pomerania. Since it extends along the coast of the Baltic Sea, the region aims to become one of the hubs for the development of marine technologies, a leader in providing modern solutions for ports and maritime logistics. In the wider region of the Baltic Sea, Pomerania already has a leading role with regard to the development of the Blue Economy. This branch definitely constitutes one of the priorities of the region's economy. Also, fairly developed are the sectors of energy supply, insurance business, banking, electronics, medicines, software development, distilleries and textile industry.

Pomerania, with its strategic location along the Baltic Sea, aims to become a leading region in sustainable maritime activities over the next decade. The region is leveraging its robust maritime heritage and modern infrastructure to enhance its Blue Economy sectors. Here are the key elements of Pomerania's vision:

1. Sustainable Maritime Transport and Infrastructure including shipbuilding: Pomerania plans to modernize its maritime transport and port infrastructure, focusing on reducing environmental impacts. This includes adopting green technologies and improving logistical efficiencies to support sustainable growth in maritime transport.
2. Marine Renewable Energy: The region is investing in marine renewable energy sources, such as offshore wind farms and wave energy. These initiatives align with broader EU goals of reducing reliance on fossil fuels and promoting green energy solutions.
3. Blue Biotechnology and Food processing: Pomerania aims to expand its blue biotechnology and sustainable aquaculture sectors. This involves developing innovative solutions for marine bio-resources and enhancing the sustainability and productivity of its aquaculture practices.
4. Research and Innovation: Pomerania emphasizes the importance of research and innovation in driving the Blue Economy. The region plans to support various research initiatives and foster collaborations between academic institutions, industry players,

and governmental bodies to develop cutting-edge marine technologies and solutions.

Poland and specifically the Pomerania region have recognized the potential of the Blue Economy as a critical component of their economic strategy. The region has a strategic vision that integrates its maritime strengths and aims to leverage them for sustainable growth and innovation over the next decade.

The Pomerania region, home to major ports such as Gdańsk and Gdynia, plays a pivotal role in Poland's maritime economy. The regional strategy emphasizes the development of maritime and logistics technologies, eco-efficient production methods, and the integration of energy systems. The region's strategic documents highlight the importance of the Blue Economy in driving regional growth and innovation.

The Pomeranian Voivodeship's strategies are documented in reports and presentations, such as the "REGIONS 2030" project, which outlines regional priorities and sustainable development goals. The University of Gdańsk and the European Commission's Joint Research Centre are key contributors to these strategic plans, focusing on integrating sustainable development goals with regional policies. University of Gdańsk is a member of the SEA-EU, a pioneer in the European Commission's initiative, unites 9 coastal universities across Europe (Cadiz, Western Brittany, Kiel, Gdansk, Split, Malta, Algarve, Naples, NORD) since 2019. The Baltic Maritime and Space Cluster is a business partner in the European Maritime University SEA EU project.

The SEA EU project offers numerous opportunities including courses, mobilities, languages, and joint degrees for its community, enhancing careers and lives. Emphasizing an inclusive, flexible, and adventurous spirit, SEA-EU connects individuals across distances, inviting them to explore the vast prospects at the European University of the Seas.

Gdynia Maritime University, Member of the BSSC, is a member of the International Association of Maritime Universities IAMU. It is a global network of leading maritime universities providing Maritime Education and Training (MET) to seafarers in the global ship industry.

Gdańsk University of Technology, Member of the BSSC, has signed over 760 international agreements with over 450 research units in the world. They include framework agreements (the so-called Memorandum of Understanding), bilateral agreements under educational projects (e.g. under the Erasmus + program) and multiple qualification agreements (e.g. Double Degree). The largest number of international agreements are agreements on bilateral cooperation under the Erasmus + program (611 agreements, including 578 with program countries and 33 with partner countries).

## PORTUGAL

### **A) NATIONAL LEVEL**

On a general note, the Portuguese RIS3 strategies are well-developed and fairly diversified, and thus should be considered among the 4 countries whose strategies were the most comprehensive (France, Spain, Poland, Portugal).

All Portuguese RIS3 strategies are synchronised with a wider Portugal 2030 development strategy and they partially reflect its goals in specific regions concerned.

The Blue Economy in RIS3 Strategies **first emerged in the national document covering the period between 2014 and 2020.**

The theme was given a **very extensive coverage** – in fact it was included into separate **Smart Strategic Priorities** and analysed in great detail (40 pages of text as part of axis 4, which addresses **Natural Resources and Environment**).

The document identified **5 distinct areas for the development of the Blue Economy:**

**1. Marine Food Resources** (fisheries, aquaculture, in-land and off-shore, and the fish industry; salt farming and food security) - Valorization and differentiation of Portuguese fish and sustainable national fishing products through scientific knowledge of species with the greatest potential for valorization and guaranteeing of environmental sustainability, through the application of innovative technologies.

**2. Natural Systems and Renewable Energy Resources** (Natural resources (Biodiversity and Climate; Ocean – Atmosphere; Climate Change) and renewable energy resources (Wind; Waves; Salinity; Tides, Biomass)) - Explore and develop knowledge of ecosystems, marine living and non-living resources, and their potential, including commercial use and value as natural capital in order to maximize the potential of the blue economy. Reduce the possible impacts of climate change, particularly in the coastal area and mitigate its risks. Boost the development of technologies for transversal use or that leverage other sectors of the marine economy, such as marine renewable energy, marine biotechnology or TICE

**3. Deep Sea Resources** (Marine biotechnology; Mining; Deep Sea fishing; Non-renewable energy resources (**Hydrocarbons, Natural Gas**) - **not mentioned by any Portuguese partner, in fact it goes against the declared goal of environmental sustainability!**) - Sustainable exploration of new resources in the Portuguese deep sea to maximize the development potential of the blue economy

**4. Ports, logistics, transport, shipbuilding and maritime works** (New Means of Transport; Low Carbon Transport; Intelligent Transport; Ports; Naval Construction and Repair; Flow Management (transport, mobility and logistics); Maritime works) - The Sea as a national purpose for eco-efficient maritime transport in a maritime space without borders, for the capitalization of the naval industry and the integration of port logistics into global logistics.

**5. Culture, tourism, sport and leisure** (Sport and Leisure; Bathing Tourism; Health Tourism; Cruises; Eco-Tourism) - The sea as a cultural and social identity factor in Portugal.

As seen above, the themes of the two value chains (a) Sustainable Fisheries, Aquaculture and Valorization of Blue Resources and b) Renewable Marine Energy and Maritime Decarbonisation) **were addressed/partially addressed**, although in a **different form**.

For each of these areas, **detailed implementation steps and sub-areas, competitive advantages, challenges, possibilities for establishing their mutual connecting points, R&D, innovation and commercialization opportunities** were identified at great length. Also, ample recommendations were given on the possibilities and necessities regarding the enhancement and upgrading of the relevant regulatory framework.

Integrated into the RIS3 for 2014-2020 is the Strategic Reflexion Workshop – Supporting document on Maritime Economy. It presents an outlook of the state and development prospects of this area of the national economy. As indicated, the sectoral GDP shares in the overall GDP generated by the Blue Economy is as follows: Tourism and leisure 39%, Maritime Transport, Ports and Logistics 36%, Fisheries, Aquaculture and relating industries 21% and all the other sectors 4%. This, in turn, means that there is still significant potential for sectors diversification. At the same time, the data provided shows high levels of specialization in Fisheries and Aquaculture (specialization coefficient of 3,5) as well as in Shipbuilding, Repair and Marine Equipment Manufacturing.

In the **current national RIS3 through 2030** (published in 2021., revision in June 2022.), the theme of the Blue Economy was addressed in the section **Great Natural Resources – Forest, Sea and Space**. The main goals set in the new period are the following:

- 1. Preserving biodiversity and fish stocks and increasing the added value of fishing**
- 2. Increasing the scale of national production of fish in aquaculture,**
- 3. Promoting the autonomy and innovation of the fish processing and conservation sector**

These three points can be considered **an equivalent of the first value chain**. The themes/equivalents of the second value chain **were not separately elaborated**.

**4. Promoting the biotechnological exploitation of non-traditional living marine organisms** – this in particular includes actions such as promoting modern technologies for the exploitation of the oceans, blue biotechnology, promoting the valorisation of waste and effluents from fishing activities, increasing research into substances and micro-organisms with health and cosmetic applications and treatment through bioremediation.

**5. Development of Marine Exploration Technologies** – the aim is to improve monitoring, safety, and maritime surveillance systems, developing coastal management technologies, minimising the impact of rising sea levels, ocean mining and underwater communications.

**6. Continuing the process of modernising ports in line with the smart ports concept and to qualify them as hubs of technological innovation in the blue economy** – this encompasses development of competitive positioning in the global market through digitalisation, standardisation, Service Level Agreement opportunities and evolution of the Smart Port concept, including autonomous intelligent navigation and logistics reduction of environmental impacts, restructuring the naval industries to meet new challenges and generally positioning Portugal as an attractive place for testing, technology development and prototyping.

The correlation between the development of the Blue Economy and the general line of development of the country is clearly visible and conditioned, among other factors, by the geographical position and related features of Portugal as a country facing the Atlantic Ocean.

Portugal's national strategy for the Blue Economy, as outlined by the Directorate-General for Maritime Policy (DGPM), emphasizes sustainable management of marine resources, marine spatial planning, and the development of scientific research and technological innovation. The national goals are aligned with the Sustainable Development Goal 14 (SDG 14) targets, focusing on reducing marine pollution, enhancing marine biodiversity conservation, and promoting the circular economy of the sea. Portugal has made significant voluntary commitments at international conferences to support these goals, reflecting its leadership in sustainable ocean governance.

## **B) REGIONAL LEVEL:**

On a regional level, it is somewhat difficult to conduct the comparisons, since all three regions analysed provided their RIS3 strategies only for the current period (2021-2027). The most diversified among them was the strategy of the Norte Region, followed by the Azores Autonomous Region and the Centro Region.

### **1. Azores Autonomous Region:**

Already in the period of 2014-2020, the Azores region included certain areas of the Blue Economy into their regional RIS3, notably **Fisheries and Sea**. The objectives were to **a) Reinforce the position of the Azores as the intercontinental platform of knowledge regarding the oceans** (probably due to the archipelago's geographical position), **b) Increase the value of the fisheries products** and **c) Forge collaborative relations and promote innovative activities related to the sea**.

In the new RIS3 for 2022-2027, the Blue Economy development remained among the **strategic priorities**, but the area of Fisheries and Sea was renamed to **Sea and Blue Growth**. Beyond the name change, its structure has remained largely unchanged. **The activity of fishing retained its central, monopolistic place**. Listed are a number of relevant production establishments which have a leading role in the sector. It is noted that the Azores participate in a number of international fisheries projects at the European and wider world level, due to having strong R&D potential in this sphere. The areas identified as prospective include the development of technologies to

**facilitate the reduction of greenhouse gases emission, further exploring the role of the oceans in climate regulation, carbon capturing, mitigation of impacts arising from climate change, economic valorization of marine ecosystem services etc.** At the same time, the main challenges include significant reduction of number of fishermen in the region, atomization of fisheries sector (fishing fleet principally made up of small boats), lack of clearly defined fishing areas despite the vast maritime space, varying amounts of caught fish (leading to imports) and unsuitable conditions for the development of aquaculture (due to deep waters with strong currents).

The priority area of Sea and Blue Growth is combined with **5 transversal areas of activity** (territorial resources and circular economy, environment and climate actions, digital transformation and economy 4.0, quality of life and social development, Atlantic and geostrategic dynamics). Concrete steps to be undertaken in each area are divided into 2 sections: **transformative activities and action lines**. Each of these sections is subsequently extensively elaborated on in corresponding tables. **No mention is made about the two relevant value chains.**

The Azores Autonomous Region has a distinct vision for the Blue Economy, heavily influenced by its geographical location and rich marine biodiversity. The region's strategy focuses on marine conservation, sustainable fisheries, and the development of marine renewable energy. The Azores aims to become a hub for marine research and innovation, leveraging its unique position in the Atlantic to attract international partnerships and funding. Initiatives such as the establishment of the Atlantic Observatory and the promotion of marine biodiversity conservation are central to the region's approach. The Azores also prioritize the development of sustainable tourism that highlights the region's natural marine assets.

## **2. Norte region:**

Blue Economy and several of its sectors are included in the **priority domains** of RIS3 2021-2027. **The 7th domain (Maritime Economy and Resources)** specifically deals with the establishment of articulated relationships between applied engineering (civil, mechanical, naval, robotics, biotechnology, energy, information technology, materials), industrial resources of the sea (living marine resources, non-living marine resources, maritime and coastal ecosystem services) and economic activities that valorize them (renewable marine energy, coastal tourism, nautical and cruise industries, naval industry, biotechnology, aquaculture, maritime equipment, infrastructure, etc.), thereby favouring the creation of a set of synergies that enhance the creation of value and generate employment from activities related to the maritime economy. At the same time, emphasis is placed on preserving and promoting the sustainable use of marine resources.

**Concrete areas** identified as part of the 7th priority domain of the strategy include:

**a) Blue Energy** – 1. significant increase in wind energy production in open sea (offshore), in installed power-generating capacities and market shares (global and renewable), although more moderate with regard to other sources such as tidal and wave energy - depending on the development and maturity of current technological

solutions: tidal power plants and underwater wave turbines respectively. 2. development of technologies to respond to challenges associated with the use of wind turbines in the open sea (offshore), such as transport and anchoring of structures, systems for mooring, mechanical wear, new materials, connections to the electrical grid or maintenance operations, commercial selection and optimization of different technologies available in experimental phase for harnessing wave and tidal energy.

**b) Aquaculture** – 1. growth in fish production in offshore aquaculture at a rate higher than that of the world population growth and increased consumption of proteins originating from maritime organism (given that this is the fastest-growing animal-origin food production sector), contributing, thus not only to the improvement of human nutrition, but also to the sustainability of fish populations of the oceans. 2. Differentiation of supply and investment in the production of juveniles and species suitable for the Portuguese coast; development of structures for open sea aquaculture under individual conditions on the continental shelf; automation of aquaculture units, using remote and real-time monitoring of life and physical-chemical and biological parameters (of water and organisms) with the support of analysing equipment.

**c) Coastal, Maritime and Cruise Tourism** – 1. growth of activities that combat the traditional seasonality of demand, such as cruise navigation, in association with shipbuilding, water sports (sailing, surfing, etc.) and green tourism (species observation in seawater and diving), reducing the carbon footprint and generally the environmental impact of traditional coastal tourism. 2. development of new tourist concepts and products associated with recreational boating and high-end sports competitions practiced at sea, new maritime transport solutions to support tourism in riverside areas and introducing new technologies for monitoring pollution - its biological and ecosystem trajectories and effects, as well as stronger recycling and use of new materials obtained from different kinds of maritime waste.

**d) Marine Mineral Resources** – 1. - potential exploration and production of minerals from ocean beds, including cobalt, copper and zinc, and, in function of technological development and market evolution, of minerals dissolved in sea water, such as boron, lithium and potassium - in a predictable global context of increased demand and prices for non-energy raw materials as well as the possible extension of the continental shelf. 2. - mapping of marine mineral resources and possible associated critical and reserve areas, such as sensitive ecosystems, development of technology for prospecting and exploring marine minerals; assessment of sea potential to reduce the risks arising from climate change and possible practical solutions for carbon sequestration.

**e) Blue Biotechnology** – 1. - potential development and production of new drugs from research and development associated with knowledge of marine organisms, similar to some recent successes (Zovirax, Acyclovir and Yondelis), as well as products intended for the cosmetics, industrial biomaterials and food products, resulting from the production of metabolites and primary compounds (such as polymers, sugars, lipids and proteins). 2. development of technologies for commercialization of marine bioactive compounds intended for the pharmaceutical, nutraceutical and cosmetic

industries, as well as the production of biofuels; promotion of pre-commercial initiatives involving bioactive compounds through processing and metabolite separation technologies; deepening the knowledge of diversity of marine organisms, their biochemical processes and ecosystems; sustainable production of bioactive compounds from their genetic resources.

**In Norte region RIS3 there is no specific mention of the two value chains but related topics are covered.**

The main economic activities/priorities of the Norte region are the production of textile, food processing, mechanical, electrical, electronics and chemical industries. In the Centro region, the main activities/economic priorities are the production of motor vehicles, food, electrical appliances, machinery, chemicals, and paper. It is also the most industrialised region in Portugal. The Azores Autonomous region, due to its specific peripheral and insular position particularly emphasizes the importance of the Blue Economy and it aims to position itself as an intercontinental platform of knowledge regarding the oceans, increase the value of its fisheries products and forge collaborative relations and innovative activities related to the sea.

The Norte region of Portugal is actively focusing on innovation and sustainability in the Blue Economy. The key areas of development include marine biotechnology, sustainable fisheries, and coastal tourism. The region aims to leverage its strong maritime heritage and existing research institutions to foster growth in these sectors. Investments in research and development, particularly in marine sciences, are prioritized to enhance the region's competitive edge and sustainable economic growth. The Norte region is committed to promoting eco-friendly practices and ensuring that its Blue Economy strategies align with broader environmental and economic objectives.

### **3. Centro region:**

In comparison with the previously analysed RIS3s, the RIS3 of the Centro region is a rather brief one, containing a total of just 38 textual pages (additions included). The strategy's structure is organised principally around the 6 main differentiating domains. None of them deals separately with the Blue Economy, however, certain elements relatable to it can be found in these domains. In particular, the 1st differentiating domain (Natural Resources and Bioeconomy) includes **Water**, along with *Forests* and *Agri-food*.

The defined goal of the subdomain Water is to contribute to the development of new products, processes and services that promote social, environmental and economic valorization of water and its resources **(the sea and marine resources being especially relevant)**, through the application of bioeconomy and circular economy. The aim is also to innovate in water management models through knowledge sharing, monitoring, modelling, protection and the search for more efficient ways of using and reusing water with the objective of a) increasing its resilience in relation to extreme meteorological phenomena resulting from climate change, b) guaranteeing the sustainability of its ecosystems and c) positively impacting water quality and quantity.

Relevant *areas of intervention* in this regard are Sustainable and Intelligent Use of Water and connected systems, Managing of Hydrographic Basins, Thermal Waters, **Sustainable Fisheries and Aquaculture, Maritime and Oceanic Resources, Valorization of Subproducts and Blue Biotechnology.**

The 4th differentiating domain (*Energy and Climate*) is generally more focused on green (terrestrial) than blue (maritime) sustainable practices, but its areas of intervention could also be largely understood as **applicable to the Blue Economy** (Renewable Energies, Integration of Energy Systems, Smart Energy Management Networks, Energy Storage Systems, Smart and Sustainable Mobility and Logistics, Carbon Catching and Storage, Waste Management and Valorization).

Finally, the 5th differentiating domain (*Culture, Creativity and Tourism*) focuses among other *areas of intervention* on **developing and promoting sustainable and creative approaches to tourism (including coastal)**, gradually abandoning its established tendency of seasonality in the summer period.

Similar to all the other Portuguese regional RIS3 Strategies, **no specific reference is made to the two value chains.**

There is no clear trend which would indicate the inclusion/greater presence of distinct Blue Economy sectors in these strategies, although sometimes the existing sectors are renamed or unified. Moreover, at the national level, the current RIS3 strategy has excluded the sector of Culture, Tourism, Sport and Leisure, which was one of the priority areas in RIS3 for 2014-2020.

In the Centro region, the Blue Economy strategy is centered around enhancing the sustainable use of marine resources and promoting blue biotechnology. The region focuses on integrating advanced technologies in marine research and fostering partnerships between academia, industry, and government entities. The strategic goals include improving the efficiency and sustainability of aquaculture, developing marine renewable energy sources, and promoting maritime tourism. The Centro region also emphasizes the importance of education and training to build a skilled workforce capable of supporting these initiatives.

## SPAIN

### A) NATIONAL LEVEL:

Although this section will focus specifically on the Blue Economy elements within the Andalusian regional smart specialization strategies, at the beginning it is worth to briefly note that the Spanish national RIS3 Strategy for the period 2021-2027 pays attention to the themes relatable to it – namely to **Climate, Energy and Mobility** (e.g. mobility at sea) as well as to **Nutrition** (e.g. based on maritime species), **Bioeconomy, Natural Resources and Environment**. These areas represent the 5th and 6th thematic pillar of the document. Within these two thematic pillars, focus is on **Climate Change**

and Decarbonization, Sustainable Mobility, Sustainable Cities and Ecosystems, Exploration, Analysis and Perspective of Biodiversity as well as on Sustainable and Intelligent Agrifood Chain.

## **B) REGIONAL LEVEL – ANDALUSIA REGION:**

The project partner from Andalusia noted that it used 2 regional smart specialization strategies – RIS3 for 2016-2020 and S4 for 2021-2027. But as it turned out, there exists no regional RIS3 2016-2016. Instead, there exists the RIS3 for 2014-2020.

