



Innovative
sustainable economy

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Executive summary

This Observatory N°1, is a critical document that aggregates and analyses essential documents to provide a comprehensive view of the Innovative Sustainable Economy (ISE) in the Mediterranean, with a focus on Blue (BE) and Green (GE) economy sectors.

Its primary objective is to offer an insightful and cohesive overview of the current state and emerging trends in the ISE, employing a rigorous methodology that includes systematic collection and analysis of various documents like policy reports, academic articles, and strategic plans, all chosen based on strict criteria of regional relevance and thematic alignment.

The synthesis offers deep insights into the BE, highlighting [maritime sustainability, marine spatial planning, and sustainable fisheries and aquaculture](#). In the GE, it emphasizes [sustainable land use, energy transition and environmental protection](#), with a particular focus on [sustainable agriculture and food security](#).

Key challenges and opportunities identified include [adapting to climate change, managing resource scarcity, and leveraging technological innovations](#). These challenges are contextualized within global sustainability frameworks, such as the United Nations (UN) Sustainable Development Goals (SDGs) underscoring the global relevance of regional efforts.

Looking ahead, the synthesis paints a future outlook that anticipates continued growth and development in sustainable practices, driven by [technological advancements, policy evolution, and increased stakeholder collaboration](#). It calls on policymakers, practitioners, and community leaders to use these insights for informed decision-making and advocacy in sustainable practices. The document emphasizes the need for actionable recommendations for future research, policy development, and community engagement.

Conclusively, this synthesis represents a significant contribution from the Observatory towards fostering a sustainable and inclusive economic future in the Mediterranean. It encapsulates the collective knowledge and efforts in the region and sets the stage for its continued growth and sustainable development, echoing a strong call to action for all stakeholders to engage and contribute to this vital journey.



1. Introduction

1.1. Mission

The [Observatory for Innovative Sustainable Economy in the Mediterranean](#) operates as a central connecting point for promoting environmentally conscious and resilient economic strategies within the Mediterranean basin. With a mission deeply rooted in sustainability, the Observatory diligently [monitors, compiles, and disseminates critical documents and insights](#) that are central to fostering an ISE. The focus on the blue and green economies is both strategic and necessary, given the unique geographical and ecological characteristics of the Mediterranean region.

The emphasis on the [Blue Economy \(BE\)](#), encompassing maritime and marine sectors, is critical due to the Mediterranean region's extensive coastline and its historical, economic, and cultural reliance on marine resources. The BE covers a wide array of areas including sustainable fishing, maritime transport, coastal tourism, and marine-based renewable energy. By focusing on these aspects, the Observatory addresses the crucial need for preserving marine biodiversity and promoting economic activities that are environmentally sustainable and economically viable for coastal communities.

The [Green Economy \(GE\)](#) aspect focuses on environmentally oriented practices that prioritize sustainability beyond the marine context. It encompasses renewable energy, sustainable agriculture, waste management, and eco-friendly tourism, among others. This category is crucial for the Mediterranean region, which faces significant environmental challenges such as climate change, land degradation, and water scarcity. By concentrating on the GE, the Observatory seeks to support and guide the transition to energy-efficient, low-carbon, and environmentally friendly practices across various sectors.

The Observatory is dedicated to being more than just a repository of information. It positions itself as a dynamic hub of knowledge, offering the latest information and in-depth analyses that are instrumental in guiding the region's transition towards more sustainable economic practices.

1.2. Vision

Envisioning a future where the Mediterranean region stands as a model of sustainable economic practices, the Observatory is dedicated to laying the foundation for this significant transformation. It seeks to foster an environment where sustainable practices are not merely aspirational but are deeply integrated into the economic fabric of the region, bolstered by an extensive, data-driven comprehension of the blue and green economies.

The Observatory's vision is to serve as a [critical informational hub, gathering and disseminating essential knowledge about sustainable economic practices in the Mediterranean region](#). While its primary role is not to directly orchestrate collaboration among various entities like government bodies, academic institutions, and civil society organizations, the Observatory's function in [offering key information](#) indirectly supports these stakeholders. It enables them to make informed decisions and engage in both independent and collaborative pursuits aimed at sustainable development.

In undertaking these ambitious efforts, the Observatory for Innovative Sustainable Economy in the Mediterranean is committed to being a vital contributor and supporter of sustainable economic development in the region. Its aim is to develop a collection of sustainable innovative economic practices designed to serve as a source of inspiration and a guide for regions worldwide.

1.3. Purpose

The Observatory for Innovative Sustainable Economy in the Mediterranean is dedicated to aggregating and centralizing crucial knowledge and insights that drive the BE and GE sectors within the Mediterranean (MED) region. Its objective is multifaceted, focusing on the collection, synthesis, and broad dissemination of information that is vital for the sustainable development of these sectors.



The Observatory proactively engages in the surveillance of a multifaceted assortment of documents and resources, as outlined in the reference section. This meticulous compilation includes an array of reports, studies, and policy papers, culminating in a thorough and expedient repository accessible to stakeholders. This repository will be transformed into an open database, seamlessly integrated into the Observatory's website. This strategic move not only enhances the

accessibility of valuable information but also

facilitates informed decision-making by providing stakeholders with a holistic view of relevant data and insights. This initiative underscores the Observatory's commitment to transparency and the democratization of information, thereby supporting stakeholders in navigating complex issues with a wealth of resources at their fingertips.

The primary purpose of the Observatory is to gather, synthesize and disseminate the information. It aims to keep the community informed about the latest developments, trends, and opportunities in the ISE landscape.

By serving as a repository of valuable information, the Observatory facilitates the exchange of best practices and innovative solutions. This role is instrumental in addressing the unique environmental and economic challenges in the Mediterranean region. Through its activities, the Observatory encourages the development of joint initiatives and collaborative efforts. It aims to be a catalyst for dialogue and action, contributing to the sustainable transformation of the region's economy. The Observatory's comprehensive overview of the latest trends and developments aids stakeholders in making informed decisions. This support is crucial for strategic planning and the implementation of sustainable practices within the Mediterranean region.

The ultimate goal of the Observatory is to expedite the transition towards a more sustainable and resilient economic model in the Mediterranean. This is achieved through a systematic approach to data collection and analysis, ensuring that the content is both comprehensive and relevant.

2. Methodology

2.1. Selection Criteria

For the data collection process of the Observatory, a comprehensive set of selection criteria was established to ensure the relevance and quality of the information gathered. These criteria were developed to define a clear and focused scope for data collection, ensuring that the documents gathered were directly relevant and applicable to the aims of the Observatory.

The criteria were structured to encompass various dimensions of data relevance, including geographical significance, thematic relevance, and the nature of the documents. This approach was designed to capture a broad and diverse range of materials, each offering unique insights and perspectives pertinent to the ISE in the MED context.

Three specific types of criteria were determined: regional focus, thematic focus, and document type. By adhering to these well-defined criteria, the Observatory aimed to compile a rich and informative database that would significantly contribute to the understanding and advancement of sustainable economic practices.

The selection of documents for the Observatory's data collection emphasized [a specific relevance to the Mediterranean](#). This focus was critical to ensure that the gathered information directly pertained to the regional context, addressing the unique challenges and opportunities in sustainable economic practices specific to Mediterranean countries. To this end, the Observatory ensured that the information was directly applicable to the stakeholders operating within this geographic area (Figure 1).

The emphasis on the Mediterranean region was also key in capturing the diverse experiences and practices across different countries in the area. Recognizing the varied socio-economic landscapes and environmental conditions this focus helped ensure that the collected data was representative of the region's multifaceted nature.



Figure 1 Regional Focus - Mediterranean Region



2.1.1. Thematic Focus

The thematic focus of the data collection for the Observatory is a critical element in aligning the information gathered with the specific objectives of the project. This criterion centred on selecting documents that directly contribute to understanding and advancing key areas within the ISE, particularly focusing on the GE and BE sectors. By narrowing down the thematic focus to these specific areas, the Observatory aimed to delve deeper into the topics most relevant and crucial to sustainable development in the Mediterranean. This chapter will discuss how this thematic focus, driven by innovation, sustainability, and a circular approach, is applied specifically to the economic and business aspects of these sectors.

Green Economy - Paving the Way for Sustainable Development

Green Economy

Documents under this theme encompassed aspects related to [sustainable land use](#), [renewable energy](#), and [environmental conservation efforts](#), providing insights into eco-friendly practices and policies.



Defined by the United Nations Environment Programme (UNEP) as an economy that enhances human well-being and social equity while drastically reducing environmental risks and ecological scarcities, the GE is fundamental to sustainable development.

The Observatory focused on three critical areas within the GE sector: [Circular Economy and Resource Efficiency](#), [Sustainable Agriculture and Food security](#) and [Energy transition and Environmental protection](#).

Circular Economy and Resource Efficiency

Embracing the CE at the forefront of its environmental agenda, the Mediterranean region is setting a benchmark for resource efficiency and sustainable management. This paradigm shift towards a CE is integral to addressing the challenges of resource depletion and waste reduction, by promoting the reuse, recycling, and recovery of materials in all sectors of the economy. This approach not only supports sustainable development but also aligns with the region's ecological balance aspirations. The adoption of circular economy principles paves the way for innovative practices in sustainability, marking a transformative step in the Mediterranean's journey towards a resilient and GE.

