DEPARTMENT OF INTERNATIONAL AND EUROPEAN ECONOMIC STUDIES

ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

Multi-Actor Forums to Advance a Sustainable Blue Economy: Blue Transitions in the Black Sea

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Working Paper Series

25-41

June 2025

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ABSTRACT

The Black Sea holds immense strategic and economic value as a hub linking Europe, Asia, and the Middle East. Yet, its Blue Economy—encompassing fisheries, tourism, transport, renewable energy, and marine biotechnology—remains underutilized and fragmented. The EU-funded DOORS project addresses this gap by fostering collaboration among scientists, citizens, and industry stakeholders to tackle marine degradation and climate impacts. Utilizing a System Innovation Approach (SIA) and Multi-Actor Forums (MAFs), the project supports the co-creation of innovation pathways aligned with stakeholder needs and regional policy agendas, including the Common Maritime Agenda (CMA) and the Black Sea Strategic Research and Innovation Agenda (SRIA). Through the design and implementation of Multi Actor Fora across six Black Sea countries – Bulgaria, Georgia, Moldova, Romania, Turkey, and Ukraine -, this study reveals the sectors with the greatest importance for the region, as well as the key challenges, and develops 26 tailored innovation pathways for all priority sectors. Results reveal major innovation gaps across sectors—particularly in sustainable aquaculture, maritime transport, and ocean governance—highlighting the urgent need for strategic planning, digital infrastructure, stakeholder engagement, and transboundary cooperation to realise a resilient and inclusive Blue Economy by 2050.

Keywords: Multi-Actor Forums, Stakeholder engagement, Blue Economy, Black Sea, Systems Approaches

INTRODUCTION

The blue economy is a central driver of the prosperity of coastal regions. The Black Sea is bordered by six nations, which collectively have around 17.5 million residents reliant on its resources (Salihoglu et al., 2024). The Black Sea (BS) is a dynamic geopolitical area situated inside a complex socio-ecological system rich in resources. The Black Sea presents both significant challenges and considerable opportunity within the blue economy sectors. It is a "strategic bridge" located on the perimeter of the EU that links the Mediterranean Sea, Asia, and the Middle East in southern Europe. However, the region's blue economy remains overlooked, despite its significant economic potential.

The Burgas Vision document and the Common Maritime Agenda highlighted its importance for regional development, as stressed by important regional stakeholders (European Commission, 2018, 2019) and set the foundations for the development fo the Black Sea Strategic Research and Innovation Agenda (Black Sea SRIA) (Black Sea Strategic Research and Innovation Agenda, 2019). The Black Sea is among the most contaminated bodies of water globally and exemplifies the deteriorating environmental condition of European seas, despite its resource richness. Fish populations have been decimated, and species diversity has been undermined due to substandard water quality. A crucial shift towards a more sustainable blue economy development path is essential due to the socio-economic impacts of inadequate environmental conditions on employment, food security, tourism, and health.

The DOORS[1] project, financed by the EU, seeks to offer optimal and transparent scientific assistance to address these difficulties in the Black Sea. It aims to stimulate a new wave of potential for the 'blue economy' by bringing together citizens, scientists, and industry to tackle the impacts of human activity and climate change on the marine ecosystem. This will be accomplished through the development of a system of systems (SoS). The System of Systems is designed with the intention of giving researchers with the datasets they need to do their jobs effectively and to resolve environmental concerns and establish strategies for the growth of the blue economy in the region. This will be accomplished by forging ties among industry, scientists, and the public. The engagement degree of various stakeholders is the critical determinant of the success, value, and effect of DOORS.

Multi-Actor Forums (MAFs) are being employed here as a form of stakeholder engagement structure. These forums bring together national stakeholders from Bulgaria, Georgia, Moldova, Romania, Turkey, and Ukraine of all different backgrounds to assist scientists in prioritising Black Sea issues with a focus on blue economy sectors and policies and the use of innovations to fill identified gaps. The MAFs are also validated by an online survey that we disseminated to stakeholders who did not participate in the MAFs. This study explores the findings of the MAFs on national and regional level for the long-term sustainable development of the Black Sea and related policy in the region.

[1] https://www.doorsblacksea.eu

MATERIALS AND METHODS

The System Innovation Approach (SIA) facilitates systemic transformation through an interrelated array of innovations that mutually impact and develop both the system and its components (Alamanos et al., 2022; De Vicente Lopez, 2016). This study employs transition management and systems thinking to address enduring challenges and advance sustainability (Loorbach et al., 2007; Meadows, 2008; Roorda et al., 2014). We stress the cross-sectoral system "as a whole" and its various actors, rather than focusing on individual roles or sectoral advantages. Stakeholders are actively involved in the MAFs to collaboratively prioritise the blue economy sectors based on their importance, map challenges and identify a cohesive array of innovations that will enable the desired transformation (Akinsete et al., 2023). MAFs serve as open innovation platforms that facilitate user co-creation to more efficiently meet stakeholder needs. In an iterative methodology, stakeholders from diverse backgrounds interact to address issues, generate information, and formulate solutions (Geels & Schot, 2007; Seyhan et al., 2025). They delineate shared goals within an aspirational future vision and map concrete steps and solutions related to the Black Sea Blue Economy. Envisioning optimal scenarios is crucial for fostering a sustainable future since it establishes a foundation for constructive transformation (Bennett et al., 2021; Milkoreit, 2017; Riedy & Waddock, 2022). Subsequent innovation pathways are also established to advance the region towards sustainability and fulfil national objectives.

Multi-actor forums, known as MAFs, are presently being established in this region as a novel method to enhance stakeholder engagement. These forums are convening national stakeholders from Bulgaria, Georgia, Moldova, Romania, Turkey, and Ukraine, encompassing a variety of backgrounds, to assist scientists in prioritising Black Sea concerns. The emphasis is on the blue economy. Challenges and priorities, together with the co-development of a shared vision and innovation pathways, are employed to rectify the needs of the region. The initial phase of executing the MAFs in each Black Sea country involves stakeholder mapping. Stakeholders from the quadruple helix were identified and evaluated using an 'influence/interest' matrix (Figure 1), where "influence" refers to the stakeholder's power and ability to effect change, and "interest" indicates the probability of the stakeholder engaging in activities relevant to the case study, whether due to potential benefits or negative consequences (Arnkil et al., 2010; Eden & Ackermann, 1998). Upon completion of the plotting, the map is assessed by an external expert, such as members of the project advisory board or other local specialists.

