



i3⁴BLUE GROWTH

green innovation for blue growth

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Executive Summary

This summary report represents one step forward towards enhancing the sustainable blue economy in Europe, a critical domain of activity for addressing climate change, promoting economic growth, and ensuring food security. The I3-4-BLUE-GROWTH project focuses on two key value chains: sustainable seafood and aquaculture, and marine renewable energy and decarbonization. The report summarizes, systematically, the main needs, challenges, and innovation investment priorities for the sustainable blue economy in Europe.

Objectives of Report

The primary objective of this summary report is to present, systematically, the main needs, challenges, and innovation investment priorities that were discussed in Quadruple Helix Working Groups for each one of the two targeted value chains that are approached in this project. The goal is to uncover potential innovation collaborations and establish a methodology for developing a solid investment pipeline for interregional innovation projects.

Methodology

The summary report was developed through a comprehensive methodology, including stakeholder workshops, a literature review on sustainability and innovation in the blue economy, and data analysis to identify needs, challenges, and innovation investment priorities.

Key Needs and Challenges

The document identifies significant challenges within the blue economy, such as complex regulatory frameworks, high initial investments for sustainable practices, and fragmented policies across regions. These challenges highlight the need for targeted interventions to promote sustainability and technological advancement.

Conclusion

The progress and growth of the Blue Economy in Europe will require coordinated and innovative approaches. The action plan that will be developed in Deliverable 2.5 will address these topics in further detail.

1. Introduction

A sustainable blue economy is vital for the future prosperity and environmental health of Europe. It represents a pivotal component in addressing climate change, fostering economic growth, and ensuring food security. The I3-4-BLUE-GROWTH project specifically targets two critical value chains within this economy: sustainable seafood, aquaculture, and the valorization of blue resources (value chain 1), and marine renewable energy and the decarbonization of the maritime sector (value chain 2). These sectors hold immense potential for innovation and development, and their advancement is essential for achieving a sustainable and smart green and blue economy.

The primary objective of this summary report is to present, systematically, the main needs, challenges, and innovation investment priorities that were discussed in Quadruple Helix Working Groups for each one of the two targeted value chains that are approached in this project. The goal is to uncover potential innovation collaborations and establish a methodology for developing a solid investment pipeline for interregional innovation projects.

The data for the development of this summary report was collected in the stakeholder workshops conducted as part of the project (T2.2). The report is divided into three main parts: a literature review on sustainability and innovation in the blue economy, the methodology employed, and data analysis according to the methodology adopted.

2. Sustainability and Innovation in the Blue Economy

2.1 Smart Specialization and Interregional Cooperation: A Pathway to Development and Innovation

The notion of smart specialization started being approached in the early 2000s to address the fragmented innovation landscape in Europe. It was

introduced by Dominique Foray, and it became a fundamental aspect of the EU's cohesion policy with the goal of promoting balanced regional development (Foray et al., 2011). Integrated into the Europe 2020 strategy, smart specialization aims for smart, sustainable, and inclusive growth across the EU. This strategic approach to regional development involves identifying and leveraging a region's unique strengths and competitive advantages to drive innovation and economic growth (Foray, 2016).

By focusing on key areas of specialization based on the region's existing assets, capabilities, and potential for innovation, resources and efforts can be channelled into developing and supporting these areas. Smart specialization became an ex-ante condition for ESIF innovation funding from 2014-2020 and an enabling condition from 2021-2027, ultimately seeking to maximize the impact of investments and policy decisions by aligning them with the specific strengths and opportunities of the regions, leading to sustainable transformation of regional economies (Gianelle et al., 2016).

In today's societies, smart specialization is crucial for addressing major challenges. The European Union still grapples with economic disparities among its regions. This approach plays a significant role in promoting balanced regional development, allowing less-developed regions to catch up with more advanced ones (Woolford et al., 2024). Moreover, in the face of rapid technological innovation, smart specialization facilitates the alignment of regional capabilities with global technological trends, fostering innovation ecosystems tailored to regional strengths and accelerating the adoption and diffusion of new technologies. Furthermore, in the context of climate change and environmental degradation, smart specialization strategies aim to align regional development with sustainability goals, encouraging investment in green technologies and sustainable practices to contribute to the fight against climate change and the transition to a low-carbon economy (Harding et al., 2021). Finally, economic resilience amidst global economic

uncertainties is essential, and smart specialization plays a pivotal role in enhancing economic resilience by diversifying economic activities based on regional strengths, making regions less vulnerable to external shocks through the development of robust, specialized sectors that can withstand economic fluctuations (Gianelle et al., 2024)

Interregional cooperation is a crucial but often overlooked aspect of smart specialisation. It involves aligning with the priorities outlined in each region's smart specialisation strategy to foster international collaboration between research institutions, innovators, businesses, and civil society (Rodríguez-Pose, 2023). This alignment should target common areas of interest and capitalize on the identification of complementary strengths between regions. To facilitate such cooperation, actions need to be taken to involve regional stakeholders - such as universities, research institutions, enterprises, clusters, and civil society - in actively participating and contributing to innovation-driven networks and relevant initiatives.

Recent reflections have highlighted the multiple benefits of interregional cooperation, particularly in the context of S3CP - S3 Community of Practice (Woolford et al., 2020; Rodríguez-Pose, 2023). For regional innovation actors, it provides access to complementary resources, skills, knowledge, and capabilities and engagement with lead users to create critical mass. It also accelerates technology demonstration, deployment, and scale-up processes, promoting an outward-looking approach and encouraging openness to external ideas and collaborations. Additionally, it promotes better alignment of smart specialisation policies, ensuring coherence and synergy, and identifies and exploits funding synergies, optimizing financial resources for innovation efforts.

For regional policies, interregional cooperation enhances regional competitiveness and attractiveness through access to diverse resources and expertise and strengthens innovation ecosystems by fostering collaboration and knowledge exchange (Gianelle et al., 2024).

Furthermore, it facilitates regional economic growth and development through the rapid uptake of innovative technologies and strengthens the region's position in wider innovation networks and global value chains. It also maximizes the impact of regional investment by leveraging complementary strengths and resources across regions.

Smart specialisation and interregional cooperation can significantly impact the sustainable blue economy by maximizing the potential of regional blue economy sectors and ensuring that investments align with sustainability goals.

2.2 The Role of the Sustainable Blue Economy

The European Union has increasingly prioritized the sustainable blue economy as a pivotal component of its broader strategy for economic transformation, encapsulated within the European Green Deal (EC, 2021). This strategic initiative aims to reorient the EU's economy towards sustainability and resilience, addressing challenges such as climate change impacts, sustainable resource management, and economic diversification across coastal and marine sectors.

The concept of the blue economy encompasses a range of economic activities related to oceans, seas, and coastal areas, including fisheries, maritime transport, tourism, and renewable energy. These activities are crucial for both economic development and environmental stewardship, aiming to balance socioeconomic benefits with ecosystem preservation (Martinez-Vazquez et al., 2021). The evolution of the blue economy concept has seen it become synonymous with terms like marine economy and blue growth, all of which emphasize sustainable utilization and conservation of marine resources (Pinto et al., 2015).

Typically, the blue economy is divided into two types of activities in terms of their link to marine resources:

- **Marine-based activities** are the core of the blue economy, i.e. those activities that take place in the ocean, sea and coastal areas, such

as marine living resources (capture fisheries and aquaculture), marine non-living resources, marine renewable energy, desalination, maritime transport and coastal tourism.

- **Marine-related activities** are major activities that use products and/or produce products and services from the ocean or from marine-based activities, such as seafood processing, biotechnology, shipbuilding and repair, port activities, technology and equipment, digital services, among others.

The sustainable blue economy holds significant importance for Europe's economic and environmental goals. By promoting sustainable practices in sectors like fisheries and renewable energy, the blue economy aims to decouple economic growth from environmental degradation, thereby supporting long-term ecosystem health and resilience (UNCTAD, 2014; UN DESA, 2014). Moreover, embracing the principles of the blue economy offers opportunities for job creation, poverty alleviation, and economic diversification, particularly in regions dependent on coastal and marine resources (UNEP, 2013; UNCTAD, 2014).

In this sense, innovation plays a pivotal role in advancing sustainable ocean-based economies by driving technological advancements and practices that improve resource efficiency and reduce environmental impacts (UN, 2014). At the same time, interregional collaboration is essential for realizing the full potential of sustainable ocean-based economies. It facilitates knowledge sharing among regions, enabling the transfer of best practices and innovative solutions in ocean management (EC, 2021). Collaborative efforts also enhance capacity building across regions, enabling less developed areas to adopt and implement sustainable practices effectively. Economically, interregional collaboration creates synergies that foster new economic activities and investment opportunities in marine sectors, benefiting participating regions collectively.

Furthermore, interregional collaboration helps aligning policies and governance frameworks related to ocean management, ensuring consistency and coherence in sustainable development efforts (UN, 2014). Interregional collaboration contributes to the preservation and prosperity of marine ecosystems and coastal communities over the long term by fostering cooperation and shared responsibility among regions.

The blue economy sector is so diverse that it needs individualised responses adapted to each industry. It is in the midst of these specificities that real opportunities for innovation and interregional cooperation can emerge. In this sense, it is important to distinguish formally the different economic activities that make up the blue economy. For this purpose, it is crucial to use common international standards.

Using the NACE code - the statistical classification of economic activities in the European Community - similar to the SIC (the Standard Industrial Classification in the US), table 1 presents a typology of economic activities that are fully maritime - such as fishing - or mainly maritime - such as shipbuilding. Or even partially marine, with many sectors, as shown in the table, for example, the main activities that we develop in universities, R&D or education.

Table 1 – Typology of Marine Sectors and Industries

Group	Marine Sector	Marine Industry
Completely marine	1. Living resources	1.1. Fishing 1.2. Aquaculture 1.3. Seafood processing 1.4. Seafood markets
	3. Ship and boat building	3.1. Ship building 3.2. Boat building 3.3. Repair and maintenance
	5. Transportation	5.1. Marine passenger transportation 5.2. Marine freight transportation
Mainly marine	2. Non-living resources	2.1. Oil and gas exploration and production 2.3. Extraction of gravel and sand 2.4. Extraction of salt
	4. Construction	4.1. Marine construction
	5. Transportation	5.3. Service activities to transportation
Partially marine	1. Living resources	1.5. Animal production 1.6. Other food products
	2. Non-living resources	2.2. Mining of metal ores 2.5. Renewable energy 2.6. Water collection 2.7. Waste and decontamination
	3. Ship and boat building	3.4. Manufactures for shipbuilding 3.5. Other manufactures and services
	4. Construction	4.2. Marine related construction
	5. Transportation	5.4. Support activities for transportation
	6. Tourism and recreation	6.1. Accommodation 6.2. Other tourism and recreational services
	7. Public administration	7.1. Administration of the State 7.2. Provision of services Foreign affairs 7.3. Social security
	8. Education and R&D	8.1. Education 8.2. Research and development
	9. Others	9.1. Office support activities 9.2. Membership organisations 9.3. Other activities not elsewhere classified

Source: Based in Pinto et al (2015), inspired in Surís-Regueiro, Garza-Gil & Varela-Lafuente (2013)

This clarity sets the stage for exploring specific value chains crucial to sustainable blue economy initiatives, including **Sustainable Fisheries, Aquaculture, and Bio-resource Valorization**, as well as **Renewable Marine Energy and Maritime Decarbonization**. These value chains represent pivotal areas where strategic investments and collaborative efforts can

drive economic growth, environmental sustainability, and innovation across European coastal and maritime regions.

2.2.1 Sustainable Fisheries, Aquaculture, and Valorisation of Bio-resources

The sustainable management of fisheries and aquaculture is essential for the development of the blue economy, ensuring the conservation and responsible use of marine resources. Sustainable fishing practices, including the implementation of quotas, habitat protection, and bycatch reduction, are vital for maintaining the health of marine ecosystems and the long-term viability of fishing communities in the face of threats such as overfishing, habitat destruction, and climate change.

In addition, aquaculture offers a promising solution to meet the increasing demand for seafood while alleviating pressure on wild fish stocks. Sustainable aquaculture practices involve the use of environmentally friendly feeds, minimal impact on local ecosystems, and the promotion of health and welfare for farmed species. Integrating aquaculture with other forms of agriculture, such as utilizing fish waste as fertilizer, demonstrates the potential for creating sustainable and circular production systems.

The World Bank (2017) emphasizes the need for responsible management in these sectors to ensure the long-term health of marine ecosystems and the livelihoods that depend on them. This is echoed in the Blue Economy voluntary commitments, highlighting sustainable fisheries as a critical sector for advancing ocean-based economies.

Blue resource valorisation aims to maximize the economic, social, and environmental benefits of marine resources through sustainable management and innovative approaches, going beyond traditional extraction and focusing on adding value to aquatic resources, efficient use, and waste minimization. By promoting sustainable fisheries and aquaculture and valorising blue resources, countries can improve food

security, create economic opportunities, and protect marine ecosystems for future generations (UN, 2014).

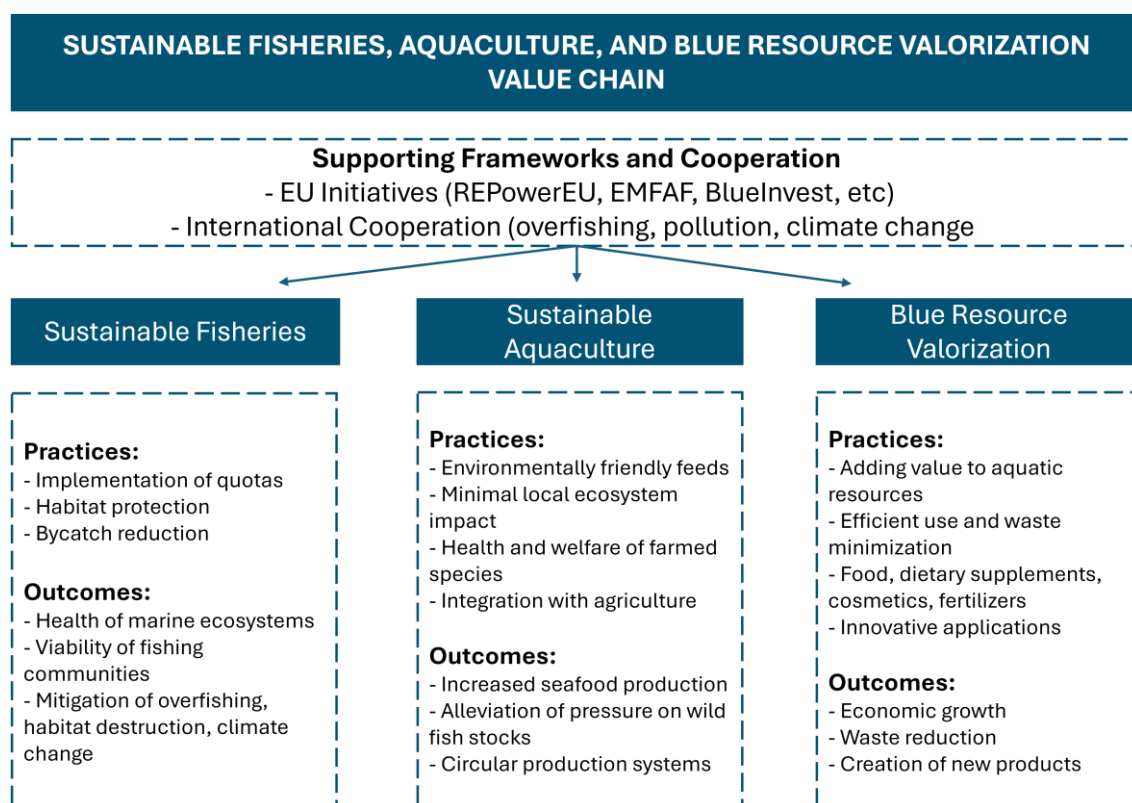
The European Commission has actively promoted sustainability in fisheries and aquaculture through initiatives such as the REPowerEU plan and the Communication on energy transition in the EU fisheries and aquaculture sector (EU, 2023). These initiatives are supported by the European Maritime, Fisheries, and Aquaculture Fund (EMFAF) and programs such as BlueInvest and the InvestEU Blue Economy Fund, which promote sustainable practices and innovation in the sector (EU, 2023).