Resource and consumption management in the Mediterranean, as part of the GE, is characterized by a multifaceted approach focusing on sustainable development and ecological balance. The region's eco-industrial development models (Loprieno et al., 2013)¹² are pivotal in this context, showcasing innovative practices in industrial sustainability and the promotion of sustainable



consumption habits, especially those related to the Mediterranean diet, which has been recognized for its low environmental impact and health benefits. Economic tools play a critical role in managing Mediterranean watersheds sustainably (Daly-Hassen et al., 2010)¹³, while awareness campaigns on islands within the region highlight the importance of community involvement in resource management (Refalo et al., 2017)¹⁴.

The integration of the water-energy-food nexus is seen as a key driver for economic growth, emphasizing the interconnected nature of resource use and the significance of adopting diets and consumption habits that reduce environmental impacts (Markantonis et al., 2019)¹⁵. Key elements for economy-wide sustainable resource management are being identified and implemented (Bringezu, 2011)¹⁶, considering the significant contributions of forests to the GE in the Mediterranean and surrounding regions. The role of integrated water resource management is evolving, addressing emerging concerns such as water scarcity, the impact of climate change on water resources, and the necessity for sustainable water use in agriculture and industry to support the GE transition (Dey, 2013)¹⁷. Building sustainable industrial areas has gained attention, sharing valuable experiences and perspectives from the Mediterranean and Western Balkan countries (Preka et al., 2013)¹⁸. The adoption of eco-resource management within the circular economy framework (Iuga (Butnariu), 2016)¹⁹ is also significant, promoting the sustainable use of resources.

Sustainable water resources management is a major issue due to the semi-arid climate, hydrological variability, and socio-economic conditions, necessitating technical and cooperative solutions for environmental security, socio-economic development, and the promotion of sustainable consumption patterns. Sustainable land management practices, such as agroforestry and green covers in perennial woody crops, are highlighted for their potential to promote ecosystem services and climate change adaptation, supporting the regulation of the hydrological cycle and maintaining the Mediterranean Basin's multifunctional landscape (Ruiz et al., 2020)²⁰.

The Mediterranean region's approach to sustainable development and consumption, including the protection of the sea from pollution and the expansion of interests to land-based development impacts on the environment, coastal management, and ultimately to sustainable development with the establishment of the Mediterranean Commission on Sustainable Development (MCSD), which aims to guide the region toward holistic environmental management and sustainable progress.

Sustainable Agriculture and Food security

The thematic focus on economy and business models highlights significant developments in this sector. Innovative and sustainable agricultural practices in the Mediterranean region are highlighted through various research papers. These studies focus on the integration of circular economy principles (Donner & De Vries, 2021)¹, particularly in the French agrifood sector and the olive oil industry, which is a staple in the Mediterranean diet (Donner & De Vries, 2023)² (Donner & Radić, 2021)³. They explore sustainable business models, emphasizing waste valorisation, resource efficiency, and the economic viability of circular practices (Donner et al., 2022)⁴. Additionally, the papers provide metrics and tools to assess the sustainability of closed-loop food systems, showcasing how these models contribute to a more sustainable and efficient food system.⁴ (Falcone et al., 2022)⁵ These insights offer a comprehensive view of the potential for circular and sustainable agricultural practices in the Mediterranean, aligning traditional methods with modern, eco-friendly approaches.



Energy transition and Environmental protection

The energy transition towards a GE in the Mediterranean region is characterized by a multifaceted approach, addressing various aspects of sustainable development and environmental preservation. This includes a focus on geopolitical shifts favouring green economic practices (Stergiou, 2023)⁶, and the specific challenges and opportunities within Mediterranean countries (Leidecker et al., 2023)⁷. The role of sustainable energy and mobility as economic growth drivers the importance of ecosystemic approaches in the energy transition (Echave et al., 2019)⁸, the potential of marine renewable energy (Theodora & Piperis, 2022)⁹, the impact of solar energy and new technologies (Ciriminna et al., 2019)¹⁰, and the technoeconomic viability of green energy transitions in isolated grids (Dimou & Vakalis, 2022)¹¹ are all crucial components of this transition. These diverse elements together depict the Mediterranean region's comprehensive strategy in embracing a sustainable, green future.

Understanding the concept and limitations of the CE and GE in the Mediterranean region (Karmoh Sowah Jr. et al., 2021)²² is crucial to overcoming challenges and harnessing opportunities. These various aspects collectively underscore the Mediterranean's commitment to aligning traditional resource management methods with innovative, eco-friendly business models in a GE context.



Blue Economy

This theme included materials focusing on **maritime sustainability, marine resource management, and sustainable development of marine and coastal areas**, highlighting the economic potential and environmental challenges associated with marine and coastal resources.

The Blue Economy, as defined by the World Bank, emphasizes the "sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems." The European Commission broadens this definition to include all economic activities related to oceans, seas, and coasts, covering a diverse array of interlinked sectors, both established and emerging. Further, a United Nations representative articulates the BE as encompassing various economic sectors and associated policies that collectively determine the sustainability of ocean resource utilization. The focus was on key sectors such as **Maritime Renewable Energy, Maritime Spatial Planning and Transport and Fisheries and Aquaculture**, each embodying innovation, sustainability, and economic vitality within the sustainable use of ocean resources and the responsible development of coastal regions.

Maritime Renewable Energy

Maritime renewable energy in the Mediterranean region is advancing towards sustainable and innovative solutions, contributing significantly to the BE. This progress is marked by strategic planning for climate neutrality (Theodora & Piperis, 2022)⁹, benchmarking of wave energy converters through life cycle assessment (Bruno et al., 2022)³⁸, and exploitation of operative wave forecast systems for energy resource assessment (Carillo et al., 2022)³⁹. Additionally, offshore floating wind farms are being benchmarked to evaluate their environmental impacts and efficiency (Pulselli et al., 2022)⁴⁰. A methodology framework is being developed for prioritizing renewable energy sources in port areas (Agostinelli et al., 2022)⁴¹, fostering a sustainable maritime sector.

Transport and Maritime Spatial Planning (MSP)

Maritime Spatial Planning (MSP) in the Mediterranean region is adopting a strategic and integrated approach to foster the sustainable growth of the BE. This encompasses leveraging blue energy sources within MSP frameworks (Pulselli et al., 2022)²⁷ to ensure **economic development is in harmony with environmental preservation**. The reimagining of the maritime transport sector aligns with BE goals, prioritizing **sustainable practices** and **growth recommendations** while protecting marine ecosystems²⁸. The exploration of maritime transport's economic potential underscores its pivotal role in the region's BE, paving the way for sustainable and innovative development opportunities (Niavis et al., 2017)²⁹. The **implementation of regional marine policies** highlights the significance of **ecosystem-based management strategies**, aiming to achieve a balance between



economic and ecological goals (Hatziyanni, 2015)³⁰. This integrated approach is supported by an [evaluation of the impacts of shipping activities](#) on the Mediterranean Sea, informing the development of sustainable maritime business models (Fink et al., 2023)³¹.

Given the cross-cutting nature of MSP, it encompasses various facets including maritime safety, which covers a wide range of concerns such as security, environmental protection, and the effective management of maritime incidents. The region faces unique security challenges due to its geopolitical complexity, necessitating focused studies to address these issues (Konrad-Adenauer-Stiftung, 2021)³². Innovations in predicting and managing marine hazards, such as oil spills (Zodiatis et al., 2016)³³, are crucial for maintaining environmental integrity. The European Maritime Safety Agency plays a key role in coordinating safety protocols across the Mediterranean's varied national jurisdictions (Carpenter & Kostianoy, 2016)³⁴. Furthermore, research into regional maritime security dynamics (Rubin & Eiran, 2019)³⁵ and the formulation of comprehensive oil spill response strategies (Seisdedos & Carrasco, 2020)³⁶ are vital. The governance of international sea borders (Fantinato, 2021)³⁷ emphasizes the necessity for advanced maritime surveillance and safety mechanisms, underscoring MSP's comprehensive scope which includes ensuring maritime safety within its ambit.

Aquaculture and fisheries

In the BE, the Aquaculture and Fisheries sector is advancing towards sustainability and innovation. This transition is marked by the adoption of sustainable practices in fish farming and fisheries management, balancing economic growth with marine biodiversity. Market initiatives in small-scale fisheries are gaining prominence, supporting sustainable practices that align with the broader goals of the BE and ensuring ecological balance and community livelihoods (Penca & Said, 2023)²³. The sector is also exploring open innovation to foster collaborative efforts and knowledge sharing, essential for developing sustainable practices (Underwood & Stempel, 2022)²⁴. Concurrently, research is focusing on sustainable feeds for aquaculture, aiming to minimize ecological footprints and enhance circularity (Colombo et al., 2023)²⁵. The concept of hybrid seafood production is being investigated to improve both sustainability and productivity within the sector (Costa-Pierce, 2023)²⁶. Moreover, strategies to reduce overexploitation of Mediterranean resources, particularly in fisheries, suggest management systems based on catch quota approaches for single or few species fisheries and efforts to reduce fishing effort to sustainable levels for mixed fisheries exploiting species with diverse biological traits (Fiorentino & Vitale, 2021)²¹.

Each sector within the BE is interlinked, collectively contributing to the sustainable and responsible use of ocean resources. This approach not only supports economic growth but also ensures the long-term health and sustainability of marine ecosystems.



2.1.2. Document Type

In the assembly of the Observatory's repository, the document type emerged as a significant criterion within the selection process. This classification played a crucial role in curating a balanced and informative compilation of materials, conducive to the Observatory's overarching goal of fostering a comprehensive understanding of the ISE in the Mediterranean region.