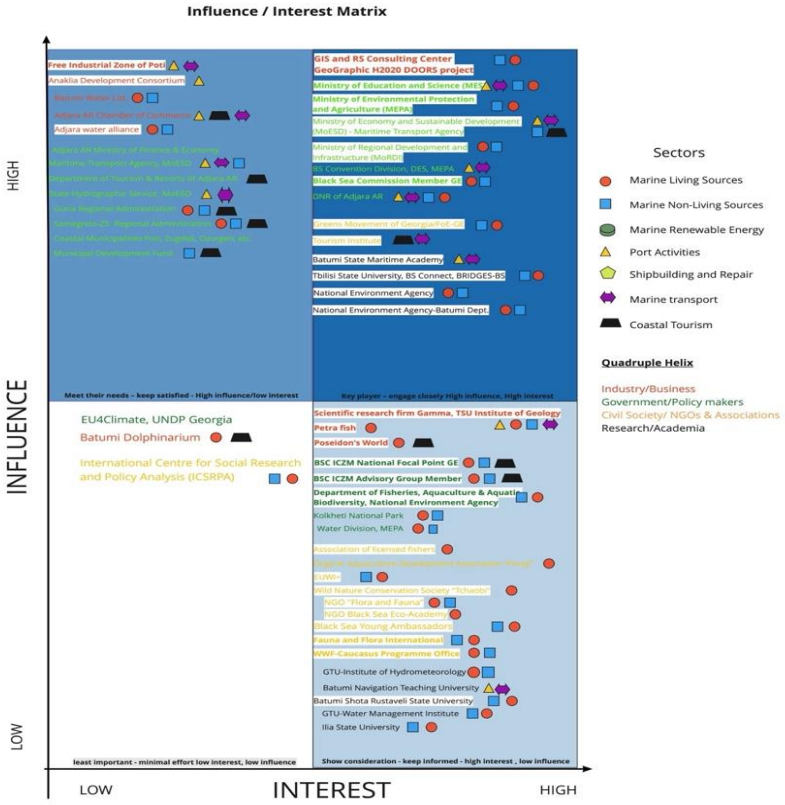

Figure 1 - Influence-Interest Matrix example from Georgia

The aim of this analysis was to identify the subset of stakeholders most suitable for involvement in the Georgia MAF. The primary group from which MAF members will be chosen will comprise stakeholders situated in the upper right quadrant, representing individuals with substantial influence and interest – see Table *1* below. Nevertheless, stakeholders from the lower right and upper left quadrants (i.e., those with minimal interest and influence) are also acknowledged, as the former group comprises individuals who may be pivotal in executing potential recommendations, while the latter group consists of individuals with significant local expertise who typically lack decision-making power (i.e., their perspectives are often overlooked). Employing this methodology for participant selection in the MAF facilitates the identification of stakeholders most pertinent to the study and those more inclined to engage in the research efforts. Although employing MAFs to engage key decision-makers presents benefits, it is also possible to identify stakeholders willing to invest time and effort in the research process by assessing their "Interest" (Brugha & Varvasovszky, 2000; Mendelow, 1981).

Table 1 - Levels of stakeholders' engagement based on influence and interest.

Influence / Interest relationship	Level of engagement	DOORS MAF engagement
High interest / High influence	Manage closely (High involvement, tap into stakeholders' expertise)	MAFs Data collection (interviews) Diffusion of project outputs
High interest / Low influence	Keep informed (one-way communication, presentation of research results)	MAFs Diffusion of project outputs
High influence / Low interest	Keep satisfied (Acting together with stakeholders based on shared goals)	MAFs Diffusion of project outputs
Low influence / Low interest	Monitor (one-way communication with minimum effort)	Diffusion of projects outputs

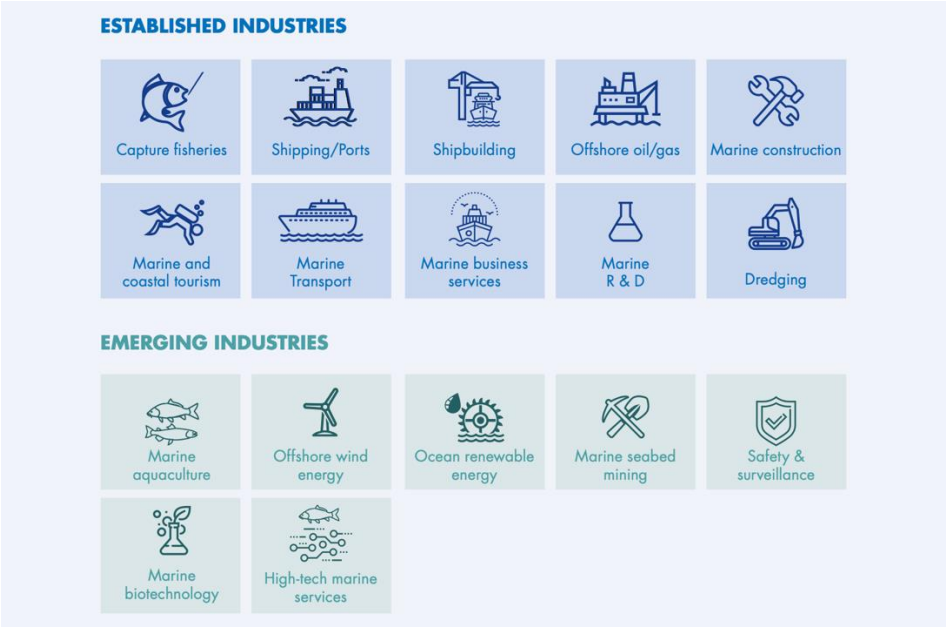

Figure 2 - Blue Economy "Established" and "Emerging" sectors (Caribbean Development Bank, 2018)

The first round of MAFs sought to classify the established and emerging blue economy sectors, as presented in Figure 2, as national priorities and to outline the challenges for each priority sector utilising the PESTLE[2] framework. The first activity involved individual voting on a scale from 1 to 3, with 1 being the most favoured option and 3 denoting the least desired. All votes were consolidated, providing the five most significant sectors in every country. The latter activity utilised the identified sectors as

[2] PESTLE: Political, Economic, Social, Technological, Legal and Environmental (challenges)

the starting point, requesting participants to map PESTLE challenges onto the respective sectors. These outcomes were then mapped onto the CMA and SRIA goals and priorities and validated through a survey that was sent to stakeholders located in the Black Sea who didn't participate in the workshops.

The second MAFs focused on downscaling generic innovation pathways using the backcasting method, creating a "Normative Qualitative Scenario" (Vision) for the DOORS Black Sea Working Vision (*Figure 3*). This vision is based on the existing Burgas Vision for 2030 and aims to build on it for a longer time horizon (2050). The working vision presented in Figure *3*, outlines specific goals, beliefs, and outcomes that represent a future that is more sustainable, equitable, or advantageous for the organization, community, or society.

The Black Sea is resilient and sustainable, with connected societies fostering multi-disciplinary research and incentivizing innovation in coastal, marine and maritime sectors - developing smart, integrated observing and monitoring systems. In addition, education is provided, opportunities for green jobs are unlocked, and specific programs exist to enhance citizen-policy dialogue. Through these efforts, the Black Sea region is able to mitigate and adapt to climate change impacts, while fostering a sustainable blue economy, managing and protecting marine and coastal ecosystems, adopting circularity principles and mobilizing green energy. The Black Sea region is an example of peace, inclusion and equity, leaving no one behind.