Marine-derived bio-resources have significant potential for various commercial applications, contributing to the EU priorities of carbon neutrality, sustainable food systems, and the circular bio-economy (EU, 2023). These resources are used in sectors such as food, dietary supplements, cosmetics, fertilizers, and innovative applications such as biomaterials, bioremediation, and biofuels. The valorisation of bio-resources adds economic value and promotes sustainability by reducing waste and creating new products from marine biomass.

For example, marine algae produce biofuels, providing a renewable energy source that can help reduce dependence on fossil fuels. Similarly, chitin extracted from crustacean shells can be processed into chitosan, a versatile biomaterial with applications in medicine, agriculture, and water treatment. These examples illustrate how innovative approaches to marine bio-resource valorisation can drive economic growth while addressing environmental challenges.

Interregional cooperation is essential for achieving these sustainability goals, particularly in addressing common challenges such as overfishing, pollution, and the impacts of climate change. Collaborative frameworks allow regions to leverage each other's strengths and address weaknesses, fostering a more resilient and sustainable global ocean economy.

Figure 1 – Value Chain 1 Diagram



Source: Own Elaboration

In sum, this value chain focuses on enhancing sustainable production and consumption of marine resources. It aims to reduce Europe's dependency on seafood imports by promoting innovative and environmentally friendly practices in fisheries and aquaculture. This includes the development of new business models, the utilization of blue biomass for value-added products, and the establishment of networks to support sustainable practices in less-developed coastal regions.

2.2.2 Renewable Marine Energy and Maritime Decarbonisation

The shift towards renewable energy and the reduction of carbon emissions in the oceans are vital for fostering sustainable ocean-based economies and addressing climate change. Ocean energy, comprising tidal, wave, and ocean thermal energy, represents a vast and mostly untapped source of renewable energy. According to the World Bank (2017), ocean energy has the potential to mitigate pollution and enhance the resilience of coastal nations. Harnessing this energy source can offer reliable

electricity, reduce reliance on fossil fuels, and contribute to energy security. The US Department of Energy's 2019 report titled "Powering the Blue Economy: Exploiting Opportunities for Marine Renewable Energy in Maritime Markets" underscores the economic and environmental advantages of ocean renewable energy. It emphasizes that ocean energy can propel economic growth, generate employment opportunities, and support the establishment of sustainable coastal economies. Moreover, marine renewable energy can play a pivotal role in meeting the energy requirements of remote and isolated communities that often depend on costly and polluting diesel generators.

Coastal countries must prioritize capacity building and technology transfer to fully harness the benefits of ocean energy. Developing the necessary technical expertise and infrastructure for deploying and maintaining renewable energy systems is crucial for these regions to participate in the global shift towards sustainable energy. According to the UN (2014), international collaboration is essential for facilitating access to advanced technologies and knowledge. This cooperation can help overcome barriers to adoption, such as high initial costs and technical complexity. Capacity-building initiatives may involve training programs, workshops, and partnerships with research institutions and the private sector. By empowering local communities and governments with the necessary knowledge and tools to implement renewable energy projects, these initiatives can drive sustainable development and enhance resilience to the impacts of climate change.

The maritime sector is a major contributor to global greenhouse gas emissions, mainly due to its reliance on heavy fuel oil. Decarbonizing maritime transport is vital for achieving broader climate goals and fostering a sustainable ocean-based economy. Transitioning to renewable energy sources like offshore wind and ocean energy can drastically reduce the shipping industry's carbon footprint. The European Union (2023) emphasizes the significance of maritime decarbonization in

its Sustainable and Intelligent Mobility Strategy and industry transition strategies. These initiatives aim to lower emissions, enhance energy efficiency, and promote the adoption of cleaner technologies in the maritime sector. Regulatory incentives, research and innovation, and an investment-friendly environment are crucial to support these endeavours.

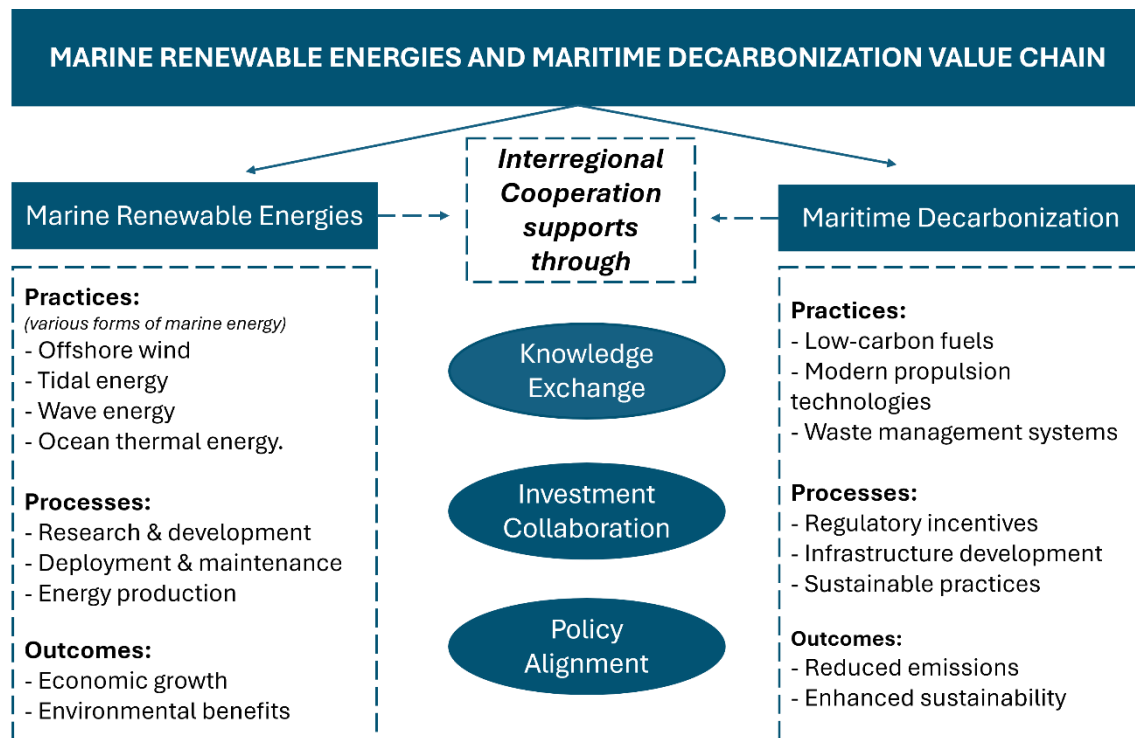
Offshore wind energy is a rapidly growing sector of marine renewable energy. The EU is home to a significant proportion of the world's installed offshore wind capacity, demonstrating its leadership in this field. Offshore wind farms harness the strong and consistent winds that blow across the oceans to produce significant amounts of clean electricity. The EU's commitment to increasing offshore wind capacity is reflected in its investment in research, development and regulatory frameworks that facilitate the sector's growth. According to the Organisation for Economic Co-operation and Development (OECD, 2016), the offshore wind sector is expected to experience high growth, driven by technological advances and falling costs. Integrating offshore wind into the energy mix can help diversify energy sources, increase grid stability and reduce greenhouse gas emissions.

In addition to offshore wind, other marine renewable energy sectors, such as tidal and wave energy, have great potential but still need further development. Research and development efforts play a crucial role in addressing the technical and economic challenges of these technologies. The EU is actively participating in international efforts, including negotiations in the International Seabed Authority (ISA), to establish a robust framework for protecting the marine environment and to support research on deep-sea ecosystems and monitoring technologies (EU, 2023). Marine biotechnology, deep-sea mining, and carbon capture and storage are other sectors with significant potential to contribute to the Blue Economy. These emerging industries require additional research and development to become commercially viable and environmentally sustainable.

Achieving maritime decarbonization and expanding the marine renewable energy sector necessitates appropriate regulatory incentives and an investment-friendly environment. Policies supporting research and innovation, streamlining permitting, and providing financial incentives can speed up the deployment of clean technologies. Public-private partnerships and international cooperation are also crucial to mobilize resources and expertise. Successfully reducing emissions from the maritime transport sector is a key objective in achieving the decarbonization goals of the Blue Economy (EU, 2023). Regulatory frameworks, such as emissions trading schemes and carbon taxes, can create economic incentives for shipping companies to adopt cleaner technologies and practices. Additionally, investments in infrastructure, such as charging stations for electric ships and ports equipped with renewable energy sources, can facilitate the transition to low-carbon shipping.

The value chain's critical importance underscores the necessity of interregional cooperation. Through collaboration, regions can exchange knowledge, technology, and resources, fostering synergies that drive innovation and efficiency. Cooperation can help address shared challenges such as the high cost of renewable energy projects and the intricacies of integrating new technologies into existing systems. Interregional collaboration also facilitates the pooling of financial resources and the establishment of consistent regulatory frameworks, which can attract investments and lower barriers to entry for new technologies. Furthermore, international partnerships can ensure that the benefits of renewable energy and maritime decarbonization are distributed equitably, supporting sustainable development and resilience across all regions. Collective efforts to transition to renewable energy and decarbonize maritime transport can advance environmental goals, promote economic growth, and enhance social well-being, illustrating the interconnected nature of sustainable development.

Figure 2 – Value Chain 2 Diagram



Source: Own Elaboration

In sum, this value chain focuses on leveraging the ocean's potential for clean energy and reducing carbon emissions in maritime transport. Marine renewable energies, such as offshore wind, wave, and tidal power, offer significant opportunities for regional economic growth and decarbonization. By investing in technology and addressing environmental impacts, these energy sources can be expanded and made cost-effective. Maritime decarbonization aims to reduce emissions from shipping and ports, enhancing sustainability through the adoption of low-carbon fuels, modern propulsion technologies, and efficient waste management. This value chain supports economic development, mitigates climate change, and revitalizes regions affected by the COVID-19 pandemic by fostering innovation, interregional cooperation, and sustainable practices.

2.3 Foundations of Innovation Ecosystems in the Sustainable Blue Economy

The sustainable development of the blue economy relies heavily on ecosystem-based management (EBM), which highlights the interconnectedness of marine ecosystems and the need to maintain their health and resilience (UNEP, 2013). EBM integrates scientific insights, stakeholder engagement, and adaptive management to sustainably manage marine resources and support the livelihoods of coastal communities dependent on fishing and tourism. Innovative financing mechanisms such as public-private partnerships (PPPs), green bonds, and impact investment funds are crucial for mobilizing capital for infrastructure development, technology deployment, and capacity building in marine conservation and coastal resilience initiatives (UNCTAD, 2014).

Furthermore, the concept of blue economy corridors serves as a strategic framework for regional development, fostering economic integration and sustainable growth through trade, investment, and cooperation (UN, 2014). These corridors enhance regional competitiveness and resilience by leveraging synergies in economic activities and promoting connectivity. In the context of business ecosystems, research emphasizes the role of territorial context in fostering agglomeration economies, learning opportunities, and networking benefits, all of which are critical for knowledge sharing and innovation generation within thriving innovation ecosystems (Pinto, 2021).

In order to effectively analyze the two value chains in this project, this report proposes a structured approach that focuses on interaction, resources, and governance dimensions. This framework is aligned with the foundational elements identified for successful innovation ecosystems (Pinto, 2021).

Interaction Dimension: Ensuring a diverse participation base within the ecosystem is essential. This involves cultivating a critical mass of

stakeholders, including companies, universities, and associations, who demonstrate interdependencies, reciprocity, and trust. The promotion of self-organization and collective engagement towards common objectives is crucial for fostering a dynamic ecosystem. Additionally, nurturing a balanced portfolio of entrepreneurs with diverse profiles is essential for stimulating innovation and resilience.

Resource Dimension: Infrastructure is a key element in supporting activities within an ecosystem. Adequate business locations, incubation facilities, and innovation intermediaries are fundamental components. These resources enable collaboration among companies, entrepreneurs, academic institutions, and financial entities, boosting the ecosystem's capacity to generate innovative products and outcomes.

Governance Dimension: Effective governance goes beyond contractual relationships by structuring ecosystem services and ensuring visibility, recognition, and self-awareness among ecosystem actors. Legal legitimacy, political relevance, and social acknowledgment are crucial aspects that support the ecosystem's ability to define collective strategies and attract supportive public policies. Governance frameworks should create an environment that allows the ecosystem to function cohesively and sustainably.

The sustainable advancement of the blue economy relies on key analytical categories that are essential for the development of a solid investment pipeline for interregional innovation projects in this domain. These categories play a crucial role in guiding initiatives aimed at promoting robust innovation ecosystems within the marine and coastal sectors. In essence, the analytical categories of Interaction, Resources, and Governance will serve as the foundational elements for a strategic action plan in the blue economy (D2.5). By prioritizing these dimensions, stakeholders can skilfully navigate complexities, drive innovation, and bolster socio-economic resilience within marine and coastal ecosystems.

3. Methodology

3.1 Rationale

The methodological approach is based on the thematic approach of S3 ("Methodological Manual, Developing Thematic Interregional Partnerships for Smart Specialisation" EUR 30172 EN) and it is used to support, monitor, and evaluate interregional cooperation. This approach comprises five interconnected stages:

- Learn (Scoping Note)
- Connect (skills mapping and business opportunities matching)
- Demonstrate (industrial cooperation and project design)
- Commercialize (business plan and funding mix)
- Scale (investment projects)

Interregional cooperation among EU regions can take various forms and follow different paths. The stages identified above should not be seen as linear or predictive; feedback loops may be necessary at certain points. In this sense, regional specificities are crucial for analysis.