### **RIS3 2014-2020**

The themes of the Blue Economy were present in the Andalusian RIS3 strategy already in the period 2014-2020. The document identified 6 specific priority areas, among which two areas were relatable to the Blue Economy. Each of these two areas also had specific lines of action

The introductory data of the RIS3 2014-2020 shows that Andalusia has all the necessary preconditions for the development of the Blue Economy – **the region features 945 km of coastline with large coastal and marine ecosystems on both Mediterranean and Atlantic Ocean sides, a very valuable natural capital as well as great wealth in its seabed.** Based on such preconditions, the Blue Economy is extensively developed. More specifically, **it generates more than 300 000 jobs** (10% of the total employment), **contributing with 17,000 M€ to regional economy** (10,5% of regional GDP). The region has **13 ports which employ over 86 000 people and the total amount of freight cargo generated in these ports in 2018. stood at 162 million tons** or 28,75% of total national amount of freight cargo. **Leading European-level facilities for shipbuilding and marine equipment manufacturing** are also available. **Particular attention is paid to the sector of Fishing and Aquaculture** - in 2018 it provided **20.790 jobs, as well as to Tourism**, since **17.8 million tourists** (57,5% of all tourist visits at the national level) **visited the region in the same period, engaging in various activities of the Blue Tourism.** Additionally, it is noted that great job creation possibilities exist in the sphere of **Blue Biotechnology, thanks to the presence of specialized universities, numerous research groups and over 6.000 relevant enterprises.** Finally, an ambitious goal of **producing 12 000 MW of electricity** (21% of total national production) **from Marine energy is set by 2030.**

Overall, the Andalusian RIS3 2014-2020 identified 6 specific priority areas (PA). Among these, special importance to us hold the **PA3 (Sustainable use of territorial-based endogenous resources)** and the **PA6 (Research and Innovation in Agroindustry and Healthy Food).**

Comparative and competitive advantages regarding the PA3 are the high number of protected spaces and areas in the region, as well as availability of coastal and marine ecosystems with substance resources (reserves for various innovations in the sphere of health, tourism, food, and energy). Based on this, **3 concrete lines of action (LA) are identified – R&I on the management of natural resources and cultural heritage (LA31), Innovation for the adaptation of territories to climate change (LA34) and Maintenance of sustained flow of ecosystem services (LA35).**

On the other hand, comparative and competitive advantages regarding the PA6 are the Andalusian maritime spaces as a source of new substances and varied foods as well as the existence of an agrifood transformation industry with a relevant weight in regional production and exports, which is able to increase the added value of productions through R, D&I, and ICT application in its processes. **In this regard, 2 concrete lines of action (LA) are identified – Taking advantage of new opportunities in the green and blue economy (LA63) and Innovation in processes and products of the food industries (L64).**

The strategy also mentions a number of remarkable projects related to Blue Economy, which were implemented in the region thanks to financing provided by EU development programmes:

- 1. VENUS** – using natural banks of bivalve mollusc in Cadiz Gulf for sustainable management and conservation of associated habitats (as part of Priority 3 – L31)
- 2. ALGARED+** - establishing a cross-border network for the Development of Innovative Products with Microalgae (-II-)
- 3. SABANA** – establishing a Sustainable Algae Biorefinery for Agriculture and Aquaculture (as part of Priority 6 – L34)
- 4. AQUA&AMBI** – providing support for the management of wetlands on the southwest Iberian coast (as part of Priority 6 – L63)
- 5. CASEAWA** – producing advanced materials using Biogenic Calcium Carbonate from Seashell Wastes (as part of Priority 6 – L64)

#### **S4Andalucia 2021-2027**

The first version of the **Smart Specialization Strategy for Sustainability of Andalusia (S4)** was published in April 2022. Among other goals, the document positions itself as a **driver for the Andalusian Sustainable Blue Growth**. This in particular is possible thanks to Andalusia being a **region with strategic sectors closely linked to the Blue Economy: shipbuilding and offshore activities, ports, logistics and transport, tourism linked to the sea, marine bioproducts, marine renewable energies and fisheries, aquaculture and transforming industry**. Consequently, the aim of the strategy is also to **act as a leverage for drive change across enterprises, research community and other stakeholders involved in Andalusian Blue Growth, encouraging their connectivity, and forming of innovative blue economy alliances. Relevant technological infrastructures and knowledge agents are widely present in the region** and represented by the entities such as AGAPA, IFAPA, CEI-MAR, TECNOBAHIA, LIFEWATCH, **CTAQUA (our project partner)**, **specialized research establishments affiliated with universities (CACYTMAR, ICMAN)**, as well as Spanish Oceanographic Institute (IEO), Marine Hydrographical Institute, Maritime Naval Cluster and Maritime-Marine Cluster. **The availability of such a vast network of institutions also enables the participation of Andalusia region in Marine Renewable Energy (MRE) RIS3 Thematic Partnership.**

The structure of the regional S4 revolves around **5 distinct environments of specialisation – ES** (ES1 – Smart, Resilient and Healthy Society, ES2 – Agrotechnology, ES3 – Natural Resources: Mining and Water Cycle, ES4 – Driving Industries and ES5 - Ecological Transition). Each of these environments of specialisation includes **specific thematic areas (sub-environments for specialisation) on a lower level.**

Of interest to us within the **ES1** is the thematic area of **Tourism and Culture** – it aims at positioning Andalusia at the forefront of **sustainable tourism and cultural innovation**, incorporating R&D&I of traditional and new products and innovative services **linked to blue and sustainable tourism.**

Within the **ES2**, attention should be paid to the thematic area of **Green and Blue Economics.** The area prioritizes the following activities:

- based on the **use of marine resources, especially in fisheries and aquaculture**, aiming to increase the awareness of producers and consumers about the importance of these productions as ecosystem services, as well as new foods such as protein sources and activities to develop the business fabric linked to the food bioeconomy.
- focusing on the **incorporation of the R&I developed on bioeconomy in the fishing systems**, circular and carbon neutral economy
- promoting the development of the **business fabric linked to the bio sectors and supporting the development of new products and services related with blue, circular economy and life sciences (biochemistry, biotechnology, bio health)** through public-private collaboration
- **fostering relationships between the different agents and clusters of the ecosystem** in biochemistry, biotechnology, and health to achieve a greater impact regarding the transfer of research results
- creating and improving **spaces of excellence in life sciences and biotechnology** for these sectors and managers, as well as **training** activities for all agents
- generating a **brand image** with a national and international impact, for the **consolidation and attraction of talent and companies** to strengthen this regional innovation ecosystem.

In the **E3**, relevant is the **Water Cycle** thematic area – the defined goal is the **generation of unconventional water resources through sustainable technologies**, such as **desalination.**

As part of **E4**, the thematic area of **Advanced Industry of Transport and Mobility Systems** should be in the focus of attention. The aim is to achieve **specialization in the naval transport value chain**, as well as in its auxiliary and marine equipment industries. Additionally, efforts are to be put into **strengthening companies' positions in new areas**, such as those linked to the offshore **naval sector.**

Finally, as part of **E5**, special relevance holds the Energy Transition thematic area. By implementing its goals, the aim is to achieve generation, storage, and distribution of

unique renewable energies, including the most innovative - marine, thus contributing to achieving the EU Green Deal objectives.

Beyond these specific sub-environments for specialisation, it is important to note that the **Institutional engagement with Blue Growth** is identified as a **strategic vector for the regional economic transformation**.

As regards the presence of the themes of the two value chains (*a) Sustainable Fisheries, Aquaculture and Valorization of Blue Resources and b) Renewable Marine Energy and Maritime Decarbonisation*) **they were addressed by both documents analysed above, although in a different form.**

The trend of increase in presence of relevant Blue Economy sectors within the new strategy can clearly be observed, despite the formally smaller number of sectors in the RIS3 2021-2027. This trend in particular goes towards focusing and specialising on new, highly technological sectors (such as Blue biotechnology or desalination, incorporation of innovative solutions based on bioeconomy in fishing systems etc.)

On a national level, the RIS3 strategy for 2021-2027, the areas of Climate, Energy and Mobility as well as Bioeconomy, Natural Resources and Environment are relatable to the Blue Economy.

Compared with the other analysed countries/regions, Andalusia has a comprehensively developed Blue Economy. In particular, it is the only participant which provided a separate overview of the presence of this sphere in the framework of their RIS3. In this regard, the only partner country (region) which has a more comprehensive elaboration of the Blue Economy is France (Bretagne and Pays de la Loire)

The regional RIS3 is integrated with the wider national strategic document, the Strategy of sustainable development 2030. The main economic activity in the region is traditionally agriculture, but in recent years the tertiary sector has been strengthening. There is no separate vision for the development of the region beyond the RIS3. Particular focus is on ensuring harmonious, equal development of all spheres of regional economy, which, in turn, should facilitate the creation of a thriving and resilient ecosystem of entities representing various economic sectors.

The correlation between the presence of the Blue Economy in the regional RIS3 and the overall development direction is quite visible. The region has a long coastline on both the Mediterranean and Atlantic Ocean sides. Also, an ample network of scientific and research institutions is available. This excellent combination of geographical preconditions and the qualified R&D personnel should ensure the sound development of the Blue Economy and its corresponding sectors. The authors of RIS3 are well aware of it, which also explains their decision to outline the Blue Economy components of the strategy in a separate document.

In 2022 the Ministry of Sustainability, Environment, and Blue Economy, assigns the General Secretariat for Sustainability, Environment, and Blue Economy the

competencies to promote and transition towards a sustainable blue economy in Andalusia, specifically the development of an Andalusian Blue Economy Strategy.

The Strategy aims to boost the economic sectors linked to the seas and the coast of Andalusia as drivers of socio-economic dynamism within the autonomous community, in the context of an innovative economy that respects the carrying capacity of natural ecosystems and environmental sustainability.

The general objectives of the Strategy are as follows:

1. Develop the blue economy in accordance with the European blue growth strategy.
2. Promote the protection and conservation of marine biodiversity and the improvement of its habitats.
3. Support climate change adaptation and coastal resilience by promoting renewable marine energies and the transition to a circular economy in seas and coasts.
4. Drive research, development, and innovation in blue knowledge.
5. Promote innovation for business development, the creation of innovative industrial communities, and new entrepreneurial initiatives.
6. Foster marine culture in Andalusia by promoting sustainable tourism in coastal and marine environments, as well as improving the visibility of port, fishing, and aquaculture activities as economic drivers of the region.

Clearly the vision for the Blue Economy development in Andalusia over the next decade is to position the region as a leader in sustainable marine and maritime activities. This ambition is driven by a comprehensive strategy focusing on innovation, sustainability, and collaboration across various sectors.

## FRANCE

**Based on many resources analysed during this task France is one of the leaders of the Blue Economy development in the EU.** Documents analysed cover the regions of Brittany and Pays de la Loire, the territories served by the project partner. Taking into account France's leading position in the development of the Blue Economy, practically all the Blue economy subsectors analysed, as well as the 2 specific value chains (*Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources and Renewable Marine Energy and Maritime Decarbonization*) were present in their strategies for both relevant periods (2014-2020, 2021-2027) Therefore, one can say that the trend is stability in this representation.

### **A) NATIONAL LEVEL**

At the national level, France enacted the **Strategic document for the North Atlantic-Western Channel seaboard**. This publication addresses concrete maritime-related

activities across a wide array of Blue Economy sectors, marine ecosystem conservation, tourist valorisation of sites, landscapes and cultural heritage, wide-ranging risks in the area of the seaboard, investments into knowledge, research, innovation and training, local initiatives regarding maritime planning, integrated handling of sea and littoral areas and other issues

**Marine Renewable Energy** – increasing its visibility for the maritime sector stakeholders, including all of them without exception in its development, creating conditions for smooth cohabitation with pre-existing activities (in particular with professional fisheries) and ensuring the acquisition and diffusion of scientific knowledge on the technologies necessary.

**Ports Sector** – ensuring evolution of the economic model of ports exploitation, achieve ecological and energy transition of all the ports in the seaboard, inter-portuary cooperation, maintaining the nautical access

**Naval and Nautical Industry** – the goals are to transform the sectors into an innovative one and ensure its competitiveness, creating a network of local competences, ensuring a coordinated approach to investments and implementing digital transition.

**Water sports, Leisure, Nautical Sports and Tourism** – ensuring the renovation of human capital, further valorisation of this sector, regular upgrading of ports and anchorages to suit new demands and providing access to the water sports practices for the general public and new users on a wider scale.

**Maritime Leisure Fishing** (from boats and from the coast) – ensuring an equal, just access to the sea and its resources, guaranteeing the access to information, but also working on the responsible attitude of the leisure fishermen towards marine resources, sensibilisation of the general public towards coastal environment and the need of its protection.

**Maritime Professional Fisheries** (from boats and from the coast) – working towards renovation of the fishing fleet as well as renovation of the workforce (boosting the attractiveness of the employment in the fisheries sector due to difficulties in employing process, investing into professional training), modernisation of downstream sector, improving general economic performance, ensuring the adaptation of the sector to the climate change

**Aquaculture** – ensuring the sector's durability in face of sanitary and epidemiological dangers, diversification of the aquaculture production, ensuring the maintenance of access to production and experimentation zones in face of pollution dangers and conflicts regarding the right to usage of such areas, working to ensure sustainability of exploitation (aquaculture farms)

**Extraction of marine aggregates** – defining the needed scope of extraction of such aggregates, an acceptable production capacity, ensuring financial and juridic stability of extracting establishments.

**Maritime Defence** – maintaining of separate maritime zones sufficient for the smooth operation of the armed forces, in particular - the national navy, development of naval defence industry, maintaining of employment levels in the maritime defence sector.

With regard to **marine ecosystems preservation**, special attention is paid to hydrographic conditions, pelagic habitats and food webs that group together particular hydrological structures; land-sea interface zones and river plumes; primary, secondary, producers, and forage species, biogenic habitats, deep habitats, rocky habitats, sedimentary habitats, structures, particular geomorphological zones which are restricted for benthic marine, fish and bird species, highly mobile species, water quality, availability of fresh water, the acquisition and sharing of a common base of knowledge regarding marine species and maritime environment in general.

In regard to **tourist valorisation of sites, landscapes and cultural heritage**, the focus is on the landscape quality and heritage capital of marine, underwater and coastal spaces, iconic sites and landscapes, raising awareness of maritime issues and coastlines, built heritage, floating heritage and nautical cultural events.

The **risk-management actions** proposed in the document are shared knowledge of hazards and their uncertainties, the culture of risk in a context of climate change, control and management of urbanization, security of populations and property in areas subject to coastal risks (e.g. low and eroding areas) and more occasionally technological risks, maritime safety and security, the health quality of bathing water, the security of seafood products consumed, health risk management.

In the **R&D area**, the emphasis is on *maritimisation* of the education process, training and qualification processes adopted to the necessities of the sea-related professions, knowledge acquisition and the research in the maritime domain, diffusion of knowledge, maintenance of maritime innovation capacity.

All the above-mentioned spheres are brought together by 9 integrated areas, namely

1. *good ecological condition of the marine space,*
2. *quality of territorial waters,*
3. *successful maritime economy, guarantor of sustainable use of marine resources, spaces and good ecological state, safe for populations and structuring for the territories*
4. *safety of property and people and economic activities located in low areas and/or areas subject to erosion of the coastline (marine cultures, tourism, coastal agriculture, industrial-portuary activities)*
5. *Défense and security activities*
6. *The carrying capacity of the coastline, insular and maritime spaces and their accessibility favouring the diversity of populations and their activities*

7. Knowledge

8. Research and innovation

9. Civil society's awareness about the importance of the maritime spaces

Overall, the document specifies 4 key strategic objectives – 1. reclaiming of good ecological state of marine space and preservation of attractiveness of littoral areas, 2. development of durable Blue Economy, 3. ecological transition for the sea and littoral areas and 4. general increase in France's influence. In particular 10 points of actions are defined regarding the objective n. 2, which is particularly important for us:

**1. Support and promote research and innovation in all areas of the maritime economy**

**2. Develop a pool of qualified labour and competent in the service of the blue economy**

**3. Promote and support the development of the maritime circular economy**

**4. Develop renewable marine energies**

**5. Accelerate the energy and ecological transition of the ports**

**6. Support and promote the sustainable naval and nautical industries**

**7. Encourage sustainable boating and tourism accessible to all**

**8. Encourage resilient and sustainable fisheries and aquaculture**

**9. Stabilize the supply of marine aggregates**

**10. Accelerate the development of marine biotechnologies.**

The process of renewing this action plan is currently underway following the publication in June 2024 of the National Strategy for the Sea and Coast covering the period 2024-2030. Four major priorities were identified at the national level:

- Carbon neutrality: To help achieve carbon neutrality by 2050, the accelerated deployment of offshore wind power, with a target of 45 GW installed by 2050, is combined with the decarbonization of ports and ship fleets, and the preservation of blue carbon ecosystems.
- Biodiversity: Drawing on knowledge and innovation, the strategy promotes the preservation of maritime and coastal ecosystems in mainland France and the French overseas territories, in particular through the deployment of high-protection zones.
- Equity: Action must contribute to the short- and long-term well-being of the populations, employees and players in the maritime and coastal areas of France and its overseas territories, in particular by rethinking the model for attracting tourists and the economy to the coasts.

- Economy: Innovation and training are mobilized to strengthen the competitiveness of our sustainable blue maritime and coastal economy and the sovereignty of France in mainland France and the French overseas territories: maritime transport, port network, sustainable fishing and aquaculture.

France's vision for the Blue Economy over the next decade focuses on several key objectives, with a strong emphasis on innovation, sustainability, and international leadership. The "France 2030" investment plan is central to this vision, aiming to transform various sectors through significant financial support and strategic initiatives.

France aims to become a leader in green hydrogen and renewable energies, with investments in developing gigafactories for electrolyzers and other associated technologies. This includes initiatives to decarbonize industries and promote sustainable practices in maritime and coastal activities.

Investments in advanced technologies are crucial. The plan includes developing innovative small-scale nuclear reactors and promoting research in marine and maritime technologies. This focus on high-tech solutions is intended to drive efficiency and sustainability in the Blue Economy.

France aims to produce nearly two million electric and hybrid vehicles and develop the first low-carbon aircraft by 2030. This aligns with broader goals of reducing emissions and advancing clean transportation technologies, including those relevant to maritime sectors.

Investment in the exploration and sustainable exploitation of deep-sea resources is a priority. This includes initiatives to ensure the protection and sustainable use of marine biodiversity, which is critical for the long-term health of marine ecosystems.

France's vision for the Blue Economy, supported by the "France 2030" plan, is ambitious and multifaceted, focusing on innovation, sustainability, and global leadership. Regions like Bretagne and Pays de la Loire play a crucial role in this vision by implementing region-specific strategies that complement national goals. These efforts are geared towards creating a resilient and sustainable Blue Economy that can serve as a model for other nations.

## **B) REGIONAL LEVEL**

### **BRETAGNE (BRITTANY) REGION**

The analysis here is based on relevant data from the regional RIS3 for 2016-2020 and 2021-2027 and the text of the latter. The importance that the region attaches to comprehensive development of the Blue Economy is clearly visible from the fact the area of *Maritime Economy for Blue Growth* is listed as the first among Breton Strategic Innovation Areas (SIAs) within the document.

On a general note, this region is a European and national hub for the development of the Blue Economy, with vast, highly developed relevant infrastructure. Brittany has

great ambitions for sea and coastline alike, and the sea offers a real opportunity for economic, social and environmental development for society. The region has always been built with and by the sea. Its relationship with the sea is mainly based on:

Rich marine biodiversity and productive marine and coastal ecosystems

A long coastline offering numerous accesses to the sea, renowned landscapes and navigational basins

A very rich maritime heritage, both tangible and intangible

A prime position where the Atlantic and the English Channel meet

High-level skills and know-how in most maritime sectors

A dense network of R&D players in varied, complementary fields.

Brittany has an exceptional potential for marine resources, on which a major world-class marine science and technology research and development strike force has developed with public and private players in research, development and innovation. Breton players address all uses of the sea and know how to collaborate between academic excellence, the creation of numerous start-ups, an industrial fabric and design offices covering the entire value chain, and a highly mobilised network of associations. By relying on these exceptional skills, the region can leverage its potential in the following areas:

- Biological, fisheries and biotechnology: Brittany is one of the leading regions in the field of fishing, shellfish farming, marine biotechnologies and a pioneer in the cultivation of seaweed, but players still need to improve their synergies and join forces to increase the attractiveness and influence of Brittany's skills, as well as the Breton contribution to European policies for the management of marine resources.
- Energy: offshore wind power (both installed and floating), tidal turbine, tidal engine with a historic lead, wave power with the greatest metropolitan potential. Under these conditions, making a successful energy transition for and thanks to the world of the sea implies taking an interest in all the development and operation phases so that the deployment of marine renewable energies (MREs) is not "imported" from outside but rather implemented in relevant collaboration with predominantly European players.