Websites and Databases

This category encompasses a variety of online platforms and databases that offer a wealth of information on sustainable economic practices. These resources are vital for staying up-to-date with the latest developments and trends in the field.

Policy Papers and Reports

Strategic documents such as policy papers and reports are essential for understanding the regulatory and institutional frameworks guiding sustainable economic practices.

Research Articles and Reports

Academic research and in-depth reports form a significant part of the repository. These documents provide detailed analyses and insights into various aspects of sustainable economic practices, contributing to a deeper understanding of the subject.

Action Reports and Plans

Practical implementation and strategic planning are covered under this category. Action reports and plans offer a glimpse into the application of theories and strategies in real-world scenarios.

News and Journalism

Current events, updates, and journalistic articles provide a real-time perspective on the ongoing developments and discussions in the field of sustainable economies.

By clearly specifying and describing the different categories of documents, the Observatory ensured that the collected data was not only diverse in perspective but also rich in the type of content it provided. This categorization allows stakeholders to access a broad spectrum of information, from conceptual frameworks and policy analysis to practical applications and current news, thereby supporting a well-rounded approach to strategic planning and informed decision-making in the Mediterranean regions sustainable economy landscape.

However, there is a noticeably lower presence of News and Journalism sources across all themes. This could imply that these topics, while significant in academic and policy circles, may not have



as much visibility or prominence in mainstream media, potentially affecting public awareness and discourse.

Moreover, the distribution of Action reports and plans, particularly their higher representation in the General category, suggests a more pronounced focus on actionable strategies and implementation plans in broader, more inclusive topics. This could indicate a shift towards practical applications and solutions in general areas, as opposed to the more research and policy-focused approach in the Green and Blue Economies.

Overall, this analysis provides a comprehensive overview of the types of sources prevalent in discussions and studies related to the Green and Blue Economies, as well as general topics.

2.2. Data Collection Process

The data collection process for the Observatory was meticulously structured to provide a thorough review of relevant materials, ensuring a rich and diverse repository of information.



Initial ad-hoc collection

This step involved the strategic compilation of key documents that were previously identified or recognized by the project team based on their existing knowledge and expertise. These documents, crucial for their relevance and impact on past and ongoing sustainable economy projects, provided a solid starting point from which to expand the Observatory's database.



Targeted database/website collections

Collection of documents compiled from relevant websites and databases including:

- Blue Economy Platform
- Circular Economy Stakeholder Platform
- Euro-Mediterranean Policy Hub
- Green Finance for Belt and Road Initiative (BRI);
- Intermediterranean Commission
- Interreg-Med initiatives and platforms
- Sustainable Food Systems Approach Knowledge Hub
- Union for the Mediterranean



Key word searches used:

- Mediterranean economy
- Blue economy
- Green economy
- Social economy;
- Circular economy

Academic libraries used:

- Springer,
- Frontiers,
- MDPI,
- Web of Science

Policy libraries used:

- UN Dag Hammarskjöld
- Library
- UNEP document portal



Citation mining and content review

This method involved the identification of pertinent databases and documents by thoroughly reviewing materials already gathered, including the examination of their cited references. This technique ensured that the scope of the collection was both expansive and reflective of the interconnected nature of research and policy within the sustainable economy domain.

The process commenced with an [initial compilation](#) of known relevant documents. The research team tapped into their existing knowledge and prior work in sustainable economy projects to gather foundational documents, such as influential reports, action plans, and other key publications that had shaped prior initiatives.

After this preliminary phase, the team employed [general web searches](#) to identify and access key online databases and knowledge platforms. These resources included specialized hubs for Circular Economy (CE) and policy-related sites focused on the Mediterranean, which are rich sources of current and foundational documents.

The data collection was further refined and expanded through [keyword searches](#) across a spectrum of academic and policy-oriented databases. This method allowed for the targeted retrieval of documents that met the established selection criteria, encompassing both broad thematic areas and specific regional focuses.

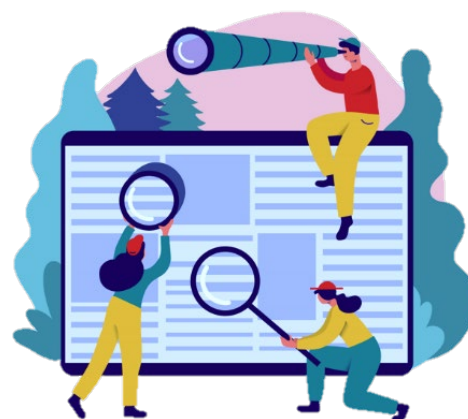
To maintain the currency and relevance of the repository, the team conducted [weekly time-restricted searches](#).

In addition to these methods, document [review and citation mining](#) played a continuous role throughout the data collection process. This rigorous approach ensured that critical documents, particularly those central to the GE and BE action plans or showcasing innovative research, were not missed. This layered strategy of document review also allowed the team to build upon the references cited in already collected materials, thus broadening the scope and depth of the collection.

The culmination of these efforts was a comprehensive and dynamic collection of documents, instrumental for informing the sustainable economy discourse and aiding decision-making processes within the Mediterranean context.

3. Synthesis of Key Findings

The synthesis of key findings from the collected documents presents a comprehensive overview of the current state and emerging trends in the Innovative Sustainable Economy of the Mediterranean region. This section distils the essence of extensive research and analysis, highlighting crucial insights and patterns gleaned from the diverse array of materials gathered during the data collection process.



In Figure 2, we observe a comprehensive breakdown of 204 sources into five distinct categories. Dominating the chart, Research Articles and Reports account for more than half of the total (121 sources), underscoring a robust research-oriented foundation in the subject matter. Following this, Policy Papers, and Reports, with 37 entries, represent a significant chunk, highlighting the importance of policy formulation and analysis in this domain.

The analysis of Figure 3 reveals several key aspects about the distribution of sources in the context of Green Economy, Blue Economy, and General themes. Firstly, the **predominance of Research articles and reports** across all themes underscores the critical role of research-based evidence in shaping these areas. This indicates a **strong foundation of academic and empirical studies driving the discourse** in these fields. Secondly, the consistent presence of Policy papers and reports in each theme highlights the **significant impact of policy frameworks and governmental inputs** in guiding and influencing these sectors. This suggests a close interplay between research findings and policy-making processes.