The learning phase (Learn) forms the anchor of this work. This phase involves several stages: gathering, preliminary mapping, gauging regional interest and seeking potential partners, expression of interest, scoping note, action plan, and governance. In this case, the first three stages have already been developed within the project, so this work will proceed from the scoping note.

It is on this reference that opportunities for interregional collaboration within specific domains of smart specialization will be outlined. Emphasis is placed on creating a comprehensive report that jointly with Action Plan (D2.5) will serve as a guiding framework to navigate through successive stages of collaboration. Building on the aforementioned methodological document, this report will include the following elements:

- Establishing links with smart specialization and articulating common or complementary interests of partner regions within the Quadruple Helix framework;
- Identifying areas of innovation relevant to the partnership's objectives, particularly in the two value chains addressed in the project;
- Identifying gaps, challenges, and market failures requiring collaborative intervention. This information will be collected during the online sessions developed by the partnership;
- Assessing policy frameworks and favourable conditions for interregional collaboration. Prerequisites or EU-level conditions that facilitate tangible outcomes;

It is based on this rationale that concrete cooperation actions will be proposed in the action plan, in Deliverable 2.5. This may include the development of research and development projects, public-private partnerships, capacity-building programs, and other actions aimed at driving innovation and competitiveness in the sectors.

3.2 Data Collection

The data used for this report was collected through a series of thematic workshops organized by the partnership². The workshops employed a systematic approach to map regional stakeholders involved in marine sectors and industries, aiming to ensure thorough stakeholder engagement and gather diverse insights across the blue economy's value chains. The Quadruple Helix model, encompassing academia, community, government, and industry, was used to effectively involve stakeholders and collect pertinent data. All project partners collaborated to map key stakeholders across targeted regions.

² Detailed minutes regarding the organization, methodology, and data collection for these workshops can be found in the report "Meetings of the Q-Helix Working Groups", Deliverable number 2.3. As Deliverable 2.3 was the main data source for this summary report, parts of this Deliverable 2.3 are reproduced in Annexes 1 -7, notably those that are the most relevant and that were used as input for this report - deliverable 2.4.

The stakeholder invitation strategy was carefully planned to align with project Key Performance Indicators (KPIs) for engagement. Partners were tasked with inviting representatives of their respective value chains, aiming to incorporate diverse perspectives and ensure comprehensive data collection.

The engagement process involved three online working group meetings for each value chain, focusing on themes within sustainable marine sectors. These meetings were strategically scheduled to address critical topics to the value chains under analysis.

In total, six workshops were developed, 3 for each value chain:

1. Value Chain “Sustainable fisheries, aquaculture and valorisation of blue resources” - Sustainable Fishing, Sustainable Aquaculture and Valorisation of Biomass and Coproducts;
2. Value Chain “Renewable energy and maritime decarbonization” - Green Ships, Green ports and logistics, Marine renewable energy

The workshops followed a structure that enabled participant engagement and discussion outcomes. During the introduction and project presentation, participants were briefed on the meeting's objectives and the overarching scope of the project. Subsequently, breakout sessions were conducted where stakeholders engaged in focused discussions within designated breakout rooms facilitated by project partners. These sessions delved into identifying challenges and needs and formulating strategies for innovation investment tailored to the marine sector. Following the breakout sessions, plenary sessions were held, during which facilitators synthesized the outcomes of the discussions, fostering broader dialogue and consensus-building around the priorities identified.

In each breakout room, the presence of a facilitator and a note-taker was ensured. These facilitators guided the discussion and identified the main

contributions to the Miro boards³. A Miro board is an online collaborative whiteboard platform that allows multiple users to collaborate in real time. It is commonly used for brainstorming, ideation, planning, and organizing information visually. Additionally, the team responsible for this report was also present at all the workshops to take notes that are reflected in this document.

In the workshops dedicated to the "Sustainable Fisheries, Aquaculture, and Valorisation of Blue Resources" value chain, a total of 38 stakeholders from 9 different regions participated. Similarly, for the "Renewable Energy and Maritime Decarbonization" value chain, 43 stakeholders from 8 regions were involved. The workshops took place between 14th May and 12th June 2024.

3.3 Data Analysis

After collecting comprehensive data from the workshops, the subsequent methodology phase involved a detailed analysis of the gathered information. This analysis encompassed reviewing workshop minutes, examining completed Miro boards, and synthesizing detailed notes meticulously compiled by the project team (see Annexes 1 -7). The primary objective was to conduct an integrated analysis across the entire spectrum of insights, focusing on understanding the specific needs, challenges, and innovation priorities identified within each value chain.

This report will be used as input for the development of the action plan (D2.5) that aims at enhancing regional ecosystem support systems by addressing critical gaps and bolstering foundational elements essential for sustainable development. This includes strengthening infrastructure, improving collaborative frameworks, and enhancing resource utilization efficiency. The methodology ensured that data from each value chain

³ Miro boards refer to digital whiteboards created using Miro, a collaborative online platform designed for brainstorming, planning, and project management. Miro boards allow users to create and organize visual content such as sticky notes, diagrams, and charts in a shared workspace, making it easier for teams to collaborate in real time, regardless of their physical location (see Annexes 3 and 7).

was systematically categorized and analyzed to derive overarching themes and actionable insights. The content analysis approach was employed to distil stakeholder perspectives into general categories that would guide the formulation of targeted interventions.

The analysis was developed using NVivo Qualitative Data Analysis Software (QSR International Pty, Ltd., version 11.1, 2015). Content analysis served as the primary qualitative technique, focusing on interpreting text, identifying the frequency of occurrences, and exploring the interconnections of various dimensions within written documents (Hsieh and Shannon, 2005). The analysis followed specific techniques: latent content analysis, which involves interpreting text to create categories that can be open (conventional analysis) or informed by existing literature (directed analysis) (Hsieh and Shannon, 2005); and quantification of qualitative information, identifying the percentage of the coded references for each idea based on the totality of references coded, enabling the assessment of prevalent ideas among respondents and indicating the breadth and relevance of specific topics (Namey et al., 2008).

The analysis categories are presented in the next section, reflecting the key dimensions addressed by stakeholders and were developed with inspiration from the approach and dimensions of innovation ecosystems identified in the literature (Pinto, 2021). After that, the occurrence of categories in the text was also classified and, finally, their interpretation and counting were analysed.

4. Data Analysis

4.1 Categorisation Process

4.1.1 Needs and Challenges

In **Value Chain 1 - Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources**, particular challenges emerged within each area. In Sustainable Fishing, the main challenge identified was overfishing, which poses a significant threat to marine ecosystems and sustainable resource management. Sustainable Aquaculture faced challenges related to limited space availability, complex regulatory frameworks, and financial constraints, hindering the sector's growth and innovation potential. The Valorization of the Biomass and Coproducts domain encountered obstacles centered around scaling up operations and navigating intricate licensing procedures essential for maximizing resource utilization and economic viability.

Shared challenges across these domains included the imperative need for capacity-building initiatives, fostering business development opportunities, facilitating technology transfer and knowledge management, promoting consumer education and awareness of sustainability practices, addressing the impacts of climate change on marine environments, and streamlining administrative processes to reduce bureaucratic burdens. These challenges collectively underscored the complex interplay of economic, environmental, and regulatory factors within this value chain, necessitating integrated strategies to foster resilience and sustainability in the blue economy sector.

In **Value Chain 2 - Renewable Energy and Maritime Decarbonization**, various challenges were identified in each domain. For Green Ships, the challenges included advancing ship design technologies for eco-friendly operations, overcoming financial barriers to adopting sustainable fuels, and promoting collaborative efforts in sustainable shipbuilding. Green Ports and Logistics faced obstacles such as navigating regulatory

frameworks for renewable energy integration, addressing workforce training needs for green port operations, and developing infrastructure for alternative fuels. Marine Renewable Energy encountered challenges in securing funding and collaboration opportunities for SMEs in renewable energy, addressing project-specific needs within marine energy ventures, and implementing technological solutions to enhance port efficiency.

Common challenges across the entire value chain included fostering stakeholder collaboration, securing sufficient funding and financial support, driving technological innovation, navigating regulatory complexities, and enhancing workforce training aligned with industry demands. These challenges underscored the comprehensive approach needed to advance sustainability goals in renewable energy and maritime decarbonization sectors.

Table 2 shows the aggregate analytical categories that emerged from this codification process. The table comprises the generic category name and identifies how those dimensions differ between the value chains.

Table 2 - Analytical Categories: Needs and Challenges

CATEGORY	VALUE CHAIN 1	VALUE CHAIN 2
<i>Innovation and Technology</i>	<ul style="list-style-type: none"> - Innovative Sustainable Tools; - Innovating to increase the value of biomass and coproducts; - Solutions to invasive species. 	<ul style="list-style-type: none"> - Infrastructure and Technological Development (e.g., green ports); - Technological Challenges (e.g., energy storage, data integration); - Digital Competency Development (e.g., port digitalization).
<i>Knowledge Transfer</i>	<ul style="list-style-type: none"> - Linking Scientific Knowledge to Practitioners; - Collective Data Collection; - Training in Digital Tools; - Technology Transfer and Sharing Best-Practices. 	<ul style="list-style-type: none"> - Data collection, analysis, and integration techniques; - Technology Transfer and Innovation (e.g., support for startups); - Training in digital tools and technologies for efficient operations.
<i>Regulatory and Policy Framework</i>	<ul style="list-style-type: none"> - Clear Legislation; - Regulations for Sustainable Fisheries Management; - Administrative Burden. 	<ul style="list-style-type: none"> - Coherent Regulatory Framework (e.g., policies for alternative fuels); - Simplification of bureaucratic processes (projects);

Interregional Collaboration	<ul style="list-style-type: none"> - Interregional Innovation (e.g., innovative sustainable tools); - Solutions to invasive species; - Collaborative approaches to biomass valorization. 	<ul style="list-style-type: none"> - Quadruple Helix Collaboration; - Cross-regional cooperation and integration with regional infrastructures; - Development of green corridors for sustainable transport.
Economic and Market Development	<ul style="list-style-type: none"> - Competition from non-EU countries; - Highlight the Benefits of Sustainable Practices; - Consumer Education and Awareness. 	<ul style="list-style-type: none"> - Strategic Investment and Financial Challenges (e.g., funding for technologies); - Sector Diversification and Regional Challenges (e.g., diversifying maritime activities).
Human Capital and Workforce Development	<ul style="list-style-type: none"> - Lack of Generational Replacement; - Capacity Building in Business Development. 	<ul style="list-style-type: none"> - Talent Workforce (e.g., shortage of qualified workers); - Attracting and retaining talent in remote locations.
Environmental Impact and Adaptation	<ul style="list-style-type: none"> - Climate degradation; - Invasive species; - Stocks. 	<ul style="list-style-type: none"> - Local Environment Conditions (e.g., adaptation to regional environments); - Energy Infrastructure and Supply (e.g., green corridors for sustainable transport).

Source: Own Elaboration

Innovation and Technology: This category focuses on advancements in technology and innovation specific to each value chain, whether it's in biomass utilization and invasive species management (Value Chain 1) or energy infrastructure and digitalization (Value Chain 2).

Knowledge Transfer: This category emphasizes the exchange and application of knowledge within each value chain. Value Chain 1 focuses on scientific knowledge dissemination and technology adoption in fisheries and aquaculture, while Value Chain 2 centers on data-driven insights and technological advancements in renewable energy and decarbonization efforts.

Regulatory and Policy Framework: Both value chains require clear regulatory frameworks but differ in the specifics, such as fisheries management regulations (Value Chain 1) and policies for renewable energy (Value Chain 2).

Interregional Collaboration: This category highlights collaborative efforts and partnerships across regions to address common challenges and leverage opportunities. Value Chain 1 emphasizes innovative approaches to sustainability and invasive species management across different regions, whereas Value Chain 2 focuses on collaborative frameworks involving multiple stakeholders for green technology adoption and infrastructure development.

Economic and Market Development: This category addresses economic challenges and market strategies relevant to sustainable practices and technological advancements in each sector.

Human Capital and Workforce Development: Both value chains highlight the need for skilled labor and workforce development strategies, albeit with different emphases on business capacity building (Value Chain 1) and talent acquisition in green technologies (Value Chain 2).

Environmental Impact and Adaptation: Both value chains deal with environmental challenges but vary in focus, such as marine species impacts (Value Chain 1) and energy-related environmental concerns (Value Chain 2).

4.1.2 Innovation Investment Priorities

In **Value Chain 1 - Sustainable Fisheries, Aquaculture, and Valorization of Blue Resources**, there are specific innovation investment priorities identified across different domains. The main goals for the entire value chain include prioritizing international collaboration and knowledge exchange to strengthen sustainable practices in fisheries and aquaculture. The significant investments are focused on advancing research and development initiatives to address sector-specific challenges.

In the Sustainable Fishing domain, the focus is on developing strong governance and regulatory strategies tailored to sustainable fisheries management, as well as exploring crucial funding mechanisms for driving

R&D in the fisheries sector. Sustainable Aquaculture emphasizes sharing best practices and refining regulatory frameworks specific to sustainable aquaculture practices. The Valorization of Biomass and Co-products domain focuses on strategies to enhance the utilization of marine by-products and resources, including efforts in data standardization, fostering collaborative networks, and leveraging targeted tendering processes to stimulate innovation within the valorization sector.

In **Value Chain 2 - Renewable Energy and Maritime Decarbonization**, there are distinct innovation investment priorities identified across specific domains, all aligned with overarching goals for the entire value chain. Common aspects include prioritizing strategic investment in renewable energy technologies, fostering collaboration and partnerships to accelerate technological advancements, and developing regulatory frameworks to support sustainable practices.

Within the Green Ships domain, investment priorities focus on Smart Ports and Alternative Fuels, collaborative research on Carbon Capture and Utilization to reduce synthetic fuel costs, and partnerships to implement feasible charging systems for electric ships. The Green Ports and Logistics domain emphasizes internationalization and regional strategies, supporting SMEs in exporting through global collaboration, providing financial incentives and grants for innovation, and reducing market entry barriers for international expansion. The Marine Renewable Energy domain prioritizes research collaboration on environmental impact, public tenders for offshore wind projects, interregional knowledge sharing, system mapping and integration of ports, and achieving public acceptance through regulatory harmonization.

Table 3 schematizes this, identifying the analytical categories created to analyse the innovation investment priorities proposed by the stakeholders.