Figure 3 - Working vision for the Black Sea

During these workshops, the participants were asked to establish milestones for realizing that vision within each important sector and to map relevant innovations with these milestones. To do so, a set of universally accepted milestones were identified prior to the workshops. Key milestones for 2050 were determined using the United Nations Sustainable Development Goals (SDGs), which are widely acknowledged as the most aspirational framework governing sustainable development in the present day. Lee et al. (2020) examined the scientific evidence about the connection between the BE and the SDGs and the alignment of stakeholders on the relationship between the BE and SDGs. They found that the most pertinent SDGs for the Blue Economy are SDG 12 "Responsible Consumption and Production", SDG 14 "Life Below Water", SDG 15 "Life on Land", SDG 16 "Peace, Justice and Strong Institutions", and SDG 17 "Partnerships for the Goals".

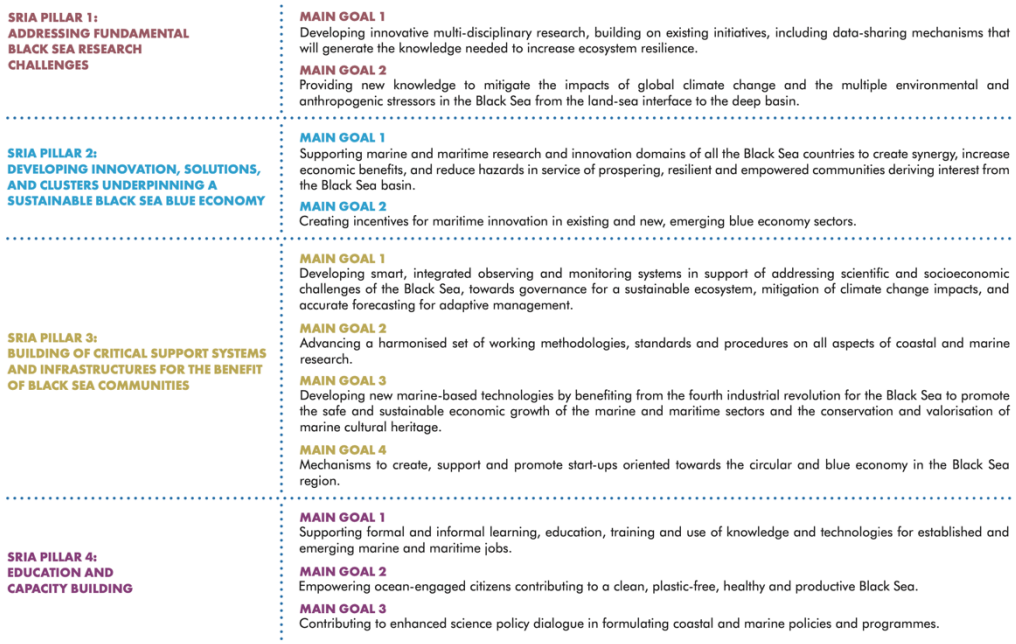

Figure 4 - Four Main Pillars of the Black Sea SRIA

The Black Sea Strategic Research and Innovation Agenda (2019) and the BS SRIA Implementation Plan (Connect Black Sea, 2023) were used to pinpoint significant milestones to be achieved by 2030 (see Figure 4**Error! Reference source not found.**). The four main pillars of the Black Sea SRIA were identified and used as key milestones for all Black Sea countries for the mid-term period. Using the innovations pathway template depicted in Figure *5*, innovation pathways were developed for each BE sector individually in each country in each MAF. These hypothetical scenarios demonstrate several potential future advancements, taking into account factors such as technical advancements, societal trends, regulatory changes, and economic growth. Finally, stakeholders were asked to map innovations that came from the Blue Growth Accelerator (BGA) onto these milestones, seeking to reveal innovation gaps.

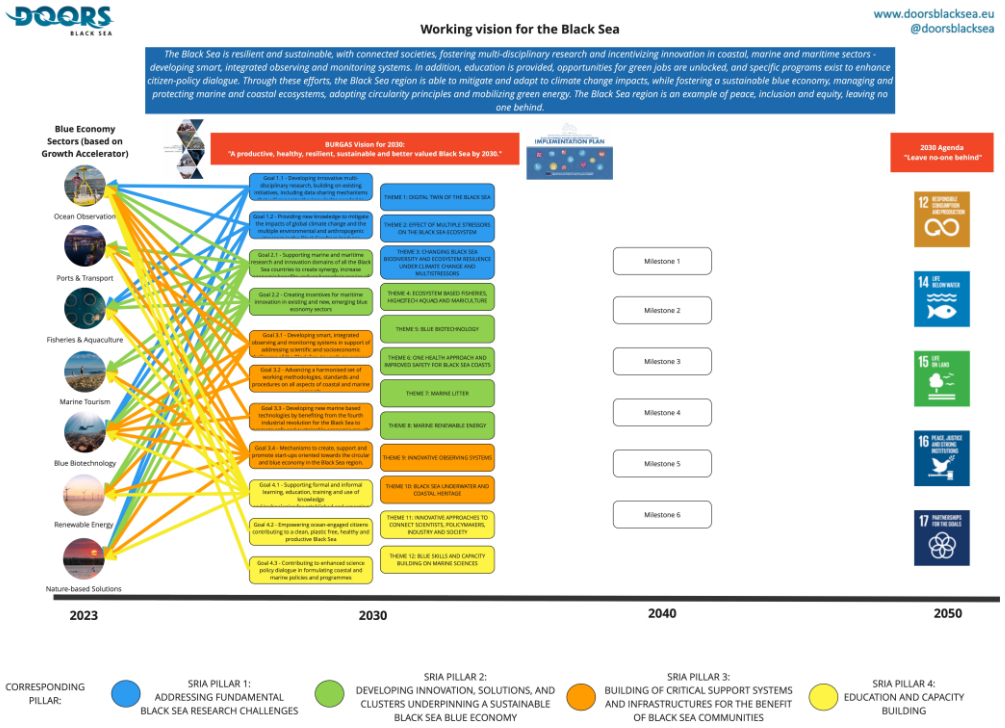

Figure 5 – 2nd MAF Innovation Pathways template

RESULTS AND DISCUSSION

The blue economy encompasses economic activities that take place directly in oceans and seas or employ marine resources for consumption or income (refer to *Figure 2*). *Table 2* presents the sectors that have been prioritized in each Black Sea country in the first MAF. As we see, stakeholders across all six countries unanimously advocate for prioritisation of the fishing sector. Indeed, the Black Sea fishing fleet amounts to almost 11,000 vessels. Despite its significance for the local economy, the fishing sector is subject to several environmental and social challenges that derail its uptake. Pollution, over-exploitation, eutrophication, unsustainable fishing, invasive species, and climate change have negatively impacted the sea, leading to a reduction in biological resources and jeopardising fisheries. The repercussions of the ongoing conflict in the region, including the devastation of the Nova Kakhovka dam in southern Ukraine, oil spills, and the existence of sea mines, intensify environmental hazards. Furthermore, the conflict has hindered essential collaborative initiatives among neighbouring nations to address transboundary issues (EPRS, 2025). Notwithstanding many favourable outcomes, such as reduced pollution and fertiliser inputs, the sea remains significantly distant from the 'excellent environmental status' targeted by the EU's Marine Strategy Framework Directive (European Union, 2008).