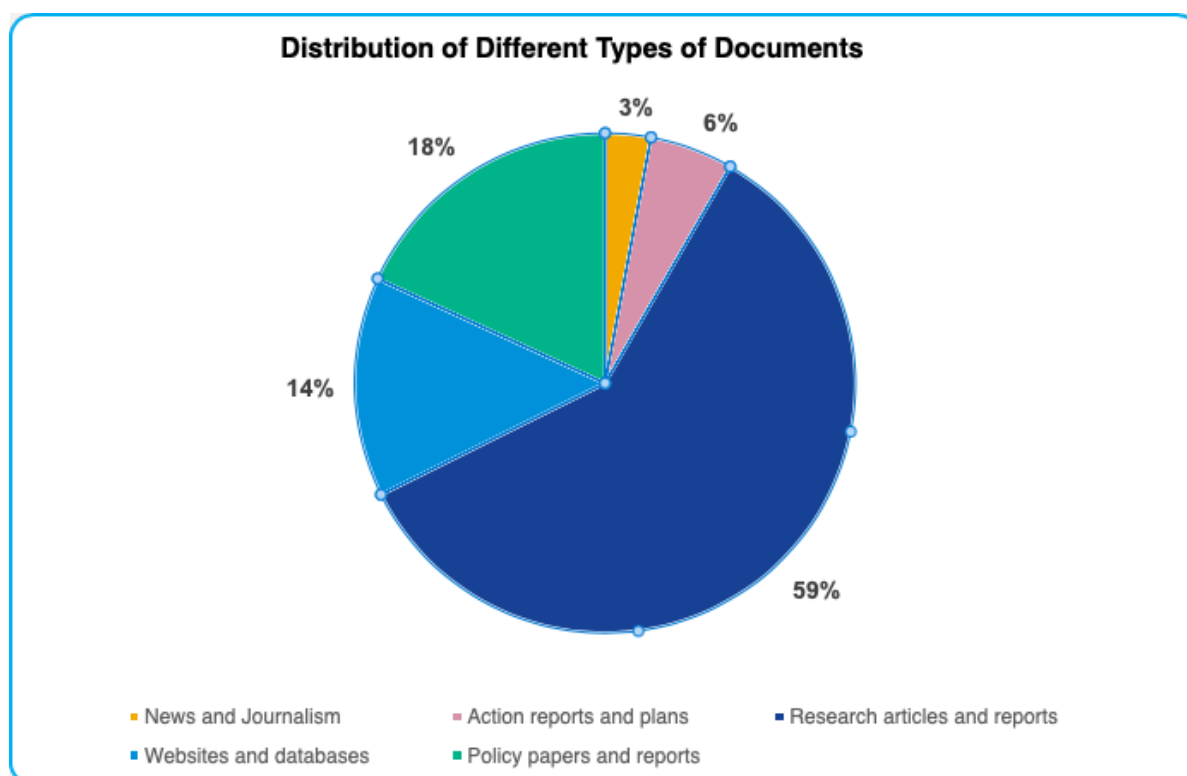


Figure 2 Distribution of different types of documents

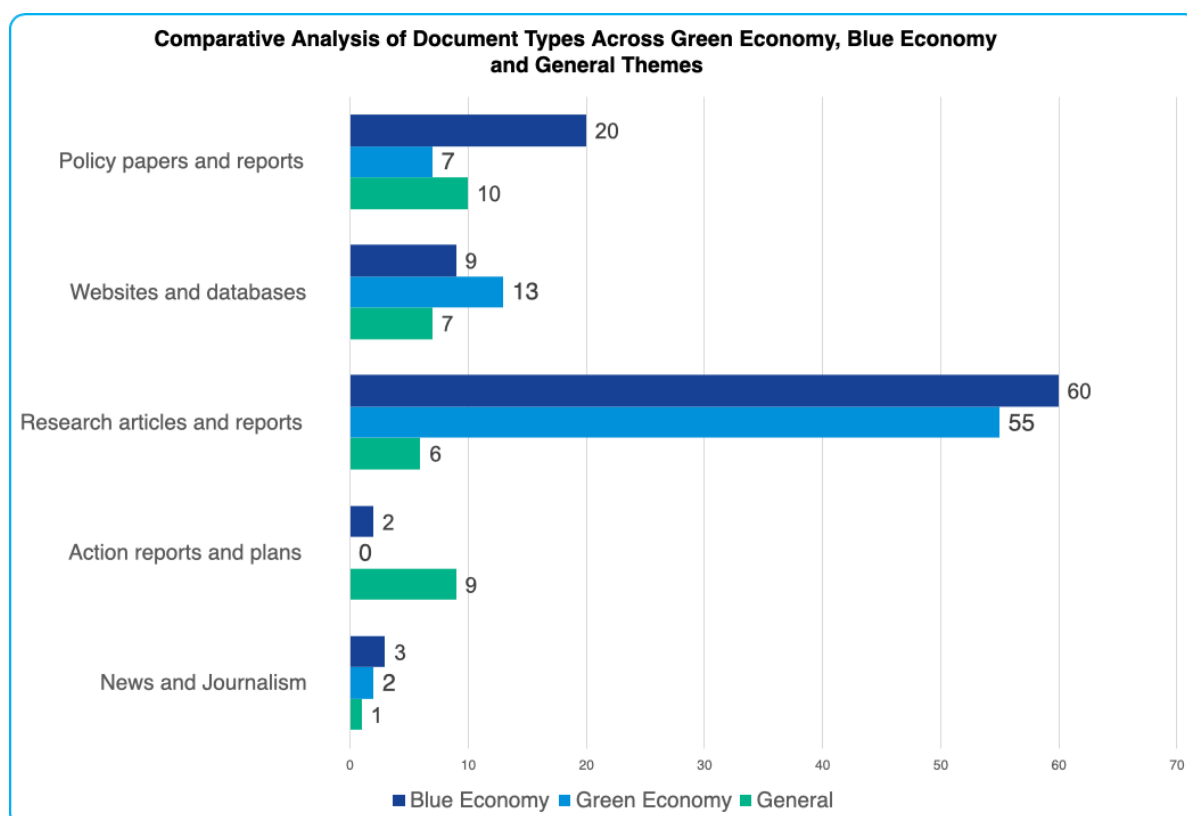


Figure 3 Comparative analysis of document types across Green Economy, Blue economy, and General themes.

3.1. Green Economy

The emphasis on the GE within the MED reflects a profound commitment to sustainable development, emphasizing the integration of circular economy and resource efficiency. This critical transition is not just about adopting new definitions but actively engaging with current trends and innovative practices across various sectors, including small and medium enterprises (SMEs), urban development, and waste management. The narrative weaves together conceptual frameworks and tangible actions, showcasing the region's efforts to harmonize economic activities with sustainability goals. Such a multifaceted approach ensures a pathway towards environmental stewardship that is economically viable and socially inclusive, underscoring the Mediterranean's vision for a resilient future where economic growth and environmental priorities are inextricably linked.



3.1.1. Strategies for Sustainable Development

In the Mediterranean, efforts are underway to transition to a GE, though challenges remain due to the region's diversity. Key strategies involve [comprehensive planning that addresses governance, technical capabilities, and the integration of environmental policies into broader economic and social frameworks](#). The European Union plays a crucial role in supporting this transition, particularly through green diplomacy and the promotion of decentralized green projects (EuroMeSCo, 2023)⁴⁶. National strategies are also being developed and assessed to align with Sustainable Development Goals (SDGs). These strategies are crucial for [ensuring environmental and economic integration, addressing governance challenges, and accommodating regional diversification and inclusivity](#) (Fosse & Petrick, 2016)⁴⁷.

Resource management and eco-efficient technologies are identified as key components in driving economic growth while reducing environmental impacts. The focus is on [making more with less](#) – a principle central to the GE. This approach not only [enhances competitiveness](#) for industries but also [mitigates material losses](#) in production and use chains (Bringezu, 2011)¹⁶.

Projects like the Mediterranean Eco-Industrial Development (MEID) (Preka et al., 2013)¹⁸ highlight the role of [sustainable industrial areas](#) in enhancing regional development and SME competitiveness. These initiatives focus on [high-level infrastructure and innovative services](#) to support SMEs in their transition to greener practices (Loprieno et al., 2013)¹². Finally, the "The Marseille recommendations on GE" (Plan-Bleu, 2023)⁴⁸ underscore the need for a [comprehensive framework promoting sustainability, job creation, and economic growth](#). These recommendations cover governance, market functioning, green project prioritization, knowledge enhancement, and the strengthening of public and private financing.



Additionally, [enhancing the role of financial policies and instruments](#), particularly through South-South and North-South cooperation, is crucial for accelerating the green transition. The inclusion of regional frameworks such as the Union for the Mediterranean (UfM), with its Ministerial Declarations on GE (GE and BE), and the UNEP/MAP with the Mediterranean Strategy for Sustainable Development (MSSD) and the Mediterranean Commission on Sustainable Development, highlights the region's efforts in [adopting sustainable innovative economies through combined policy actions](#) at the EU and regional levels, alongside [emerging economic opportunities](#). This comprehensive approach aims to ensure that sustainable development in the Southern Mediterranean is not just a goal but a reality, backed by strong governance, effective resource management, and inclusive economic strategies.

The Mediterranean region's journey towards a GE and sustainable development is marked by a holistic approach that blends policy development, resource management, industrial transformation, and regional cooperation. Despite diverse challenges, the concerted efforts across the region signal a strong commitment to achieving sustainable growth and environmental preservation.

3.1.2. Circular Economy and Resource Efficiency

The Mediterranean region is increasingly embracing the principles of circular economy and resource efficiency, a shift crucial for fostering sustainable development and environmental stewardship.

This transition is characterized by [innovative practices across various sectors, from small and medium enterprises \(SMEs\) to urban development and waste management](#). SMEs in the Mediterranean are pivotal in driving the circular economy. Their role in [enhancing competitiveness and innovation](#) is critical, as they significantly impact both the economy and the environment. Innovative projects and collaborative efforts are leading to the adoption of circular economy principles among these businesses⁴². These initiatives are not only boosting economic growth but also contributing to environmental protection.

The concept of [sustainable consumption and production \(SCP\)](#) is becoming increasingly representative of the current discourse on sustainability within the region. It emphasizes a more comprehensive approach to sustainability that includes the [social dimension, such as human rights, business ethics, and community involvement, as crucial components of the green transition](#). [Green competitiveness](#), particularly through [cleaner production techniques](#), is reshaping the business landscape in the Mediterranean. These techniques offer both environmental and financial benefits, contributing to sustainable business practices across various sectors. The transition to cleaner production involves a holistic approach that includes improving institutional arrangements and adopting preventive environmental actions (De Castro, n.d.)⁴³.



Urban areas in the Mediterranean are also undergoing a transformation towards circularity. Municipalities are focusing on [integrating green and smart public services](#), which play a crucial role in minimizing the environmental impact of urban development. This involves [rethinking public procurement to close energy and material loops](#), thereby moving towards a more sustainable urban ecosystem (European Circular Economy Platform, 2023b)⁴⁴. Waste management is another critical area where innovative practices are evident. The region is seeing a shift towards waste prevention and management strategies that align with the circular economy. This includes the adoption of [Best Available Technologies and the establishment of policy guidelines](#) to foster sustainable waste management practices, particularly in the agri-food sector (European Circular Economy Stakeholder Platform, 2023c)⁴⁵.



3.1.3. Sustainable Agriculture and Food Security

A key development in the region is the [transformation of food systems](#) to embrace sustainability and resilience. Multi-stakeholder collaboration, inclusive governance, and public-private finance are pivotal in this transformation, [ensuring sustainable consumption and production](#), particularly through the promotion of the Mediterranean diet (One Planet Network, n.d.)⁴⁹. The focus is on [fostering sustainable food systems](#) that not only [enhance food security](#) but also [respect cultural and dietary practices](#). The challenges and opportunities in agriculture and food security, especially considering climate change, are being addressed through various regional strategies. Recommendations include [transitioning to agro-ecological practices, efficient water management, and enhancing food sovereignty](#).