Table 3 – Analytical Categories: Innovation Investment Priorities

CATEGORY	VALUE CHAIN 1	VALUE CHAIN 2
<i>Innovation and Technology Development</i>	<ul style="list-style-type: none"> - R&D for sustainable fisheries and aquaculture; - Digital solutions for aquaculture productivity and traceability; - Technologies for valorizing marine by-products and circular economy. 	<ul style="list-style-type: none"> - Advancements in alternative fuels and smart ports; - R&D in offshore wind integration and CO2 capture; - Innovations in electric ship charging and renewable energy.
<i>Regulatory and Policy Frameworks</i>	<ul style="list-style-type: none"> - Interregional frameworks for sustainable fisheries and aquaculture; - Flexible regulations for environmental adaptation; - Policies for data harmonization and stakeholder engagement; 	<ul style="list-style-type: none"> - Regulations supporting sustainable shipping and renewables; - Harmonization of EU rules for green shipping and offshore energy; - Public acceptance policies for offshore wind and renewables.
<i>Financial Support and Investment</i>	<ul style="list-style-type: none"> - Incentives for aquaculture and blue resource investments; - Funding for R&D and international cooperation. 	<ul style="list-style-type: none"> - Public funding for green shipping and smart ports; - Incentives, grants, and tenders for renewable technologies.
<i>Environmental Sustainability</i>	<ul style="list-style-type: none"> - Research on aquaculture impacts and ecological strategies; - Circular economy through marine by-product valorization. 	<ul style="list-style-type: none"> - Environmental assessments for renewables and marine integration; - Sustainability initiatives for small ports and offshore coexistence.
<i>Stakeholder Engagement and Networking</i>	<ul style="list-style-type: none"> - Networking to address blue economy challenges; Engagement for collaboration and partnership in aquaculture. 	<ul style="list-style-type: none"> - Partnerships driving innovation and market access in renewables; - Initiatives for community acceptance of renewable projects.
<i>International Cooperation</i>	<ul style="list-style-type: none"> - International collaboration among stakeholders to exchange insights, tools, and strategies for sustainable fisheries management; - Platforms for sharing data, research findings, and best practices; - Benchmarking; - Innovation hubs to support interregional cooperation and knowledge exchange 	<ul style="list-style-type: none"> - Collaborative research across regions; - International education programs to attract talents; - Share data on environmental impact and promote public access; - Share technological facilities, enhancing the efficiency and cost-effectiveness of R&D.

Source: Own Elaboration

Innovation and Technology Development: This category encompasses the research, development, and implementation of cutting-edge technologies specific to each value chain. In Value Chain 1, innovation focuses on advancing technologies for sustainable fisheries management, enhancing aquaculture productivity, and promoting circular economy practices. Examples include digital solutions for aquaculture productivity, traceability systems to ensure product quality and origin, and technologies for valorizing marine by-products. In Value Chain 2, the emphasis is on technological innovations such as alternative fuels (e.g., hydrogen, synthetic fuels), smart ports infrastructure development, integration of offshore wind energy, advancements in electric ship charging systems, and technologies for CO2 capture and utilization to reduce environmental impact in maritime operations.

Regulatory and Policy Frameworks: This category pertains to the development and implementation of regulatory frameworks and policies that support sustainable practices and technological advancements within each value chain. In Value Chain 1, regulatory efforts include establishing interregional frameworks for sustainable fisheries management, maintaining flexible regulations to adapt to environmental changes, and implementing policies that promote transparency and stakeholder engagement. These efforts aim to ensure sustainable practices in aquaculture and fisheries while facilitating innovation and compliance. In Value Chain 2, regulatory frameworks focus on supporting sustainable shipping practices, harmonizing EU regulations for cross-border operations in renewable energy and green shipping sectors, and implementing policies to gain public acceptance of offshore wind projects and renewable energy initiatives.

Financial Support and Investment: This category involves the allocation of financial resources and incentives to support research, development, and infrastructure deployment within each value chain. In Value Chain 1, financial support mechanisms include incentives for private investments in

aquaculture infrastructure, dedicated funding for research and development initiatives in sustainable fisheries and aquaculture, and international cooperation funding to foster collaborative projects. In Value Chain 2, financial strategies include public funding mechanisms to support green shipping initiatives, development of smart ports infrastructure, and investment in renewable energy projects. Financial incentives, grants, and calls for tenders are also used to accelerate the adoption of sustainable technologies in maritime decarbonization and renewable energy sectors.

Environmental Sustainability: This category focuses on initiatives and practices aimed at minimizing environmental impact and promoting sustainability within each value chain. In Value Chain 1, environmental efforts include conducting research to understand and mitigate the environmental impacts of aquaculture, promoting circular economy practices through the valorization of marine by-products, and implementing strategies to reduce waste and optimize resource utilization. Value Chain 2 addresses environmental sustainability through conducting environmental impact assessments for renewable energy projects, integrating renewable energy solutions with marine activities to optimize sustainability, and developing tailored sustainability initiatives for small ports, isolated regions, and the coexistence of offshore energy with aquaculture.

Stakeholder Engagement and Networking: This category emphasizes collaboration, knowledge sharing, and partnership building among stakeholders within each value chain to achieve common goals. In Value Chain 1, stakeholder engagement focuses on fostering networks among EU countries to address regional challenges in blue economy sectors, organizing workshops to share best practices and foster collaboration among stakeholders in aquaculture and fisheries, and enhancing engagement to promote partnership building. In Value Chain 2, stakeholder engagement initiatives include forming strategic partnerships between ports, regional authorities, corporations, startups, and SMEs to

drive innovation and market access in renewable energy and green shipping sectors. Efforts also include community engagement strategies to ensure public acceptance of renewable energy projects, offshore wind developments, and sustainable maritime practices.

International Collaboration: involves collaborative efforts between countries or international entities to address shared challenges or pursue common goals. This collaboration spans various domains, including economic, environmental, scientific, and technological cooperation. It often involves the exchange of knowledge, resources, and expertise to leverage collective strengths and resources to achieve mutual benefits.

4.2 Coding and Quantification of Categories

4.2.1 Sustainable Fisheries, Aquaculture, and Valorisation of Blue Resources

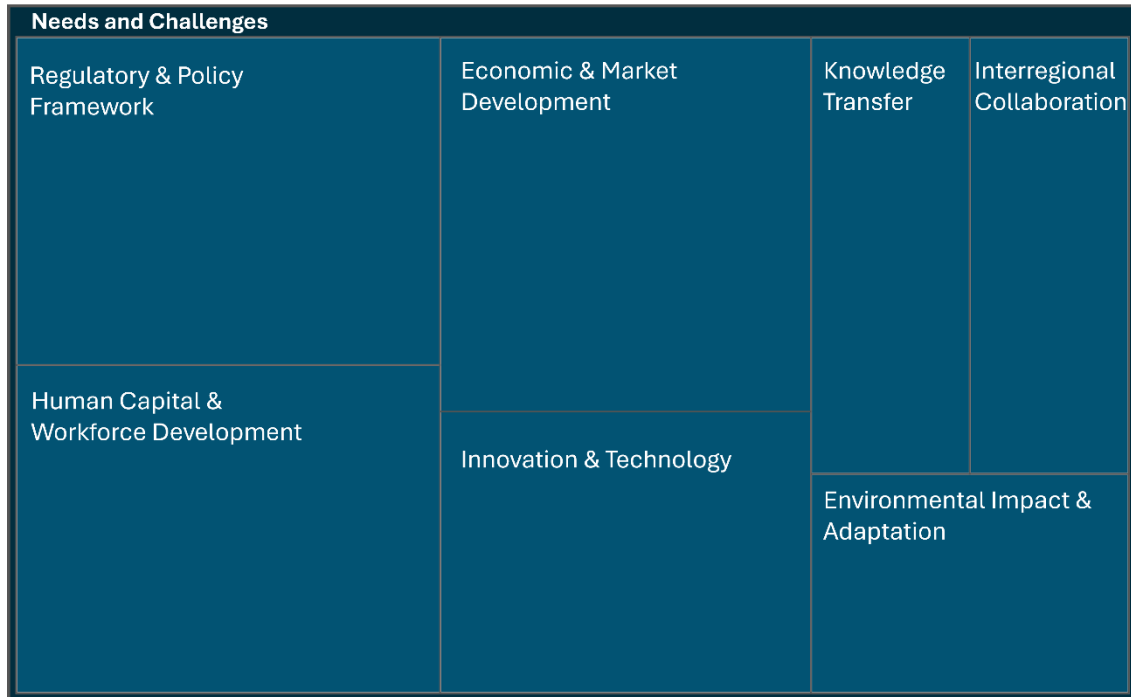
After the creation of these categories, the data was analysed in Nvivo software. The text from the sources used was codified into different categories (nodes), and hierarchical graphs were created.

A hierarchical graph is a visual representation that showcases the relationships and structures within the qualitative data. These graphs are particularly useful for displaying the organization of nodes (categories) in a hierarchical manner, aiding in the understanding of the structure and flow of themes or categories within the research.

Hierarchical graphs reflect how broader themes are divided into more specific subthemes. Additionally, the dimension of the squares in the graph represents the quantity of text coded in each category (node), providing information on the relative importance of each category. This visual cue helps identify which themes or subthemes are more prominent based on the volume of coded text, thereby highlighting key areas of interest in the data.

Figure 3 shows the hierarchical graph of the needs and challenges associated within value chain 1.

Figure 3 – Needs and Challenges in Value Chain 1



Source: Own Elaboration using *Nvivo11*

Of all the categories created for the analysis, it can be seen that the biggest challenges in this value chain are issues related to the regulatory and policy framework, followed by problems linked to human capital and the workforce, and economic and market development. The dimension of innovation and technology also weighs heavily on the minds of workshop participants. Finally, with less relative weight but still important to emphasize are issues related to knowledge transfer, interregional collaboration, and the environment.

In the dimension of **regulatory and policy framework** (12,96% of the total coded references for this dimension), participants identified several key challenges. Sustainable fisheries management needs effective crisis strategies and advanced technologies to improve production sustainably, but current regulations are burdensome and require more user-friendly compliance systems. Space limitations and high initial

investments in aquaculture, particularly in regions like the Azores, along with stringent regulations, pose significant constraints. Administrative issues, including licensing, further hinder growth. Public investment and strategic policies are essential for improving investment attractiveness and addressing human resource shortages, especially in peripheral regions. Lastly, complex legal and administrative procedures impede sector growth, highlighting the need for simplified processes to facilitate stakeholder collaboration.

In the dimension of **economic and market development** (10,52% of the total coded references for this dimension), key challenges include competition from lower-priced non-EU products, a lengthy licensing process, and the need for investment and research to introduce new species. Authorities must develop continuous promotional strategies to educate consumers about environmentally friendly aquaculture products. Scaling up production, particularly in microalgae and seaweeds, requires industrial support and suitable locations, with licensing being a major hurdle. Lastly, educating consumers about marine resources is essential to drive demand and growth.

In the dimension of **human capital and workforce development** (9,51% of the total coded references for this dimension), several key challenges were identified. Fishing firms, especially smaller ones, lack the technical capabilities to access European funds and participate in innovation initiatives, limiting their adoption of sustainable practices. There's a need for digitization and training in sustainable practices, fisheries management, and digital tools to improve operations and decision-making. The sector also suffers from a lack of generational replacement, as young people find fishing unappealing due to its high physical demands and low innovation. Capacity building in aquaculture and business development is essential, particularly in regions like the Black Sea, to reduce fish costs and increase competitiveness.

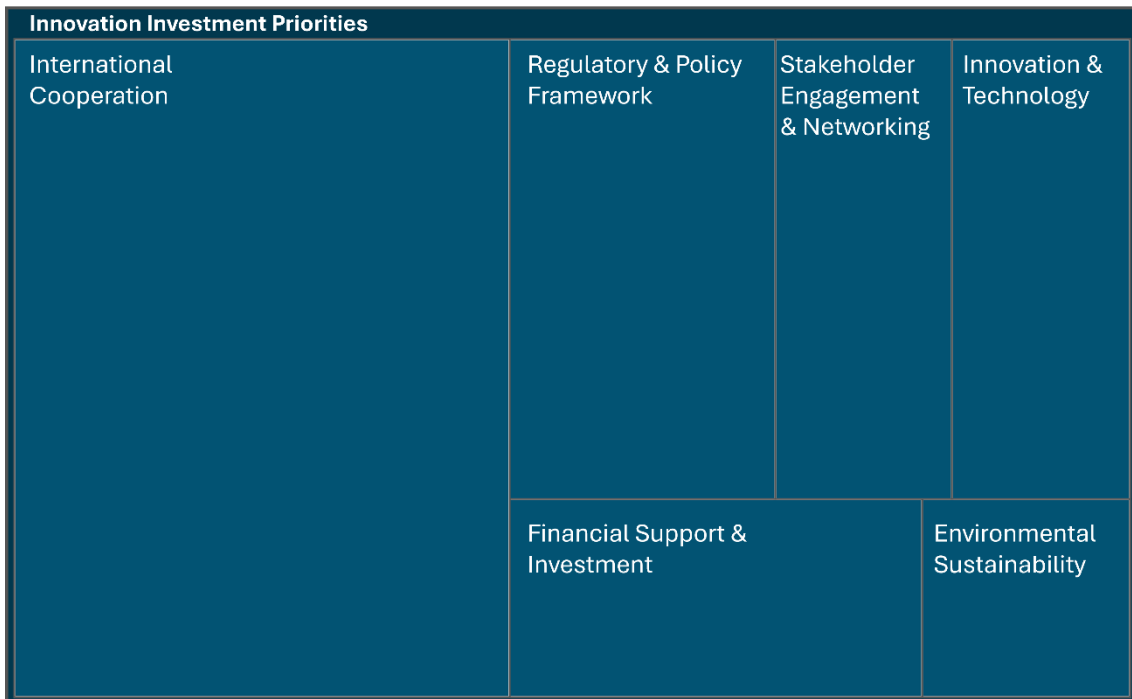
Innovation and technology (7,81% of the total coded references for this dimension), play crucial roles in advancing the fishing sector. The existing fleet of fishing vessels can significantly contribute to data collection, which is essential for research and development. This data informs sustainable practices, enhances fisheries management, and supports innovative solutions. Financial support is vital but must be complemented with other measures to address sector challenges and promote competitiveness.

And finally, one key challenge is **knowledge transfer** (6,76%), where bridging the gap between scientific research and practical application is essential to promote sustainable practices and innovations. **Interregional collaboration** (4,48%) is crucial for sharing best practices, research findings, and data across Europe to address issues such as disease outbreaks and enhance sustainable practices. **Environmental impact and adaptation strategies** (4,85%) are also pivotal, encompassing efforts to control invasive species and mitigate climate change effects, including rising temperatures and microplastic pollution. These challenges highlight the importance of coordinated efforts among researchers, policymakers, and practitioners to foster a sustainable future for the fishing sector.

The innovation investment priorities participants consider the more important to prioritize for collaboration and investment to foster cross-border collaboration and internationalization opportunities in the sector (figure 4) are directly related with the challenges posed.

The first important thing to mention is that although interregional collaboration was not a very prevalent need, participants assume that all challenges need this co-operation in order to be overcome, and so this was the most coded category. Other major areas where innovative investment strategies should focus include: the policy and regulatory framework, financial support and investment, stakeholder engagement and networking, innovation and technology and, finally, environmental sustainability.