As a response to these challenges, some Black Sea countries (Georgia, Turkey, Romania) identified aquaculture as an emerging sector that could meet the needs of their countries. (FAO, 2023a) states that marine and brackish water aquaculture production has nearly doubled in the past decade, rising by 91.3 percent, while profits have increased by 74.5 percent in the Mediterranean and Black Sea region collectively. A study by the General Fisheries Commission for the Mediterranean indicates that aquaculture productivity in the Black Sea region has steadily risen from over 500,000 tonnes of farmed seafood (mainly salmonoids, carp, and European seabass) in 2017 to more than 700,000 tonnes in 2019 (FAO, 2023b). If aquaculture is administered and regulated properly, it might yield numerous socio-economic advantages.

An adequate provision of food is also linked to the marine and coastal tourism pillar that was highlighted by all countries except Turkey. However, this sector is bringing new challenges, such as tourism-related pollution (hotels and boats) and non-planned coastal development for resorts and marinas, that stress further the marine ecosystems if not adequately managed (e.g., through Integrated Coastal Zone Management or the establishment of Marine Protected Areas). The Tourism 4.0 for the Black Sea initiative, co-financed by the European Maritime and Fisheries Fund (EMFF), seeks to empower local stakeholders in the public and private sectors of the tourism industry to improve their understanding of current trends, visitor impact, and flow patterns.

Table 2 - Black Sea Blue Economy sectors prioritization (results from the 1st MAF (Bulgaria, Georgia, Romania and Turkey) and from the online Survey (Republic of Moldova and Ukraine))

Sector	Definition	Established or Emerging	MAFs in which this sector was prioritized
Capture Fisheries	The practice of obtaining naturally occurring living resources in both freshwater and marine environments in a sustainable manner.	Established	Bulgaria, Georgia, Turkey, Republic of Moldova, Romania, Ukraine
Marine & Coastal Tourism	The provision of tourism-related services in and around littoral or marine environments, which support the local community's sustainable development.	Established	Bulgaria, Georgia, Republic of Moldova, Romania, Ukraine
Marine R&D	The activities centred around the advancement of technology, knowledge, and capabilities pertaining to marine environments, encompassing oceans, seas, and other aqueous bodies.	Established	Bulgaria, Georgia, Turkey, Romania
Shipping/ Ports	The operations related to maintaining a sustainable maritime transport ecosystem, encompassing terminal services and the conveyance of passengers and cargo via water.	Established	Bulgaria, Georgia, Republic of Moldova, Ukraine

Marine aquaculture	The practise of aquaculture and farming with the intention of minimising any adverse effects on the purity of air, water, and soil.	Emerging	Georgia, Turkey, Romania
Ocean Renewable Energy	The production of pure and renewable energy from natural sources, such as wind, wave, tidal, and solar, at sea, offshore, on land, and in close proximity.	Emerging	Turkey, Romania
Marine Transport	The transportation of commodities, individuals, and valuable resources through waterways, encompassing lakes, rivers, oceans, and watercraft, in the company of vessels such as ferries, boats, and ships.	Established	Republic of Moldova, Ukraine
Shipbuilding	The goods and services necessary for the construction, upkeep, restoration, and repair of vessels used for ecologically conscious maritime transportation.	Established	Ukraine, Turkey
Marine Business Services	The commercial activities that rely on water and are associated with marinas and other vessel service operations.	Established	Bulgaria
Safety & Surveillance	Transportation, public spaces, and critical infrastructure are among the domains in which the application of technologies and measures designed to ensure protection, monitoring, and security is underway.	Emerging	Republic of Moldova
Offshore wind energy	The design, deployment, and management of wind turbines situated in aquatic environments with the purpose of extracting sustainable energy reserves and generating electrical power.	Emerging	Republic of Moldova
Offshore oil & gas	The extraction of gas and hydrocarbons from submerged sources.	Established	Turkey

When it comes to renewable energy, three Black Sea countries seem to value it as a driving factor for their economies – Turkey and Romania have prioritised ocean renewable energy, while Moldova identified offshore wind energy as an important sector. The commercial feasibility of floating offshore wind in difficult conditions and deep waters is progressively being revealed. Floating offshore wind for depths between 50 and 1000 meters seems to be a feasible alternative for EU member states and regions with insufficient shallow waters; it may enable access to unexploited markets in the

Mediterranean Sea, the Atlantic Ocean, and the Black Sea (European Commission, 2022). Nonetheless, a Black Sea country appears to prioritise traditional and polluting energy sources, such as offshore oil and gas.

Maritime activities have also been the epicentre of the Black Sea economies for centuries. Shipping and ports, marine transport and shipbuilding are some examples that seem to be valuable for Bulgaria, Georgia, the Republic of Moldova, Turkey and Ukraine (see *Table 2*). Over the past two decades (2003-2023), the transport sector in Georgia has contributed an average of 145 million euros to the nation's gross domestic product (GDP), reaching a zenith of 285 million euros in the second quarter of 2023. In contrast, Bulgaria's port and shipping activities generated 115 million euros in 2020 (The World Bank, 2020; Trading Economics, 2023). In the same timeframe, Moldova's transport sector, though lower in magnitude, has consistently grown, contributing over 75 million euros annually to GDP by 2022, propelled by regional commerce and logistical enhancements. Prior to 2022, Ukraine sustained a resilient transport and maritime infrastructure, with port and shipping revenues exceeding 300 million euros annually, underscoring the strategic significance of the Black Sea for grain and commodity exports (European Cluster Collaboration Platform, 2024; GMK, 2024; Ustymenko et al., 2023).

Finally, research and development (R&D) activities seem to also gain ground in the development of the Black Sea agenda, with marine R&D being prioritised by four BS countries, namely, Bulgaria, Georgia, Turkey and Romania. For example, Bulgaria has engaged in blue biotechnology and marine environment monitoring via national initiatives that connect with the EU's Horizon Europe program, including involvement in the DOORS and BRIDGE-BS projects. Conversely, Turkey has enhanced its oceanographic research capabilities via institutions such as the Institute of Marine Sciences at METU, which facilitates initiatives on marine pollution and biodiversity, thereby contributing to national strategies and regional collaborative frameworks like the Black Sea Commission and the Black Sea Strategic Research and Innovation Agenda (SRIA).