Promoting Sustainable Practices in Olive Farming

An innovative approach to tackling these challenges is evident in the adaptation of [Mediterranean olive groves](#) to climate change. Sustainable cultivation practices are being implemented to [manage soil health, reduce erosion, and combat desertification](#). These practices align with the principles of a circular economy, promoting sustainability and resilience in agroecosystems (Michalopoulos et al., 2020)⁵⁰. The [Sustainolive project](#) funded by the PRIMA (Partnership for Research and Innovation in the Mediterranean Area) program is promoting sustainability in the Mediterranean olive oil sector. This project integrates agroecological concepts to address the environmental and socioeconomic concerns arising from mechanization and intensive farming practices. The methodology [combines Social Agrarian Metabolism \(SAM\) and Life Cycle Sustainability Assessment \(LCSA\)](#) to provide insights into the sustainability aspects of different olive farming practices, enhancing the understanding of societal-nature interactions, and supporting the transition towards sustainable practices (De Luca et al., 2023)⁵¹.

Enhancing Resilience through Agroforestry and Water Management

Agroforestry, as a sustainable land use option, is gaining traction in the region. It offers a means to reduce wildfire risks, enhance biodiversity, and improve soil fertility and microclimate regulation. Agroforestry practices are being adapted to the unique Mediterranean landscapes, contributing to ecosystem services and sustainable land management (Damianidis et al., 2021)⁵².



The [utilization of reclaimed water for irrigation](#) is another key aspect of sustainable agriculture in the Mediterranean. This approach addresses [water scarcity](#), and it involves the integration of agronomic, environmental, economic, and social considerations, standardizing practices for safe and sustainable water reuse. Examples of these practices include the adaptation of drip irrigation systems to distribute treated wastewater directly to the root zones of plants, minimizing evaporation and runoff. Additionally, the implementation of crop rotation and the selection of crop varieties that are more tolerant to the quality of reclaimed water can optimize agricultural output while conserving water. These practices, alongside the careful monitoring of soil and water quality to prevent the accumulation of harmful substances, embody the multifaceted approach required to harness reclaimed water as a valuable resource for agriculture in water-scarce regions of the Mediterranean (Ait-Mouheeb et al., 2018)⁵³.

The emphasis on [Euro-Mediterranean cooperation](#) underscores a strategic commitment to advancing sustainable agriculture within the context of a changing climate. This commitment is realized through practical and actionable strategies—termed "operational proposals"—designed to directly address and mitigate the impacts of climate variability and ensure the resilience and sustainability of agricultural practices across the Mediterranean region. Examples of these operational proposals include the [promotion of water-efficient irrigation technologies](#) to combat increasing water scarcity, the adoption of agro-ecological farming methods that enhance soil health and biodiversity, and the implementation of climate-smart agricultural policies that support farmers in transitioning to more sustainable practices⁵⁴.

Circular Bioeconomy, Hydroponics, and Watershed Management

In the realm of circular bioeconomy, [innovative business models are emerging](#), especially in the French agri-food domain. These models [focus on valorising agricultural waste and by-products](#). The emphasis is on [creating synergies and value co-creation](#) across different sectors, combining technological and organizational innovations for a sustainable circular bioeconomy (Donner & De Vries, 2023)².

Furthermore, sustainable practices in [hydroponic agriculture](#) are being validated to conserve water and nutrients. [Smart nutrient solution replenishment strategies](#), particularly in tomato cultivation, demonstrate the potential for improving water use efficiency and nutrient management, which are crucial in regions facing water scarcity and saline conditions (Donner & De Vries, 2023)². Specifically, the [integration of decision support systems](#) and the [use of recirculated nutrient solutions under controlled salinity](#) highlight the effectiveness of these strategies. For instance, the [application of recalculated uptake concentrations](#) based on real-time chemical analysis allows for [precision nutrient management](#), [minimizing waste](#) and [enhancing crop resilience to salinity stress](#) (Neocleous & Savvas, 2022)⁵⁵. Moreover, the exploration of aquaponic systems, combining aquaculture with hydroponics, offers a holistic approach to sustainable agriculture by [recycling fish waste as a nutrient source for plants](#), further emphasizing the synergy between water and nutrient conservation (Graber & Junge, 2009)⁵⁶. Together, these innovative practices underscore the transformative potential of hydroponic agriculture towards achieving greater environmental sustainability and resource efficiency.

Efforts are also being made to manage [Mediterranean watersheds sustainably](#). Economic instruments, such as [payments for environmental services](#) (PES), are proposed to encourage



sustainable forest management and reduce degradation, thereby addressing watershed-related challenges like overgrazing, soil erosion, and fires (Daly-Hassen et al., 2010)¹³.

In conclusion, the Mediterranean region is actively pursuing sustainable agriculture and food security through various innovative practices and strategic collaborations. These efforts encompass transforming food systems, adapting to climate change, promoting circular bioeconomy, and implementing sustainable land and water management practices. The focus is on integrating ecological, economic, and social dimensions to build a resilient and sustainable agricultural sector in the Mediterranean.

3.1.4. Energy Transition and Environmental Protection

The Euro-Mediterranean region faces unique challenges and opportunities in its green transition. [The European Green Deal](#) has a significant impact on Southern Mediterranean countries, necessitating collaborative efforts for a successful transition. This involves [enhancing partnerships, increasing sustainable investments, and promoting regional cooperation](#).



The key is to anticipate and mitigate potential side effects while maximizing the green transition's benefits (EuroMeSCo, n.d.)⁵⁷. It emphasizes the need for supporting renewable energy, fostering regional cooperation, and ensuring a balanced approach to environmental and economic growth⁵⁸. Greece exemplifies the complexities of transitioning to a GE. The country's efforts to reduce emissions, improve energy efficiency, and adapt to climate change are critical. Policy recommendations include [carbon pricing, infrastructure investments, and support for renewable energy, highlighting the importance of integrated policies for a successful green transition](#) (Leidecker et al., 2023)⁷.

The Mediterranean region's biodiversity and ecosystems face significant threats due to pollution, climate change, and ecosystem degradation. Understanding and addressing these challenges requires geospatial data and regional environmental agreements. The [World Environment Situation Room \(WESR\)](#) offers access to essential [environmental data and analytical tools](#). WESR promotes global cooperation, real-time advocacy, and capacity building, aiming to ensure a sustainable future by enabling policymakers and environmentalists to monitor and analyse environmental trends, such as the impact of rising temperatures on marine life, thereby informing targeted conservation strategies and facilitating international efforts to mitigate environmental threats in the Mediterranean region. (UNEP, n.d.)⁵⁹.

In addressing [water scarcity and pollution challenges](#), the MENA region, particularly Lebanon, demonstrates the potential of decentralized wastewater treatment using eco-innovative technology. This approach, focusing on local resource recycling, aligns with circular economy practices and highlights the role of community involvement in sustainable water management (El Moll, 2023)⁶⁰.

Innovations in renewable energy, particularly the potential of waste from agricultural processes, offer sustainable solutions for the region. Utilizing [waste for energy production](#) not only contributes to rural development but also fosters circular economy practices (Atilgan et al., 2023)⁶¹.



The Eastern Mediterranean's **energy geopolitics** is shifting towards a GE , **moving away from conflicts over hydrocarbon exploration**. The focus is on **renewable energy sources** as a **response to climate change** and **geopolitical stability** (Stergiou, 2023)⁶. A comprehensive ecosystemic approach is required for the energy transition in the Mediterranean region. This includes focusing on renewable energy sources, **addressing rural vulnerabilities**, and **promoting sustainable practices** through initiatives like the Renewable Energy Community (Echave et al., 2019)⁸.

Solar energy and new technologies present significant opportunities for Mediterranean countries. With abundant sunshine, these countries **can leverage photovoltaic (PV) modules and solar thermal collectors for efficient energy production**. The integration of **solar technology** into buildings and public infrastructure, such as streetlights, is crucial for a sustainable energy transition (Ciriminna et al., 2019)¹⁰. The "Ai Stratis – Green Island" project in Greece showcases the technoeconomic **feasibility of green energy transitions in isolated grids**. By analysing different energy setups, the study provides insights into achieving high renewable energy penetration, reducing carbon emissions, and maintaining cost-effectiveness (Dimou & Vakalis, 2022)¹¹.

Sustainable forestry in the Mediterranean region brings economic benefits while addressing biodiversity, ecosystem services, and climate change mitigation. This approach emphasizes the importance of **sustainable land use and rural development** for environmental protection (CORDIS, 2023)⁶². Incorporating carbon pricing into sustainable forestry practices in the Mediterranean region can further enhance these benefits by providing financial incentives for carbon sequestration and emissions reductions. Studies comparing scenarios of maximizing carbon sequestration versus timber harvesting have shown that maximizing carbon sequestration is often **more financially profitable**. However, a challenge highlighted by these studies is the **absence of a market price for carbon**, unlike timber (Enríquez-de-Salamanca, 2021)⁶³. This underscores the need to **establish mechanisms for valuing carbon sequestration** to mobilize resources from polluting sectors to support sustainable forestry practices (Ruiz-Peinado et al., 2017)⁶⁴. By integrating carbon pricing, policymakers can incentivize sustainable forest management, bolstering efforts to address biodiversity loss, enhance ecosystem services, and mitigate climate change while promoting economic prosperity and rural development in the Mediterranean region.