Figure 4 – Innovation Investment Priorities in Value Chain 1



Source: Own Elaboration using Nvivo11

International cooperation (8,04%) and knowledge transfer are crucial for addressing global challenges in the fisheries sector. Collaborative research encourages stakeholders from different countries to share insights, tools, and strategies for sustainable fisheries management. Education and training initiatives aim to equip fishermen and industry professionals with knowledge in new technologies, sustainable practices, and innovative approaches. Information sharing platforms facilitate the exchange of data, research findings, and best practices to enhance sustainable fisheries management globally. Identifying and disseminating successful practices across European regions, including regulatory frameworks and farming technologies, promotes the adoption of sustainable methods through collaboration and benchmarking. Promoting international collaboration leverages expertise and resources to accelerate the adoption of innovative technologies and practices. Establishing innovation hubs supports interregional cooperation and knowledge exchange, while a unified framework for data collection and accessibility aids collaboration and informed decision-making regarding

marine by-products and resources. These efforts underscore the importance of coordinated international cooperation to ensure the sustainability and resilience of the fisheries sector worldwide.

Encouraging private sector participation through incentives and **financing** (7,74%) options is essential to stimulate investment in sustainable fisheries projects. Allocating funds to support research and development initiatives focused on sustainable fisheries management and aquaculture is another key strategy. Facilitating international cooperation and knowledge transfer through established funding mechanisms enhances collaboration across borders. Additionally, targeted tenders and EU innovations are vital for promoting advancements in marine by-products and resources. This includes developing specific tenders for sectors related to marine resources, promoting EU innovations nearing commercialization, and conducting research on valorization and upcycling of by-products. Establishing dedicated funding lines for infrastructure projects and investing in marine protected areas further strengthen management and enhance their environmental and economic value.

The **regulatory and policy framework** (5,88%) is crucial for ensuring sustainability and effective management. Effective governance and regulation strategies include harmonizing regulations across different regions and countries to foster cooperation and consistency. Monitoring and evaluation systems are crucial, enabling the tracking of progress and identification of challenges to inform policy decisions. Robust regulatory frameworks are essential to ensure compliance with sustainability standards, while policy harmonization across regions facilitates the adoption of best practices in fisheries management. These efforts are critical for balancing regulation with regional needs and promoting sustainable practices throughout the value chain.

Stakeholder engagement and networking (3,38%) stands up as crucial for fostering collaboration in this value chain. Strategies include establishing

networks among EU countries to address regional crises like the North Adriatic blue crab situation and facilitating cross-border collaboration for accessing testing sites. Workshops play a key role in connecting stakeholders, demonstrating biomass potential, and enhancing supply chain management through digitalization. Meanwhile, **innovation and technology** (5,39%) advancements are crucial, focusing on investing in research infrastructure, training programs for aquaculture staff, and promoting international collaboration to transfer knowledge and accelerate the adoption of sustainable practices. **Environmental sustainability** (4,06%) efforts involve adopting circular production processes, commercializing aquaculture subproducts, and investing in technologies to reduce environmental impacts, particularly for low-trophic organisms. These integrated approaches aim to enhance sustainability, resilience, and productivity in the fisheries sector.

4.2.2 Renewable Energy and Maritime Decarbonization

The first aspect that stands out in the Renewable Energy and Maritime Decarbonisation value chain is that there are a wide range of specificities in the sectors of this value chain that ended up being the most codified category, i.e. the one most mentioned by stakeholders (figure 5).

These **specificities** (20,38% of the total coded references for this dimension) include issues such as regional challenges (5,93%) in places like the west coast of Ostrobothnia, Finland, highlight issues such as the difficulty in undertaking innovation projects due to limited capacity and the necessity for increased collaboration among smaller ports. These ports face common challenges in producing green fuels and enhancing logistics, compounded by their small size which limits talent attraction and international recognition. Investment and financial support (8,75%) are critical for transforming infrastructure towards future fuels, yet small and medium-sized ports struggle to secure adequate funding and anticipate future requirements, particularly in remote areas and small islands where energy demands for port operations are disproportionately high.

Accessing funding for R&D (5,69%) remains a significant obstacle across the marine renewable energy sector, necessitating improved financial networks and easier access to funding mechanisms to foster innovation and growth.

Figure 5 – Needs and Challenges in Value Chain 2

Needs and Challenges			
Specifics	Interregional Collaboration	Knowledge Transfer	
		Human Capital & Workforce Development	Environmental Impact & Adaptation
Regulatory & Policy Framework	Innovation & Technology	Economic & Market Development	

Source: Own Elaboration using *Nvivo11*

With similar weight are the following categories:

In the **regulatory and policy framework** (14,23%) for the renewable energy and maritime decarbonization sector, several critical issues and strategies have emerged. Firstly, establishing national strategies and robust regulatory frameworks are essential to facilitate the adoption of alternative fuels and renewable energy solutions in port operations. Current fragmented regulations across Europe highlight the need for harmonization, especially concerning shore power and infrastructure standards, to ensure consistency and eliminate uncertainties. Moreover, simplifying the regulatory environment for marine renewable energy projects is crucial to spur innovation and development, including

streamlining bureaucratic processes for testing and deploying technologies at sea.

Innovation and technology (16,94%) present both challenges and opportunities for maritime decarbonisation. Developing green ports for electric ships requires overcoming infrastructure complexities and improving data integration capabilities. In addition, the transition to green energy faces challenges such as energy storage and the intermittent availability of renewable energy, especially on small islands with limited energy production capacity. These factors underscore the need for comprehensive solutions and strategic investments to effectively advance sustainable maritime practices.

Interregional cooperation (10,82%) has a key role to play in promoting the sector, particularly in diversifying beyond fisheries and tourism. Regions are encouraged to learn from each other's strategic frameworks and implement concrete actions to promote the blue economy. Collaboration is needed across the value chain to increase accountability, incentivise innovation and support digitalisation to improve port efficiency and environmental sustainability.

Lastly, **knowledge transfer** (7,29%) in the maritime sector is essential to foster innovation and support new businesses. Enhanced cooperation between academia, industry and public authorities is essential to bridge gaps and accelerate the development of green ships and sustainable technologies. Cross-regional partnerships are particularly important to effectively integrate different infrastructures and regulatory frameworks. In addition, addressing the **skills shortage** (5,93%) through targeted training programmes is essential for the transition to green ports to ensure a skilled workforce capable of operating and maintaining green infrastructure. And also **environmental adaptation** (2,40%) in marine renewable energy, **economic diversification** (2,85%) beyond fishing and tourism.

Considering the innovation investment priorities for this value chain, the most coded categories relate to financial support and investment, interregional cooperation and stakeholder engagement and networking.

Figure 6 – Innovation Investment Priorities in Value Chain 2

Innovation Investment Priorities		
Financial Support & Investment	Stakeholder Engagement & Networking	Regulatory & Policy Framework
Interregional Collaboration	Innovation & Technology	Environmental Sustainability

Source: Own Elaboration using Nvivo11

Cross-regional research (18,06%) efforts focus on optimising Carbon Capture and Utilisation (CCU) to reduce the cost of synthetic fuels, with an emphasis on stakeholder engagement to improve CO2 capture efficiency. International cooperation and education programmes are essential to bring innovative solutions to global markets. Ports, regional authorities and stakeholders are increasing cooperation to share best practices and leverage unique competencies globally. In addition, inter-regional partnerships are essential to develop shared research facilities, particularly for sectors such as algae production and biofuels, and to advance knowledge on the operation and maintenance of marine renewable energy projects through demonstration and pilot sites.

Financial support and investment (17,84%) in the maritime sector is crucial to drive innovation, particularly in smart ports and alternative fuels.

Partnerships between larger companies, start-ups and SMEs play a crucial role in driving innovation and investment, especially at the European level. Public funding mechanisms such as grants and tenders are essential to help SMEs and start-ups overcome market entry barriers. In addition, better connections between ports and local cities, as well as tailored policies for different sea basins, are needed to effectively address regional needs and demands. Increasing investment through public tenders for offshore wind projects and ensuring the timely release of information are also key strategies to attract large companies and foster competition in the sector.

Stakeholder engagement and networking (12,08%) is the third category and includes suggestions such as establishing partnerships to develop viable charging systems for electric ships to ensure seamless integration and operational efficiency. Convincing ship owners of the benefits of hydrogen-powered vessels requires the sharing of best practices and financing strategies among investors. Supporting SMEs through international cooperation, participation in events and specific incentives in the outermost regions will facilitate their growth. Mapping stakeholders and improving links between ports and regions will improve the sustainability of marine renewable energy projects. Finally, promoting public acceptance of offshore wind projects means working with local communities to effectively address concerns.

Innovation and technology (3,71%) development in this value chain must focus on progress through efforts to integrate small ports into regional activities, promoting sustainability and innovation. These initiatives include promoting the adoption of innovative solutions through calls for tender and studying the impact of offshore energy on fish production. **Regulatory and policy frameworks** (11,44%) are crucial for promoting green shipping by assessing and potentially investing in efficient ship development. Strategies focus on sustainability regulations for companies and coordinating approaches for ships using ammonia, hydrogen and methane. Efforts are also needed to harmonise EU regulations to

streamline marine renewable energy projects and to integrate offshore energy with aquaculture to overcome complexities. Overall, linking small ports with regional activities remains key to promoting **environmental sustainability** (3,10%) and technological innovation in maritime operations.

5. CONCLUSIONS

This summary report highlights the urgent need for a coordinated and innovative approach to address the challenges within the Blue Economy, particularly in the areas of sustainable fisheries and aquaculture and marine energy and decarbonisation. The identified needs, including complex regulatory frameworks, high initial investments and fragmented policies, require targeted interventions to promote sustainability and technological progress.

Public policy will have a vital role in addressing the needs, challenges and opportunities identified in this report. We anticipate that the action plan that will be designed in Deliverable 2.5 will put forward several actions that might be useful responding to these issues. Nevertheless, this will not be possible without policy changes. Thus, the implementation of some of the policy recommendations that will be approached in Deliverable 2.5 will be essential for the successful development of Interregional innovation investments within the Blue Economy, notably in each of the value chains addressed in this project.

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ANNEX 1 – Meetings of the Q-Helix Working Groups – VALUE CHAIN 1

Working groups: main insights

Sustainable Fisheries, Aquaculture, and Valorisation of Blue Resources

1° meeting – Sustainable Fishing

List of participants

The first working group's meeting of the value chain "Sustainable Fisheries, Aquaculture, and valorisation of Blue Resources" was held on 16th May and focused on the theme of Sustainable Fishing.

The meeting was attended by a total of 19 stakeholder from various organizations and countries, representing the whole quadruple-helix asset, as reported in the following table (Table 2).

Participant	Category	Region
Participant 1	Community	Italy
Participant 2	Government	Spain
Participant 3	Academia	Portugal and Azores
Participant 4	Academia	Portugal and Azores
Participant 5	Government	Portugal and Azores
Participant 6	Academia	Croatia
Participant 7	Community	Croatia
Participant 8	Government	Portugal and Azores
Participant 9	Industry	Portugal and Azores
Participant 10	Industry	Italy
Participant 11	Industry	Italy
Participant 12	Industry	Croatia
Participant 13	Community	Portugal and Azores
Participant 14	Academia	Italy
Participant 15	Industry	Italy
Participant 16	n.a	n.a.
Participant 17	Industry	Italy
Participant 18	Academia	Portugal and Azores
Participant 19	Academia	Italy

Table 2. List of participants that attended the meeting "Sustainable Fishing" held on 16th of May within the value chain "Sustainable Fisheries, Aquaculture, and valorisation of Blue Resources" and their respective role during the workshop.

The partners who participated in the meeting and their respective roles are listed in Table 3.

Participant	Partner	Role in the meeting
Participant 20	Ctaqua	Workshop leader and facilitator
Participant 21	Ctaqua	Workshop assistant and annotator
Participant 22	PMBA	Facilitator
Participant 23	PMBA	Annotator
Participant 24	Clust-ER	Facilitator
Participant 25	Merinova	Annotator
Participant 26	ANI	Facilitator
Participant 27	ANI	Annotator

Table 3. Partners that attended the meeting “Sustainable Fishing” held on 16th of May within the value chain “Sustainable Fisheries, Aquaculture, and valorisation of Blue Resources” and their respective role during the workshop.

Identification of challenge and needs

The sustainable fishing sector is a critical component of the blue economy, providing a vital source of food and livelihoods for millions of people around the world. However, the sector faces numerous challenges that threaten its long-term viability, including environmental degradation, overfishing, and the impacts of climate change. The following section summarizes the various challenges facing sustainable fishing that emerged during the workshop.

1. Linking Scientific Knowledge to Practitioners

One of the significant gaps in the sector is the disconnect between scientific research and its practical application in the fishing sector. This hinders the adoption of sustainable practices and innovative solutions by fishing firms and practitioners. It is essential to bridge this gap by linking scientific knowledge to practitioners, enabling them to make informed decisions and adopt sustainable practices. In some regions, such as Croatia, there is an absence of applied research groups that can provide

research closely connected to the reality of practitioners in the field. This limits the availability of practical solutions to address the sector's challenges, as research is often disconnected from the needs of practitioners.

Another challenge is the lack of intermediaries who can facilitate connections between fishermen and valuable resources, such as research institutions and funding agencies. This lack of mediators creates a significant obstacle to the adoption of sustainable practices, as fishermen often struggle to access the resources they need to improve their operations.

The link between research and production issues in territories must be strengthened to ensure that research is relevant and applicable to the needs of practitioners. This includes promoting collaboration between researchers, policymakers, and practitioners to develop practical solutions to the sector's challenges.

2. Limited Technical Capabilities

Fishing firms, particularly smaller ones, often lack the technical capabilities to access European funds, which further exacerbates the challenges they face in adopting sustainable practices. This limited technical capacity hinders their ability to participate in innovation initiatives and access critical resources. Moreover, the fishing sector is characterized by a diverse range of actors, including smaller, more sustainable firms that often have limited awareness and capacity to participate in innovation initiatives. This diversity presents both opportunities and challenges, as smaller firms may be more agile and open to sustainable practices, but they often lack the resources and knowledge to implement them effectively.

3. Data Collection, Digitalization and Training

The existing fleet of fishing vessels could contribute significantly to the collection of data, which is essential for pushing forward research and

development in the sector. This data can inform sustainable practices, improve fisheries management, and support the development of innovative solutions. The integration of information in databases across the European spectrum is crucial for addressing issues such as disease outbreaks and promoting sustainable practices. This includes sharing best practices, research findings, and data to support the development of innovative solutions. Thus, there is a need for digitization and training in the fishing sector to ensure that stakeholders are aware of available resources and can effectively utilize them. This includes training in sustainable practices, fisheries management, and the use of digital tools to improve operations and decision-making. As an example, the use of non-recyclable and non-biodegradable plastic materials in fishing tools is a significant environmental concern. Thus, education and training are needed to promote sustainable fishing practices, such as avoiding overfishing and maintaining healthy fish stocks. This requires a shift towards more sustainable tools and practices that minimize the sector's environmental impact.