The blue economy sectors (see above) that were prioritised in the 1st MAF, were cross-mapped onto the two BS strategies, CMA and SRIA. *Figure 6* illustrates the frequency with which the prioritised Blue Economy sectors from Table *2* are referenced in the strategic goals, pillars, and priority areas of the Common Maritime Agenda (CMA) and the Black Sea Strategic Research and Innovation Agenda (SRIA). It highlights the degree of alignment and emphasis placed on each sector within these two regional policy frameworks, offering insights into which areas receive the most strategic attention and where potential gaps or opportunities for further integration may exist. As we see in *Figure 6*, shipbuilding and offshore wind energy are notably absent from the CMA, indicating a potential oversight in addressing key emerging sectors that are critical for advancing maritime industrial capacity and clean energy transitions. Similarly, marine transport is not explicitly referenced in the BS SRIA, despite its central role in regional connectivity, trade, and decarbonization efforts. Furthermore, sectors such as ocean renewable energy, offshore oil and gas, and maritime safety and surveillance

receive limited attention across both strategies. This limited coverage suggests that while these frameworks aim to support a broad Blue Economy agenda, certain high-impact sectors remain under-represented, highlighting the need for more comprehensive and future-oriented strategic planning.

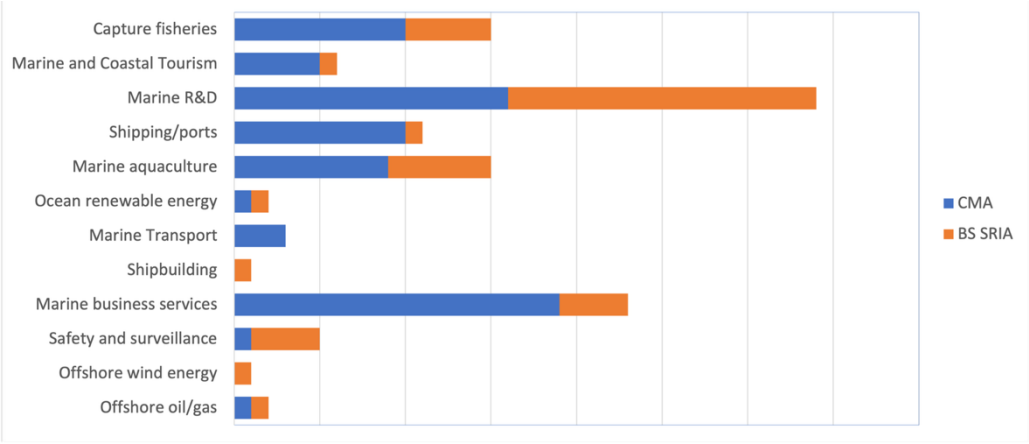

Figure 6 – Frequency of Blue Economy Sector Mentions in CMA and SRIA Strategic Frameworks

Table 3 presents the collective challenges faced in the Black Sea region resulting from the first round of MAFs. The need for interdisciplinary, international, and institutional cooperation to further the implementation of the Blue Economy in the Black Sea is evident. Environmental degradation and pollution constitute the paramount issues in all four Black Sea nations. At the national level, however, priorities differ. The primary hurdles in Bulgaria include insufficient investment in coastal infrastructure, inadequate infrastructure and renewable energy, and limited funding for scientific research on the Black Sea. Georgia confronts issues related to marine litter and waste management, the lack of a beach quality certification system, and insufficient financing for scientific research on the Black Sea. In summary, both Turkey and Romania have focused the monitoring and regulation of maritime litter and trash, with Romania highlighting the need of digitalisation.

Table 3 - Challenges in the Black Sea region as presented in the first round of MAFs

POLITICAL	ENVIRONMENTAL	SOCIAL
○ Geopolitical instability ○ Lack of collaboration between all state institutions ○ Need for regional cooperation and intersectoral synergies ○ Lack of international cooperation ○ Insufficient political will	○ Pollution and environmental degradation ○ Seawater quality ○ Imbalance of aquaculture sustainability and overfishing ○ Climate change's impact on biodiversity	○ Need for training and capacity building in all Blue Economy sectors (limited human resources available) ○ Lack of job opportunities ○ Public awareness on aquaculture sector ○ Need for connectivity through cultural and natural

○ Lack of vision and long-term planning ○ Lack of a Black Sea brand at local and regional level ○ Lack of compliance with political obligations towards the EC		heritage, between neighbouring countries
TECHNOLOGICAL	**LEGAL**	**ECONOMIC**
○ Need for marine research ○ Need for initiatives, such as a beach quality award system (e.g., Blue Flag) ○ Lack of adequate infrastructure ○ Lack of advanced technologies (e.g. for monitoring the fishing vessel in the region) ○ Need for digitization and creation of a unitary database. ○ Need for use of non-polluting technologies	○ Harmonization of national and EU legislation ○ Specific and integrated legislations drafted clearly and concisely, with the elimination of legislative loopholes. ○ Lack of implementation of existing regulations ○ Lack of carrying out adequate monitoring and control ○ High bureaucracy ○ Corruption	○ Need for state aid for fisheries and aquaculture sectors ○ Need for removing the tax barriers for the maritime sector ○ Lack of quotas in the fishing industry ○ Financial crisis ○ High international competition in marine products ○ Lack of Investments

These priorities and challenges were also validated via the online survey. Specifically, *Figure 7* shows the order of the challenges that exert the most significant influence on the operation of the blue economy in each BS country. In Turkey, Bulgaria, and Georgia, collaboration among national institutions has been identified as a priority. This need represents a significant undertaking in achieving effective coordination and collaboration among various governmental entities within those countries. Inadequate collaboration can lead to slow decision-making processes, inconsistent policies, and inefficient resource allocation. To overcome this challenge, it is essential to foster a collaborative environment, enhance communication channels between agencies, and consider implementing institutional changes that improve workflows and boost productivity.

The challenge that notably impacted Bulgaria, Georgia, the Republic of Moldova, and Ukraine was a lack of understanding of local particularities. Not understanding the local specifics, such as socio-economic, cultural, and geographical characteristics of specific regions, may lead to ineffective policies, uneven resource allocation, and dissatisfaction among the local communities. Policymakers should engage local communities in decision-making processes, conduct thorough assessments of regional needs and barriers, and tailor interventions accordingly. Lack of strategic vision and long-term planning is another central challenge for the Republic of Moldova, Georgia, and Ukraine, which can lead to impromptu decision-making and overlooked opportunities for sustainable development. Prioritizing strategic planning procedures, engaging stakeholders from various sectors, and establishing mechanisms for

monitoring and evaluation are some mechanisms to surpass this gap. Investing in public institutions' capacity to engage in evidence-based policymaking and cultivating a culture of strategic thinking can contribute to resilience and adaptability in the face of complex challenges. International cooperation is considered of lesser significance in most Black Sea countries, except for Ukraine, which may result in a reduced focus on cooperative initiatives. However, Ukraine could place greater emphasis on global collaboration due to its strategic geographical location and continuous developments in the region.