However, Breton ports are facing many environmental and digital transitions, some of which are already well underway. On an economic level, the fundamentals of commercial port models were already shaken, as traffic volumes have been declining in recent years. The COVID-19 crisis has made the passenger transport sector more fragile than imaginable and has also called into question globalised supply chains. In the face of these changes, many avenues for diversification and renewal of traffic and activities exist. In this context, ports, their infrastructures and associated economic activities must evolve. Ships too must evolve towards the "vessels of the future" and

increase the capacity and industrial competitiveness of players in shipbuilding, the nautical industry and, more broadly, the maritime engineering sector, with a view to designing, producing, maintaining and repairing ships that are more efficient, safer and more respectful of the marine environment. To achieve this goal, there is a need to encourage research, innovation, development and technology transfer in the fields of digital technology, on-board intelligence, mechanics and energy. The importance attached in the region to the portuary sector is also evidenced by the fact that the project partner provided a separate document – *Brittany Ports Strategy 2023-2033*, which accordingly outlines the relevant challenges and its prospects of development

With regard to the *SIA Maritime Economy for Blue Growth*, it has 3 *strategic objectives*, with the corresponding thematic levers (indicated in the brackets):

*Strategic objective 1: Strengthening regional excellence in energy transition for and through the world of the sea (Marine Renewable Energies, Vessels of the future, Ports, Logistics and Maritime Transport)*

*Strategic objective 2: Increasing innovation capacity in maritime safety of the seas and oceans and coastal management (Maritime safety, Ports, Logistics and Maritime Transport, Environment, Ocean Health and Coastline Management)*

*Strategic objective 3 Developing marine biotechnologies and bioresources (Marine bioresources and biotechnologies, Environment, Ocean Health and Coastline Management)*

The key objectives and challenges of the thematic levers are as follows:

**Marine Renewable Energies** – it is indicated that this **lever is organised as a value chain - from design to marketing**, but specific elements of it are not further elaborated. The planned actions are:

- Setting up a rapidly competitive offshore floating wind energy sector with a maximum of local spinoffs in Brittany, by targeting key components with high added value and continuing to support wind turbines installed on facades
- Continuing cost reduction demonstrations and demonstrating the relevance of tidal turbines for island communities and local power generation
- Anticipating the deployment of wave energy recovery solutions
- Developing tools for predicting, smoothing, transporting and storing the energy produced at sea in relation to the particularities of Brittany (high load factors, energy peninsula) and facilitating cross-fertilisation between sectors on subjects such as hydrogen or the naval industry
- Evaluating and monitoring energy resources and MRE systems, optimising production and maintenance, conducting high added value operations
- Developing joint activities and specifically using MREs: aquaculture, algoculture, shellfish farming, fishing, biodiversity monitoring, tourism, etc
- Facilitating procedures for the examination of commercial and industrial files in compliance with administrative, legal and environmental protection rules

- Training engineers, technicians, environmentalists, project managers and administrators
- Ensuring that the Groix-Belle-Ile floating wind turbine pilot farm allows a maximum number of Breton players to take advantage of the entire value chain and that the South Brittany AO is one of the very first commercial floating wind turbine farms in the world, thanks to the responsiveness of its R&D studies
- Guaranteeing the success of ongoing demonstrator projects in order to maximise feedback and trigger complementary R&D, and supporting the structuring of test sites and the deployment of demonstrators on pilot and test sites
- Conducting several demonstrations on wave-engine sites already identified (Audierne, Esquibien, etc.) for a variety of solutions (onshore, nearshore, offshore)
- Backing developers of moderate-power devices (tidal turbines, etc.) for isolated consumers
- Mastering the techniques of in situ measurement and observation, at the level of environmental parameters as well as the monitoring of machines in service
- Establishing an economic observatory for continuous analysis of cost trends (development, installation, operation, maintenance, dismantling, etc.).

**Marine Bioresources and Biotechnologies** – the goals are the following:

- Making the Breton sector competitive in the European and global context
- Structuring, strengthening and promoting sustainable macro- and micro-algae, fisheries and aquaculture and maritime waste treatment sectors
- Pursuing ecosystem-based management of coastal and deep-sea fisheries as well as fishing on foot, in the context of climate change.
- Developing and strengthening infrastructures and pilot platforms for the control of life cycles and the domestication of marine species
- Developing innovative systems that limit environmental impacts and allow species selectivity
- Supporting demonstrator-type projects and RDI programmes for the knowledge and development of marine bioresources
- Funding R&D projects for the development of innovative technologies for integrated multi-trophic aquaculture towards zero waste and alternative nutrient sources (insects, microalgae, algae)
- Accompanying the digitalisation of seafood distribution
- Producing a report (position paper) on Brittany' strategy and strengths in the field of marine bioresources and marine biotechnologies (health, nutrition-health, cosmetics, agri-agro, etc.), and ensuring its dissemination and promotion at European level
- Supporting industrial-university chairs and joint laboratories, and ensuring the widest and most educational dissemination of results for professional actors and decision-makers.

**Vessels of the future** – the specific objectives are as follows:

- Energy efficiency; Eco-design; Ship safety and security; Conduct and operation of vessels; Competitiveness of the manufacturing base and needs of the sectors.
- Strengthening long-term relations between research and industry (especially shipyards) is essential to enhance the value of upstream work on all the above themes, thus reinforcing the competitiveness of the manufacturing base. In the nautical industry, and in particular for competitive sailing, manufacturing processes using multi-material assemblies and gluing pose a real challenge. The fishing industry wishes to improve fishing techniques that are more efficient, more selective and respectful of resources. The defence sector has specific needs in terms of platform survivability, acoustic sensors and robotics.
- Increasing ships' energy efficiency (reducing consumption of on-board systems and propulsive power requirements)
- Developing complementary energy production systems based on renewable resources
- Developing on-board control systems and their automation for greater autonomy
- Reducing environmental impacts through the use of new materials, manufacturing processes, ship architecture, optimising recycling throughout the life cycle (manufacturing, in service, maintenance and decommissioning)
- Enhancing the performance of marine infrastructures (acoustic and electromagnetic radiation pollution, resistance and durability of structures, robotics)
- Developing sensors and systems for the detection of dangerous events (collisions, storms), diagnosis of premature wear and damage and predictive maintenance systems.
- Reducing energy requirements: consumption of on-board systems, propulsive power requirements by optimising hull and propeller shapes, treating coatings, lightening structures, improving innovative or alternative propulsive concepts (sails), based on renewable resources and more efficient electrical energy management systems.
- Reducing environmental impacts: materials, processes, ship architecture optimising recycling and material and energy consumption throughout the life cycle. Materials, paints and coatings must limit their discharges of effluents, pollutants and biocides. Finally, shipboard systems must include technologies to limit acoustic nuisance and electromagnetic radiation.
- Increased safety: faced with harsh sea conditions, the resistance and durability of ships, which are essential safety components, are based on improved methods of mechanical dimensioning to fatigue, marine ageing and extreme loading. The development of sensors and systems for the detection of dangerous events (collisions and storms) and diagnosis of premature wear and tear and damage also contribute thereto, as do operational safety and predictive maintenance of on-board systems. It will be necessary to set up an R&D programme on health safety on board ships (crew and passenger protection) in order to develop solutions for dealing with pandemics.

- Autonomy and automation of on-board control systems: telecommunications capabilities and information processing, decision support functionalities and in particular route optimisation, limitation of ship damage.

**Ports, Logistics and Maritime Transport** – the priorities are:

- Developing logistics' attractiveness by maintaining the fluidity of flows, monitoring performance to optimise the management of the passage of goods, and improving the performance of port equipment and predictive logistics
- Monitoring and improving the environmental performance of ports through the production of data to understand and act on air quality, noise, water quality, water and electricity consumption, etc. The Brittany Region thus intends to anticipate and adapt to the digital and energy transitions and to the new uses expected by industrialists, shipping companies, users and passengers by relying in particular on real time information, traceability, the fluidity of flows in the port area and its connectivity to all international and European ports. It pays particular attention to the development of an optimum quality of service for port users and customers in order to help its regional port network evolve towards a "smart port" of the future, a data port at the service of logistics and environmental performance.
- Deploying technological and usage innovations in the port of the future using a "smart port" approach
- Increasing the fluidity of the port passage and the experience of maritime transport users and reducing the environmental impact of ports and maritime; introducing equipment to produce new data enhancing the fluidity of the port passage or facilitating the piloting of environmental performance such as sensors (e.g. aid and water quality probes, monitoring of water and energy consumption in real time...), new networks (5G network), dematerialisation of embarkation/disembarkation procedures, etc
- Producing interoperable data through the evolution of information systems for the management of ports of call/ships/goods; optimising port infrastructures for the supply and bunkering of hydrogen
- Assisting innovative SMEs that develop port solutions.
- Including Brittany in a "smart ports" approach to innovation and reducing the environmental impact of port and maritime transport activities (reduction of water and electricity consumption, improvement of air and water quality, quayside and/or on-board storage and supply of hydrogen etc.)
- Setting up innovative companies in or near the ports
- Improving the cost and port transit time of goods, particularly for containers in Brest and ferry freight from the United Kingdom; improving the customer experience for ferry passengers in Brest and Roscoff (in the post-Brexit and post-COVID-19 context).

**Maritime Safety** – the defined priorities are:

- Deploying systems and services that provide services on the coast and at sea

- The defence of the interests and sovereign rights of States and the maritime defence of territories
- The fight against illegal and malicious acts and the fight against environmental risks
- Compliance with regulations and fisheries control
- Safety of people and property.
- Being a leader in the development of maritime security solutions and systems in the fields of maritime cybersecurity
- Developing the use of robotics for maritime safety purposes
- Using AI and Big Data to monitor the ocean and associated activities
- Develop training to meet the skills and expertise needs of the State and companies, particularly in maritime cybersecurity
- Development of complex systems and algorithms for the use of multiple data sources. They should be capable of facilitating the digitalisation of maritime activities and optimising maritime control and surveillance operations above and below the water. By way of example, these advances must be able to guarantee e-navigation and autonomous vessels. It is also a question of developing all components of maritime cybersecurity (research, training, industry) for greater collaboration between players and greater visibility of the players and therefore of the territory at European and international level.

**Environment, Ocean Health and Coastal Management** – the objectives are:

- Reinforcing operational infrastructures for research into and observation of marine and coastal socio-ecosystems
- Providing decision-making tools for the implementation of public policies for research, observation, risk and crisis prevention and remediation, management of coastal areas and coastlines
- Establishing a regional coastline observatory
- Developing new services for risk monitoring, analysis and prevention, based on new technologies (remote sensing, data mining, artificial intelligence, virtual reality, genomic and metagenomic analyses, isotope analyses, etc.)
- Developing regional collaboration between observation stakeholders at all scales of time and space, based on synergies between different technologies (satellites, multi-sensors, data transfer and management)
- Encouraging the development of participatory science to improve knowledge of these areas and societal appropriation of the Sustainable Development Goals – SDGs
- Successfully training and integrating a new generation of researchers and engineers around these issues thanks to the synergies between the territorial actors.
- Better monitoring of the oceans, physio-chemical properties and ecosystems, thanks to the synergy of new in situ and satellite observation systems and the development of new vectors and sensors (UAVs, etc.), greater consideration of the role of the oceans in climate change, and control of the evolution of exploited marine resources (fisheries);

- Tools for forecasting and assessing risks in the marine and coastal environment (scenarios or risk mapping for extreme sea states, erosion, landslides, tsunamis, etc. and risks related to pollution and entropic pressures)
- Development of new services for risk monitoring, analysis and prevention, based on new technologies
- Better knowledge of the availability and quality of marine resources (biological and non-biological) in relation to their environment and global changes.

Finally, the **regional strategy of economic and social transition of Brittany for 2023.-2027. (SRTEs 2023.-2027.)** sets the goal of **strengthening the maritime dimension of Brittany** and includes it among its priority axes. The aims are:

- To make Brittany a major maritime region in Europe and in the world by restoring what has enabled its influence in the past.
- The transformation of a historical, cultural, geographical and physical reality into economic evidence. To make the sea an asset for creating wealth, activities, image and influence for Brittany. It is a major differentiating criterion.
- The invention and deployment of a development strategy fully integrating ecological challenges. The sea is par excellence the area in which the logic of sustainable development must be deployed, starting with the port sector and that of maritime transport. Otherwise, Brittany could let its maritime potential slip away. It is a question of making its maritime character a major axis of its strategy of influence and attractiveness, of consolidating Brittany's first place in marine sciences and technologies, of consolidating all its sectors of excellence, of supporting the necessary changes in the fishing sectors and fishing activities. Otherwise, Brittany would miss out on value creation relays essential to its future.
- The development of a new dynamic for promoting regional ports to make them an engine of value creation linked to logistics challenges, and the new RTE-T. Promoting the activity of these ports as they are a major player in maritime transport flying the French flag. Otherwise, Brittany would remain on the fringes of major flows of trade and prosperity.
- Articulating the strategy with the regional "sea and coastline" strategy
- Supporting the development and ecological changes of maritime sectors and sectors linked to sovereignty issues (fisheries resources and aquaculture, marine biotechnologies, marine renewable energies, green hydrogen, defense, maritime cyber security, etc.)
- Integrating more strongly the dimension of maritime ambitions and potential in the forward-looking management of skills, orientation and training policies
- Fully deploying the potential for higher education research and innovation linked to the sea (as part of RIS3). Strengthening Brittany as the leading region in Europe in marine research, as the base of European marine research
- Proposing and deploying a regional port and logistics project serving economic development (development of new freight lines, cabotage and low-carbon transport, particularly sailboats, etc.). By being part of a territory of strategic reflection integrating the Loire Atlantique and the port of Montoire.

Bretagne's regional strategy aligns with the national vision by emphasizing the development of sustainable maritime activities and promoting innovation in marine technologies. The region focuses on leveraging its strong maritime heritage and existing infrastructure to advance marine renewable energy projects, such as offshore wind farms and tidal energy initiatives. Bretagne also prioritizes marine biodiversity conservation and sustainable fisheries.

## **PAYS DE LA LOIRE**

Similarly to the situation in Brittany, the Blue Economy is extensively developed in Pays de la Loire region. This region aims to strengthen its position as a hub for maritime innovation and sustainable development. Key areas include the advancement of shipbuilding technologies, the development of green ports, and the promotion of circular economy principles in maritime industries. Pays de la Loire also supports initiatives to enhance maritime logistics and improve the sustainability of coastal tourism. Consequently, the regional Smart Specialization Strategy also has a number of areas connected to this type of economy. In particular, as part of the thematic area n. 2 - **Food and Bioresources**, focus is (among other elements) on ensuring comprehensive development of the sector of **Fisheries, Aquaculture and extraction/production of sea salt**.

Of particular interest is the thematic area n. 4 – **Blue Economy**, which is declared as central to the development of the region. Its key pillars are the following:

- Extensive development of Fisheries sector – as evidenced by the publication of the extensive Regional Plan for the Organisation and Equipping of Fishing Ports, covering the period of 2021-2027 (46 pages).
- Making the large seaport of Nantes Saint-Nazaire a locomotive for its hinterland
- Deploying the industry of the future within the **naval value chain** (although the specific components of such a chain are not defined)
- Ensuring the future of boating/Nautic sector
- Building a sustainable industrial sector for renewable marine energies
- Developing the microalgae sector
- The scientific **basis with regard to the Blue Economy is particularly ample in Pays de la Loire, enabling the implementation of several** large-scale innovative projects in the sphere of the Blue Economy:
  - The region will soon be home to two fixed-bottom wind farms: Fance's first offshore wind farm was inaugurated in 2023 off the coast of Saint-Nazaire on the Banc of Guérande, while another between the islands of Yeu and Noirmoutier is currently under construction and is planned to begin operations in 2025.
  - EMR Ocean ERA-NET Cofund Project
  - CLIPPER European Maritime Initiative (Pays de la Loire as a lead project partner)
  - The establishment of The Ecole Nationale Supérieure Maritime (ENSM) on the site of the Ecole Centrale de Nantes (ECN) – among other initiatives, educational institution is implementing the following priority projects in the field of maritime economy:

a) *NEMO 2 project* - extension of the testing resources of the Ecole Centrale de Nantes for the creation of an experimentation center for Naval Systems, Marine Energies and Ocean Engineering

b) *The MENFAT (Marine ENVironmental and FATigue Testing) project* - aimed at assessing sustainable mooring (steel and synthetic) and dynamic (multi-component) cables, used in the marine renewable energy industry. It is about knowing better and mastering the scale effects that can appear when moving from experimental tests to laboratory for force or full-scale tests

In addition, the thematic area n. 7 – **The Energies of Tomorrow** addresses among other sectors the sector of **offshore wind power** (related to the Blue Economy) and represented by the two offshore wind farms mentioned earlier.

Probably the best proof of the level of development of the Blue Economy in Pays de la Loire region is the regional Maritime Ambitions Strategy, published in 2018. This extensive document elaborates in detail the future priorities across a wide array of Blue Economy sectors.

Its key pillars and relevant priorities are the following:

*1. Raising awareness – radiating the valuation of regional maritime identity*

- Further sharing maritime culture, memory and knowledge of heritage
- Developing sea education for the regional youth
- Shining and federating by events and festive manifestations

*2. Developing – innovating – the challenges of Blue Growth*

- Making a Great Maritime Port an Economic Locomotive for its Hinterland
- The Naval Industry – a Flagship of Pays de la Loire
- Comforting the Dynamism of the Sectors of Fisheries and Aquaculture
- Continuing the Development of Coastal Tourism
- Assuming the Nautic Leadership of Pays de la Loire
- Building a Sustainable Industrial Sector of Renewable Marine Energies
- Marine Biotechnologies – Passing from the Laboratory to the Industrial Stage
- Research and Innovation, Digital Revolution and the Energy Transition at the Heart of the Maritime Economy
- Training for the sea professions to respond to skills needs
- Financial levers and politics at the service of maritime projects

*3. Protecting and saving – preservation and valorisation of the sea and the coast*

- A need for knowledge at the service of a shared strategic vision
- An innovative and adapted response to challenges of coastal attractiveness
- A regional plan for recovering water quality
- Protection of Natural Spaces
- Climate Change – Risk Prevention and Reasonable Management of the Coastline

The Region's maritime ambition is expressed in a multitude of concrete actions which cut across all of its areas of competence and its sectoral strategies. In the future, new opportunities may complete this vast panorama. Several key points emerge which constitute priorities:

- The desire to share the culture, awareness, maritime identity that can be revealed in each its inhabitant
- A proliferation of innovations benefiting all facets of the maritime economy and relying in particular on digital technology
- The need to promote and develop maritime professions by adapting the training offer, promoting their image, guidance, etc.
- A significant need for interdisciplinary and 3D knowledge of the marine environment and coastal spaces, so that the sea is no longer this great unknown and allows informed strategic planning in order to “share without cadastre, manage without enclosing, preserve without freezing, protect without hindering”
- A logic of sustainable development in the exploitation of resources, the energy transition, the preservation of natural environments, the restoration of water quality:  
**blue growth will only have a future if it is sustainable.**

To conclude, we will briefly look at the *Regional scheme of economic development, innovation and internationalisation*, which indicates 25 distinct priority areas of action. Among them, of particular interest to us are those under number 6 (*Continuing the voluntaristic policy of support to the sustainable development of the sectors of Fisheries, Aquaculture and Agriculture*), 9 (*Strengthening the strategic and supporting the emerging sectors of excellence – among them Naval Construction and Maritime Economy*), 10 (*Continuing the structuration of the emerging sectors of Blue Growth – Marine Renewable Energies and Microalgae*), 12 (*Strengthening the nautical leadership of Pays de la Loire*), 13 (*Developing the tourist capital of the regional territory by supporting the competitiveness of stakeholders and the emergence of new sectors – this could include traditional Coastal Tourism, but also new, more sustainable areas*) and 19 (*Making the Great Maritime Port of Nantes-Saint Nazaire a locomotive in service of sustainable economic development of the Greater West of France*).

As our analysis shows, **the Blue Economy is extensively and comprehensively developed in France in general and in Bretagne and Pays de la Loire in particular.** These two regions position themselves as **genuine Blue Economy leaders** at the European and wider world level, regularly undertaking **new initiatives and promoting top-quality innovations.** In this regard, they also serve as a **point of reference for all European territorial entities (regions) striving to develop the Blue Economy.** Consequently, it is **highly advisable to establish relevant cooperation links and knowledge-exchange mechanisms** with them.

## ITALY

**B) REGIONAL LEVEL**

The project partner from Emilia-Romagna region provided only the current RIS3 strategy covering the period of 2021-2027, therefore it is not possible to track the trend change over time (increase/decrease in the number of the Blue Economy sub sectors). We can, however, observe that the sectors of the Blue bioeconomy, Maritime manufacturing as well as Preservation of the Coastal strip and Tourism 2.0 were included in the document as areas relatable to the Blue Economy. With regard to the specific value chains, they are present, but are different from the ones defined by the project's methodology. In particular, under the sub-area of Blue Biotechnology, it is mentioned the fish supply chain. Similarly, value chains are also mentioned with regard to protection from anthropogenic pollution of the sea and in relation to marine manufacturing. More In-Depth Analysis could not be performed due to lack of elaboration of concrete elements of these value chains.

In comparison with other strategies analysed Emilia-Romagna's regional RIS3 strategy for 2021-2027 is a well-developed document but could include even more sectors of the Blue Economy and be more diversified. It describes **8 industrial specialisation systems** (1. Agrifood, 2. Construction and buildings, 3. Mechatronics and motoring, 4. Health and wellness industries, 5. Creative and cultural industries, 6. Tourism, 7. Energy and sustainable growth as well as 8. Innovation in the services). These specialisation systems are further elaborated through **15 cross-sector areas** (1. Clean, safe and accessible energy, 2. Circular economy, 3. Climate and natural resources, **4. Blue Growth**, 5. Innovation in materials, 6. Digitalisation and artificial intelligence, 7. Manufacturing 4.0, 8. Ground and space-based connectivity of systems, 9. Sustainable and innovative mobility, 10. Cities and communities of the future, 11. Territorial heritage and regional identity – Made in Emilia-Romagna, 12. Wellbeing of the person, diet and lifestyle, 13. Health, 14. Social innovation and participation as well as 15. Inclusion and social cohesion). In addition, the strategy has identified two areas with high potential of growth – *Aerospace Economy and Critical infrastructures*.