The Mediterranean region's journey towards energy transition and environmental protection encompasses a variety of strategies and initiatives. These include enhancing renewable energy sources, adopting sustainable practices, fostering regional cooperation, and embracing Nature-Based Enterprises (NBEs) through platforms like **Oppla**¹ and the **Connecting Nature Enterprise Platform (CNEP)**². Oppla serves as the EU Repository of Nature-Based Solutions, providing a comprehensive knowledge marketplace where stakeholders can access the latest insights on natural capital, ecosystem services, and nature-based solutions. On the other hand, CNEP, launched in 2020, connects Nature-Based Enterprises, offering them a platform for networking, learning, and market visibility. By leveraging these platforms and the region's unique geographical and climatic

¹ <https://oppla.eu/>

² <https://naturebasedenterprise.com/>



advantages, these initiatives emphasize the importance of balancing economic growth with environmental sustainability, promoting resilience, and fostering a nature-positive economy.

3.1.5. Community Engagement and Cultural Sustainability

In the Mediterranean region, a dynamic blend of innovation, community engagement, and cultural sustainability is emerging, reshaping the approach to regional challenges and opportunities. This transformative wave is characterized by several key initiatives and practices and a growing emphasis on sustainable business models that leverage the region's unique demographic structure, behaviours, cultural aspects, and labour market dynamics.

The [sustainability of the Mediterranean diet](#), coordinated by the Food and Agriculture Organization of the United Nations (FAO) and the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM-Bari), tackles the [nutritional transition and the erosion of traditional dietary practices](#). This initiative underscores the diet's role beyond nutrition, emphasizing its significance in sustainable food systems and encapsulating a unique lifestyle and cultural diversity. There's a [growing recognition of the need for multidisciplinary approaches](#) and stakeholder collaboration to revitalize the Mediterranean diet, which is pivotal for achieving Sustainable Development Goals in the region (Meybeck et al., 2017)⁶⁷.

Parallely, the role of agri-food SMEs in sustainable development is gaining focus. Linking these SMEs to innovation is critical for the future of Mediterranean food systems. Emphasizing [multi-stakeholder collaboration](#), this approach brings together farmers, researchers, and entrepreneurs in a participatory and user-driven model of innovation. This collective effort is geared towards creating a [sustainable, circular food system, underpinning the region's economic and ecological resilience](#). This is achieved through initiatives such as the farmer-driven innovation approach advocated by organizations like the World Farmers' Organization (WFO), which emphasizes the repositioning of farmers at the heart of the innovation process and the co-designing of solutions through partnerships between farmers, researchers, governments, academia, and civil society (One Planet Network, n.d.)⁶⁸. This emphasis on sustainable entrepreneurship is further enriched by a commitment to inclusivity, addressing the need to bridge age and gender gaps among entrepreneurs to fully harness the innovative potential and cultural diversity of the Mediterranean region.

In the realm of tourism, an insightful case study explores the efforts to mitigate the environmental impact of tourism on Mediterranean islands. Using macroalgae as bioindicators, the project highlights the success of an integrated approach in managing seasonal waste variations due to tourism. This initiative underscores the importance of [sustainable tourism management](#), which not only prioritizes environmental preservation but also recognizes the economic significance of maintaining pristine natural environments and involving stakeholders in decision-making processes. By striking a balance between environmental conservation and economic interests, such initiatives contribute to the long-term sustainability and resilience of tourism-dependent economies in the Mediterranean region (Andolina et al., 2021)⁶⁹.

[Urban sustainability](#) is also being reimagined through the cultivation of [self-sustainable extensive green roofs](#) in Mediterranean climates. Research focuses on [the use of sustainable materials and plant strategies](#) to enhance ecosystem services and adapt to climate change. This green



infrastructure, emphasizing circular economy practices, is a step towards sustainable urban development in the region (Vannucchi et al., 2023)⁷⁰.

Moreover, the [promotion of biodiversity in urban areas is gaining momentum](#). Efforts like [sowing wildflower meadows](#) in peri-urban green areas not only aim to enhance local flora and provide habitats for pollinators but also contribute to the development of nature-based tourism and eco-friendly recreational activities. By increasing overall biodiversity, these initiatives not only improve the quality of life for urban residents but also attract visitors and stimulate economic activity in surrounding areas. This approach is crucial for enhancing urban biodiversity, fostering sustainable urban ecosystems, and unlocking the economic potential of biodiversity conservation initiatives (Fernandes et al., 2023)⁷¹.

[Eco-innovation is driving circularity](#) in the Mediterranean, focusing on sustainable [resource management](#) and [reducing environmental impact](#). For example, transnational cooperation methodologies have facilitated the establishment of pilot plants for green manufacturing in different Euro-Mediterranean regions, promoting smart specialization and collaboration among stakeholders. Similarly, efforts to address barriers to eco-innovation include offering tools for electronic Green Public Procurement (eGPP) and supporting SMEs in accessing finance through GPP tenders. Moreover, capacity-building tools for regional public authorities and business support organizations facilitate SMEs' access to innovation financing. Additionally, fostering business innovation capabilities through creativity methodologies enables SMEs to cost-effectively tackle growth challenges. These initiatives demonstrate how eco-innovation in the Mediterranean contributes to sustainable economic growth and environmental protection by embracing circularity principles (Castillo Sánchez, 2022)⁷².

The adoption of the “Set of regional measures to support the development of green and circular businesses and strengthen the demand for more sustainable products in the Mediterranean” (Decision IG 25/18, COP22 of the Barcelona Convention) by all contracting parties signifies a concerted effort to boost eco-innovation and social responsibility through effective policy instruments.

The Mediterranean region is witnessing a significant shift towards integrating innovation, community engagement, and cultural sustainability. These efforts are not only preserving the unique cultural heritage of the region but also addressing contemporary environmental challenges. By focusing on [sustainable food systems, responsible tourism, urban green initiatives, and eco-innovation](#), the region is setting a precedent for sustainable development. This holistic approach, characterized by multi-stakeholder collaboration and a deep respect for cultural and ecological diversity, is essential for the long-term resilience and prosperity of the Mediterranean region. The initiatives and practices currently underway are a testament to the region's commitment to [balancing economic development with environmental stewardship and cultural preservation](#), ensuring a sustainable future for the Mediterranean and its communities.

3.2. Blue Economy

The BE represents a sustainable approach to utilizing ocean resources for economic growth, improving livelihoods, and preserving the health of ocean ecosystems.



In the Mediterranean context, the significance of knowledge sharing and cooperative platforms like the Mediterranean Blue Economy Stakeholder Platform³ and The European Maritime Spatial Planning Platform⁴ is paramount. These platforms offer invaluable resources for maritime knowledge, facilitating effective management and sustainable development of marine resources by promoting networking and information exchange among stakeholders. The Union for the Mediterranean's (UfM) 2021 declaration on the Sustainable Blue Economy highlights the need for promoting sustainable practices in the Mediterranean. It focuses on various international agreements and frameworks, **emphasizing cooperation and comprehensive policy responses** (Ministerial declaration, 2021)⁷⁵.

In the Mediterranean, **marine renewable energy**, including wave and offshore wind power, is advancing towards energy independence and climate change mitigation through innovative technologies like floating wind farms. **Maritime Spatial Planning** and **Transport** focus on a balanced approach, integrating advanced technologies for sustainable marine resource use. Sustainable practices in **Fisheries and Aquaculture** aim to harmonize economic activities with environmental conservation. **Community Engagement and Governance** highlight the critical role of local communities in sustainable development, emphasizing collaborative efforts in sustainable tourism and BE initiatives for a resilient Mediterranean future.

In conclusion, the Mediterranean's approach to the BE is comprehensive, integrating sustainable practices across various sectors to balance economic growth, environmental preservation, and social equity. This strategy, aligned with global sustainability goals, faces challenges like climate change and overfishing, requiring continued innovation, sustainable technology investment, and collaborative regional efforts to ensure the sustainable development of the Mediterranean's marine and coastal resources.

3.2.1. Strategies for sustainable development

The Mediterranean region is actively progressing towards sustainable development within its BE, marked by innovative practices and policies that intertwine economic growth with environmental stewardship and social equity.

The Mediterranean is increasingly integrating CE principles into its BE sectors. This involves **reducing resource consumption and regenerating nature**, thereby leading to sustainable, efficient, and profitable sectors. Key recommendations include **policy coherence, sustainable industrial development, and circular business model design** (CPRM & MedWaves, 2022)⁷⁶. The EU Blue Economy Report 2023 (European Commission, 2023)⁷⁷ examines the **economic performance and sustainability potential** of the EU's BE sectors. It highlights the **impacts of recent global events** on these sectors, emphasizing the ongoing transition towards sustainable practices and renewable energy. **Focusing on biodiversity conservation, restoring ecosystems, and wisely using biodiversity** to ensure a positive coexistence with economic sectors (Plan Bleu, 2022)⁷⁸.

³ <https://medblueeconomyplatform.org/>

⁴ <https://maritime-spatial-planning.ec.europa.eu/mssp-resources/related-initiatives-databases>



A significant shift is underway towards [sustainable aquaculture and marine industries](#). Efforts focus on [balancing economic growth](#) with resource conservation. Innovations in these sectors are driven by a need for environmental sustainability and economic efficiency, which also foster social equity. These changes are evident in the region's strategic focus on sustainable maritime activities, where [governance improvements, technological advancements, and multi-stakeholder cooperation play crucial roles](#) (Interreg-Med Blue BioMed project, n.d.)⁷⁹. [Sustainable marine trade](#) has emerged as a key component of the Mediterranean's BE. This involves not just the sustainable harvesting of marine resources but also their equitable and efficient utilization. The region is witnessing a shift towards practices that enhance the economic [value of natural capital while simultaneously preserving ecosystem services](#) (Blue BioTrade, 2018)⁸⁰.