4. Regulations for sustainable fisheries management

The sector must develop strategies to manage crises effectively and incorporate cutting-edge technologies to improve production in a more sustainable way. This includes adopting precision farming and other smart technologies to reduce the sector's environmental impact and improve its efficiency. The regulatory environment is often seen as a heavy burden for fishermen, and more user-friendly systems are needed to facilitate compliance. Regulations must be designed to support sustainable practices and provide a framework for responsible fisheries management. As an example, the establishment of protected areas and the management of fish populations, particularly those with market value, are critical concerns that require careful attention. This includes addressing the decline of local fish populations and promoting sustainable fisheries management practices.

5. Financial Support

Financial support is essential to address the various challenges faced by the fishing sector, but it is not a panacea and must be combined with other solutions. Financial support can help to improve the sector's competitiveness, support innovation, and promote sustainable practices. Support is also needed for the exportation and commercialization of fish products, particularly in regions with limited market access. This includes providing training and resources to improve the sector's competitiveness and access to international markets.

Island regions, such as the Azores, face unique challenges due to their geographic location. These include difficulties in maintaining equipment, acquiring technical support, and accessing research and development personnel. These challenges must be addressed through targeted support and innovative solutions that cater to the specific needs of these regions.

6. Lack of generational replacement in the fishing sector

Another issue to consider is that small fishing villages, historically dedicated to fishing and passed down through generations, have traditionally viewed artisanal coastal fishing as a physically demanding activity with little innovation. As a result, young people now perceive fishing as an unappealing career path due to the high physical and personal demands involved. This perception is partly due to a lack of information and training regarding the potential of new technologies to enhance the daily fishing experience. However, it is also true that starting a business requires a significant initial financial investment.

6. Control of Invasive Species

The impact of invasive species, such as the blue crab, must be studied and addressed to prevent further damage to local ecosystems. This includes developing collaborative strategies for the management and control of invasive species, as well as promoting sustainable practices that

minimize their impact. In addition, in regions such as Andalusia, fishermen have been heavily affected for the last five years by an invasive Asian alga "Ruguloptery okamurae". Currently, several national and regional bodies are carrying out projects to find an economic viability for the number of algae that accumulates on the beaches. With an added problem because, according to Spanish legislation, the competence of a city's coastline is the responsibility of the municipality, and this circumstance complicates the decision-making process regarding its collection, management and subsequent recovery.

Identification of innovation investment priorities

To ensure the long-term viability of the fishery industry, it is essential to identify and implement effective investment strategies that prioritize sustainability. The following section summarizes the key areas to be prioritized for sustainable investments in the fisheries sector, focusing on aquaculture, research, and international cooperation.

1. International Cooperation and Knowledge Transfer

During the meeting, international cooperation and knowledge transfer emerged as essential for addressing the global challenges faced by the fisheries sector. Strategies include:

- **Collaborative Research:** Encouraging collaboration among stakeholders from different countries to share insights, tools, and strategies for sustainable fisheries management.
- **Education and Training:** Providing training and education for fishermen and industry professionals in new technologies, sustainable practices, and innovative approaches.
- **Information Sharing:** Establishing platforms for sharing data, research findings, and best practices to facilitate the development of sustainable fisheries management.

2. Governance and Regulation

Effective governance and regulation were considered critical for ensuring the sustainability of the fisheries sector. Key strategies include:

- **Harmonization of Regulations:** Developing a common framework for regulations across different regions and countries to facilitate cooperation and consistency. To address over-regulation concerns, the Andalusian fisheries sector advocates for flexible regulations that consider local social and commercial factors. Effective governance and management of shared fishing grounds, such as the Spain-Portugal collaboration for anchovy and sardine species, can inform investment strategies that balance regulation with regional needs.
- **Monitoring and Evaluation:** Establishing monitoring systems and databases to track progress, identify challenges, and inform policy decisions.

3. Investment and Financing

Investments in research and development were considered crucial for addressing the challenges faced by the fisheries sector. Key strategies include:

- **Encourage Private Sector Participation:** Providing incentives and financing options to encourage private sector investment in sustainable fisheries projects.
- **Support Research and Development:** Allocating funds for research and development initiatives that focus on sustainable fisheries management and aquaculture.
- **Facilitate International Cooperation:** Establishing funding mechanisms to support international cooperation and knowledge transfer initiatives.

2° meeting – Sustainable Aquaculture

List of participants

The second working group's meeting of the value chain "Sustainable Fisheries, Aquaculture, and valorisation of Blue Resources" was held on 23rd May and focused on the theme of Sustainable Aquaculture.

The meeting was attended by a total of 14 stakeholder from various organizations and countries, representing the whole quadruple-helix asset, as reported in the following table (Table 4).

Participant	Category	Region
Participant 1	Academia	Portugal and Azores
Participant 2	Industry	Netherlands
Participant 3	Industry	Italy
Participant 4	Government	Portugal and Azores
Participant 5	Industry	Croatia
Participant 6	Industry	Portugal and Azores
Participant 7	Academia	Portugal and Azores
Participant 8	Government	Portugal and Azores
Participant 9	Academia	Croatia
Participant 10	Government	Portugal and Azores
Participant 11	Industry	Italy
Participant 12	Industry	France
Participant 13	Community	Croatia
Participant 14	Academia	Italy

Table 4. List of participants that attended the meeting "Sustainable Aquaculture" held on 23rd of May within the value chain "Sustainable Fisheries, Aquaculture, and valorisation of Blue Resources".

The partners who participated in the meeting and their respective roles are listed in Table 5.

Participant	Partner	Role in the meeting
Participant 15	Ctaqua	Workshop leader and facilitator
Participant 16	Ctaqua	Workshop assistant
Participant 17	PMBA	Facilitator
Participant 18	Clust-ER	Annotator
Participant 19	BBA	Annotator
Participant 20	ANI	Facilitator

Table 5. Partners that attended the meeting “Sustainable Aquaculture” held on 23rd of May within the value chain “Sustainable Fisheries, Aquaculture, and valorisation of Blue Resources” and their respective role during the workshop.

Identification of challenge and needs

The sustainable development of aquaculture is crucial for meeting the world's growing demand for seafood while minimizing environmental impacts. As the sector continues to expand, it is essential to identify and address the key challenges and opportunities that arise from its growth. The following section aims to provide a comprehensive overview of the priorities and needs for sustainable aquaculture that emerged during the meeting, drawing on the experiences and insights shared by experts from various regions.

1.Space Limitations, Regulatory Frameworks and Financial Constraints

The availability of suitable areas for aquaculture is a significant constraint. Land-based aquaculture faces space constraints, particularly in regions like the Azores where available land is limited. Moreover, establishing offshore farms is challenging due to high initial investments and stringent regulations. Administrative issues, such as obtaining licenses and permits, hinder the growth of both onshore and offshore aquaculture. The need for a comprehensive map of legally usable areas is crucial for sustainable

development. Regulatory frameworks often hinder the growth of new producers, with administrative procedures and licensing requirements being major obstacles. Small companies face significant restrictions due to laws and high investment requirements, limiting their access to necessary know-how and investment. The initial investment for offshore production is high, and EU regulations can be stringent, making it challenging for farmers to compete with lower-priced production from non-EU countries. There is a lack of clear legislation on new aquaculture processes and species, leading to confusion among producers. Licenses and market requirements for novel species, such as algae, are unclear.

2. Climate Change and Environmental Impacts

Rising temperatures and changing salinity levels affect the immune systems and metabolic rates of Mediterranean mussels and clams, leading to high mortality rates. Microplastic pollution is a growing concern, with constant increases in microplastic presence observed in aquatic environments. The introduction of new invasive species, such as the blue crab, poses challenges and requires innovative solutions.

3. Market and Economic Challenges

The market is often dominated by lower-priced products, forcing farmers to sell at lower prices, and there is a need for more research to introduce new species and improve competitiveness. Unfair competition from non-EU countries, particularly in the finfish and shellfish sectors, affects the market. The licensing process can be lengthy, and more investment is needed in the sector to support sustainable growth. Collaboration between stakeholders from different sectors, such as agriculture, fisheries, and aquaculture, is crucial for sharing best practices and addressing common challenges. During the meeting, the lack of technological and innovative start-ups in the field of sustainable aquaculture has also emerged.

It is very necessary for authorities to design and develop authentic promotional strategies in favor of aquaculture products so that final consumers really know the production systems and the benefit of consuming aquaculture products grown in environmentally friendly, healthy and safe environments. high quality. But specific promotional campaigns are of little use. Actions are needed that are programmed and designed to be carried out throughout the year.

Identification of innovation investment priorities

Effective investment strategies are essential to promote environmentally friendly practices, mitigate climate change risks, and enhance the productivity and profitability of aquaculture operations. The following section outlines key areas for investing in sustainable aquaculture, focusing on best practices sharing, research infrastructure, knowledge dissemination, and digitalization.

1. Best Practices and Regulatory Frameworks

Key innovation strategies include:

- Identify and disseminate successful practices across European regions, including regulatory frameworks, technologies, and species selection for farming.
- Encourage collaboration and benchmarking to ensure the adoption of sustainable methods.
- Develop and implement robust regulatory frameworks to ensure compliance with sustainability standards.
- Harmonize policies across regions to facilitate the adoption of best practices.

2. Research Infrastructure and International Collaboration

Key innovation strategies include:

- Invest in research infrastructure to support the development of sustainable aquaculture practices.
- Invest in training programs to enhance the technical skills of staff working in aquaculture farms.
- Promote international collaboration to leverage expertise and resources.
- Establish structures to facilitate the transfer of knowledge from research projects to companies.
- Foster international collaboration to accelerate the adoption of innovative technologies and practices.
- Establish innovation hubs to support interregional cooperation and knowledge exchange.

3. Digitalization and Traceability

Key innovation strategies include:

- Leverage digital technologies to increase productivity and mitigate risks in aquaculture.
- Implement digital solutions to enhance the traceability of aquaculture products.
- Utilize blockchain technology to ensure the quality and origin of live products.
- Implement traceability systems to provide consumers with detailed information about the production process.

4. Climate Change, Circular Production Processes and Subproducts

Key innovation strategies include:

- Encourage the adoption of circular production processes to minimize waste and optimize resource utilization.
- Invest in research for commercializing subproducts related to aquaculture.

- Identify and develop markets for subproducts, such as those derived from algae and invertebrates and promote the use of these subproducts in various industries, including food, cosmetics, and pharmaceuticals.
- Invest in research, technologies and practices that reduce the environmental impact of aquaculture.
- Support research and development targeting low-trophic organisms, such as marine invertebrates and algae.

3° meeting – Valorisation of Biomass and Coproducts

List of participants

The third working group's meeting of the value chain "Sustainable Fisheries, Aquaculture, and valorisation of Blue Resources" was held on 5th June and focused on the theme of Valorization of biomass and coproducts.

The meeting was attended by a total of 17 stakeholder from various organizations and countries, representing the whole quadruple-helix asset, as reported in the following table (Table 6).

Participant	Category	Region
Participant 1	Industry	Croatia
Participant 2	Government	France
Participant 3	Industry	Italy
Participant 4	Government	Spain
Participant 5	n.a	n.a
Participant 6	Academia	France
Participant 7	Industry	Italy
Participant 8	Industry	Portugal and Azores
Participant 9	Community	Portugal and Azores
Participant 10	Industry	Spain
Participant 11	Academia	Portugal and Azores
Participant 12	Academia	Italy
Participant 13	Industry	Spain
Participant 14	Government	Portugal and Azores
Participant 15	Academia	France
Participant 16	Industry	Spain
Participant 17	Community	Finland

Table 6. List of participants that attended the meeting "Valorization of Biomass and Coproducts." held on 5th of June within the value chain "Sustainable Fisheries, Aquaculture, and valorisation of Blue Resources".

The partners who participated in the meeting and their respective roles are listed in Table 7.

Participant	Partner	Role in the meeting
Participant 18	Ctaqua	Workshop leader and facilitator
Participant 19	Ctaqua	Workshop assistant
Participant 20	PMBA	Facilitator
Participant 21	ANI	Facilitator
Participant 22	PMBA	Annotator
Participant 23	ANI	Annotator
Participant 24	Clust-ER	Annotator
Participant 25	Clust-ER	Annotator

Table 7. Partners that attended the meeting “Valorization of Biomass and Coproducts” held on 5th of June within the value chain “Sustainable Fisheries, Aquaculture, and valorisation of Blue Resources” and their respective role during the workshop.

Identification of challenge and needs

The valorization of coproducts and marine resources is a crucial sector which has been promoted as key to the establishment of a sustainable blue bioeconomy. However it faces various challenges and requires strategic support to ensure its growth and sustainability. The following section summarizes the primary challenges and needs in this sector, based on the experiences and opinions shared by participants from diverse backgrounds and regions during the workshop.

1. Scaling Up Activities and Licensing

The biomass sector, particularly microalgae production, struggles to be competitive due to small-scale production. Scaling up production is necessary to meet the demands of specialized markets, but this requires significant industrial support, including investments in infrastructure and technology. Additionally, the sector needs to transition from harvesting to breeding, especially for seaweeds in Europe, to keep pace with developments in other parts of the world. One of the significant challenges faced by the sector is the need for suitable locations for scale-up activities, particularly for SMEs. This issue is not limited to SMEs, as large companies also encounter difficulties in finding appropriate locations. Furthermore,

the administrative burden for licensing new activities is a major obstacle, affecting both SMEs and large companies. This burden can be overwhelming, hindering the sector's ability to expand and innovate.

2. Capacity Building and Business Development

Another critical need in the sector is capacity building, specifically in the areas of aquaculture and business development. This is particularly evident in regions like the Black Sea, where there is interest in introducing aquaculture to decrease the cost of certain goods. Currently, the cost of fish is very high, making it inaccessible to the local population. Capacity building in these areas can help address this issue and increase the sector's competitiveness.

3. Public Investment and Policy

Public investment is crucial to improve investment and attractiveness in regions like the Azores, which face significant constraints. Public policies can help create an enabling environment for the sector to grow, attracting private investment and talent. This investment can also help address the lack of qualified human resources, which is a major constraint in the sector. The sector lacks profitability, which prevents interest from private investors. Strategic policies and mapping of the system are necessary to organize stakeholders and attract investment. This requires a critical mass of stakeholders working together to create a more attractive and sustainable sector. Peripheral regions like the Azores face significant logistical challenges, such as transportation, which can hinder their ability to participate in the sector. To overcome these hurdles, greater financial support for research is necessary. This support can help these regions develop the necessary infrastructure and expertise to fully engage in the valorisation of coproducts and marine resources.

4. Legal and Administrative Procedures

Complex legal and administrative procedures hinder the sector's growth, and connecting different entities is a significant challenge. Simplifying these procedures and creating a more streamlined regulatory environment can help reduce the administrative burden and facilitate collaboration among stakeholders.

5. Technology Transfer and Knowledge Management

Technology transfer, including both patents and the sharing of knowledge, is essential to address the challenges faced by the sector. This transfer can help bridge the gap between research and industry, enabling the sector to adopt new technologies and innovations. Effective knowledge management is also crucial, as it can facilitate the sharing of best practices and expertise among stakeholders.