In accordance with the purpose of this analysis, primary focus is on the **area n. 4 – Blue Growth, although certain links with the** Blue Economy can also be found within the areas n. 1, 2, 3, 9, 12 and 13.

Clean sea and sustainable use of marine resources from a circular perspective are fundamental conditions for the development of regional production specializations linked to the sea, which have growth potential at an international level.

a) *Thematic framework of the cross-sectoral area:*

The *Blue Growth* area concerns **all areas of activity of the maritime economy with high innovative potential for the production specializations of the regional territory** and has the objective to **direct growth towards a more sustainable model of use of the sea and coasts**.

On the basis of these elements, **three major areas of innovation have been identified for regional production specialisations:**

### **1. Blue bioeconomy**

- marine biotic resources (sustainable and circular fishing and aquaculture, ecosystem services, biodiversity and combating the spread of alien species)
- blue biotechnologies (bioremediation, biopharmaceuticals, biomolecules, biomaterials)
- protection from anthropogenic pollution (administrative decree on saving the sea, elimination of marine litter, environmental intervention services, combatting emerging pollutants).

### **2. Maritime manufacturing**

- renewable energy from the sea (offshore wind, wave and tidal energy)
- sustainable shipbuilding and marine robotics (port and offshore vehicles, systems and infrastructures - extractive, energy, civil, fisheries -, marine robotics for monitoring and safety, surface and submarine vehicles, dual systems for safety)
- marine abiotic resources (technology for oil and gas conversion, mining) and conversion/different and multiple use of offshore platforms no longer operational.

### **3. Preservation of the Coastal strip and Tourism 2.0**

- marine environment and coastal zone (environmental and safety monitoring, sea and port safety, protection and defense of coasts, marine habitats, anthropic and non-anthropic areas, and ports)
- maritime and coastal tourism 2.0 (technologies for the regeneration and development of tourist systems, development of new participatory models for the quality of the offer)
- sustainability and economic uses of the sea (Big Data analysis, development of impact models on the economy and environment, construction of scenarios, new governance and business models).

*b) Relevance of the cross-sectoral area for Emilia-Romagna region:*

Emilia Romagna with its 135 km of coastline **ranks first as the region with the greatest number of environmental services provided by the sea in terms of biodiversity, landscape quality, natural water purification and maintenance of the health of the coasts.**

The region boasts three main specialized production areas of national importance which, although spread throughout the regional territory, find a significant concentration in three main coastal areas:

- **Ferrara area:** primary economic activity (aquaculture and fishing and in particular shellfish farming and related economic sectors linked to food processing)
- **Ravenna & Forlì-Cesena area:** manufacturing activity (in particular off-shore oil & gas industry, pleasure shipbuilding, port and coastal infrastructures)
- **Rimini area:** Emilia Romagna tourist system which winds along 135 km of coastline (of which 108 km of beaches) but which finds a historical concentration in the Rimini area.

Over the last few years, awareness of the relevance of activities linked to the sea in the weight of the Mediterranean economy and its potential development has grown. Likewise, the difficulty of reconciling economic growth with environmental sustainability is increasingly evident for the sea. Not only marine ecosystems are increasingly exposed to growing anthropogenic pressure but also the coasts and coastal infrastructures prove to be extremely vulnerable to the effects of climate change. In fact, the present thematic area is characterized by global trends that show increasingly marked lights and shadows, a trend which is expected to see further intensification in the coming years.

#### **Negative aspects:**

- the considerable increase in human pressure on the seas due to the growth of the world population and maritime and coastal activities which require greater exploitation of marine resources
- climate change (increase in temperatures, acidification, deoxygenation, rise in sea levels) exacerbates anthropic pressure and requires timely mitigation and adaptation measures, especially to protect the coastal strip
- the constantly decreasing trend of the fishing sector, the strong reduction in the profitability of the sector, caused by the impoverishment of fish resources, the increase in business costs and the competition from foreign fish is pushing operators to abandon the sector of fishing and look for new, more sustainable opportunities, such as aquaculture

#### **Positive aspects:**

- growing coastal tourism: driving employment in the European and Italian blue economy (59% of blue jobs)
- renewable energy from the sea is an emerging sector with the highest potential in the sector. In particular, a marked development of offshore wind power is expected thanks to the push of European policy (Green Deal) which will bring the current 22 GW

of installed power to Europe to 240-440 GW by 2050. Potentially important opportunities for the transition of the offshore sector.

- growing aquaculture and mussel farming (for example with new opportunities for diversification of shellfish farming with the introduction of oyster farming).

c) *Evolutionary trajectories:*

From the intersection of this global framework with the capabilities, industrial and research skills of the territory and the analysis of the technological trajectories of the Blue Italian National Technological Cluster Growth (BIG), descend the impacts and development opportunities that can be generated in the region.

They are reported below, divided into macro-categories:

### **1. Blue bioeconomy**

**Marine biotic resources** (sustainable and circular fishing and aquaculture, ecosystem services, biodiversity and combating the spread of alien species).

The regional fishing sector (small scale and with limited level of innovation) shows a constantly decreasing trend due to the reduction of the fleet and catches. Innovation opportunities for the relaunch of the sector are linked to the development of digitalisation (technologies for the modernization of the product marketing system, technologies for the traceability and certification of the catch, strengthening of the control and monitoring systems of illegal fishing) but also to the development of technologies for: conservation of fish products on board and on land to improve shelf-life, energy saving and new fuels for boats, new fishing systems to reduce environmental impact.

Aquaculture and in particular shellfish farming represents the regional strong point of the sector. Innovation opportunities concern the development of technologies and plants with reduced environmental impact, integration of plant equipment with new technologies (Precision fish farming), diversification of aquaculture production (e.g. oyster farming, and others), improvement of farmed fish species and their feeding.

**Blue** biotechnology - the use of marine biological resources for the development of blue biotechnologies relevant to industry (pharmaceutical, food, cosmetics, chemical, textile, environmental and energy) is growing rapidly. In the biotechnology sector, the areas of activity of greatest interest for the territory are those linked to the valorisation of scraps/waste from the **fish supply chain** according to the principles of circular economy. For example, the use of mild technologies and biotechnological processes based on safe and appropriately selected microorganisms, aimed at recovering by extraction valuable components such as proteins, peptides and short-chain amino acids from molluscs and fish waste through enzymatic hydrolysis, or gelling agent proteins, vitamins, minerals and antioxidants from macroalgae to obtain semi-finished products to be used as food ingredients or for the valorisation of aquaculture products. A second area of particular interest is that linked to the

*cultivation of microalgae*, as the latter can in fact be a source of compounds with a high nutritional and functional (nutraceutical) value. However, their cultivation necessitates the **development of an adequate supply chain** that takes care of processing and commercialization.

**Protection from anthropogenic pollution** this evolutionary perspective aims to contribute to the restoration of the marine ecosystem, as well as to raising awareness among the community for the diffusion of virtuous behavioural models aimed at preventing the phenomenon of abandonment of waste at sea and at its correct management. Complexity requires a multi and interdisciplinary approach both in terms of good practices and technologies to:

- remove or valorise waste accidentally caught or occasionally/voluntarily collected by any means, inserting it into **existing value chains**
- encourage virtuous behaviour to prevent waste abandonment at sea, also through awareness campaigns
- reduce anthropogenic pollution of emerging pollutants, noise pollution and acidification and monitoring through surface, aerial and underwater investigation technologies
- carry out the measurement and classification of plastics (macro, meso and micro) in all biotic and abiotic components.

## **2. Maritime manufacturing**

The valorisation of regional skills in the offshore oil&gas sector, marine robotics and shipbuilding in the marine renewable energy sector will impact both the energy transition and the use/re-use of marine abiotic resources and related infrastructure. The development or reconversion of sustainable industrial and tourist port infrastructures (e.g. electric and, in general, decarbonised naval propulsion, energy communities) that synergistically integrate the different sectors of the maritime economy, is one of the challenges that the regional system can aspire to achieve.

In particular, these areas of opportunity are highlighted:

- the development of renewable energy from the sea (offshore wind, wave and tidal energy), and especially offshore wind, a key theme of Horizon Europe, and a sector in which industrial projects are also being launched in the region. The challenge for the regional system is not to be the driving force, but to guide these investments and the development of the **related supply chains**, also through agreements with large energy companies
- the sustainable use of marine abiotic resources thanks to the development of innovative solutions for the conversion of non-operational offshore platforms with a view of integrating them with the various **marine supply chains**.

- sustainable shipbuilding and marine robotics with the development of port and offshore vehicles, systems and infrastructures - extractive, energy, civil, for fisheries - using marine robotics for monitoring and safety.

### **3. Preservation of the Coastal strip and Tourism 2.0**

Sustainable management of the coastal strip capable of guaranteeing ecosystem services and well-being of coastal communities, starts from the protection of the marine ecosystem (habitat and biodiversity of the marine environment) and from the protection of the coast up to the tourist enhancement of the marine and coastal area. The issue of safety is of growing importance in the technological scenario both for the intensity of the anthropic use of resources and for the extremity of the phenomena linked to climate change and hydrogeological risk in the sea (rising sea levels, flooding, erosion). All these factors impose new paradigms for coastal infrastructure resilience and require new interoperable decision support tools for monitoring, reporting and warning. To support sustainable management and sustainable economic use of the sea and coasts, a key role is played by Big Data analysis, also used for the development of decision-making tools, impact models on the economy and the environment, scenario building, new governance and business models.

In particular, the main areas of interest are:

- the regeneration and redevelopment of infrastructures present in the coastal strip, both tourist and non-tourist, including aspects of monitoring and management of the safety of the coasts, the marine environment, and ports through the development of low-cost technologies for remote monitoring, the reclamation of the areas marine coastal and flood and erosion protection, safety at sea
- the development of new models for maritime and coastal tourism 2.0 that integrate technologies for the regeneration and development of tourist systems, but also the implementation of new participatory models for the quality of the offer.

*d) Future prospects:*

The *Blue Growth* cross-sector area includes **traditional production specializations of Emilia-Romagna region that are highly interdependent with each other, and which perhaps more than anything else must be able to grasp the new challenges of the Green Deal.**

**Maritime and coastal activities** (Tourism 2.0, offshore manufacturing, blue bioeconomy first and foremost) **must find a virtuous balance that can guarantee employment and growth without depleting marine biological resources.** In addition to these, **infrastructure adaptation measures for the coastal strip are increasingly necessary** to deal with the more frequent **extreme climatic events caused by climate change.**

**Environmental sustainability is the key to the paradigm shift expected in production specializations:**

- sustainable tourism: towards new solutions that can integrate processes of regeneration and redevelopment of the coastal strip, digitalisation, sustainable mobility, zero km products, energy infrastructures, etc.
- the oil & gas sector operating at an international level must drive the ecological transition and decarbonisation by moving towards offshore renewable energy by capitalizing on existing know-how and energy infrastructure. In this course of action, the involvement of large national players is necessary – these who can lead the regional production sector
- the blue bioeconomy - the value of blue biotechnologies is now not very relevant but nonetheless, it is characterized by a strong potential for innovation and interest in the regional volumes of marine biotic resources (for the pharmaceutical, food, cosmetics, chemical, environmental textile and energy industries). From here arises a potential for extraordinary and strategic economic growth for the protection of the environment provided that two conditions are met: - a) to push the community of operators to resolve any conflicts of interest and b) to adopt a more extensive adoption of the principles of circular economy which, through the development of blue biotechnologies, can virtuously close the production cycle.

This report has on multiple occasions identified **the presence of the oil & gas sector** in the RIS3 strategy of Emilia-Romagna region, which runs contrary to the generally visible trend among other partners at abandoning its inclusion into their RIS3 strategies.

The regional RIS3 of Emilia Romagna is in line with the general goals of the Italian national strategy for sustainable development and the corresponding document with the same name covering the regional level. These two documents were prepared and enacted in the framework of Italian preparation for the achievement of the Sustainable Development Goals (SDGs) by 2030.

The correlation between the Blue Economy and the development of the region is visible, but on a lesser scale. For example, the Blue Economy is much less dominant in the structure of the regional GDP than, for instance, in the case of Bretagne, Andalusia or Azores Autonomous Region. Also prominent are the sectors of agriculture, industry (food, automotive, machine building, chemical, ceramic, textile).

## NETHERLANDS

### **B) REGIONAL LEVEL**

South Netherlands **regional RIS3 strategy of its region for the period of 2021-2027** has identified 5 key challenges, towards the solution of which its implementation is oriented. These challenges are essentially focused on achieving sustainable transitions in the areas of **Energy, Raw materials management, Climate, Agriculture and Food** as

well as **Health**. The so-called *strengths of the South* should stimulate the achievement of each of the transitions, in particular thanks to the existence of **strong clusters with influential SMEs, start-ups and scale-ups, an inherently collaborative culture and infrastructure, advanced technological knowledge position (KETs), knowledge institutions and campuses**, which, in turn, **increase the cross-border potential of the region and open up bright prospects for collaboration in this sphere**. On a larger note, the strategy aims for a **multi-level social impact**, through concrete actions towards obtaining/ensuring **flexible energy systems, more biobased material, water quality and safety, healthy affordable food and longer healthy life**. From an economic standpoint, the aims are to ensure **sustainable prosperity of the society and create jobs, improve competitiveness and stimulate exports from the region**.

The document has identified four national clusters with international potential. Of particular interest to us is cluster of **Logistics** - thanks to its geographical location between Rotterdam, the Randstad, the ports of Moerdijk, the Flemish Diamond, and the Ruhr Valley, logistics is a strong cluster in South Netherlands. Logistics are strongly interwoven with the manufacturing industry and HTSM, maintenance, and agrifood. For the energy transition, it is important to focus on sustainable energy carriers and urban/maritime logistics. The above-mentioned is closely related to the Port Services and Infrastructure sector of the Blue Economy.

Out of the 5 key challenges identified at the beginning, related to the Blue Economy are **Energy and Climate**. It is envisaged, in particular, to establish **wind turbines (potentially offshore)** with coatings made of composite materials. It is also planned to establish a system of **carbon capture by applying relevant chemical technology**. In addition, the region features establishments which have vast experience in production of **green hydrogen obtained from renewable wind energy, tidal energy** – e. g. based on the expertise of the Tidal Technology Center Grevelingendam (TTC-GD) etc. Finally, a **highly innovative practice of obtaining desalinated water based on energy surpluses in sunny weather and strong winds** has been established - Seawater can be desalinated through reverse osmosis (when seawater is pressed through membranes under osmotic pressure). This process produces drinking and irrigation water. The project aims to use wind energy in combination with reverse osmosis. Wind energy is used for the reverse osmosis process and additional electricity can be generated.

As regards climate, the focus is on **producing/establishing climate-resilient structures with the help of clean-tech environmental technology, to combat the negative effects of climate change** (rising sea levels, high tide).

While the document does not extensively cover the Blue Economy, the inclusion of aquaculture indicates a recognition of its importance within the regional innovation strategy. The focus on sustainable aquaculture in Zeeland through projects like Aqua Valley suggests an effort to enhance the region's capabilities in this sector.

The emphasis on sustainable agriculture and food transition, with a specific mention of aquaculture, aligns with the broader goals of the Blue Economy, which aims to utilize marine and freshwater environments to support sustainable economic growth.

In the **Deliverable 2.1. Handbook on Innovative Best Practices** specific projects/initiatives from Netherlands were analyzed in detail and presented with its main elements. This document does not which to repeat what has already been covered in another document however it does analyses described examples from the perspective of RIS3 implementation and development in relation to blue growth topics.

### **1. Strategic Integration of Technology and Sustainability**

#### *a) Analysis*

Across the diverse projects in the blue economy, such as those exemplified by the Kingfish Company, PortXL, Zero Emission Services (ZES), and the Dutch Marine Energy Centre (DMEC), there is a significant emphasis on integrating advanced technologies to enhance sustainability. These initiatives reflect a concerted effort to not only adopt green technologies but also to develop systems that monitor and reduce environmental impacts effectively.

For instance, the Kingfish Company utilises advanced aquaculture technologies to significantly reduce ecological footprints, demonstrating a model where technology directly supports environmental goals. Similarly, PortXL's accelerator program focuses on nurturing startups that bring forth emission-reducing technologies and digital advancements for maritime applications, reflecting a proactive blend of innovation and sustainability requirements.

ZES's introduction of interchangeable battery containers to facilitate emission-free inland shipping showcases how innovation can be applied to traditional sectors to achieve sustainability targets effectively. Meanwhile, DMEC's efforts to scale up ocean energy technologies highlight the role of strategic partnerships and international collaboration in advancing marine energy solutions that are both sustainable and economically viable.

#### *b) Insight*

The integration of technology and sustainability practices across these projects signals a sector-wide recognition that future competitiveness in the blue economy is increasingly dependent on leveraging technological advances. This trend not only enhances sustainability but also drives economic growth, showcasing a model that other sectors could emulate. The synergy between technology and sustainable practices indicates a shift towards more integrated, systemic approaches to environmental challenges, where technology serves as both a facilitator and an enhancer of sustainable outcomes.

This strategic integration not only addresses immediate environmental impacts but also sets a foundation for long-term sustainability strategies that are essential for the health of the planet and the viability of global economies. As such, these initiatives exemplify a broader movement within the blue economy to harness technological

innovations in service of sustainability goals, providing a blueprint for other industries to follow.

## **2. Collaborative Ecosystems and Stakeholder Engagement**

### *a) Analysis*

Projects like Campus@Sea and RDM Campus underscore the critical importance of fostering collaborative ecosystems that integrate various stakeholders, including businesses, research institutions, and government bodies. Campus@Sea, for example, creates a dynamic environment for testing and innovation that involves multiple stakeholders, reflecting a comprehensive approach necessary for addressing complex challenges like sustainable marine

utilisation. Similarly, RDM Campus effectively bridges the gap between academic research and industrial needs by fostering close collaborations, ensuring that innovations are both practical and aligned with market demands.

### *b) Insight*

The success of these projects in creating impactful and sustainable solutions highlights the essential role of robust stakeholder engagement. By establishing collaborative platforms that bring together academia, industry, and policymakers, these initiatives lead to more integrated and impactful innovations. This collaborative model suggests that future initiatives within the blue economy should prioritise and nurture broad-based partnerships to enhance their effectiveness and reach. The ability to work across traditional boundaries and foster intersectoral cooperation is key to unlocking innovative solutions that can tackle the multifaceted challenges of sustainability in the maritime sector.

## **3. Overcoming Scalability and Adoption Challenges**

### *a) Analysis*

A central theme in projects like the Kingfish Company and PortXL is the challenge of scalability and the widespread adoption of sustainable practices. The Kingfish Company, for instance, deals with scaling up sustainable fish farming to effectively meet both economic and environmental objectives. PortXL faces hurdles in getting corporate partners fully prepared and committed to implementing innovative pilot projects, which often requires significant alignment of internal processes and buy-in at all organisational levels.

### *b) Insight*

These cases illustrate the common implementation gap that exists between the concept of innovative pilot projects and their application in real-world settings. Bridging this gap often demands not only substantial financial investments but also supportive changes in regulatory frameworks and market structures that foster sustainable practices. Highlighting the necessity for feasibility studies on scalability

during the initial stages of project development is crucial for anticipating challenges and planning effective scaling strategies.

#### **4. Long-term Sustainability and Continuous Learning**

##### *a) Analysis*

Projects such as DMEC and RDM Campus demonstrate a deep commitment to long-term sustainability, underscored by a focus on continuous learning and adaptation. DMEC's development of a transnational scale-up offer and RDM Campus's ongoing redevelopment initiatives reflect a recognition that sustainability targets in the blue economy are dynamic, necessitating continual adjustment and innovation.

##### *b) Insight*

This approach emphasises the importance of adaptability and continuous learning within sustainability initiatives. As these projects evolve, learning from successes and setbacks becomes essential, ensuring that each step informs the next. Incorporating mechanisms for ongoing monitoring and evaluation is also critical, allowing projects to remain adaptive and responsive to new information and changing environmental conditions.

The analysis of these initiatives reveals several key factors critical for innovation success in the blue economy: the integration of advanced technologies with sustainability goals, the creation of collaborative ecosystems, the management of scalability challenges, and a focus on long-term sustainability through continuous learning. These elements not only enhance the immediate success of such projects but also ensure their lasting impact, providing a strong foundation for future initiatives in the sector.

As can be seen, a relatively limited number of the Blue Economy sectors is addressed. However, it should be noted that these sectors, despite their limited number, are highly specialized. In addition, the project partners provided the previously analysed separate brochure, extensively outlining the examples of best practices. This also shows high level of integration of the subsectors in general economy outline.

The Netherlands has a comprehensive development approach aimed at achieving significant climate and sustainability goals by 2030. This is outlined in several key documents including the Climate Act, the National Climate Agreement, and the National Energy and Climate Plan (NECP).

The Climate Act, adopted in 2019, sets ambitious targets for reducing greenhouse gas emissions by 49% by 2030 compared to 1990 levels, with a longer-term goal of achieving a 95% reduction by 2050. The National Climate Agreement details the measures and sectoral contributions needed to meet these targets. This agreement includes initiatives across electricity, industry, built environment, traffic and transport, and agriculture sectors, emphasizing a cost-effective and equitable transition towards sustainability.