Sustainable tourism in the Mediterranean is undergoing significant transformation. Innovative strategies are being implemented to [manage tourist flows, promote sustainable mobility, enhance energy and waste management efficiency, and encourage ecotourism](#). These efforts aim to balance tourism growth with environmental preservation and community well-being (Interreg-Med Sustainable Tourism Community, 2022)⁸¹. The Mediterranean is working towards a sustainable and resilient tourism model post-COVID-19. This involves [enhancing coastal and maritime tourism, building resilience and inclusivity](#), and promoting cooperation among states and stakeholders. [Skills development and awareness of sustainable tourism](#) are also key focuses (Union for the Mediterranean / CPMR Intermediterranean Commission, 2022)⁸².

[Marine biotechnology](#) is gaining attention for its potential in the Mediterranean. This includes the [identification of high-potential value chains](#) and addressing the technical and non-technical aspects necessary for advancement (Rotter et al., 2023)⁸³. The importance of an [ecosystem approach](#) in marine management is recognized. This approach integrates ecological, economic, societal, and cultural aspects for sustainable development and management of marine resources (Tseliou & Tselepides, 2020)⁸⁴.

These diverse initiatives and reports (CPRM & MedWaves, 2022)⁷⁶ collectively illustrate the Mediterranean's commitment to innovating and implementing sustainable practices in its BE, ensuring a balance between economic growth, environmental preservation, and social equity.

3.2.2. Marine Renewable Energy

Marine renewable energy is explored as a key contributor to [achieving climate neutrality and supporting the GE](#). This involves focusing on the planning and management of marine energy resources, considering the unique geographical and environmental characteristics of Mediterranean coastal countries (Echave et al., 2019)⁹.

The region is [harnessing its potential for marine renewable energies](#) (MREs) like [wave](#) and [offshore wind power](#). Innovations in these areas are crucial for the region's energy independence and for mitigating climate change impacts. For instance, the [implementation of blue energy technologies](#), including marine wind and wave energy, is a growing focus, with projects aiming to contribute substantially to the EU's power demand by 2050 (European Commission, 2023)⁸⁵.

Technological advancements are key in the development of sustainable energy sources. The Mediterranean is witnessing [a surge in innovative projects](#) such as [floating wind farms and wave energy converters](#) (Stančin et al., 2022)⁸⁶. These technologies are being adapted to the region's unique maritime conditions, which include challenges like lower wind and tidal strengths and



greater sea depths. The integration of such renewable energy sources is seen as a strategic move towards a sustainable energy future.

3.2.3. Maritime Spatial Planning and Transport

The state of **Marine Spatial Planning (MSP)** in the Mediterranean region reflects a dynamic interplay between technological innovation, environmental sustainability, and socio-economic development. The integration of BE technologies within MSP processes in countries like Greece, Croatia, and Cyprus illustrates a forward-looking approach that seeks to harmonize economic growth with environmental protection. The development of a BE planning framework, signifies a proactive step towards leveraging the Mediterranean's marine resources for renewable energy production while ensuring the minimization of ecological impacts (Pulselli et al., 2022)²⁷. The application of **high-frequency radars (HFRs)** in the Mediterranean further underscores the region's commitment to enhancing maritime safety and environmental monitoring. The deployment of HFRs boosts our understanding of coastal processes and supports a broad range of applications aimed at addressing key regional challenges such as maritime safety, extreme hazards, and environmental transport processes. This technological advancement is indicative of the Mediterranean's emphasis on leveraging cutting-edge science to inform MSP and safeguard marine ecosystems (Reyes et al., 2022)⁸⁷. These developments reflect a holistic understanding of the intricacies involved in coastal and marine ecosystem management. The emphasis on incorporating accurate spatial data through tools like **Geographic Information Systems (GIS points)** to an acknowledgment of the need for precise, data-driven decision-making processes. Such methodologies are essential for balancing the various demands on marine spaces, ensuring the sustainability of marine resources, and supporting the broader goals of the BE.

Maritime safety and security are paramount in the Mediterranean, given its strategic geopolitical location and extensive maritime activities. Recent efforts have emphasized the integration of advanced technologies and collaborative frameworks to **improve surveillance, emergency response, and overall maritime governance**. The European Maritime Safety Agency (EMSA) has been pivotal in this transformation, offering operational services to prevent and respond to pollution incidents, enhancing vessel tracking, and improving marine environmental protection (Oil Pollution in the Mediterranean Sea, 2019)⁸⁸.

Regional approaches and sustainable solutions for maritime surveillance have been increasingly adopted, focusing on the use of state-of-the-art technologies and fostering regional cooperation (Fantinato, 2021)³⁷.

The environmental impact of shipping in the Mediterranean has also been a focus, with studies evaluating the potential influence of **maritime traffic on air quality** and **particulate matter concentrations**. These concerns have prompted detailed studies aimed at evaluating maritime traffic's influence on the region's environment. Such evaluations are indispensable for shaping policy decisions related to shipping regulations and devising strategies to mitigate environmental impacts (Fink et al., 2023)³¹. Within this context, the transport sector, especially maritime shipping, is witnessing a pivotal shift towards sustainability.

The role of **maritime transport** in the BE, particularly in the Adriatic-Ionian Region, is also reevaluated. This transport sector not only supports economic growth through trade and connectivity but also poses environmental challenges, such as marine pollution and habitat



disruption. A study by Kyriakou, Panagakos, and Psaraftis calls for a more [integrated policy framework](#) to manage its environmental, economic, and social impacts effectively (Niavis et al., 2017)²⁹.

A significant development in this direction is the maritime industry's move towards green fuels, notably highlighted at COP28, where shipping leaders and green hydrogen producers signed a Joint Commitment agreement to produce over 11 million tons of low-emission fuel by 2030. This initiative [positions green hydrogen as a cornerstone fuel](#) for the shipping industry by 2050. Supported by the International Maritime Organisation's 2023 revised Strategy, this transition emphasizes the critical period until 2027 for the industry to align with zero emissions measures, highlighting the need for [investments in green technologies](#) and the [development of a supportive ecosystem for green hydrogen](#). This collaborative effort aims to ensure a smooth transition to a zero-emission maritime sector and marks a key step towards sustainable practices within the BE, projecting a resilient and sustainable future for the Mediterranean (Toubal, 2024)⁸⁹.

The Mediterranean's vulnerability to oil spills due to heightened maritime traffic and offshore installations has led to the development of [dedicated decision support systems](#) like MEDESS-4MS. This multi-model oil spill prediction service enhances maritime safety by providing real-time and delayed-mode oil spill forecasting (Zodiatis et al., 2016)³³.

Furthermore, integrating socio-economic considerations into the transition towards green fuels elucidates the broader implications of this shift. The economic benefits, such as job creation in green technology sectors and enhanced energy security through reduced reliance on imported fuels, alongside the challenges of high initial costs and the need for infrastructure development, underline the complexity of achieving a sustainable maritime future. Emphasizing the socio-economic and environmental dimensions of this transition highlights the interconnectedness of sustainable practices and the critical role of comprehensive planning and international collaboration in fostering a sustainable, resilient Mediterranean maritime sector.

3.2.4. *Fisheries and Aquaculture*

[Fisheries and aquaculture](#) are integral to the Mediterranean's BE. Sustainable practices in these sectors are not just about environmental conservation but also about supporting the livelihoods of local communities. The emphasis on [sustainable fishing practices and the protection of marine habitats](#) is a response to the growing awareness of the need for a balance between economic activities and environmental stewardship. Key initiatives and organizations, such as the Union for the Mediterranean (UfM) and the General Fisheries Committee for the Mediterranean (GFCM), are at the forefront of promoting sustainable practices in these sectors (Nadcrinicinii, n.d.)⁹⁰. This sub-chapter provides a synthesis of current practices and management strategies in the sector, supported by pertinent documents.

The fisheries sector's transformation is rooted in the need for sustainable maritime activities, essential for regional development. Key documents like the "Blue Economy in the Mediterranean" report by Plan Bleu, MAP, UNEP (2020) (Plan Bleu, 2020)⁹¹ highlight the importance of [improving governance, expanding economic instruments, supporting innovation, and utilizing statistics](#) for informed policymaking. These recommendations are vital for ensuring that maritime activities contribute positively to the region's sustainable growth. The CPMR Intermediterranean Commission's document from October 2023 offers a detailed look into Cleaner Production in the



Mediterranean, [proposing effective strategies for enhancing green competitiveness](#) in the region. These approaches align with broader efforts to integrate sustainable practices across all sectors of the BE (Conference of Peripheral Maritime Regions, 2023)⁹².

The European Commission (European Commission, 2023)⁸⁵ highlights [initiatives addressing the transition of fishing and aquaculture sectors to cleaner energy sources](#), focusing on the adoption of renewable energy like solar and wind power, the use of electric and hybrid engines for vessels, the implementation of energy-efficient equipment, and innovations in aquaculture systems such as recirculating systems to reduce water and energy use. This transition aligns with the European Green Deal and involves exploring alternative fuels and adapting fishing practices to reduce emissions and environmental impacts. The "Economic and Social Analysis of the Uses of Mediterranean Coastal and Marine Waters" by Plan Bleu (2021) provides a comprehensive [socioeconomic analysis of key sectors, including fisheries and aquaculture](#). The

report assesses production, economic contributions, and environmental impacts (Plan Bleu, 2014)⁹³.