6. Consumer Education and Awareness

Educating consumers about the benefits and uses of coproducts and marine resources is essential to increase demand and drive growth. This education can help create a market pull, encouraging the sector to innovate and expand.

7. Upcycling Biomass Products

Finally, focusing on upcycling biomass products can help overcome challenges and create new opportunities in the sector. This approach can help reduce waste, increase the value of biomass, and create new products and markets.

Identification of innovation investment priorities

The successful valorisation of marine by-products and resources requires a multifaceted approach that incorporates data harmonization, networking, targeted tenders, research, infrastructure development, and

a focus on the circular economy. The following section outlines the primary areas for innovation and investment in the sector.

1. Data Harmonization and Accessibility

Main key strategies are:

- Establish a unified framework for collecting and sharing data on marine by-products and resources.
- Ensure data accessibility to facilitate collaboration and informed decision-making.

2. Networking and Collaboration

Main key strategies are:

- Foster networks among different EU countries to address crises (like the blue crab situation in the North Adriatic region).
- Encourage cross-border collaboration and communication about transnational access opportunities for using testing sites.

3. Targeted Tenders and EU Innovations:

Main key strategies are:

- Develop tenders specifically for sectors related to marine by-products and resources.
- Promote EU innovations close to commercialization, highlighting their added value and fostering networks among different EU countries.
- Conduct research on how to foster the valorization and upcycling of side streams and by-products.
- Establish dedicated funding lines for projects on infrastructure development, separating them from other contenders at different phases of maturity.
- Explore the use of seaweed for agriculture processes, such as fertilizers.

- Increase investment in marine protected areas to enhance their management and valorization.

4. Workshops and Stakeholder Engagement

Main key strategies are:

- Organize workshops to connect stakeholders, demonstrate biomass potential, and create partnerships.
- Improve supply chain management through digitalization and dynamize networks, projects, and partnership building.

ANNEX 2 – Main Conclusions of the Meetings of the Q-Helix Working Groups – VALUE CHAIN 1

Conclusions – Value Chain #1

Through the organization of the working groups in “Sustainable Fisheries, Aquaculture, and valorisation of Blue Resources” value chain, it has been possible to identify the main challenges and needs of the sector and the areas to prioritize for innovation and investment. This report reflects the insights and experiences of **38 stakeholders** from 9 different European regions, representing all categories of the quadruple helix.

Bridging the gap between scientific knowledge and practical application is crucial. This involves fostering collaboration between researchers, policymakers, and practitioners to develop solutions that are both innovative and applicable to real-world scenarios. Enhancing the technical capabilities of smaller fishing firms and providing them with access to European funds and resources is essential for promoting sustainable practices and innovation. Regulatory frameworks must be designed to support sustainable practices and facilitate compliance. This includes developing user-friendly systems and harmonizing regulations across regions to ensure consistency and cooperation.

Financial support, while necessary, must be combined with other solutions to improve competitiveness, support innovation, and promote sustainable practices. Addressing the impact of invasive species and promoting international cooperation and knowledge transfer are also critical. Collaborative research, education, and information sharing can help develop strategies for sustainable fisheries management. Effective governance and regulation, along with investment in research and development, are essential for ensuring the long-term sustainability of the fisheries sector.

In conclusion, the sustainable development of the fishing and aquaculture sectors requires a comprehensive and integrated approach. By addressing the identified challenges and leveraging opportunities for

innovation and collaboration, we can ensure the long-term viability and sustainability of these critical components of the blue economy.

ANNEX 3 – Miro Boards – VALUE CHAIN 1

Figure 1. Sustainable Fishing - representative Miro Boards

Breakout room 2

16th May: Sustainable Fishing

SESSION 1: Challenge and needs

What are the biggest challenges and needs for fostering innovation in your region: key deficiencies in the current support system? Technical, industrial or investment support? Other?

- Linking scientific knowledge to aquaculture practitioners
- Absence of applied research groups
- Gathering information for research from fleet
- lack of identification of mediators (sharing ecosystemic information)
- Technical capabilities to assess European funds for fishing farms
- Geographic limitations in Aquaculture - fishers are constrained by the need to maintain equipment and acquire technical support
- Lack of RandD personnel
- Variation in types of firms and capability and awareness of smaller firms concerning innovation
- Tools used in fishing: plastic materials
- Education of fishermen in increasing stock (avoiding overfishing)

Breakout room 4

16th May: Sustainable Fishing

SESSION 2: Innovation investment strategies

From your viewpoint, what specific areas should we prioritize for collaboration and investment to foster cross-border collaboration and internationalization opportunities in the sector?

- share and identification of problems among countries,
- share solutions and best practices
- making available cost-effective tools
- app that can share data (chemical data, amount of alien species, etc.)
- problem of eu projects: not concrete results to solve issues, the timing of project: too long, delay between the identification of problems and concrete results/help
- having common framework, but local regulations might be different
- tools for early detection in different areas of europe, early detection of alien species with DNA, to anticipate the problem of alien species before it's too late: the sharing of these information is crucial!
- there's should be more collaboration between companies and academy
- harmonize the catches of fishermans

Figure 2. Sustainable Aquaculture - representative Miro Boards

Breakout room 2

23rd May: Sustainable Aquaculture

SESSION 1: Challenge and needs

What are the biggest challenges and needs for fostering innovation in your region: key deficiencies in the current support system? Technical, industrial or investment support? Other?

The sticky notes contain the following text:

- Fernando (PT): Challenge in establishing offshore farms, establishing onshore farms also face administrative issues
- Natalia (ES): Lack of clear legislation on new aquaculture processes and species - licenses and market (need for clarity to producers) e.g. algae and sea cucumbers
- Andy: Many experienced actors, technologies and investors in NL - marketing, branding, comms matters
- Maria Joao: Assessing impacts of aquaculture, financing research on sustainable aquaculture (Azores, PT)
- Kresimir (HR): Crucial challenges for mussels and oysters: seabream predation,
- climate change issues - water temp impact on immune systems and slows metabolic rate
- Salinity levels
- Microplastics

Breakout room 3

23rd May: Sustainable Aquaculture

SESSION 2: Innovation investment strategies

From your viewpoint, what specific areas should we prioritize for collaboration and investment to foster cross-border collaboration and internationalization opportunities in the sector?

The sticky notes contain the following text:

- Investment to support highly polluting actors (including transport and tourism) to become sustainable
- Off-shore technologies for low-trophic organisms
- Address climate change impacts and adaptation through international cooperation
- Concile different activities and sectors environmental impact by reducing the harm caused
- Lack of workforce, particularly manual work.
- The topic of Integrated multitrophic aquaculture should be targeted by research and international collaboration.
- Continuous support inter-regional collaboration by supporting tools such as Digital Hubs or interregional research projects
- Sustainable feed food development
- Monitoring and assessment of impacts
- Lack of technical Skills of aquaculture workers

Figure 3. Valorization of coproducts - representative Miro Boards

Breakout room 3

5th June: Valorization of Biomass and Coproducts

SESSION 1: Challenge and needs

What are the biggest challenges and needs for fostering innovation in your region: key deficiencies in the current support system? Technical, industrial or investment support? Other?



Breakout room 1

5th June: Valorization of Biomass and Coproducts

SESSION 2: Innovation investment strategies

From your viewpoint, what specific areas should we prioritize for collaboration and investment to foster cross-border collaboration and internationalization opportunities in the sector?



ANNEX 4 – Meetings of the Q-Helix Working Groups – VALUE CHAIN 2

Renewable energy and maritime decarbonization

1° meeting – Green Ships

List of participants

The first working group's meeting of the value chain "Renewable energy and maritime decarbonization" was held on 14th May and focused on the theme of Green Ships.

The meeting was attended by a total of 21 stakeholder from various organizations and countries, representing the whole quadruple-helix asset, as reported in the following table (Table 8).

Participant	Category	Region
Participant 1	Industry	Azores
Participant 2	Industry	Azores
Participant 3	Research	France
Participant 4	Community	France
Participant 5	Academia	Finland
Participant 6	Community	Portugal
Participant 7	Industry	France
Participant 8	Government	Finland
Participant 9	Industry	Portugal
Participant 10	Academia	Finland
Participant 11	Government	Finland
Participant 12	Community	Croatia
Participant 13	Academia	Finland
Participant 14	Industry	Poland
Participant 15	Academia	Finland
Participant 16	Academia	Finland
Participant 17	Industry	France
Participant 18	Industry	Portugal
Participant 19	Industry	Portugal
Participant 20	Industry	Poland
Participant 21	Industry	Poland

Table 8. Participants that attended the meeting "Green Ships" held on 14th of May within the value chain "Renewable Energy and Maritime Decarbonization".

The partners who participated in the meeting and their respective roles are listed in Table 9.

Participant	Partner	Role in the meeting
Participant 22	Merinova	Workshop leader and facilitator
Participant 23	Merinova	Workshop assistant
Participant 24	PMBA	Facilitator
Participant 25	Clust-ER	Annotator
Participant 26	BBA	Annotator
Participant 27	ANI	Facilitator
Participant 28	ANI	Annotator
Participant 29	PMBA	Annotator
Participant 30	BSSC	Facilitator

Table 9. Partners that attended the meeting “Green Ships” held on 14th of May within the value chain “Renewable Energy and Maritime Decarbonization” and their respective role during the workshop.

Identification of challenge and needs

The concept of green ships is revolutionizing the maritime industry by emphasizing sustainability and environmental responsibility. Green ships are designed and operated with the goal of minimizing their ecological footprint throughout their entire lifecycle. This includes the use of eco-friendly fuels, advanced technologies for energy efficiency, and sustainable materials in construction. The following section summarizes the various challenges revolving around green ships that emerged during the workshop, including the technological, financial, and collaborative efforts required to transition towards more sustainable maritime operations.

1. Infrastructure and Technological Development

The development of green ports to support electric ships presents significant challenges. Extending electrical energy storage solutions from land to maritime applications requires connections with companies experienced in building electric ships, particularly from Canada. The need for collaboration and expertise exchange is critical. Additionally, the existing infrastructure, controlled by the state and operated by various

entities, complicates the development of facilities that allow for piloting and demonstrating new technologies. The need for adaptable and supportive infrastructure is evident. The collection and analysis of maritime data also face hurdles. Limited availability of data, despite significant collection efforts, restricts accessibility. The complexity of combining different data sources to gain a comprehensive understanding of the sea environment underscores the need for advanced data integration techniques. Exploring business opportunities through data fusion remains in its early stages, highlighting the need for further research and development.

2. Investment, Financial Challenges and need for collaboration

Another significant challenge is the dependency on Chinese batteries, which supply 90% of the market. Exploring alternative energy storage solutions, such as hydrogen, is thus crucial. The challenges associated with alternative fuels, particularly green hydrogen, is the requirement of significant technological and financial resources, as well as infrastructure development. Substantial investments are necessary to adopt new technologies, and industries heavily rely on public funding to support these investments. Thus, the need to establish national strategies and a robust regulatory framework is critical to facilitate the adoption of alternative fuels. The importance of fostering innovation through support for startups and partnerships was also emphasized. There is a need for more support to encourage the creation of new ventures. Collaboration between academia, business, and public administration is essential. Partnerships across regions are particularly important for projects like the development of green ships, which must integrate with different regional infrastructures and regulations. The need for greater cooperation between ship operators, harbours, and city administrations was also stressed.

3. Diversification of the Maritime Sector

The need in some regions for diversification of the maritime sector beyond fishing and tourism, particularly through public policy levers and understanding the links between subsectors, was discussed. The strategic framework of regions should learn from other regions and implement concrete actions to develop the blue economy, with fruitful interregional cooperation.

Identification of innovation investment priorities

The transition towards greener and more sustainable shipping practices is a complex endeavour that requires collaboration and investment across the maritime industry. The following section summarizes the main areas to be prioritized for investments. The findings underscore the collaborative effort required to drive the necessary innovations for decarbonizing the shipping industry and achieving environmental sustainability goals.

1. Investment in Smart Ports and Alternative Fuels

Key strategies include:

- Collaborative research across regions to optimize Carbon Capture and Utilization (CCU) to reduce the costs of synthetic fuels. This involves sharing outcomes among stakeholders to enhance the efficiency of CO₂ capture and utilization.
- Establish partnerships to determine feasible charging systems for electric ships, ensuring seamless integration and efficient operations.
- Convincing ship owners of the need for hydrogen-powered ships is crucial. Sharing best practices and funding strategies among investors can facilitate similar projects.

2. Investment Support and Partnerships

Key strategies include:

- Partnerships between larger corporations and startups, as well as between SMEs and startups, are vital for driving innovation and investment. This is particularly important at the European level.
- Collaboration between ships and ports is necessary to utilize forecast tools and minimize constraints posed by unexpected weather conditions. European partnerships can play a significant role in this area.

3. Regulations and shared strategies

Key strategies include:

- Assessment of existing regulations need for their adequacy in producing more efficient vessels for green shipping. Further investment may be necessary to support this goal.
- Regulations for sustainability in companies are crucial for understanding the needs of companies and promoting sustainable solutions.
- Establishment of a shared strategy for vessels using green energies like ammonia, hydrogen, and methane for a coordinated approach to sustainable shipping.

2° meeting – Green Ports and Logistics

List of participants

The second working group's meeting of the value chain "Renewable energy and maritime decarbonization" was held on 28^h May and focused on the theme of Green Ports.

The meeting was attended by a total of 23 stakeholder from various organizations and countries, representing the whole quadruple-helix asset, as reported in the following table (Table 10).

Participant	Category	Region
Participant 1	Industry	Portugal
Participant 2	Industry	Finland
Participant 3	Academia	Finland
Participant 4	Government	Azores
Participant 5	Government	Azores
Participant 6	Academia	Finland
Participant 7	Government	Finland
Participant 8	Academia	Poland
Participant 9	Community	Portugal
Participant 10	Academia	Finland
Participant 11	Industry	Poland
Participant 12	Industry	Netherlands
Participant 13	Government	Finland
Participant 14	Community	Finland
Participant 15	Academia	Merinova
Participant 16	Academia	Finland
Participant 17	Government	Poland
Participant 18	Community	Portugal
Participant 19	Community	Croatia
Participant 20	Industry	Poland
Participant 21	Industry	Portugal
Participant 22	Industry	Portugal
Participant 23	Industry	Poland

Table 10. Participants that attended the meeting “Green Ports and Logistics” held on 28th of May within the value chain “Renewable Energy and Maritime Decarbonization”.

The partners who participated in the meeting and their respective roles are listed in Table 11.

Participant	Partner	Role in the meeting
Participant 24	Merinova	Workshop leader and facilitator
Participant 25	Merinova	Workshop assistant
Participant 26	PMBA	Facilitator
Participant 27	Clust-ER	Annotator
Participant 28	BBA	Annotator
Participant 29	ANI	Facilitator

Participant 30	Unknown Group	Facilitator
Participant 31	BSSC	Annotator

Table 11. Partners that attended the meeting “Green Ports and Logistic” held on 28th of May within the value chain “Renewable Energy and Maritime Decarbonization” and their respective role during the workshop.