Additionally, the National Energy and Climate Plan (NECP), submitted to the European Commission, integrates these goals into the broader EU framework, ensuring that the Netherlands meets its commitments under international agreements, such as the Paris Agreement.

During the analysis separate region development strategy beyond RIS3 could not be determined. However based on the relevant resources the most important economic sectors in the region are Horticulture, Flower bulb cultivation, Petrochemical industry, service sector (particularly in the Hague), Animal husbandry etc.

The correlation between the presence of the Blue Economy sectors and the general direction of development is especially visible through ports and logistics sector, since the region (with its world-level port at Rotterdam) positions itself as a widely known leader in this sphere.

## FINLAND

### **B) REGIONAL LEVEL**

Overview and Summary of "Strategy for Innovation and Growth in Ostrobothnia 2022–2025: Smart Specialisation" states the need for continuous innovation and reforms to maintain the region's success in a rapidly changing global environment. The digital and green transitions are highlighted as key areas of focus, with Ostrobothnia needing to leverage its strong export economy and advanced manufacturing industry. The strategy aims to support the region's transformative capacity through targeted investments in research, education, and public-private collaborations.

#### Starting Points of the Strategy

This section discusses the foundational elements of the strategy, emphasizing smart specialization to identify and invest in priority areas where the region excels. It highlights the importance of regional and international cooperation, particularly in the manufacturing industry, which is crucial for Ostrobothnia's economy. The development of new areas of expertise and export sectors, along with the horizontal transfer of expertise across industries, are key components. The strategy's priority areas include advanced production methods, digital solutions, energy technology, and circular economy.

#### Regional and International Cooperation

The strategy emphasizes strong regional cooperation between businesses, educational institutions, and the public sector, along with the necessity for international collaboration to acquire new expertise and partnerships.

#### Manufacturing Industry

Ostrobothnia's manufacturing industry is highlighted as a cornerstone of the regional economy, with a high export turnover and advanced technological capabilities. The

need for continuous innovation and new technologies is stressed to maintain competitiveness.

#### Development of New Areas of Expertise and Export Sectors

The strategy focuses on identifying new growth sectors and investing in them, leveraging existing regional strengths and knowledge resources.

#### Horizontal Prioritisations and Transfer of Expertise

Cross-sectoral knowledge transfer is emphasized, with the strategy targeting technological competencies and new operational models applicable across multiple industries.

#### Vision, Goals, and Priority Areas

The vision for 2022–2025 focuses on improving the innovative and competitive capacity of SMEs, enhancing higher education support for innovation, and fostering new business sectors and export industries. The strategy seeks to develop a robust regional innovation system through triple helix coordination involving businesses, educational institutions, and public sector organizations.

#### A Method to Identify Cooperation Gaps and Bottlenecks for Innovation Diffusion

The strategy employs a continuous learning process to identify gaps and bottlenecks in regional cooperation, involving regular dialogue with businesses and other stakeholders. This process aims to pinpoint new technologies and areas for collaboration, assess the regional innovation system's effectiveness, and coordinate development measures.

#### Short Analysis of Achieved Results: Where Are We Now?

The strategy reviews the results of its structured dialogue initiated in 2014, noting significant advancements in international cooperation, alignment with national policies, and regional innovation initiatives. However, it also identifies ongoing challenges in achieving a unified regional understanding of strategic priorities and targeted investments.

#### Description of the Priority Areas and Key Technologies of Ostrobothnia's Innovation-Driven Growth

##### Advanced Production Methods

This area focuses on increasing automation, robotics, and digital solutions to maintain regional manufacturing competitiveness. It highlights the need for new expertise and stronger collaboration between businesses and educational institutions.

##### Digital Solutions

Digital solutions are central to innovation across all priority areas, enabling new business models and enhancing existing ones. The strategy underscores the importance of data-based decision-making, cybersecurity, and the development of new digital services.

### Energy Technology and System Solutions for Renewable Energy Production

Ostrobothnia's energy cluster is a significant driver of regional growth, focusing on renewable energy production, smart grids, and energy storage. The strategy calls for more investments in regional demonstration environments to support innovation and commercialisation of new energy solutions.

### Circular Economy and Carbon-Neutral Economy

The transition to a circular economy is seen as crucial for sustainable growth, requiring changes in business models and new approaches to production and value creation. The strategy emphasizes the need for education, demonstration projects, and cooperation to foster circular economy practices and reduce carbon footprints.

### Good Governance of the Strategy

Good governance is critical for the strategy's success, involving systematic implementation, monitoring, and evaluation processes. The European Commission's criteria for smart specialisation are integrated into the strategy, ensuring it meets the requirements for innovation diffusion, stakeholder cooperation, and continuous improvement.

The Blue Economy holds a significant position in the Strategy for Innovation and Growth in Ostrobothnia 2022–2025, emphasizing its importance across various thematic priority areas and as a key component of the region's strategic development focus. The strategy outlines the following aspects related to the Blue Economy:

#### Integration into Thematic Priority Areas

The Blue Economy is interwoven into several thematic priority areas of the strategy, each contributing to sustainable growth and innovation in maritime and coastal sectors:

##### 1. Advanced Production Methods:

The strategy highlights the need for transformation in production methods, including advanced automation and robotics, which are critical for the efficiency and competitiveness of maritime industries. This involves integrating digital solutions and new technologies to enhance productivity and create value-added services in sectors like shipbuilding and marine engineering.

##### 2. Digital Solutions:

Digital innovations are essential for the Blue Economy, facilitating smart maritime logistics, operational efficiency in ports, and sustainable fisheries management. The strategy focuses on the application of IoT, big data, AI, and advanced analytics to optimize maritime operations, improve resource management, and support new business models in the marine sector.

### 3. Energy Technology and System Solutions for Renewable Energy Production:

The region's emphasis on renewable energy includes marine renewable energy sources such as offshore wind, wave, and tidal energy. The strategy calls for significant investments in R&D for renewable energy technologies, which are integral to the Blue Economy. This includes developing system solutions for energy production, storage, and smart grid integration to support sustainable maritime activities.

### 4. Circular Economy and Carbon-Neutral Economy:

Promoting circular economy principles is crucial for the sustainable development of the Blue Economy. The strategy focuses on reducing waste, optimizing resource use, and developing sustainable products and services. This includes valorizing marine biomass, recycling maritime waste, and fostering innovations in sustainable aquaculture and fisheries.

#### Role in Innovation and Growth

The Blue Economy R&D is positioned as a driver of regional growth and competitiveness. Ostrobothnia's strategy aims to leverage the Blue Economy's potential by:

#### Enhancing Collaboration:

Fostering partnerships between businesses, research institutions, and public authorities to create innovation ecosystems that support the Blue Economy. This includes collaboration on marine technology development, sustainable fisheries, and marine biotechnology.

#### Investing in Research and Development:

Significant R&D investments are directed towards technological advancements in marine sectors, supporting the development of new products, services, and sustainable practices. This is critical for maintaining the region's competitive edge in the global Blue Economy.

#### Supporting Sustainability:

Emphasizing eco-friendly practices and the adoption of circular economy principles to ensure the Blue Economy's growth is sustainable. This involves developing technologies and processes that minimize environmental impact and promote the long-term health of marine ecosystems.

#### Strategic Importance

The Blue Economy is strategically important for Ostrobothnia due to the region's geographical and economic context. The strategy recognizes the Blue Economy as vital for:

#### Economic Diversification:

Diversifying the regional economy by developing new sectors and export opportunities within the Blue Economy, leveraging the region's existing strengths in maritime industries and renewable energy.

#### Global Competitiveness:

Enhancing the global competitiveness of Ostrobothnia's businesses through innovations in marine technologies and sustainable practices. This includes participating in international networks and partnerships to share knowledge and best practices.

#### Sustainable Development:

Aligning with EU and national goals for sustainable development, the strategy integrates Blue Economy initiatives to contribute to climate action, environmental protection, and resource efficiency.

In summary, the Blue Economy is a cornerstone of Ostrobothnia's strategy for innovation and growth, playing a critical role in driving sustainable economic development, fostering innovation, and enhancing regional and global competitiveness in maritime and coastal sectors.

The region is comprehensively and highly economically developed. The area has a strong tradition of entrepreneurship and the largest number of companies per capita on the mainland of Finland. The export share of approximately 71 % is also exceptionally high. Another indicator of the area's strong economy is that the unemployment rate is the lowest in the country.

Kokkola has a significant concentration of inorganic chemistry businesses. The city provides a complete, top-class operating environment for large-scale industry due to its excellent logistics and location. Transport connections include the first all-weather terminal in the Nordic countries.

Jakobstad also called Pietarsaari in Finnish, is a hub of small and medium-sized export companies. The city is full of export-oriented niche businesses that thrive on the global markets. There are companies that have fewer than 50 employees yet export to more than 50 countries.

Vaasa is home to the biggest concentration of energy technology companies in the Nordic countries. Vaasa's export percentage in industrial production is nearly 80, which makes it the biggest exporting city in Finland.

These are also the key economic sectors of the region, to which the highest degree of attention is paid and are therefore accorded priority positions.

While Ostrobothnia does not have a **dedicated Blue Economy strategy**, its approach to sustainable development **includes several blue economy activities**.

1. Sustainable Marine and Coastal Development: Focus on sustainable fisheries and aquaculture, implementing eco-friendly practices and innovative technologies. Development of marine renewable energy projects, such as offshore wind and wave energy, to promote green energy solutions.

2. Innovation and Technological Advancement: Investment in research and development (R&D) to drive technological advancements in marine biotechnology, aquaculture, and other marine sectors. Collaboration between businesses, research institutions, and public authorities to create innovation ecosystems.

3. Environmental Sustainability: Promotion of eco-friendly practices across blue economy sectors, including sustainable fishing methods and protection of marine biodiversity. Adoption of circular economy principles to enhance economic competitiveness while protecting the marine environment.

4. Economic Growth and Job Creation: Stimulate economic growth and create job opportunities by developing sustainable blue economy sectors. Support new business initiatives and the formation of innovative industrial communities in the blue economy sphere.

By leveraging its strategic position and resources, Ostrobothnia aims to become a leader in sustainable marine and maritime activities, fostering innovation, sustainability, and economic growth within the blue economy sector.

## CROATIA

### A) NATIONAL LEVEL

**The current Croatian national RIS3 strategy through 2029 did not introduce the concept of the Blue Economy in any way.** Despite this, some elements of its 7 thematic priority areas (TPP) (see below) are relatable to the Blue Economy. Particularly important is the **Shipbuilding** sector, which has a long tradition in Adriatic Croatia

On the other hand, **the Action Plan for the Blue Growth of Adriatic Croatia** specifies three concrete areas – **Vessels of the Future, Luxury Coastal Tourism as well as Smart Fisheries and Aquaculture**. This plan also outlines the necessary conditions and the available infrastructure (including scientific and technical) necessary for its quality implementation.

Due to the absence of the Blue Economy from the national RIS3 strategy, it is impossible to conduct comparative analysis on the increase/decrease of the presence of relevant Blue Economy sectors. In the same way, as of 2024, there exists

only one version of the Action Plan for the Blue Growth of Adriatic Croatia and therefore it is impossible to comparatively analyse this document as well.

**The region of Adriatic Croatia does not have other strategic documents beyond the above mentioned which would regulate its strategic development in a long-term perspective.**

Traditionally, agriculture, animal husbandry, fisheries, shipbuilding, construction sector as well as coastal tourism due to natural beauties are developed in the region of Adriatic Croatia. New possibilities for the region's economic development are increasingly opening up after the accession of the Republic of Croatia to the European Union. In recent years, there has been a boom in the development of tourism sector, but it also brings increasing challenges, first and foremost as regards the possible **negative impact on the environment. In this regard, it is necessary to develop resilient, sustainable forms of tourism, which take into account the existing natural preconditions, the availability of the relevant resources but also the wellbeing of the local population.**

Formally, a correlation between the presence of the Blue Economy sectors and the general direction of the region's development cannot be established, since the national RIS3 lacks the Blue Economy section altogether. In practice however, the development of the Blue Economy directly influences the development of the region, due to its geographical features and climate conditions. For this reason, it is all the more important to include the Blue Economy thematic priority area in the future national RIS3 strategy of the Republic of Croatia.

Below is a detailed overview of the sections of Croatian national RIS3s published thus far (2016-2020, 2022-2029), which are relatable to the Blue Economy, despite its absence from both relevant documents.

### **RIS3 Strategy of the Republic of Croatia 2016-2020. – Blue Economy sectors overview**

The strategy makes no distinct reference to the concept of Blue Economy, nor does it distinguish between specific (traditional or emerging) sectors within it.

Croatian RIS3 2016.-2020. identifies instead 5 Thematic Priority Areas (**Tematska Prioritetna Područja** or TPPs) with additional Sub-Thematic Priority Areas (**Podtematska Prioritetna Područja** or PTPPs) Each PTPP includes certain elements of Blue Economy sectors. The TPPs are the following: **1. Health and Quality of Life, 2. Energy and Sustainable Environment, 3. Traffic and Mobility, 4. Security and 5. Food and Bioeconomy.**(see pp. 86).

**1. As part of Health and Quality of Life TPP**, of relevance to us is PTPP1, specifically Biopharmaceuticals. In this sector, Biotechnology (potentially Marine Biotechnology in the future\*) is identified as one of the key drivers for Research, Development and Innovations (**RDI**) (or Istraživanje, Razvoj, Inovacije (IRI) in Croatian. On the list of the so-called *indicative RDI themes* (promising sectors/areas for development),

production of herbal medicines (some of them could come from marine plants\*) features among other proposals. (pp. 90).

Equally important is the PTPP3 – Nutrition, where one of indicative RDI themes is the production of natural healthy products (it can be assumed that some of them could have maritime origin (e.g. fish, molluscs, algae etc.) (pp. 98).

**2. As part of Energy and Sustainable Environment TPP**, relevant is the PTPP2 – Eco-friendly technologies, equipment and advanced materials. Among the *indicative RDI themes* we can find technologies and technological processes linked to environmental sustainability, development of technology and equipment for maritime protection, new sources of biomass (potentially marine biomass\*) and bio-based products, monitoring the sea and sea habitats by using autonomous underwater vehicles, technologies and use of autonomous unmanned vehicles for environmental monitoring (including for the marine environment) (pp. 110.)

**3. As part of Traffic and Mobility TPP**, attention is to be paid to PTPP2 – Eco-friendly traffic solutions. Listed are such *indicative RDI themes* as: environmentally-friendly vessels and ship propulsion based on more environmentally-friendly combustion, advanced marine constructions and light materials, safer traffic and maritime operations (reduction of the consequences of maritime accidents), innovative vessels and floating structures with higher added value, reduction of environmental impact by large merchant ships, *short sea shipping, ports of the future*, equipment, systems, applications and solutions used for the modernization and establishment of smart ports and terminals equipped with systems with renewable energy sources, smart lighting and smart networks, navigation, guidance and management of vessels, autonomous unmanned vessels (both underwater and surface) (pp. 119.).

**4. As part of Security TPP**, relevant is the PTPP2 – Defence technologies and dual-purpose products, where among the identified *indicative RDI themes* we find: unmanned vessels (underwater and surface) as systems for monitoring the maritime border and maritime traffic, as well as preventing environmental disasters, key development technologies for satellite or unmanned broadband surveillance of air, land and sea areas. (pp. 133.)

5. Finally, **as part of Food and Bioeconomy TPP**, special relevance for us holds the PTPP1 – Sustainable production and processing of food. The strategy separately deals with the sectors of Fisheries and Aquaculture, given that these have a long tradition in our country. The estimated share of fisheries in the GDP varied at the time between 0.2 and 0.7%. However, if the accompanying activities are included, the real contribution of this sector was underestimated and then the contribution to the national GDP was exceeding 1%. The entire fishing sector was employing (directly or indirectly) around 25,000 people.

The data indicated that the total catch and production doubled in the period from 2005. to 2014., and a similar trend was observed for exports, which evidenced the strong development of the mentioned sector in the last decade. Similarly, aquaculture was a particularly important sector with significant potential for the entire

fishing industry. By 2010, the share of aquaculture in the total production of fish and seafood exceeded 21%, which was higher than the European Union average of 20.4%. (pp. 24.).

Listed as *indicative RDI themes* are innovative technologies and processes to produce high quality and added value food, health food safety, product preservation, solutions for an integrated supply and value chain, innovative by-product processing, development of fishing ecosystem, regional approach in the assessment and management of fish stocks, development of smart fishing tools and protection of critical habitats, protection of marine areas, the impact of climate change and invasive species on the ecosystem and fisheries, increasing the value of the catch and diversification of fishing methods, introduction of new species and the use of environmentally-friendly technologies, development of added value of aquaculture products, development of innovative solutions for the valorisation of unwanted catches and the development of new breeding technologies, aquaponics, blue biotechnology for sustainable environment, robotic systems for growing food and monitoring in aquaculture (pp. 143-144.).

Two of the established Blue Economy sectors are particularly important for the economy of our country as a whole – these are **tourism (including coastal tourism) and shipbuilding**.

In fact, **Croatian export of services is mainly oriented to services in tourism, while the export of services in high-income countries is more oriented towards the export of business services**. With an increase in the share from 68% in 2000 to 73% in 2012, **the sale of travel packages dominates the exporting commercial services**. The export of services for the sale of travel packages (NKD 79) **grew at an average rate of 10% per year during the period between 2000. and 2012**. Moreover, **the export of travel package sales services grew at a much higher annual rate of 19% in the period before the recession**. The high share of services for the sale of travel packages is in line with their **distinct comparative advantage**, which grew strongly in the period between 2000. and 2009. and is **the highest of all service sub-activities** (pp. 27.).

**Shipbuilding** has retained its importance for overall production and exports, thanks to the process of privatization and restructuring of shipyards. Most of the total revenue in this sector is generated by a small number of high-value ships built in several large shipyards in Croatia. The three largest companies according to the criterion of total revenue are *Brodosplit brodogradilište d.o.o.*, *Brodograđevna industrija 3. MAJ* and *Uljanik d.d.* As of July 31, 2015, the large Croatian shipyards *Uljanik*, *3.MAJ*, *Brodotrogir* and *Brodosplit* had 43 ships and other floating objects in their order book, with a total value of over 1.6 billion (currency not indicated\*), which corresponds to approximately 600,000 DWT (Dead Weight Tonnage) and 480,000 cGT (compensated Gross Tonnage). In the last 25 years, starting in 1987, Croatian shipyards have won numerous international awards for the quality of shipbuilding. (pp. 26). The available data also shows that in the period between 2002 and 2012 the export of ships and boats was becoming increasingly important in the overall structure of Croatian exports. (pp. 19). As a result, in 2011.-2012. it accounted for 7,21% of all our exports,

thus becoming the single most-successful exporting sector of the national economy, although it was not the most complex one (as measured by the complexity coefficient). What's more, it had a significant advantage over the 2nd placed sector on the same list (pharmaceuticals, which accounted for 3,79% of all exports) (pp. 11.).

Blue Economy has an exceptional potential to flourish in our country. However, in order to give an additional impetus to this process, new approaches should be adopted and implemented (including in the sphere of strategic planning). For instance, instead of dealing with various Blue Economy sectors as part of separate TPP's, all of them should be listed and dealt with in one place. In addition, the Republic of Croatia should strive to significantly diversify the development of these sectors (beyond the established ones, such as tourism, fisheries, aquaculture and shipbuilding).

### **RIS3 Strategy of the Republic of Croatia through 2029. – Blue Economy sectors overview**

The new national RIS3 Strategy was published in November 2023. In comparison with the previous version (2016.-2020.) important changes have been made. On the other hand, the document still didn't introduce the concept of the Blue Economy or list its separate sectors. The authors have generally adopted a more descriptive approach. Thematic Priority Areas (TPPs) were unified and a new TPP (Digital Products and Platforms) was added. Sub-Thematic Priority Areas (PTPPs), as well as indicative RDI themes were fully excluded.

The goals of the 1st Thematic Priority Area (Personalised Healthcare TPP) have shifted more towards providing integrated and personalised healthcare solutions. In this respect, the emphasis on preventive actions (such as maintaining a healthy diet, including by consuming marine products) seems to have somewhat diminished (pp. 58-71).

The goals of the 2nd Thematic Priority Area (Smart and Clean Energy TPP) have retained their relevance. Areas such as the storage of energy, use of biomass (potentially marine biomass\*), green (potentially blue\*) heating systems, technologies to catch, use and store carbon (potentially blue carbon\*), further developing renewable energy (solar, wind, wave-power) are identified as important. They form an integral part of green transition of the whole sector (pp. 71, 78-79, 81). Such areas can also be regarded as having certain connections to the Blue Economy.

The 3rd Thematic Priority Area (Smart and Green Traffic TPP) focuses on the development of industries providing (spare) parts and systems for various types of traffic, including marine and underwater traffic. Stakeholders in this TPP are involved in development and implementation of technologies with positive effects on the environment (noise reduction, reduction of CO2 emissions etc.), which is highly relevant for the Blue Economy. Several of them are also focused on the development of technologies related to engines with efficient combustion, parts and solutions for electric vessels and alternative propulsion systems oriented towards sustainable mobility.