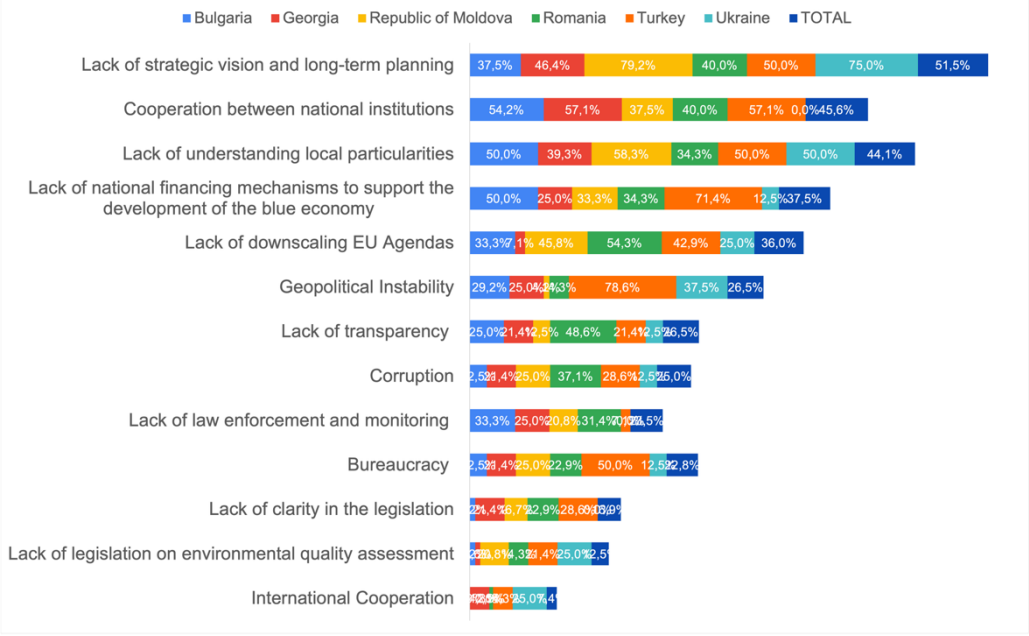

Figure 7 - Challenges with the greatest impact on the operation of the blue economy in each BS country

Bulgaria, Georgia, and Romania agree on adequate legislation for environmental quality assessment, while Moldova and Turkey do not consider transparency as a significant issue. Transparency is crucial for good governance and can foster confidence, thwart corruption, and increase public engagement in democratic procedures. Legislation clarity is a minor concern in Ukraine and Bulgaria, but consistent assessment and revision are necessary to address emerging challenges and accommodate changing societal demands. Georgia's lack of downscaling of EU agendas does not prioritize aligning national priorities and EU agendas, suggesting a lack of perception of a significant disparity between national priorities and EU agendas.

Complementary, *Figure 8* depicts the hierarchy of the challenges that have the greatest impact on the development of the blue economy in each BS country. Pollution and environmental deterioration followed by marine litter and waste management are dominating in the Black Sea for most participating countries, with low salaries,

corruption and lack of a beach quality award system, such as the Blue Flag, being relatively insignificant. A closer look indicates that Bulgaria and Turkey face significant challenges due to the lack of digitisation and a cohesive database. This indicates that the digital infrastructure of their governmental and organisational systems may be insufficient, which could hinder the efficiency of data management and communication. Without digitisation, operational procedures such as record-keeping, information sharing, and decision-making may face diminished efficiency and speed.

The Republic of Moldova, Georgia, and Ukraine are notably focused on maritime-related incidents, such as maritime disasters, ocean pollution, illegal fishing, as well as challenges related to port management and security. In contrast, participants living in Romania recognised limited job opportunities as a notable domestic obstacle. These barriers can emerge from various sources, including economic conditions, mismatches in skill sets, or systemic issues present in the labour market. In the context of Ukraine, financial assistance through subsidies and investments is viewed as a significant challenge following the ongoing war. The conflict has significantly affected Ukraine's economy, requiring external support to restore stability and rebuild the affected areas. Subsidies and investments can significantly contribute to economic recovery, enhance infrastructure development, and meet pressing humanitarian needs.

Figure 8 - Challenges with the greatest impact on the development of the blue economy in each BS country

One of the ambitions of the second MAF was to validate the Black Sea collective vision for 2050, which is displayed in Figure 9. The extended form of this vision is as follows: "*The Black Sea is resilient and sustainable, with connected societies that foster multi-disciplinary research and incentivise innovation in coastal, marine, and maritime sectors. Through the development of smart, integrated observing and monitoring systems, the region ensures effective joint management of the Black Sea ecosystem, strengthening cooperation and sustainable governance. Education, citizen engagement,*

and transparency are central pillars, ensuring open and inclusive dialogue between citizens and policymakers. Children and youth are actively involved in environmental stewardship, fostering a culture of responsibility and innovation from an early age. Opportunities for green jobs are unlocked, and targeted training programs enhance coordination and quality improvement in priority sectors. The region is committed to reducing pollution, strengthening regulations on persistent and emerging pollutants, and ensuring a clean and healthy marine environment. Through researching green energy potential before large-scale implementation, the Black Sea countries adopt a strategic approach to renewable energy development. Sustainable infrastructure and mobility are prioritized, with investments in multi-modal transportation systems that enhance connectivity and efficiency. Policies emphasize cultural diversity and regional integration, fostering collaboration while respecting the unique identities of Black Sea communities. The "open sea" concept is embedded in governance and development strategies, promoting free and sustainable access to marine resources. The Black Sea region embraces adaptive production models suited to a changing climate, ensuring resilience and economic stability. By exchanging knowledge and best practices, stakeholders drive innovation and sustainable transformation across sectors. Through these collective efforts, the Black Sea region mitigates and adapts to climate change impacts, manages and protects marine and coastal ecosystems, and adopts circular economy principles while mobilizing green energy. The Black Sea stands as a model of peace, inclusion, and equity, ensuring that no one is left behind in the transition to a sustainable and prosperous future."