Identification of challenge and needs

The concept of green ports is becoming increasingly significant in the maritime industry as a means of promoting sustainability and reducing environmental impact. Green ports aim to integrate eco-friendly practices and technologies into their operations, focusing on reducing emissions, improving energy efficiency, and managing waste effectively. The following section delves into the various challenges and needs associated with developing green ports, highlighting the importance of regulatory frameworks, alternative fuels, circular economy practices, workforce training, collaboration, and technological innovation.

1. Regulatory Framework

One of the primary areas of focus is the improvement of regulation and the introduction of new policies for the integration of renewable energy. Current regulations are often fragmented, and there is an absence of cohesive national norms, which hampers the effective implementation of renewable energy solutions in port operations. To overcome this, there is a need for harmonized regulations at the European level, particularly concerning shore power and construction, to eliminate grey areas and ensure consistency across member states.

Another critical aspect is the improvement of regulation and policies related to alternative fuels. The deployment of alternative fuels infrastructure is essential for reducing the carbon footprint of port activities. However, the regulatory framework must be robust and clear to support the adoption of these fuels. This includes setting mandatory national targets for the deployment of alternative fuels infrastructure and ensuring

full interoperability of the infrastructure to facilitate seamless integration across different transport modes.

2. Lack of qualified workers

A significant challenge in the transition to green ports is the lack of qualified workers and adequate training programs. The adoption of new technologies and sustainable practices requires a skilled workforce. Therefore, there is a pressing need for training programs that equip workers with the necessary skills to operate and maintain green infrastructure and equipment. There is a high demand for experts, including those in transportation, and connecting regions with the expertise they need is difficult. The need for increased collaboration, the challenges of transitioning to green energy, and the critical issue of attracting and retaining talent in remote and small port locations were recurring themes during the workshop.

3. Collaboration between regions

Collaboration and funding ecosystems, particularly for small and medium-sized enterprises (SMEs), are still in their infancy and need to mature. There is a need to foster collaboration across the value chain, ensuring upstream and downstream accountability. This includes providing incentives to introduce innovation in the upstream chain and supporting technological solutions for digitalization to increase port efficiency and environmental accountability.

4. Regional Challenges

The situation on the west coast of the Ostrobothnia region (Finland), with its five relatively small ports, exemplifies several of these challenges. The difficulty in gathering the capacity to undertake innovation projects and the need for collaboration with other ports are significant issues. Collaboration between the ports themselves is low, and the challenges they face are similar, such as producing green fuels and improving

logistics. The small size of the ports leads to a lack of talent and difficulty in attracting people to remote locations. Additionally, port profiling when traveling abroad is problematic, as the largest ports are well-known and have the best logistical connections, which is not the case for smaller ports.

5. Energy Infrastructure

The issue of charging electric ships, particularly on small islands with limited capacity to produce energy, presents another challenge. The transition towards green ports is troubled by the necessary infrastructure, and the short time available to charge ships complicates matters further. While the future will likely be all-electric, reliance on renewable energy presents challenges due to its intermittent availability. Energy consumption is a tricky problem, and energy production cannot always be controlled, complicating the transition to green energy.

6. Investment and Financial Support

Investment support is crucial for the costly transformation required for future fuels and bunkering infrastructure. Small and medium harbours face difficulties in gaining financial support and are often unaware of future needs. Small ports often struggle to advance larger projects and face difficulties in attracting investment, especially on small islands.

The needs of outermost regions, where a very high proportion of energy is required for port operations compared to the locality, must be taken into account. The technical challenge of how energy will be produced in regions like the Azores or Madeira requires an ecosystemic approach, considering which solutions can be implemented. Thus, financial and technical support is essential, especially for small ports where energy production is difficult, and the high cost of compliance with green ports objectives is a significant burden. The identification of green corridors,

such as the one between Sweden and Finland, which involves new daily ferries using LNG, batteries, and potentially e-methanol, is an interesting development.

Identification of innovation investment priorities

The following section summarizes the key points discussed during the workshop session focused on innovation investment strategies for green ports. The discussion highlighted the importance of integrating renewable energy, enhancing connectivity, and attracting investments to small ports, particularly in isolated regions. The aim is to foster sustainable development in maritime operations through collaborative efforts and technological advancements.

1. Investment, collaboration and public funding

Key strategies include:

- Fostering international collaboration, education programs, and market knowledge to facilitate the entry of innovative solutions into the market.
- Connection of small ports with regional activities to foster innovation and sustainability.
- Providing public funding mechanisms, such as grants and tenders, to support SMEs and startups in overcoming barriers to market entry.
- Investing in improving connections between ports and local cities and defining different policies for different sea basins to fulfil regional needs and demands.
- Enhance collaboration between ports, regional authorities, and stakeholders to share best practices, identify unique competencies, and connect with the global network of ports.

2. Internationalization and Regional Strategies

Key strategies include:

- Supporting SMEs in exportation through international collaboration and participation in events, fairs, and projects.
- International education programs to attract talents.
- Finance and grants for innovation and connections for collaboration with worldwide players.
- Attracting SMEs and startups to operate in outermost regions with special incentives such as tax breaks and direct support.
- Push the sector to adopt innovative solutions through call for tenders of innovative projects.
- Decrease European market entry barriers: ensure that national regulations favour internationalization.

3rd meeting – Marine Renewable Energy

List of participants

The third working group's meeting of the value chain "Renewable energy and maritime decarbonization" was held on 12^h June and focused on the theme of Marine Renewable Energy.

The meeting was attended by a total of 13 stakeholder from various organizations and countries, representing the whole quadruple-helix asset, as reported in the following table (Table 12).

Participant	Category	Region
Participant 1	Academia	Portugal and Azores
Participant 2	Industry	Netherlands
Participant 3	Industry	France
Participant 4	Industry	Portugal and Azores
Participant 5	n.a.	n.a.
Participant 6	Academia	Portugal and Azores
Participant 7	Academia	Portugal and Azores
Participant 8	Government	Finland
Participant 9	Academia	Finland
Participant 10	Academia	Finland
Participant 11	Government	Finland

Participant 12	Community	Finland
Participant 13	Industry	Portugal

Table 12. Participants that attended the meeting “Marine Renewable Energy” held on 12^h of June within the value chain “Renewable Energy and Maritime Decarbonization”.

The partners who participated in the meeting and their respective roles are listed in Table 13.

Participant	Partner	Role in the meeting
Participant 14	Merinova	Workshop leader and facilitator
Participant 15	Merinova	Workshop assistant
Participant 16	PMBA	Facilitator
Participant 17	PMBA	Annotator
Participant 18	ANI	Annotator
Participant 19	ANI	Facilitator
Participant 20	BSSC	Facilitator

Table 13. Partners that attended the meeting “Marine Renewable Energy” held on 12^h of June within the value chain “Renewable Energy and Maritime Decarbonization” and their respective role during the workshop.

Identification of challenge and needs

The marine renewable energy sector is continuously evolving, but it faces several challenges and needs that limit its development. The following section summarizes the main challenges and needs of the sector based on the experiences and observations of experts from various regions during the workshop.

1. Financial Challenges

One of the primary challenges in the marine renewable energy sector is the lack of funding and appropriate financing for Research and Development (R&D) and Innovation. Accessing available funding is also a significant hurdle. This lack of financial support hinders the development of innovative technologies and limits the sector's growth. To address this, there is a need for increased funding opportunities and simplified access to existing funds. Moreover, the lack of financing networks and connections with financial institutions limits the growth of startups and

innovations. There is a need to establish risk financing mechanisms and improve connections with financial institutions to support startups.

2. Regulatory Framework

The regulatory framework for marine renewable energy projects is complex and often rigid, making it difficult to implement projects. There is a need for clearer rules and responsibilities, particularly regarding Zone Limitation Technologies. The regulatory environment must be simplified to facilitate the development of marine renewable energy projects. Moreover, bureaucratic hurdles hinder access to the sea for testing and developing marine technologies. There is a need to streamline the process and reduce bureaucratic barriers to facilitate innovation and development.

3. Collaboration between Academia and Industries

The collaboration between academic research centres and industry is insufficient, limiting the development of innovative technologies. There is a need to support academia in producing knowledge at higher Technology Readiness Levels (TRL), closer to the market. This collaboration is crucial for the sector's growth and innovation.

4. Environmental Sustainability

The marine renewable energy sector must adapt to specific environmental conditions in different regions. For example, in Finland, there is a need for solutions tailored to the colder climate. This requires a focus on environmental sustainability and region-specific solutions.

5. Limited coordination among the value chain actors

There is a lack of systemic thinking and awareness of one's role in the value chain, leading to limited coordination among actors. There is a need to improve systemic thinking and coordination to ensure the sector's growth and development. The absence of uniform standards for marine renewable energy projects, such as tidal and wave energy, creates

challenges for project developers. There is a need to establish uniform standards to facilitate project development and innovation.

Identification of innovation investment priorities

The following section outlines the main areas to be prioritised for innovation and investment in the marine renewable energy sector, focusing on research collaboration, public tenders, and interregional collaboration.

1. Research Collaboration in Environmental Impact:

Key strategies include:

- Support more effective regulation through collaborative research on environmental impact.
- Share data on environmental impact and promote public access to facilitate informed decision-making.

2. Public Tenders for Offshore Wind Projects:

Key strategies include:

- Increase investment in the sector by announcing and implementing public tenders for offshore wind projects, attracting large companies and promoting competition.
- Ensure the timely release of information on tenders to facilitate investment decisions.
- Increase the preparation time between call openings and deadlines to allow for consortium formation and ease access to calls adapted for marine renewable energy.

3. Interregional Collaboration and Knowledge Sharing:

Key strategies include:

- Develop interregional collaborations to share techno facilities, enhancing the efficiency and cost-effectiveness of research and development in various sectors.
- Apply this collaboration to sectors such as algal production and biofuels.
- Establish collaboration between regions that have already implemented marine renewable energy projects, sharing knowledge on operation and maintenance.
- Create demonstration and pilot sites for research purposes, facilitating the development of marine energy sites.

4. System Mapping and Integration of Ports:

Key strategies include:

- Map the actors and their roles in the system to understand how to give agency to the system.
- Improve the connection between ports and regions to enhance the sustainability of marine renewable energy projects.

6. Public Acceptance and Regulatory Harmonizations:

Key strategies include:

- Foster public acceptance of offshore wind projects by engaging with local communities and addressing their concerns.
- Harmonise regulations across EU countries to simplify the implementation of marine renewable energy projects.
- Develop regulatory frameworks that allow for the integration of offshore energy with aquaculture, addressing the complexities and challenges involved.
- Address the need for knowledge on the impacts of offshore energy on fish production.

ANNEX 5 – Main Conclusions of the Meetings of the Q-Helix Working Groups – VALUE CHAIN 2

Conclusions – Value Chain #2

Through the organization of the working groups in “Renewable energy and maritime decarbonization” value chain, it has been possible to identify the main challenges and needs of the sector and the areas to prioritize for innovation and investment. This report reflects the insights and experiences of **43 stakeholders** from 8 different European regions, representing all categories of the quadruple helix.

The marine renewable energy sector and the decarbonization of maritime operations are critical components in the global effort to mitigate climate change. The challenges and needs identified in this report highlight the complexities involved in transitioning towards a more sustainable maritime industry. Key areas that require attention include financial challenges, regulatory frameworks, collaboration between academia and industries, environmental sustainability, and limited coordination among value chain actors. To address these challenges, innovation investment strategies must prioritize research collaboration, public tenders, interregional collaboration, system mapping, and integration of ports. The development of green ports, green ships, and the adoption of alternative fuels are crucial steps towards reducing the environmental impact of maritime operations. The successful implementation of these strategies will depend on fostering collaboration across the value chain, supporting startups and SMEs, and establishing robust regulatory frameworks. Furthermore, the integration of eco-friendly practices and technologies into port operations, the development of green ships, and the adoption of alternative fuels will require significant investments and technological advancements. Ultimately, the decarbonization of the maritime industry is a complex, multi-faceted task that demands a coordinated effort from governments, industries, and stakeholders.

**ANNEX 6 – Main Conclusions of the Meetings of
the Q-Helix Working Groups – VALUE CHAIN 1
AND VALUE CHAIN 2**

General Conclusions

- In the meetings of the stakeholder working groups, the project completed an important phase in the achievement of its objectives. Project partners successfully activated their networks to engage a critical mass of stakeholders, surpassing the quantitative targets established at the project's conception and achieving geographical and sectoral diversity. The discussions allowed for a recognition of challenges and needs shared across regions but also those which emerge from local specifics which must inform capacity building activities. The results of these meetings will allow partners to tailor future activities to the needs and priorities of our target beneficiaries.
- By framing open prompts and actively soliciting the points of view of all present, a diversity of responses was collected – some specific to a given economic activity in a specific locality, others applying to multiple value chains throughout Europe. Some observations suggest clear paths for interregional innovation projects. Others point to issues beyond the scope of the project, but which give essential context to our actions. Furthermore, the articulation of needs for peer learning, improved interregional knowledge sharing, mapping and B2B opportunities confirm the demand for the types of activities to be pursued within the project. Partners will reactivate the connections forged in the working groups in future phases. Members of the working group constitute an important portion of participants in the I3 Hub and it is anticipated that some members will apply to take part in the capacity building programme, including workshops and ecosystem visits. They also constitute a core of high information stakeholders who will extend the reach of project communication and dissemination efforts.
- In short, the rich and wide-ranging discussions held over the course of these six meetings will allow for a better-informed and more

impactful push toward a sustainable blue economy over the project lifetime.

ANNEX 7 – Miro Boards – VALUE CHAIN 2

Figure 4. Green ships - representative Miro Boards

Breakout room 1

14th May: Green Ships

SESSION 1: Challenge and needs

What are the biggest challenges and needs for fostering innovation in your region?



Breakout room 4

14th May: Green Ships

SESSION 2: Innovation investment strategies

From your viewpoint, what specific areas should we prioritize for collaboration and investment to foster cross-border collaboration and internationalization opportunities in the sector?



SESSION 1: Challenge and needs

What are the biggest challenges and needs for fostering innovation in your region: key deficiencies in the current support system? Technical, industrial or investment support? Other?



SESSION 2: Innovation investment strategies

From your viewpoint, what specific areas should we prioritize for collaboration and investment to foster cross-border collaboration and internationalization opportunities in the sector?



Figure 6. Green ports and logistics - representative Miro Boards

Breakout room 1

SESSION 1: Challenge and needs

What are the biggest challenges and needs for fostering innovation in your region: key deficiencies in the current support system? Technical, industrial or investment support? Other?



Breakout room 4

12th June: Marine Renewable Energy

SESSION 2: Innovation investment strategies

From your viewpoint, what specific areas should we prioritize for collaboration and investment to foster cross-border collaboration and internationalization opportunities in the sector?