Traditionally, shipbuilding is one of the important economic sectors in Croatia. It has a long and distinguished tradition, but in recent years its own competitive position is weakening due to a drop in profitability and the global shifting of production to East Asia. Since 2018, large Croatian shipyards have been shifting from ro-ro ships for the transport of cars and bulk cargo, containers or tankers to passenger ships, ships for polar cruises, passenger ships for coastal cruises, luxury yachts and special work boats. Although many domestic and European shipyards continue to build vessels with high added value, some European marine competitors are increasingly focusing on repair and upgrade services. Still, the lack of correspondence between the type of ships that Croatia traditionally builds and its geographical location (outside the main routes for large vessels) does not leave much room for transition from production to repair and maintenance services. In addition, Croatian productivity amounts to about 75 000 € while in South Korea it reaches 220 000 € and in this respect our productivity can hardly be competitive (World Bank, 2018). Another challenge to overcome is the lack of regulations to strengthen the transition of the maritime sector to environmentally friendly technologies. As part of the National Plan for Recovery and Resilience, a reform of legal framework is envisaged, enabling the reorganisation of public ports as well as improvement of sustainable waste management there. Moreover, the document also provides for the procurement of six solar-electric powered ships. These ships are to be used for public maritime transport. However, more needs to be done to encourage development and transition of the domestic mobility sector towards sustainable fuels and technologies. Without tangible regulatory catalysts, Croatian maritime industry is likely to fall behind in terms of sustainability (pp. 91, 94). To prevent this scenario, several key activities should be strengthened, allowing the positioning of the sector in green (blue\*) energy transition. According to the overview of value chains for short maritime routes (pp. 96), our maritime industry lacks the following segments: a) system integration and development of electric and other alternative propulsion systems, b) supporting infrastructure and development of electric/hybrid vessels, hydrogen and LNG-powered vessels, vessels having other alternative propulsion systems, c) repair and overhaul infrastructure for conversion to electric and hybrid propulsion systems, d) development of skills and knowledge to strengthen capacities in electric/hybrid/alternative fuel systems and laying the foundations for smart, autonomous and connected ships.

Mobility over short distances at sea is the focal point of modern innovations in maritime sector, such as green ships and smart ships. In the personal segment, short-distance trips are dominated by small, motorized vessels. Ferries are an archetypal type of vessel used for the mass transport of people over short distances within coastal waters and therefore this segment is prominent in Croatia. Most of the new technologies that are ready for applications in the maritime sector, at least those of general application, have first to be tested and applied on short sea routes. Only after that can they be accepted for use on the long ones. Short sea routes are also, at least for the time being, more suitable for testing and initial applications of electric and hybrid propulsion systems. Several smaller shipyards in our country already produce and export customized hybrid propulsion passenger vessels, including solar-powered catamarans. Although it can be predicted that the electrical systems will be basic technology for all vessels, for now electrically powered vessels are feasible for shorter

routes in relatively stable weather conditions. Therefore, the focus on short sea routes, innovative and technically complex development within these segments would help Croatian companies in specializing and maintaining competitiveness in relation to low-cost competition.

Passenger transportation on long routes does not exist as a commercial segment in our country. Short-haul freight traffic is defined as coastal trade and includes the transfer of cargo from maritime to other modes of transport and trade on inland waterways. Ocean freight transport over long distances dominates global trade. Vessel types include bulk carriers, tankers and cargo ships for containers/other general cargo. This segment is present in Croatia with several companies dealing with cargo transportation, logistics and engineering services and large shipyards. In addition, certain Croatian companies appear in the luxury long-distance segments, including the building of cruisers and custom vessels. This could also be an area of potential growth for Croatian maritime industry actors. In order to ensure the realisation of such possibilities, the whole sector will need to adopt certain new approaches, such as: one-off production or production in small series, concept-based design and sophisticated production chains (pp. 99-101).

In the 4th Thematic Priority Area (Security and Dual Purpose Technologies TPP), the Blue Economy sectors possibilities are overall modest. However, good prospects open for the sector of Maritime Security and Surveillance, as well as Underwater Communication and Navigation. The strategy puts an emphasis on developing smart solutions for natural, technical and technological catastrophes (disasters management). In this sense, development of unmanned maritime/underwater vessels could be considered a useful direction. Similarly, due to climate change, attention is paid to developing innovative solutions that could possibly mitigate its most dangerous effects (rising sea temperature and sea levels, unbalanced amount of precipitation, climate insecurity, heat and cold waves...) (pp. 108-110.)

The Blue Economy has considerable possibilities for development in the framework of the 5th Thematic Priority Area (Sustainable and Circular Food TPP). In line with the trend of increased awareness of the population about the multiple benefits of consuming healthy and sustainable food, bright prospects open for our country. According to the available data (pp. 126.), ecological and sustainable production practices show potential and increasingly exceed European norms. What's more, interest in ecological and sustainable production has grown since the entry Croatia in the EU. In 2023, the total registered area under organic production in Croatia stood at 129.4 thousand hectares, or 9% of all farmlands. Croatian food producers also seem to be turning to ecological and sustainable cultivation methods, although there is still plenty of room for growth.

Fish, molluscs, algae etc. have long been recognised as healthy nutrition options and the above-mentioned positive trend should absolutely be used in order to further promote their consumption. However, the same trend also presents the relevant industries in our country (fisheries, aquaculture) with the challenge of adopting more sustainable operating practices. If such practices are not adopted, our marine ecosystem soon risks facing several serious problems (e.g. scarcity of fish stock and

difficulties in its regeneration, decrease in marine biodiversity...). The sector of cultivation of algae, edible sea moss and seaweed (all recognised as healthy and highly nutritive) is virtually non-existent in our country and untapped potential certainly exists in this sphere as well.

The strategy also focuses on innovations to ensure the adoption of bio-packaging made of renewable polymers and compostable materials, thus gradually phasing-out traditional metals and, above all, plastic. In addition, it aims to ensure the development of technologies which would enable the mapping of food waste (including fisheries and aquaculture waste), assisting the relevant companies to implement the principles of green (blue\*) transition, and achieve the goal of circularity (pp. 136). These two aspects, especially the management of ever-increasing plastic pollution of maritime spaces, are crucial for sustainable development of the Blue Economy.

The concept of Blue Economy and its sectors in general are hardly applicable to the 6th Thematic Priority Area of the strategy (Customized and Integrated Wooden Products TPP) (pp. 139-151.). Nonetheless, certain possibilities might exist as regards the development of specific wooden constructions to be immersed in seawater on a long-term basis. Cooperation might also be established between the traditional Blue Economy sector of Coastal Infrastructure and Construction, since wooden structures that could be used for the needs of this sector are generally non-detrimental to the (marine) environment. Similarly, attention should be paid to preventing excessive deforestation of our coastal areas, as this could cause them irreparable damage (artificial erosion, decreased coastal resilience etc.).

The 7th Thematic Priority Area (Digital Products and Platforms TPP) (pp. 152-167.) is the newly added one with respect to the previous strategy. It is a highly innovative and very recent sector, whose full potential largely has yet to be discovered. As elsewhere, no explicit reference to the possibilities it brings for the Blue Economy is made. Despite this, given that the Blue Economy itself is a rather new concept, the possibilities are in fact very broad. It should be noted that the Blue Economy proposes the use of numerous technologically advanced (smart) solutions across its sectors. For the so-called traditional/established sectors, it suggests the adoption of new approaches based on sustainability and the application of new technologies as well. As a result, Blue Economy and the 7th TPP could in fact be naturally oriented towards each other. In the emerging Blue Economy sectors, as well as in the sector of the Blue Technologies, digital products and services could soon become highly sought after, potentially becoming the backbone of the whole sphere.

In conclusion, the national RIS3 of the Republic of Croatia through 2029. has adopted several new approaches to the sphere of strategic planning. The addition of a new TPP bears witness to the fact that the authors have taken into account the rising importance of the digital market sector and the fast pace at which it is developing. At the same time, they have not introduced the concept of the Blue Economy. This could be considered a significant drawback, given that Croatia is a Mediterranean country with a long coastline, and it has all the natural preconditions for the vibrant development of this sphere. Its inclusion in the future RIS3 strategies is even more

relevant if we take into account the paramount importance of coastal tourism (which itself is one of the Blue Economy sectors) for the national economy as a whole.

### 3.3 Interregional Innovation Investment Policies and promotion of Cross-border Collaboration and Investment in the Blue Economy

The Blue Economy encompasses a broad spectrum of activities that utilize ocean and marine resources for economic growth, job creation, and environmental sustainability. Within this vast domain, it is crucial to focus on high-priority and value-added markets to maximize the impact of innovation and investment policies and related projects.

High-priority markets in the Blue Economy are those areas identified as having significant potential for economic growth and sustainability. These markets are often prioritized due to their strategic importance, scalability, and relevance to regional and global economic goals.

As presented in the previous chapter, high priority markets are well represented in all RIS3 and are in line with developmental goals of specific participating regions or a country.

This chapter will give an overview how this is represented in relevant EU approach reflecting dedication to development interregional innovation and related investments and to cross border collaboration in this context.

As elaborated previously these key high-priority markets include:

1. Marine Renewable Energy: Harnessing energy from tidal, wave, and offshore wind sources to provide sustainable and low-carbon energy solutions.
2. Sustainable Fisheries and Aquaculture: Developing advanced practices and technologies to ensure the sustainable harvesting and farming of marine resources, promoting food security, and reducing environmental impacts.
3. Blue Biotechnology: Exploring marine resources for biotechnological applications, including pharmaceuticals, biofuels, and innovative materials.
4. Maritime Transport and Logistics: Enhancing efficiency and sustainability in shipping, ports, and maritime logistics through advanced technologies and practices.
5. Marine Conservation and Ecosystem Services: Implementing projects that protect marine biodiversity, restore habitats, and recognize the value of ecosystem services.

Value-added markets in the Blue Economy are defined by their potential to create additional economic value through innovation and creativity. These markets extend the economic benefits derived from marine resources by introducing advanced technologies and novel products.

Key value-added markets include:

1. Coastal and Marine Tourism: Developing sustainable tourism practices that provide economic benefits while preserving the natural and cultural heritage of coastal regions.
2. Marine Robotics and Autonomous Systems: Investing in cutting-edge technologies such as autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs) for applications in exploration, monitoring, and maintenance.
3. Marine Data and Spatial Planning: Leveraging big data, satellite technology, and geographic information systems (GIS) to inform marine spatial planning and decision-making processes.
4. Blue Circular Economy: Promoting the circular economy principles in marine industries, including recycling, waste reduction, and the repurposing of marine resources.
5. Innovative Marine Infrastructure: Advancing the development of resilient and sustainable marine infrastructure, such as artificial reefs, floating structures, and adaptable coastal defenses.

The primary objectives of innovation and investment policies and projects within these high-priority and value-added markets are:

1. Economic Growth: Stimulating economic development by creating new jobs, businesses, and revenue streams within the Blue Economy.
2. Sustainability: Ensuring that economic activities are conducted in an environmentally sustainable manner, preserving marine ecosystems for future generations.
3. Technological Advancement: Driving technological innovation to enhance efficiency, safety, and competitiveness of marine-related industries.
4. Interregional Collaboration: Encouraging collaboration between regions to share knowledge, resources, and best practices, thus fostering a more cohesive and innovative Blue Economy.
5. Skill Development: Building capacities and training a skilled workforce adept in the latest technologies and sustainable practices within the Blue Economy.

### Major EU Interregional Initiatives Enhancing the Blue Economy

Financing innovation is essential for economic growth and addressing societal challenges. However, market failures and funding gaps are prevalent, especially in less developed regions where financial markets are underdeveloped and heavily reliant on traditional public policy instruments like subsidies and grants. These gaps stem from various factors, including the high-risk, high-reward nature of innovation, limited access to capital, and market uncertainty. These issues are particularly acute in emerging and rapidly growing sectors such as the Blue Economy.

The most significant Interregional Innovation Investment policies and programs promoting cross-border collaboration in the Blue Economy within the EU are many and in everyday development with more participating countries each as well as bigger financial allocations.

Some of the most prominent ones are elaborated further in this chapter.

The Interregional Innovation Investments (I3) Instrument aims to strengthen innovation ecosystems across the EU by supporting interregional partnerships. These partnerships focus on developing value chains and fostering collaboration across regions, including those involved in the Blue Economy (for example project such as this one and many more).

European Maritime, Fisheries and Aquaculture Fund (EMFAF) provides critical support for sustainable blue growth. It funds initiatives that promote innovation in maritime sectors, encourage cross-border collaboration, and support coastal communities.

For example, The Blue Economy Window Call10 launched in 2021 funded various projects that develop sustainable aquaculture and innovative fishing techniques. For instance, the AQUA-LIT11 project focuses on preventing marine litter in the aquaculture sector, demonstrating EMFAF's commitment to environmental sustainability and innovation.

Horizon Europe is the EU's flagship program for research and innovation, addressing global challenges and promoting collaborative projects across various sectors, including the Blue Economy. For example, The BRIDGES12 project, funded under Horizon 2020 (now Horizon Europe), developed advanced underwater vehicles for environmental monitoring and resource exploration. This project showcases the program's role in supporting technological innovation and environmental stewardship in marine environments.

The European Regional Development Fund (ERDF) focuses on reducing regional disparities by funding projects that enhance economic cohesion. It supports initiatives that foster cross-border cooperation in maritime industries. The SEAS 2 GROW13 project, co-funded by the ERDF through the Interreg North-West Europe program, fosters innovation in the Blue Economy by creating a cross-border accelerator for SMEs. This program helps businesses scale their innovative maritime solutions, promoting economic growth in the sector.

BlueInvest is an EU initiative aimed at boosting investment readiness and access to finance for SMEs in the Blue Economy. It connects innovators with investors, enhancing the sector's growth potential. The BlueInvest Readiness Assistance program14 provides tailored support to selected SMEs, helping them refine their business models and attract investment. Successful projects include innovations in ocean energy and

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<sup>10</sup> [https://cinea.ec.europa.eu/news-events/news/new-emff-blueinvest-grants-are-ready-take-2021-09-09\\_en](https://cinea.ec.europa.eu/news-events/news/new-emff-blueinvest-grants-are-ready-take-2021-09-09_en)

<sup>11</sup> <https://aqua-lit.eu/>

<sup>12</sup> <https://www.bridges-horizon.eu/>

<sup>13</sup> <https://www.seas2grow.com/>

<sup>14</sup> [https://blueinvest-community.converve.io/readiness\\_assistance\\_home.html](https://blueinvest-community.converve.io/readiness_assistance_home.html)

sustainable aquaculture, demonstrating BlueInvest's impact on driving entrepreneurial growth in the Blue Economy.

Interreg however is a crucial EU program fostering cooperation across borders through joint projects and networks. It includes specific initiatives targeting maritime regions and the Blue Economy. There are numerous examples of best practice co finance through Interreg program.

Interreg programs have recognized The Blue Economy significance for sustainable development, particularly within Europe's coastal and maritime regions. Interregional investments and policies play a crucial role in promoting innovation and collaboration across borders. Programs like Interreg facilitate projects that harness marine resources sustainably, foster economic growth, and address environmental challenges. This presentation highlights five exemplary projects funded through Interreg initiatives that embody the spirit of cross-border cooperation and innovation. These projects focus on areas such as sustainable aquaculture, port development, biotechnology, and urban resilience, showcasing the potential of interregional collaboration to drive the Blue Economy forward. By leveraging regional strengths and fostering partnerships, these initiatives contribute not only to regional economic growth but also to the broader goals of sustainability and resilience in European maritime sectors.

#### 1. Baltic Blue Growth<sup>15</sup>

Program: Interreg Baltic Sea Region

Focus: This project aims to enhance the sustainable farming of blue mussels in the Baltic Sea. By developing mussel farming as an environmentally friendly method of nutrient removal, it also creates opportunities for the use of mussels in animal feed and other products, contributing to the circular economy.

#### 2. Atlantic Smart Ports Blue Acceleration Network (AspBAN)<sup>16</sup>

Program: Interreg Atlantic Area

Focus: AspBAN focuses on transforming ports into hubs for the Blue Economy by fostering innovation and accelerating the development of new business models. It connects ports with startups and SMEs to drive sustainable economic growth and digital transformation across the Atlantic Area.

#### 3. Blue Platform<sup>17</sup>

Program: Interreg Baltic Sea Region

Focus: This project consolidates results from various Blue Economy initiatives in the Baltic Sea, providing a knowledge platform for stakeholders. It emphasizes innovation in blue biotechnology, aquaculture, and sustainable maritime development.

#### 4. Blue Green City<sup>18</sup>

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<sup>15</sup> <https://interreg-baltic.eu/project/baltic-blue-growth/>

<sup>16</sup> <https://aspban.eu/en/home/>

<sup>17</sup> <https://interreg-baltic.eu/project/blue-platform/>

<sup>18</sup> <https://projects2014-2020.interregeurope.eu/bluegreencity/>

Program: Interreg Europe

Focus: This project promotes the integration of blue and green infrastructure in urban areas to enhance biodiversity and resilience to climate change. It supports cities in developing strategies that incorporate both water and vegetation systems, contributing to the sustainability of urban environments.

#### 5. FAN-BEST (Funding Atlantic Network for Blue Economy Technology Transfer)<sup>19</sup>

Program: Interreg Atlantic Area

Focus: FAN-BEST supports the transfer of technology and innovation in the Blue Economy by enhancing funding opportunities for SMEs. The project fosters collaboration between research institutions, businesses, and investors, focusing on areas like marine renewable energy and blue biotechnology.

The Blue Growth Strategy is part of the EU's broader maritime policy, aimed at harnessing ocean resources for economic growth, job creation, and ecosystem health.

The Atlantic Action Plan under the Blue Growth Strategy promotes sustainable development along the Atlantic seaboard. Projects like ATLAS20, which explores deep-sea ecosystems to inform sustainable ocean governance, exemplify the strategy's focus on balancing economic development with environmental protection.

The EU's commitment to promoting cross-border collaboration and innovation in the Blue Economy is reflected in various policies and programs. From supporting sustainable aquaculture and marine biotechnology to fostering investment in renewable energy, these initiatives enhance the resilience and competitiveness of coastal regions. By encouraging regional cooperation and leveraging unique strengths, the EU aims to create a thriving Blue Economy that benefits both people and the planet.

Each of these programs and projects not only supports economic development but also ensures that innovation aligns with sustainability goals, paving the way for a vibrant and resilient maritime future.

One significant gap in current funding schemes is the lack of instruments to support pilot projects, pre-seed, and seed investments. This creates a financing gap that disrupts the innovation cycle and hinders the transformation of successful research and development into market-ready business ventures. This issue is especially challenging for early-stage startups in sectors requiring substantial and long-term investments, such as companies developing innovative marine technologies like wave energy converters or sustainable aquaculture systems.

There is a pressing need for public policy to transition from a culture of grants and subsidies to one of financial instruments, leveraging public funds, particularly within the context of EU cohesion policy. Public funding can act as a catalyst for private

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<sup>19</sup> <https://fanbest.eu/>

<sup>20</sup> <https://www.eu-atlas.org/>

sector investment, creating a multiplier effect. Financial instruments offer more flexibility, adaptability, and scalability than traditional grant-based funding schemes.

To promote innovation and support emerging sectors like the Blue Economy, sector-specific financial instruments are needed. These instruments should address the specific needs of actors in less developed regions, providing targeted support for innovation and entrepreneurship in critical links of the blue economy value chains where gaps are identified. Financial instruments such as equity, debt, and guarantee schemes can effectively bridge these gaps, offering benefits like reduced investment risk, increased access to capital, and enabling scalable growth.

The success of policies and instruments in promoting interregional innovation within the Blue Economy can be attributed to several key factors. These initiatives are designed to foster cross-border collaboration, leverage regional strengths, enhance capacity building, and ensure access to funding. Programs such as Interreg URBACT IV, the Atlantic Strategy, the Common Maritime Agenda for the Black Sea, EUSAIR, EUSBSR, WEST MED Strategy, and NSR 2030 play a pivotal role in these efforts.

#### Case Study Cross-Border Collaboration and Investment

Interreg URBACT IV is a prime example of how cross-border collaboration is facilitated. This program supports cities in implementing green, just, and digital transitions through collaboration, capacity building, and expertise sharing. By bringing together stakeholders from different regions, Interreg URBACT IV promotes the exchange of best practices and innovative solutions, helping cities to address common challenges more effectively. This collaborative approach not only enhances innovation but also ensures that solutions are tailored to the specific needs of each region.

Similarly, the Atlantic Strategy and Common Maritime Agenda for the Black Sea foster collaboration among EU Member States and neighbouring countries. These programs focus on enhancing the sustainable development of marine and maritime sectors by promoting joint initiatives and projects. By working together, countries can leverage their collective knowledge and resources to tackle complex issues such as marine pollution, overfishing, and climate change. This collaborative framework is essential for fostering innovation and ensuring the sustainability of the Blue Economy.

Programs like EUSAIR (EU Strategy for the Adriatic and Ionian Region) and EUSBSR (EU Strategy for the Baltic Sea Region) emphasize capacity building and expertise sharing. These initiatives provide platforms for regional authorities, research institutions, and industry stakeholders to collaborate on developing and implementing sustainable urban development strategies. Through workshops, training sessions, and knowledge exchange events, these programs enhance the skills and capabilities of local actors, enabling them to drive innovation in their respective regions.