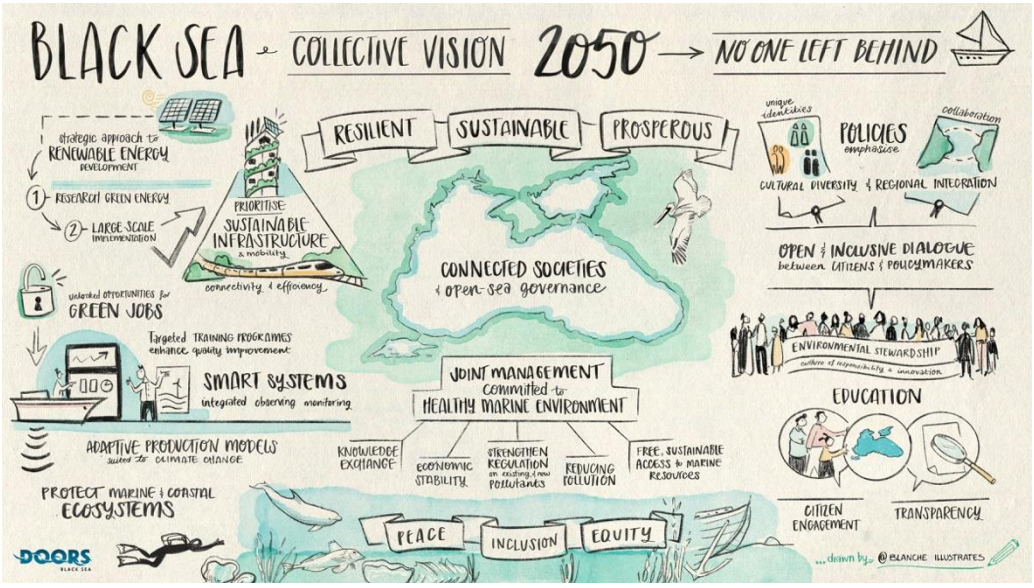

Figure 9 - Black Sea Collective Vision for 2050

Table 4 – Innovation pathways per country and per sector (In green are denoted the sectors for which an innovation pathway was developed in the corresponding country)

Sectors	Ocean Observation	Ports & Transport	Fisheries and Aquaculture	Marine Tourism	Blue Biotechnology	Renewable Energy	Nature-Based Solutions
BULGARIA							
GEORGIA							
MOLDOVA							
ROMANIA							
TURKEY							
UKRAINE							

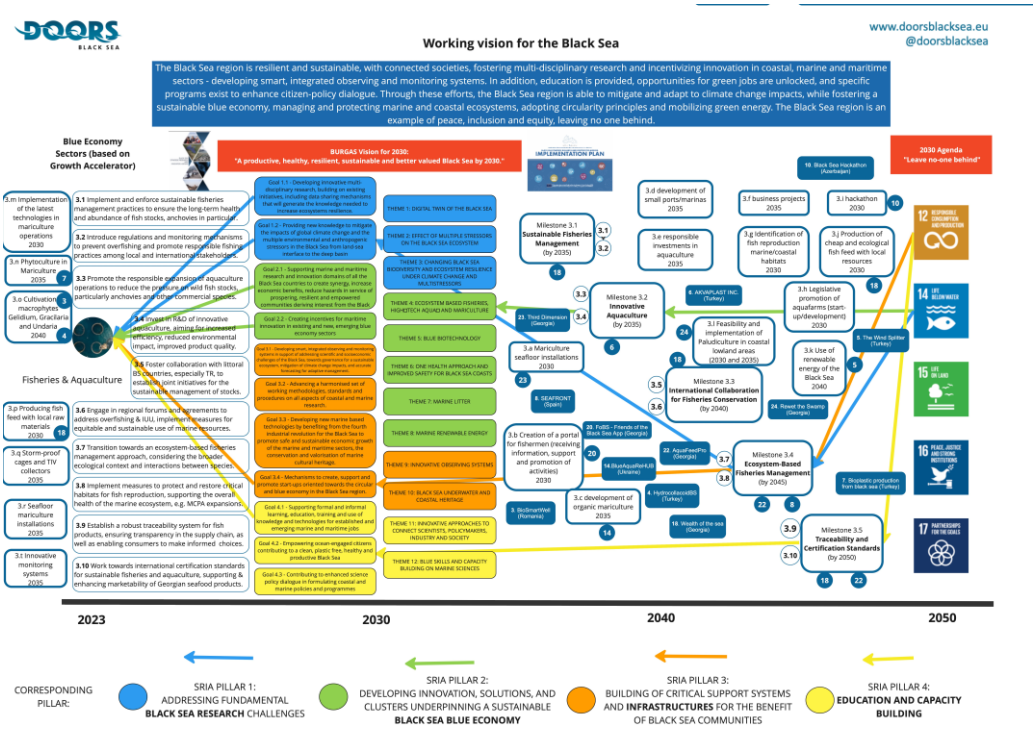

Figure 10 - 2nd MAF in Georgia – Innovation Pathways for the Fisheries and Aquaculture sector (example)

To realise this collective vision for the Black Sea, specific milestones must be specified for each sector and time frame individually. In total, 26 innovation pathways have been developed for each priority sector, identified in the 1st round of MAFs, per country (see example in Figure 10). Table 4 presents a map of the innovation pathways that have been developed, with the sectors for which an innovation pathway was established in the respective country indicated in green. As we see, all countries developed innovation pathways for the "Fisheries and Aquaculture" as well as for the

"Marine Tourism" sectors. Figure 11 and Figure 12 depict those pathways, with each row representing the milestones indicated in each country. The first set of milestones in light purple pertains to steps required from 2025 to 2030, the subsequent set in blue relates to actions necessary from 2030 to 2040, and the final set in purple addresses actions needed for the long-term future, spanning 2040 to 2050. Some of these milestones are matched with innovative solutions from the BGA portfolio, leading to the right next column that consolidates the milestones lacking existing solutions, hence necessitating focused attention.