Capacity building is further supported by the WEST MED Strategy, which focuses on enhancing the economic potential of the Western Mediterranean region. This strategy promotes the development of maritime clusters and innovation hubs, which serve as centers for research, development, and commercialization of new technologies. By providing access to state-of-the-art facilities and fostering collaboration among

academia, industry, and government, the WEST MED Strategy helps to create a thriving innovation ecosystem in the region.

### Access to Funding and Integrated Approaches

One of the critical challenges for fostering innovation in the Blue Economy is access to funding. Programs like NSR 2030 (North Sea Region 2030) address this issue by improving access to various funding sources. These initiatives provide financial support for innovative projects, ensuring that promising ideas can be developed and brought to market. By offering grants, loans, and other financial instruments, these programs help to bridge the funding gap and stimulate investment in sustainable maritime technologies.

Moreover, these programs promote integrated and participative approaches, ensuring that all relevant stakeholders are involved in the decision-making process. This inclusive approach is crucial for developing policies and strategies that reflect the needs and priorities of different regions. By fostering a sense of ownership and collaboration among stakeholders, these initiatives create a conducive environment for innovation and sustainable development.

The success of policies and instruments in promoting interregional innovation within the Blue Economy lies in their ability to facilitate cross-border collaboration, enhance capacity building, provide access to funding, and promote integrated approaches. Programs like Interreg URBACT IV, the Atlantic Strategy, and EUSAIR exemplify how collaborative efforts, supported by targeted investments and expertise sharing, can drive innovation and sustainability in the maritime sectors. These initiatives not only address current challenges but also pave the way for future growth and development in the Blue Economy.

The European Union has launched several initiatives to promote the use of financial instruments in the Blue Economy. The BlueInvest platform connects innovative Blue Economy startups and SMEs with investors, facilitating access to finance. Additionally, the BlueInvest Fund is a dedicated equity fund investing in innovative and sustainable SMEs within the Blue Economy. However, accessing these financial instruments can be challenging for actors from less developed regions, who often lack information, capacity, and experience in utilizing them, putting them at a disadvantage.

Building the capacity of actors in less developed regions is crucial for improving access to existing support for innovative investments and enhancing their knowledge and expertise in effectively using financial instruments. This not only improves the success rate of innovative investments but also enables these actors to guide public authorities in creating new and improved solutions tailored to their specific challenges.

In addition to traditional financial instruments, novel approaches like crowdfunding and innovation public procurement show great potential for addressing funding gaps and supporting innovative investments in the Blue Economy. Crowdfunding offers a new channel for raising capital and engaging with potential customers, while innovation public procurement can drive the development of solutions to meet

specific regional and interregional needs driven by public institutions. Combining financial instruments with traditional tools, such as R&D tax incentives, can create a more comprehensive and effective support system for innovative investments.

### Importance of multilevel governance (MLG) in Implementing Smart Specialisation Strategies

Implementing Smart Specialisation Strategies (RIS3) in the European Union presents numerous governance challenges, particularly at the regional and sub-national levels. MLG has a role of effective coordination among various levels of government and stakeholders.

Regions with a strong historical background in innovation and significant transformation, such as North Rhine-Westphalia (NRW) and Saxony in Germany, demonstrate the critical role of national authorities in shaping regional innovation strategies. These regions benefit from a balanced involvement of both national and local governments in the Entrepreneurial Discovery Process (EDP), which is essential for discovering new domains and aligning them with Smart Specialisation principles.

Effective coordination and communication mechanisms between different levels of authority are crucial. This coordination ensures that regional innovation strategies are not only well-defined but also effectively implemented, leveraging national resources and local expertise.

In regions like Galicia in Spain, where innovation policies are well-established and integrated nationally, regional authorities face difficulties in monitoring and evaluating policy implementation. Involving multiple stakeholders from the EDP stage to the monitoring and evaluation phases can significantly enhance the effectiveness of RIS3 strategies.

Continuous interaction between institutions and government levels acts as a learning channel, allowing regions to absorb external knowledge and adapt to changes at the national or EU level. This adaptive governance is vital for the dynamic landscape of innovation policies.

Regions with geographical and demographic limitations, such as Nordland in Norway and Lapland in Finland, face unique governance challenges. Despite these challenges, they can still develop robust innovation strategies by leveraging their regional uniqueness and fostering harmonized innovation projects. Effective local coordination and strong synergies between different government levels are essential to optimize the impact of innovation projects in these areas. This coordination helps in overcoming inherent limitations and driving sustainable regional development.

The concept of MLG is pivotal in addressing the governance challenges associated with implementing Smart Specialisation. MLG emphasizes not only the need for coordination but also the importance of creating solid, harmonious, and balanced synergies among stakeholders at various government levels.

The evidence suggests that these elements are key in success of RIS3:

- **Coordination Mechanisms:** Effective coordination mechanisms can address governance issues by ensuring that policies and strategies are aligned across different government levels and stakeholder groups.
- **Stakeholder Engagement:** Engaging a wide range of stakeholders, including public authorities, private sector entities, academia, and civil society, ensures that diverse perspectives and expertise are integrated into the innovation strategies.
- **Learning and Adaptation:** Continuous learning and adaptation through interactions among institutions help regions remain responsive to evolving challenges and opportunities in the innovation landscape.

While Smart Specialisation strategies offer a structured approach to regional innovation, their implementation is fraught with governance challenges that require careful management. The role of MLG in facilitating these strategies is crucial, particularly in fostering coordination and synergies among different levels of government and stakeholders.

However, further research is needed to fully understand the impact of MLG on Smart Specialisation. Future studies should focus on different types of regions, including less developed areas of the EU, to draw more precise and generalizable conclusions. By addressing these gaps, policymakers can better design and implement strategies that harness the full potential of regional innovation.

This analysis underscores the need for ongoing evaluation and adaptation of governance structures to ensure the successful implementation of Smart Specialisation strategies, ultimately driving sustainable and inclusive growth across the EU.

Case Study: Bretagne's Success in Promoting Cross-Border Collaboration and Investment in the Blue Economy

Bretagne, a region in northwestern France, stands out as a leading example of how to effectively promote cross-border collaboration and investment in the Blue Economy. The region's success can be attributed to several key factors: robust marine research infrastructure, active membership in strategic networks, and the implementation of innovative projects and initiatives.

Bretagne has established a formidable network of marine research infrastructure, which includes technology transfer and innovation centers, marine biology stations, and a prominent regional marine competitiveness cluster. This extensive infrastructure supports a wide array of marine and maritime activities, fostering an environment conducive to innovation and collaboration.

**1. Technology Transfer and Innovation Centers:** These centers play a crucial role in bridging the gap between research and industry. By facilitating the transfer of cutting-edge technologies from research institutions to commercial applications, these centers help companies in Bretagne stay at the forefront of maritime innovation.

2. Marine Biology Stations: These stations conduct essential research on marine ecosystems and biodiversity. Their findings inform sustainable practices and policies, ensuring that economic activities in the Blue Economy are environmentally responsible.

3. Marine Competitiveness Cluster: Known as "Pôle Mer Bretagne Atlantique," this cluster brings together businesses, research institutions, and public authorities to work on collaborative projects. It serves as a hub for innovation, driving forward initiatives that enhance the region's competitiveness in the marine and maritime sectors.

Bretagne's active participation in strategic networks further strengthens its capacity for cross-border collaboration. One notable example is its membership in the Network of European Regions Using Space Technologies (NEREUS). This membership allows Bretagne to collaborate and exchange knowledge with other regions using space technologies for marine research and monitoring. By leveraging satellite data and other space-based technologies, Bretagne can enhance its marine research capabilities and develop more effective solutions for maritime challenges.

Bretagne has also implemented several innovative projects and initiatives that promote cross-border collaboration and investment in the Blue Economy:

1. EUSBSR Governance Flagships: These projects are part of the EU Strategy for the Baltic Sea Region (EUSBSR), focusing on governance improvements and fostering cooperation among Baltic Sea countries. Bretagne's involvement in these flagships exemplifies its commitment to enhancing regional collaboration and governance in marine and maritime sectors.

2. EEIG Submariner Network for Blue Growth: The Submariner Network promotes innovative and sustainable uses of marine resources in the Baltic Sea region. Bretagne's participation in this network facilitates the exchange of best practices and the development of joint projects with other regions, driving forward sustainable blue growth.

3. Interreg Mediterranean: Through its involvement in the Interreg Mediterranean program, Bretagne has helped establish Blue Economy alliances and communities. These alliances foster interregional cooperation and create opportunities for joint investments and collaborative projects. The program supports initiatives that address common challenges in the Mediterranean region, such as marine pollution, biodiversity loss, and climate change impacts.

Bretagne's success in promoting cross-border collaboration and investment in the Blue Economy is multifaceted. The region's strong marine research infrastructure, active membership in strategic networks, and implementation of innovative projects have created a thriving environment for maritime innovation and sustainable development. By leveraging these strengths, Bretagne not only enhances its regional competitiveness but also contributes to broader European efforts to achieve a sustainable and resilient Blue Economy. This case study of Bretagne illustrates the importance of strategic investments, collaborative networks, and innovative initiatives in driving forward the Blue Economy and fostering interregional cooperation.

### 3.4 Technologies and Innovative Blue Economy Projects: Identifying and analysing cutting-edge technologies and initiatives within the Blue Economy sector

The Blue Economy encompasses a wide range of economic activities related to oceans, seas, and coasts. It includes industries such as fisheries, maritime transport, renewable energy, tourism, and biotechnology. The European Union (EU) has been actively promoting innovations in the Blue Economy as part of its sustainable growth strategy.

There are many cutting-edge technologies and initiatives within the Blue Economy sector in the EU. Based on the analysis here are some of the newest initiatives/technologies/solutions that are detected in areas of interest (both topic of 2 specific value chains and participating regions) in this report:

#### Offshore Renewable Energy

The EU has been a pioneer in tapping into offshore wind energy. Advanced technologies such as floating wind turbines allow energy generation in deeper waters, where winds are stronger and more consistent. Moreover, there are explorations into harnessing tidal and wave energy, with projects like the world's first grid-connected wave energy array in **Portugal**.

The United Kingdom has emerged as a global leader in offshore renewable energy, notably through its substantial investments in offshore wind farms like the Hornsea Project. This project, set to be the world's largest offshore wind farm with over 6 GW capacity, exemplifies the UK's dedication to renewable energy. It features advanced turbines exceeding 8 MW each, designed for North Sea conditions and enhanced by digital technologies for optimal performance. Sustainability is a core focus, with measures to protect marine wildlife and innovative HVDC systems for efficient electricity transmission. The Hornsea Project will power over 6 million homes, significantly contributing to the UK's renewable energy targets and job creation. It underscores the UK's role in advancing clean energy and the economic and environmental benefits of large-scale renewable initiatives.

Newest trends, initiatives, news and projects

#### 1. Sumitomo Corporation's Offshore Wind Power Initiatives

Sumitomo Corporation is investing in offshore wind power as part of its renewable energy portfolio. This initiative aims to enhance the sustainable energy supply in coastal regions, contributing to environmental protection and reducing reliance on fossil fuels. The company collaborates with various stakeholders to develop and operate wind farms, reinforcing its commitment to the global energy transition.

Sumitomo Corporation has been actively participating in European offshore wind power projects, primarily in Germany, Belgium, the UK, and France. The EU aims to increase renewable energy use to 40% by 2030, leading to rapid growth in offshore

wind projects, especially in the North Sea. Sumitomo began its involvement in 2014 through strategic partnerships and has since contributed to several projects, including Belwind, Northwind, Nobelwind, and Northwester 2 in Belgium. Their success in Belgium led to further projects in the UK (Gallopier, Race Bank, Five Estuaries) and France (Le Tréport, Noirmoutier). These projects leverage advanced technology, large-scale turbines, and strategic local and global collaboration. The company aims to continue expanding its presence in the offshore wind market, moving towards a self-supporting renewable energy business model.

<https://www.sumitomocorp.com/en/cis/business/case/group/wind-power>

## 2. EU Offshore Renewable Energy Ambitions

The European Wind Package, adopted on October 24, 2023, is a comprehensive initiative designed to accelerate the deployment of wind energy and enhance the competitiveness of the European wind energy industry. This package is integral to achieving the EU's climate and energy goals, particularly increasing renewable energy capacity.

Key Components of the Wind Power Package:

Wind Power Action Plan:

- **Deployment Acceleration:** The plan emphasizes expediting wind energy projects through faster permitting processes and enhanced predictability.
- **Auction Design:** It proposes better pre-qualification criteria to ensure only viable projects bid, focusing on areas like data security and environmental protection.
- **Financial Support:** The plan includes measures to improve access to finance for new factories and infrastructure, with significant involvement from the European Investment Bank (EIB).

### 2. Renewables Auctions Platform:

A new EU-wide platform to provide detailed information on planned auctions, enhancing visibility and predictability for renewable energy investments.

### 3. Offshore Wind Expansion:

A roadmap to significantly increase offshore wind installations to nearly 12 GW per year by 2030, up from current levels.

### 4. Trade and Competition:

Measures to ensure a fair competitive environment for European wind energy companies, addressing unfair trade practices from non-European competitors.

### 5. Permitting and Digital Tools:

Development of digital tools like EasyPermits to streamline the permitting process.

#### 6. Cybersecurity Measures:

Implementation of cybersecurity measures and surveillance plans for offshore infrastructure, ensuring the protection of critical energy assets.

The European Commission's communication, Delivering on the EU Offshore Renewable Energy Ambitions, builds on this package by setting higher targets and outlining specific actions to meet these goals.

The communication underscores the need to address current challenges, such as high costs, fragmented supply chains, and increasing competition. It sets out several key actions to achieve the EU's ambitious targets for offshore renewable energy:

1. **Developing Cross-Border Offshore Grids:** Establishing methods for cost-benefit analysis and cost allocation to support the development of cross-border grids.
2. **Fast-Tracking Permitting:** Streamlining and expediting the permitting process to ensure quicker project deployment.
3. **Strengthening Maritime Spatial Planning (MSP):** Enhancing regional cooperation and sustainable coexistence between offshore renewables and other maritime activities.
4. **Improving Infrastructure Resilience and Security:** Strengthening the resilience of offshore renewable infrastructure and maritime security measures.
5. **Sustaining Research and Innovation (R&I):** Ensuring continuous investment in R&I to maintain technological leadership and develop sustainable solutions.
6. **Supporting EU Supply Chains:** Developing capabilities to remain competitive and meet higher installation targets through dedicated trade dialogues and industry involvement.

The communication highlights the need for a dramatic increase in offshore wind installations to meet the new targets—approximately 111 GW by 2030 and 317 GW by 2050. It also emphasizes the importance of regional cooperation and efficient infrastructure development to realize these goals.

By aligning these initiatives with a commitment to sustainability and resilience, the EU aims to lead the global transition toward renewable energy sources, ensuring a stable and competitive energy landscape.

#### 3. Planning Approval for a 560MW Floating Offshore Wind Project

A major floating offshore wind project with a capacity of 560MW has received planning approval. This project represents a significant step forward in the deployment of floating wind technology, which allows for the installation of turbines

in deeper waters where traditional fixed-foundation turbines are not feasible. This project, part of Crown Estate Scotland's Innovation and Targeted Oil & Gas (INTOG) leasing round, aims to deliver renewable electricity to oil and gas platforms, replacing natural gas and diesel power generation. The project will feature up to 35 floating wind turbines, producing up to 560MW of renewable energy, contributing to the UK grid. This advancement is expected to contribute substantially to the renewable energy supply and coastal protection efforts.

<https://www.current-news.co.uk/560mw-floating-offshore-wind-project-receives-planning-approval/>

#### 4. Romania's Offshore Wind Energy Law

Romania has passed a new law to support the development of offshore wind energy. This legislation provides a regulatory framework to facilitate the planning, construction, and operation of offshore wind farms in the Black Sea. The law aims to attract investment in renewable energy and enhance Romania's energy independence and sustainability.

<https://renewablesnow.com/news/romania-parliament-passes-offshore-wind-energy-law-854595/>

#### 5. EU's Message on Renewable Energy Independence

The European Union has emphasized the importance of diversifying renewable energy supply chains to reduce dependency on China. The EU advocates for increased investment in domestic production capacities for renewable technologies and closer collaboration with international partners to ensure a stable and secure energy transition.

<https://www.euractiv.com/section/energy-environment/news/eu-to-world-dont-depend-solely-on-china-to-hit-renewable-goals/>

#### 6. New Offshore Wind Farms in the Netherlands

The Netherlands is actively developing new offshore wind farms as part of its commitment to renewable energy. These projects are expected to contribute significantly to the country's energy mix, providing sustainable power and supporting the EU's climate objectives. The Dutch government is focused on facilitating the growth of offshore wind capacity through strategic planning and regulatory support.

<https://english.rvo.nl/topics/offshore-wind-energy/new-offshore-wind-farms>

#### 7. Hywind Scotland - Masdar's Offshore Wind Project

Masdar's Hywind Scotland project is a pioneering floating wind farm that harnesses strong offshore winds to generate renewable energy. This project demonstrates the viability and efficiency of floating wind technology, paving the way for future developments in deep-water wind energy production. Hywind Scotland is part of Masdar's broader strategy to expand its renewable energy portfolio.

<https://masdar.ae/en/renewables/our-projects/hywind-scotland>

#### 8. Community-Owned Wind Farm in Scottish Borders

A new wind farm project in the Scottish Borders is set to become Britain's largest community-owned renewable energy initiative. This project empowers local communities by involving them directly in the ownership and benefits of renewable energy production. It represents a model for sustainable development and community engagement in the renewable energy sector.

<https://www.current-news.co.uk/wind-farm-in-scottish-borders-to-be-britains-largest-people-owned-renewable-project/>

### Aquaculture Innovations

Sustainable aquaculture is crucial for the Blue Economy. Innovations include integrated multi-trophic aquaculture (IMTA), where the waste from fish farming is used to grow other marine species like shellfish and seaweed, creating a circular economy approach. There are also land-based recirculating aquaculture systems (RAS) that reuse water and control environmental conditions to maximize efficiency.

Denmark has emerged as a leader in European aquaculture innovation, driven by strong research infrastructure, strategic initiatives, and innovative approaches. Key

factors include the Danish Aquaculture Research Platform, which unites research centers and universities to focus on sustainable solutions like fish health and feed efficiency. Denmark's participation in European programs such as Interreg URBACT IV and the European Maritime and Fisheries Fund (EMFF) promotes cross-border collaboration and investment. Innovative technologies like Recirculating Aquaculture Systems (RAS) and Integrated Multi-Trophic Aquaculture (IMTA) enhance sustainability and productivity. Denmark's role in European networks and programs, including NEREUS and the Atlantic Strategy, fosters cooperation and knowledge sharing, positioning Denmark at the forefront of sustainable aquaculture and the Blue Economy.

Newest trends, initiatives, news and projects

#### 1. AQUAEXCEL3.0 - Advanced Aquaculture Research Infrastructure

AQUAEXCEL3.0 is a project under the Horizon 2020 program aimed at enhancing the sustainability and innovation of aquaculture in Europe. It provides researchers with access to top-tier aquaculture research facilities and promotes collaboration across disciplines. The project's goals include improving the efficiency of aquaculture systems, developing new technologies, and advancing scientific knowledge to support the industry's growth.

<https://aquaexcel.eu/about/>

#### 2. Copernicus Marine Service

The Copernicus Marine Service offers comprehensive marine data and products to support various marine activities, including aquaculture. This initiative provides essential information on ocean conditions, such as temperature, salinity, and currents, which are crucial for sustainable aquaculture operations. The service aims to enhance the efficiency and environmental impact of aquaculture by providing accurate and timely marine data.

<https://marine.copernicus.eu/about>

#### 3. ALEGHOOP - Integrating Animal and Plant Protein Sources

The ALEGHOOP project focuses on developing innovative aquafeeds by integrating alternative protein sources, including plant-based and insect-derived proteins. This initiative aims to improve the sustainability of aquaculture by reducing the reliance on traditional fishmeal and fish oil. The project also explores the economic and environmental benefits of these alternative proteins in aquafeed formulations.

<https://alehoop.eu/objectives/>

#### 4. Aquaculture Trends and Innovations Guide

StartUs Insights provides an extensive guide on the latest trends and innovations in aquaculture. This guide highlights various technological advancements such as automated feeding systems, AI-driven monitoring tools, and sustainable aquafeed

developments. It also covers emerging practices in aquaculture management that aim to increase productivity and environmental sustainability.

<https://www.startus-insights.com/innovators-guide/aquaculture-trends/>

## Maritime Transport Technologies

Maritime transport technologies are at the forefront of transforming global shipping and logistics, aiming to enhance efficiency, sustainability, and safety across the industry. These technologies encompass a wide range of innovations, including advanced navigation systems, autonomous vessels, and eco-friendly propulsion methods. By integrating digitalization, automation, and green energy solutions, maritime transport technologies are pivotal in reducing operational costs, minimizing environmental impact, and improving the reliability and security of maritime operations. As the maritime industry evolves, these technological advancements play a crucial role in driving the future of global trade and transportation.

The Port of Rotterdam in the Netherlands exemplifies the transformative power of maritime transport technologies, thanks to innovations led by the Rotterdam Port Authority. A key advancement is the development of a digital twin, a virtual replica of the port for real-time monitoring and management, optimizing logistics, reducing congestion, and improving efficiency. Automation, with automated guided vehicles (AGVs) and cranes, reduces manual labor and enhances safety.