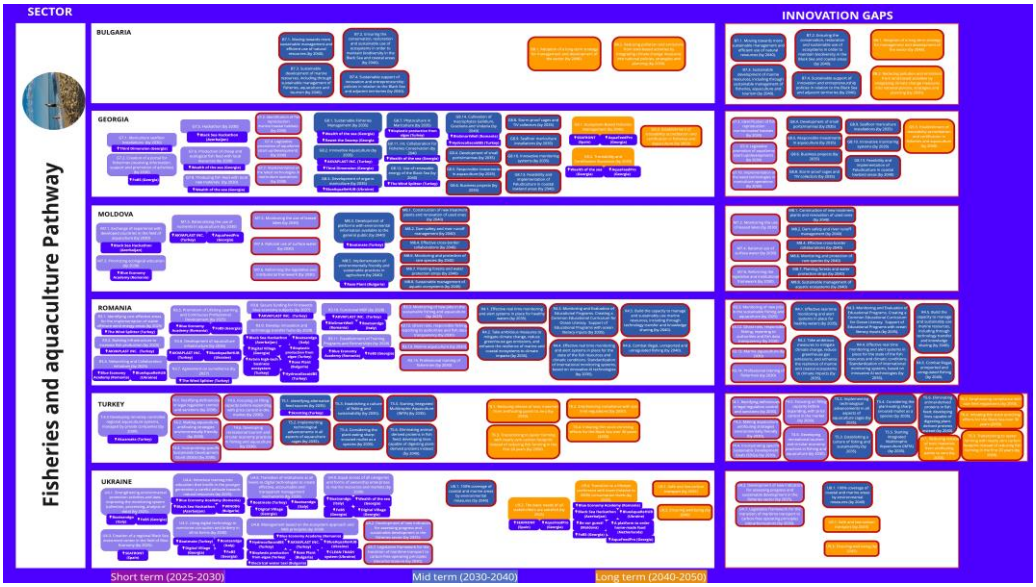

Figure 11 - Fisheries and aquaculture pathway

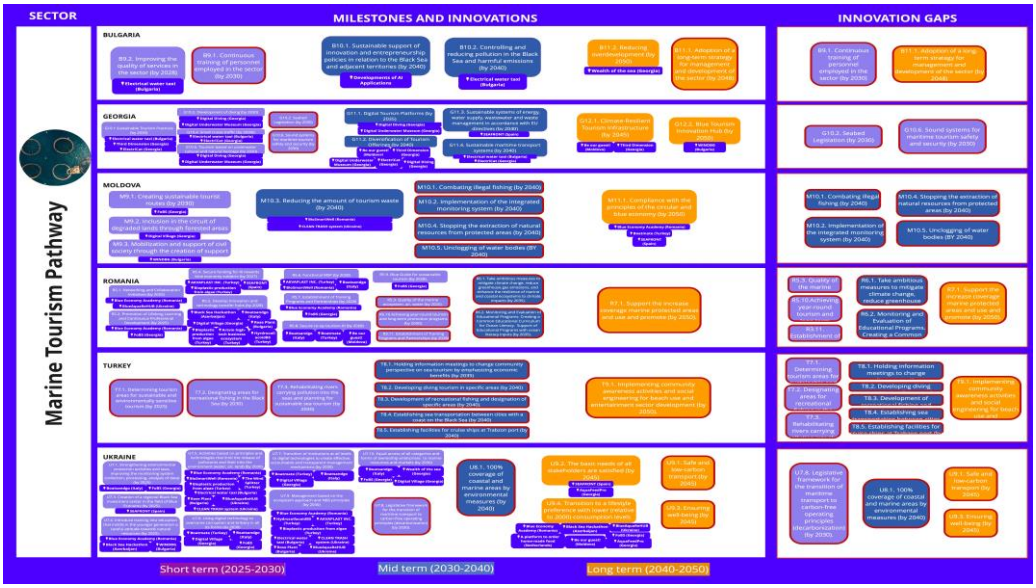

Figure 12 - Marine tourism pathway

Despite the heightened emphasis on the Blue Economy throughout the Black Sea area, substantial innovation gaps remain in critical priority sectors. Table 5 summarises the innovation gaps across each sector resulting from the innovation pathways established during the MAFs. In fisheries and aquaculture, obstacles persist in enhancing ecosystem restoration, implementing sustainable aquaculture practices, and pushing modernisation initiatives that safeguard marine resources while fostering circularity and entrepreneurship. On the other side, the marine tourist sector necessitates improved governance frameworks, climate resilience measures, and investment in sustainable coastal economies, as well as enhanced monitoring, decarbonised transportation, and capacity building in ocean literacy.

Ports and maritime transport encounter innovative deficiencies with anti-corruption governance, intelligent and sustainable infrastructure, digitalisation, and decarbonisation, while also requiring enhancements in security, social effect, and sector competitiveness. Black Sea countries require a resilient monitoring infrastructure, international collaboration, and strategic governance to facilitate effective marine resource management in the realm of ocean observation. Marine renewable energy is limited by deficiencies in technology integration, biofuels advancement, and education for clean energy transitions. Ultimately, blue biotechnology is deficient in synchronised investment in sustainable marine sectors, green innovation, and alternatives to plastic, as well as requiring enhanced education and knowledge transfer systems. Addressing these interrelated deficiencies is essential for realising the complete potential of an inclusive, resilient, and sustainable Blue Economy in the Black Sea.

Table 5 - Innovation Gaps per sector

Blue economy sector	Innovation Gaps
Fisheries and Aquaculture	• Ecosystem Restoration & Biodiversity Management • Circular & Sustainable Aquaculture • Fisheries Modernization & Resource Protection • Climate-Smart Infrastructure & Pollution Control • Blue Economy Innovation & Entrepreneurship • Knowledge Systems, Literacy & Capacity Building • Governance, Policy & Legislative Reform
Marine Tourism	• Governance, Policy & Legal Frameworks • Climate Resilience & Environmental Protection • Blue Tourism & Coastal Economy • Monitoring & Risk Management Systems • Decarbonized & Safe Maritime Transport • Human Capital, Training & Ocean Literacy
Ports & Transport	• Governance, Anti-Corruption & Cross-Sector Collaboration • Human Capital & Sector Competitiveness • Strategic Infrastructure • Smart and Green Maritime Transport • Digitalization, Smart Systems & Monitoring • Decarbonization, Eco-Efficiency & Circularity • Security & Compliance • Social Impact & Well-being
Ocean Observation	• Marine Observation, Monitoring & Data Infrastructure • Scientific & Technical Capacity Building • Marine Governance & Strategic Planning • International & Cross-Border Cooperation • Marine Resource Management & Enforcement
Renewable Energy	• Renewable Energy Development and Integration • Transition to Clean and Efficient Energy Use • Emerging Marine Biofuels • Marine Conservation and Climate Resilience • Capacity Building, Education & Technology Transfer • Sustainable Marine Industries
Blue Biotechnology	• Transition to Low-Carbon and Sustainable Blue Economy • Marine Biotechnology & Green Innovation • Circular Economy & Plastic Alternatives • Education, Capacity Building & Knowledge Transfer

CONCLUSIONS

The development of a sustainable and resilient Blue Economy in the Black Sea region requires coordinated action, inclusive planning, and targeted innovation. The findings from the DOORS project underscore the potential of stakeholder-driven

approaches, such as MAFs and the System Innovation Approach, in identifying challenges, setting strategic priorities, and mapping future-oriented innovation pathways. Despite progress in aquaculture, tourism, transport, and R&D, critical sectors like shipbuilding, offshore wind, and marine safety remain underrepresented in key regional strategies. Cross-cutting challenges—including governance fragmentation, environmental degradation, digital infrastructure gaps, and limited financial resources—must be addressed with collaborative, long-term visioning. The collective vision for 2050 provides a strong foundation for advancing clean maritime mobility, sustainable infrastructure, and regionally integrated blue growth. Realizing this vision depends on sustained investment in science-policy interfaces, inclusive stakeholder engagement, and adaptive governance frameworks that can respond to complex environmental and socio-economic dynamics in the Black Sea.

Acknowledgement. This research was carried out in the frame of the DOORS Black Sea Project. DOORS has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement No 101000518. This work benefitted from the use of AI tools, including ChatGPT and QuillBot, for editing text and data analysis. All analyses and interpretations are the sole responsibility of the authors.

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