Sustainability is a major focus, with investments in shore power systems to reduce emissions and exploration of hydrogen and renewable energy sources. The port's blockchain technology, developed with IBM, streamlines logistics, enhances transparency, and improves cargo tracking security.

These advancements have led to significant efficiency gains, reduced turnaround times, improved cargo handling, and a marked reduction in greenhouse gas emissions. Economically, the port has become more competitive, attracting more business and boosting regional growth. The Port of Rotterdam sets a global benchmark for innovation in maritime transport, showcasing the potential of modern technologies to drive efficiency, sustainability, and economic prosperity.

Newest trends, initiatives, news and projects

### 1. EU Initiatives for Reducing Emissions in the Shipping Sector

The European Union is actively working to reduce emissions in the shipping sector as part of its broader climate action goals. This includes implementing measures to improve energy efficiency, promoting the use of alternative fuels, and developing regulations to limit greenhouse gas emissions from ships. The EU's strategy aims to make maritime transport more sustainable and align with the goals of the European Green Deal.

[https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-shipping-sector\\_en](https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-shipping-sector_en)

## 2. FuelEU Maritime - Decarbonising Maritime Transport

The FuelEU Maritime initiative is part of the EU's efforts to decarbonize maritime transport. It sets out regulations to increase the uptake of sustainable alternative fuels and improve the overall energy efficiency of ships. The initiative is designed to reduce the carbon footprint of maritime activities and support the transition towards zero-emission shipping.

[https://transport.ec.europa.eu/transport-modes/maritime/decarbonising-maritime-transport-fueleu-maritime\\_en](https://transport.ec.europa.eu/transport-modes/maritime/decarbonising-maritime-transport-fueleu-maritime_en)

## 3. Renewable and Low-Carbon Fuels Value Chain Industrial Alliance

This alliance aims to develop a comprehensive value chain for renewable and low-carbon fuels within Europe. It focuses on fostering collaboration between industry stakeholders to innovate and scale up the production and use of these fuels in maritime transport. The alliance supports the EU's objectives of achieving sustainable mobility and reducing dependency on fossil fuels.

[https://transport.ec.europa.eu/transport-themes/clean-transport/alternative-fuels-sustainable-mobility-europe/renewable-and-low-carbon-fuels-value-chain-industrial-alliance\\_en](https://transport.ec.europa.eu/transport-themes/clean-transport/alternative-fuels-sustainable-mobility-europe/renewable-and-low-carbon-fuels-value-chain-industrial-alliance_en)

## 4. EU Funding for Zero-Emission Mobility Projects

The European Union is boosting zero-emission mobility through significant funding allocations. In 2024, the EU is investing over €424 million in 42 projects aimed at promoting zero-emission transport technologies. These projects include the development of advanced maritime transport solutions that contribute to reducing greenhouse gas emissions and supporting the EU's climate targets.

[https://transport.ec.europa.eu/news-events/news/eu-boosts-zero-emission-mobility-over-eu424-million-funding-42-projects-2024-04-10\\_en](https://transport.ec.europa.eu/news-events/news/eu-boosts-zero-emission-mobility-over-eu424-million-funding-42-projects-2024-04-10_en)

## Marine Biotechnologies

Marine biotechnologies are revolutionizing our understanding and utilization of oceanic resources, unlocking new potentials in medicine, agriculture, and environmental management. By harnessing the unique properties of marine organisms, these technologies drive innovations in pharmaceuticals, biofuels, and sustainable aquaculture practices. The field encompasses a diverse array of applications, from developing novel antibiotics and anti-cancer agents to creating biodegradable materials and enhancing food security. As research advances, marine biotechnologies hold the promise of addressing critical global challenges while fostering sustainable economic growth through the responsible exploitation of marine biodiversity.

Norway has become a leader in marine biotechnologies, leveraging its marine resources to drive innovation in various sectors. Marine bioprospecting, supported by the MABIT program, has led to significant discoveries such as novel antibiotics and anti-cancer agents from marine organisms. Unique enzymes from cold-water species are used in efficient biotechnological processes at low temperatures, benefiting industries like pharmaceuticals and environmental management.

Norway's investment in sustainable aquaculture includes innovations like vaccines and probiotics, reducing antibiotic use and promoting healthier fish farming. Algae-based feeds have also decreased dependence on wild fish stocks, enhancing sustainability. Collaboration between universities, research institutes, and industry has facilitated the commercialization of scientific discoveries, with dedicated centres like the Norwegian Centre for Marine Biotechnology underscoring the commitment to this field.

The marine biotechnology sector has significantly impacted Norway's economy by creating high-value jobs and driving growth, especially in coastal communities. Norway's strategic investment in research, collaboration, and sustainable practices has positioned it as a global leader in marine biotechnologies, contributing to advancements in medicine, agriculture, and environmental sustainability, serving as a model for other nations.

Newest trends, initiatives, news and projects

#### 1. Ocean4Biotech Platform

This platform serves as a networking hub within the marine biotechnology sector. It likely facilitates collaboration, information sharing, and possibly funding opportunities for professionals and organizations involved in biotechnology research related to oceanic resources.

<https://www.ocean4biotech.eu>

#### 2. IMAGINE: Next Generation Imaging Technologies to Probe Structure and Function

The IMAGINE project, under the umbrella of the European Marine Biological Resource Centre (EMBRC), focuses on developing advanced imaging technologies for investigating the structure and function of marine organisms. This collaborative effort likely aims to enhance scientific understanding and potentially unlock novel applications in marine biotechnology.

<https://www.embrc.eu/collaborative-projects/imagine-next-generation-imaging-technologies-probe-structure-and-function>

#### Ocean Observing and Sensing

Ocean observing and sensing technologies are critical for advancing our understanding of marine environments and addressing global challenges such as climate change, biodiversity loss, and resource management. These technologies

encompass a wide range of tools and systems, including satellite remote sensing, autonomous underwater vehicles (AUVs), and sensor networks, which collectively provide comprehensive data on oceanographic conditions. By enabling real-time monitoring and long-term data collection, ocean observing and sensing technologies facilitate scientific research, inform policy decisions, and support sustainable ocean stewardship, ensuring the health and productivity of marine ecosystems for future generations.

Portugal has emerged as a leading success story in ocean observing and sensing, thanks to a combination of innovative projects, robust infrastructure, and dynamic institutions. This collective effort supports sustainable management of marine resources and contributes to global oceanographic research.

One of the key initiatives is JERICO-NEXT21, a European project that enhances coastal observatories by integrating ocean observing systems. Portugal's active participation in this project demonstrates its commitment to advancing research and technology in marine science. Additionally, the EMSO-PT (European Multidisciplinary Seafloor and Water Column Observatory)<sup>22</sup> plays a vital role in long-term ocean monitoring, providing critical data essential for understanding marine ecosystems.

The MARE (Marine and Environmental Sciences Centre)<sup>23</sup> is another pivotal player, dedicated to advancing marine science and technology. MARE collaborates on various national and

Several key institutions bolster Portugal's ocean observing efforts. The IPMA (Portuguese Institute for Sea and Atmosphere)<sup>24</sup> is a governmental body essential for oceanographic research, weather forecasting, and climate monitoring. Its contributions are vital to the success of ocean observing initiatives in the country.

The CIIMAR (Interdisciplinary Centre of Marine and Environmental Research)<sup>25</sup> engages in cutting-edge marine science research, focusing on sustainable marine resource management and monitoring technologies. Additionally, the FCT (Foundation for Science and Technology)<sup>26</sup> provides critical funding and support for ocean research, fostering collaborations that drive innovation in marine science.

Portugal's collaborative spirit is evident in its involvement in international projects such as ATLANTIS<sup>27</sup> and various H2020 projects. They further demonstrates Portugal's commitment to marine and environmental research, contributing to advancements in ocean observing technologies. Additionally, involvement in the EOOS (European Ocean Observing System) reflects Portugal's role in enhancing Europe's capacity for comprehensive ocean monitoring.

In conclusion, Portugal's success in ocean observing and sensing is a result of strategic projects, advanced infrastructure, and dynamic institutions. This collective effort not

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<sup>21</sup> <https://www.jerico-ri.eu/previous-project/jerico-next/>

<sup>22</sup> <https://emso.eu/>

<sup>23</sup> <https://www.mare-centre.pt/en>

<sup>24</sup> <https://www.ipma.pt/en/>

<sup>25</sup> <https://www.ciimar.up.pt/>

<sup>26</sup> <https://www.fct.pt/en/>

<sup>27</sup> <https://www.atlantis-h2020.eu/project/>

only supports environmental monitoring but also fosters innovation and sustainable management of marine resources. Through collaborations and partnerships, Portugal continues to make significant contributions to marine science, solidifying its position as a leader in the field.

Newest trends, initiatives, news and projects

### 1. EOOS: European Ocean Observing System

EOOS is a framework established to coordinate and enhance Europe's ocean observing efforts. It likely aims to improve data collection, sharing, and utilization for various applications such as marine research, environmental monitoring, and policymaking.

<https://eurogoos.eu/eoos/>

### 2. EMSO: European Multidisciplinary Seafloor and water column Observatory

EMSO provides infrastructure for observing the seafloor and water column across European marine regions. It likely supports research in oceanography, geology, and marine biology, contributing to a better understanding of marine processes and ecosystems.

<https://emso.eu/what-is-emso/>

### 3. GEORGE Project

The GEORGE project likely focuses on advancing technologies for ocean observation and data collection. It may involve the development of innovative sensors, platforms, or data processing techniques to improve our understanding of the marine environment and its dynamics.

<https://george-project.eu>

### 4. DTO-BioFlow: Integration of Biodiversity Monitoring Data into a Digital Twin of the Ocean

The DTO-BioFlow project, part of the European Marine Biological Resource Centre (EMBRC), likely aims to integrate biodiversity monitoring data into a digital twin of the ocean. This integration could provide researchers with a comprehensive virtual representation of marine ecosystems, aiding in conservation efforts and sustainable management.

<https://www.embrc.eu/collaborative-projects/dto-bioflow-integration-biodiversity-monitoring-data-digital-twin-ocean>

## Seabed Mining Technologies

Seabed mining technologies represent a frontier in resource extraction, targeting valuable minerals like polymetallic nodules, cobalt-rich crusts, and hydrothermal vent deposits found on the ocean floor. These technologies include remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), and advanced drilling and dredging systems, designed to operate in extreme deep-sea conditions. By enabling the exploration and extraction of deep-sea resources, seabed mining technologies have the potential to supply critical materials for electronics and renewable energy sectors. However, they also pose significant environmental and regulatory challenges, necessitating sustainable practices and robust international oversight.

Germany has become a leader in seabed mining technologies, driven by sustainable resource extraction and innovation. The Helmholtz Institute for Ocean Research Kiel (GEOMAR) has developed advanced mining robots and remotely operated vehicles (ROVs) for extracting polymetallic nodules rich in minerals like manganese, nickel, and cobalt, essential for batteries and renewable energy technologies. GEOMAR's key innovations include the Autonomous Underwater Vehicle (AUV) "Abyss," which operates at depths of up to 6,000 meters, and the "MeBo" seabed drilling rig, both designed for precise mapping and sampling of the seabed.

GEOMAR also emphasizes environmental monitoring, employing a comprehensive impact assessment framework to ensure minimal ecological impact. This includes baseline studies, continuous monitoring during mining, and post-mining rehabilitation. Germany's advancements aim to reduce dependence on terrestrial mining and secure a stable supply of critical materials for high-tech industries, supporting economic growth and sustainability goals.

In conclusion, Germany's integration of advanced seabed mining technologies, such as the Abyss AUV and MeBo drilling rig, alongside strong environmental stewardship, demonstrates the potential for sustainable ocean floor resource extraction. These efforts set a high standard for responsible seabed mining practices, balancing technological advancement with ecological preservation.

Newest trends, initiatives, news and projects

### 1. Deep Sea Mining Initiatives Expanding Reach to National Waters

This article discusses the expansion of deep-sea mining initiatives into national waters. It likely explores the increasing interest and activity in exploiting mineral resources from the seabed, highlighting regulatory challenges, environmental concerns, and potential economic impacts.

<https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/deep-sea-mining-initiatives-expanding-reach-to-national-waters-80049135>

## 2. European Commission Announces Plans to Step-Up Deep-Sea Mining Exploration on Same Day as IUCN Adopts Moratorium Motion

This announcement likely discusses the European Commission's plans to intensify exploration activities for deep-sea mining. It may highlight the policy decisions, research initiatives, or industry collaborations aimed at advancing the exploration and potentially the exploitation of mineral resources in the deep sea.

<https://seas-at-risk.org/general-news/european-commission-announces-plans-to-step-up-deep-sea-mining-exploration-on-same-day-as-iucn-adopts-moratorium-motion/>

## 3. Deep Sea Mining Summit

The Deep Sea Mining Summit likely serves as a conference or forum where experts, stakeholders, and industry leaders gather to discuss advancements, challenges, and opportunities in deep-sea mining technologies and operations. It may cover topics such as technological innovation, environmental impact assessment, regulatory frameworks, and market trends related to seabed mining.

<https://www.deepsea-mining-summit.com>

# Conclusions

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The Blue Economy encompasses a broad spectrum of economic activities related to oceans, seas, and coasts. It includes sectors such as fisheries, maritime transport, renewable energy, tourism, and biotechnology. The analysis presented in the "Trend Analysis and Ecosystem Mapping" report highlights key trends, value chains, and the performance of the Blue Economy across various European countries and regions. This conclusion synthesizes the main points from the report, focusing on specific value chains and overall trends shared by the analyzed countries/regions. Additionally, it includes the visions for the Blue Economy of each country and region as presented in subchapter 3.2.

### **Key Trends and Value Chains**

Marine Renewable Energy:

Marine renewable energy, particularly offshore wind, wave, and tidal energy, has shown remarkable growth and potential. The EU has been a leader in developing these energy sources, which are crucial for meeting renewable energy targets and climate objectives. Significant investments and advancements have been made in this sector, with notable projects in countries like the UK, Germany, and Portugal.

Offshore Wind Energy:

The offshore wind energy sector has experienced substantial growth, with a 326% increase in Gross Value Added (GVA) from 2015 to 2021. Countries like the UK and

Germany have pioneered in this field, supported by robust policy frameworks and substantial investments in research, development, and infrastructure. For instance, the UK's Hornsea Project, set to be the world's largest offshore wind farm, exemplifies significant advancements in this sector.

Sustainable Fisheries and Aquaculture:

Sustainable fisheries and aquaculture are vital components of the Blue Economy, focusing on the responsible management and cultivation of aquatic organisms to ensure long-term food security and ecosystem health. Innovations in this sector include integrated multi-trophic aquaculture (IMTA) and land-based recirculating aquaculture systems (RAS).

Fisheries and Aquaculture:

This sector emphasizes environmentally friendly practices, such as the development of sustainable feed and disease management protocols. Regions like Norway and Denmark have led in developing sustainable aquaculture technologies, benefiting from strong innovation ecosystems and supportive regulatory environments.

Blue Biotechnology:

Blue biotechnology involves the exploration of marine resources for biotechnological applications, including pharmaceuticals, biofuels, and innovative materials. This sector is gaining momentum, driven by advancements in marine research and the growing need for sustainable and eco-friendly products.

Biotechnology Applications:

Innovations in blue biotechnology are creating new business opportunities and driving economic growth. The development of bioactive compounds from marine organisms for pharmaceuticals and nutraceuticals is one of the promising areas within this sector.

Coastal and Marine Tourism:

Coastal tourism remains the largest sector within the Blue Economy, generating significant economic activity and employment. However, it was the most affected by the COVID-19 pandemic and had not fully recovered by 2021. Efforts are being made to promote sustainable tourism practices that balance economic benefits with environmental preservation.

Tourism Recovery:

While coastal tourism is crucial for many regions, it needs to adopt more sustainable practices to ensure long-term viability and environmental sustainability. Regions like Andalucía in Spain and coastal areas of Croatia heavily rely on tourism for economic stability.

## **Overall Trends and Shared Characteristics**

Emphasis on Sustainability and Climate Action:

Across all analyzed regions, there is a strong emphasis on sustainability and climate action. The Blue Economy is seen as a pivotal sector for achieving carbon neutrality

and environmental goals set by the European Green Deal. Initiatives focus on promoting renewable energy, reducing carbon emissions, and adopting circular economy principles.

#### Sustainable Development Goals:

The integration of sustainable practices is evident in sectors like marine renewable energy, sustainable fisheries, and the valorization of blue resources. Efforts to reduce plastic pollution, enhance resource efficiency, and promote eco-friendly technologies are common across regions.

#### Innovation and Technological Advancement:

Innovation is a driving force in the Blue Economy, with significant investments in research and development. The adoption of digital technologies, artificial intelligence, and advanced marine engineering is transforming traditional maritime activities and creating new economic opportunities.

#### Technological Integration:

Regions with strong innovation ecosystems, such as Finland and the Netherlands, are leveraging technological advancements to enhance their Blue Economy sectors. Smart specialization strategies (RIS3) are crucial in promoting regional strengths and driving innovation.

#### Regional Cooperation and Policy Support:

Interregional cooperation and supportive policy frameworks are critical for the growth of the Blue Economy. The EU's Smart Specialization Platform on Blue Economy, along with funding instruments like InvestEU and the Connecting Europe Facility, are instrumental in fostering collaboration and investment across regions.

#### Policy and Investment:

Strategic policies aimed at enhancing regional competitiveness and innovation capacities are essential. Developed regions are effectively using RIS3 strategies to focus on niche areas of competitive strength, such as marine renewable energy and sustainable aquaculture.

#### Economic Resilience and Growth:

The Blue Economy sectors have shown resilience and growth despite challenges such as the COVID-19 pandemic and rising energy prices. Emerging sectors like blue biotechnology and desalination are creating new business opportunities and driving economic resilience.

#### Economic Performance:

Data from the report indicates significant increases in employment, turnover, and GVA in the Blue Economy sectors, underscoring their role in regional economic development. For instance, employment in the Blue Economy stood at 3.6 million people in 2021, with substantial increases in GVA and turnover across various sectors.

## **Trends in Each Country/Region**

### Poland - Pomerania Region:

The Pomerania region aims to become a leading hub for sustainable maritime activities, leveraging its maritime heritage and modern infrastructure. Key elements of Pomerania's vision include:

- Modernizing maritime transport and port infrastructure to reduce environmental impacts.
- Investing in marine renewable energy sources like offshore wind farms.
- Expanding blue biotechnology and sustainable aquaculture sectors.
- Supporting research and innovation in marine technologies.

### Portugal - Azores, Norte, and Centro Regions:

Portugal's vision for the Blue Economy emphasizes sustainable management of marine resources, marine spatial planning, and technological innovation. Key elements include:

- The Azores focusing on marine conservation, sustainable fisheries, and marine renewable energy.
- The Norte region prioritizing the sustainable use of marine resources and promoting marine biotechnology.
- The Centro region integrating advanced technologies in marine research and fostering partnerships between academia, industry, and government.

### Spain - Andalusia Region:

Andalusia's vision is to develop a sustainable Blue Economy that promotes innovation, sustainability, and collaboration. Key elements include:

- Protecting marine biodiversity and improving habitats.
- Supporting climate change adaptation and coastal resilience.
- Driving research and innovation in blue knowledge.
- Promoting sustainable tourism and fostering marine culture.

### France - Brittany and Pays de la Loire Regions:

France aims to become a leader in green hydrogen and renewable energies, focusing on innovation, sustainability, and global leadership. Key elements include:

- Investing in renewable energy technologies and decarbonizing maritime industries.
- Developing marine biotechnologies and sustainable fisheries.
- Promoting maritime transport, port modernization, and coastal tourism.

### Italy - Emilia-Romagna Region:

Emilia-Romagna's vision focuses on sustainable Blue Growth and integrating circular economy principles. Key elements include:

- Promoting blue biotechnology and sustainable aquaculture.
- Enhancing the resilience of marine ecosystems.
- Developing marine renewable energy sources and sustainable coastal tourism.

#### Netherlands:

The Netherlands aims to lead in maritime innovation and sustainability. Key elements include:

- Advancing renewable marine energy and maritime decarbonization.
- Supporting sustainable fisheries and aquaculture.
- Fostering technological innovation and collaboration in maritime sectors.

#### Finland - Ostrobothnia Region:

Ostrobothnia's vision focuses on leveraging its innovation ecosystem to drive the Blue Economy. Key elements include:

- Promoting sustainable fisheries and aquaculture.
- Advancing renewable marine energy technologies.
- Supporting maritime decarbonization efforts.

#### Croatia:

Croatia aims to enhance its Blue Economy by focusing on sustainable fisheries, renewable energy, and technological innovation. Key elements include:

- Promoting sustainable fishing practices and aquaculture.
- Developing marine renewable energy projects.
- Leveraging digital technologies for maritime activities.

The analysis of the Blue Economy across different European regions reveals shared trends of sustainability, innovation, and resilience. Marine renewable energy, sustainable fisheries, blue biotechnology, and coastal tourism are key value chains driving economic growth and environmental sustainability. Regional cooperation, strategic policy support, and technological advancements are critical for harnessing the full potential of the Blue Economy. The collective efforts across regions highlight the importance of a coordinated and sustainable approach to leveraging marine resources for long-term economic and environmental benefits. Each country's and region's vision for the Blue Economy reflects a commitment to innovation, sustainability, and global leadership, contributing to the overall resilience and growth of this vital sector.

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