An [ecosystem approach](#) to managing the Mediterranean marine environment is pivotal for its sustainable development. This holistic strategy accounts for the interplay among ecological, economic, societal, and cultural factors, ensuring a comprehensive and sustainable management of marine resources. For instance, the implementation of [Marine Protected Areas \(MPAs\)](#) serves as a specific example of this approach in action. MPAs are designed based on thorough ecological studies and stakeholder consultations, aiming to conserve marine biodiversity while allowing sustainable use of marine resources. These areas balance conservation goals with the interests of various stakeholders, including fishermen, tourism operators, and local communities, demonstrating the ecosystem approach by integrating conservation efforts with sustainable economic development. Through MPAs, the Mediterranean region exemplifies how ecosystem-based management can protect marine biodiversity, support sustainable fisheries and tourism, and preserve the cultural heritage of coastal communities, ensuring the marine environment's resilience and sustainability (Tseliou & Tselepides, 2020)⁸⁴.

Additionally, there is a focus on addressing the challenges posed by the expansion of the aquaculture industry within these protected areas, with strategies aimed at harmonizing the growth of aquaculture with the imperative of marine conservation, offering actionable insights to reconcile economic development with ecological preservation (Bolognini et al., 2019)⁹⁴.

These documents collectively provide insights into the ongoing efforts and challenges in managing the fisheries sector in the Mediterranean. They underscore the importance of sustainable practices, policy frameworks, and cooperation among regional stakeholders to ensure the balance between economic development, environmental conservation, and social inclusion.



3.2.5. Community Engagement and Cultural Sustainability

In the Mediterranean region, the journey towards sustainable development and environmental conservation is closely interwoven with community engagement. This chapter delves into the various facets of the BE where local communities play a pivotal role, illustrating how sustainable practices are being implemented and supported by collaborative efforts.

Tourism, a vital economic sector in the Mediterranean, has seen a **paradigm shift** towards sustainability. The region witnesses an increasing adoption of **practices that balance tourism growth with environmental preservation and community well-being**. Innovations in sustainable tourism, such as managing tourist flows and promoting ecotourism, are reshaping the tourism landscape. These strategies, which focus on **minimizing the environmental impact while maximizing socio-economic benefits** for local communities, are detailed in the "Catalogue of Best Practices on Sustainable Tourism in the Mediterranean" (Plan Bleu, 2022)⁹⁵. These practices, emblematic of the BE's ethos, demonstrate a comprehensive approach to sustainability—balancing tourism development with the preservation of marine and coastal ecosystems and ensuring the well-being of the community.

The integration of Blue Energy plants in the Mediterranean, particularly in Greece, highlights the importance of **local community involvement**. Blue energy technology, a promising renewable energy source, requires a context-specific approach considering each location's unique features. Blue Energy, derived from the harnessing of marine resources such as wave, tidal, and ocean thermal energy conversion (OTEC), represents a significant stride towards sustainable energy solutions. In Greece, the focus has been on establishing wave energy converters and tidal stream generators, tailored to the unique geographical and environmental characteristics of the region. This approach highlights the importance of collaborative efforts among citizens, scientists, policymakers, and local authorities in the planning and establishment of BE plants, ensuring they are socially accepted and align with the specific attributes of the Mediterranean environment (Andreadou et al., 2019)⁹⁶.



Community engagement in the Mediterranean BE is multifaceted, encompassing sectors from tourism and fisheries to renewable energy and wastewater management. This engagement ensures that sustainable practices are not only environmentally effective but also socially inclusive and economically beneficial, driving the region towards a more resilient and sustainable future.

The Mediterranean region's progression towards a sustainable BE is underscored by a [strategic alignment of regional policies with global sustainability goals](#), including the 2030 Sustainable Development Agenda and the Paris Agreement on Climate Change. (Valletta Declaration, 2017)⁹⁷ This alignment is exemplified by initiatives such as the Mediterranean Blue Innovation Deal⁷⁹ and the Blue Economy in the Mediterranean policy paper (Bocci, Papaioannou, & Dubreuil, 2019)⁹⁸, which emphasize the integration of economic growth with environmental stewardship.



While there is significant progress, the Mediterranean faces challenges such as climate change, marine pollution, and overfishing. Addressing these requires continued innovation, [investment in sustainable technologies, and collaborative regional efforts](#). The future direction involves enhancing renewable energy capacities, fostering sustainable maritime activities, and ensuring the protection and wise use of marine and coastal ecosystems (Plan Bleu, 2022)⁹⁹.

In conclusion, the Mediterranean region's commitment to MSP is a cornerstone of its strategy to achieve maritime safety, security, and sustainable development. The adoption of innovative MSP practices, underscored by the integration of Blue Energy technologies and the use of advanced tools like high-frequency radars and Geographic Information Systems, exemplifies a forward-looking approach to harmonizing economic growth with environmental protection. These initiatives, supported by [regional cooperation and advanced technologies](#), are essential for ensuring the sustainable development of the Mediterranean's BE. Additionally, [the integration of environmental protection efforts](#) through organizations and instruments like the Barcelona Convention, Programme for the Assessment and Control of Marine Pollution in the Mediterranean (MED POL) and the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC) highlights the [nexus between maritime security and environmental sustainability](#), further underscoring the region's holistic approach to fostering a secure and sustainable BE.

4. Conclusions

The synthesis of key findings in the Mediterranean's blue and green economies reveals a region dedicated to sustainable development and environmental stewardship. The analysis highlights significant themes and key takeaways that showcase the Mediterranean's commitment to informed decision-making and holistic approaches.



In the **Green Economy**, the Mediterranean is actively transitioning toward circular economy principles, sustainable agriculture, and energy efficiency. Collaborative efforts and innovative practices across various sectors, including small and medium enterprises, urban development, and waste management, are reshaping the economic and environmental landscape.



The **Blue Economy** in the Mediterranean focuses on sustainable maritime activities, renewable energy, and circular economy principles. The region places a strong emphasis on balancing economic growth with the preservation of marine ecosystems and social equity, with particular attention to sustainable tourism and renewable energy sources.

Both the GE and the BE in the Mediterranean region exhibit parallel patterns and trends, highlighting a unified approach towards **sustainability, circularity, and innovation**. Despite their distinct domains—GE focusing on terrestrial ecosystems and sustainable agriculture, and BE on maritime activities and marine conservation—the underlying principles guiding both economies are remarkably similar.

This congruence showcases an overarching commitment to **integrating circular economy principles** across sectors, whether on land or at sea. Both economies are pioneering efforts to **reduce waste, enhance resource efficiency, and promote the reuse and recycling of materials**.

Innovation serves as a critical driver in both the GE and BE, facilitating the **development of sustainable practices and technologies**. Whether it's through advancing renewable energy sources, like **solar and wind** in the GE, or tapping into **marine renewables** in the BE, the region is



actively exploring and implementing solutions that **reduce carbon footprints** and **mitigate climate change impacts**.

Sustainable practices form the cornerstone of both economies, ensuring that economic growth does not come at the expense of environmental degradation or social inequity. In the GE, this is reflected in the **promotion of sustainable agriculture** and **energy-efficient urban development**. Similarly, in the BE, there is a strong emphasis on **sustainable maritime activities**, particularly in **fostering sustainable tourism** that respects marine ecosystems and promotes social equity.

This unified approach to sustainability in the Mediterranean, encompassing both the GE and the BE, underscores the indispensable role of empowered local communities in driving change. Their engagement in sustainable practices—ranging from agriculture and urban development on land to tourism, fisheries, and marine conservation at sea—highlights the **comprehensive impact of community involvement** in promoting environmental preservation, economic resilience, and social equity across all sectors. Furthermore, the integration of **social value creation and circular economy principles** is identified as essential to fostering a sustainable, innovative economy. Embracing a **circular society concept**, where social value is considered from the production process's start, is crucial for sustainable development. This approach invites a revaluation of circular economy models, advocating for systems that incorporate ecological, economic, and social dimensions equally. By adopting such holistic and inclusive strategies, the Mediterranean region demonstrates a profound commitment to creating a resilient, sustainable future, where economic activities and environmental stewardship coexist harmoniously.

The Mediterranean region showcases a commitment to **reducing environmental impacts** through the integration of circular economy principles and sustainable practices across both green and blue economies. Efforts in marine renewable energy, sustainable agriculture, and waste management exemplify innovative approaches to conserving biodiversity, optimizing resource use, and mitigating climate change.

Empowered local communities are at the forefront of driving **sustainable development**, playing pivotal roles in sectors such as tourism, fisheries, and renewable energy. The promotion of sustainable practices and community involvement emphasizes social equity, improving livelihoods, and fostering inclusivity, contributing to the overall well-being of the Mediterranean society.

Economic resilience is fostered through innovative and sustainable practices that balance growth with environmental and social considerations. Initiatives in circular economy, sustainable tourism, and renewable energy are contributing to economic diversification, job creation, and the promotion of green and blue growth, highlighting a commitment to sustainable economic development.

Strong governance structures support the sustainable development of the Mediterranean's GE and BE. Collaborative regional efforts, policy coherence, and the adoption of comprehensive strategies align with global sustainability goals, ensuring effective management of marine and terrestrial resources. The emphasis on multi-stakeholder cooperation and international agreements underscores the Mediterranean's holistic approach to achieving maritime safety, security, and sustainable development.

In summary, the Mediterranean region's integrated approach to sustainability within its green and blue economies demonstrates a profound commitment to environmental stewardship, social equity, economic resilience, and effective governance. By balancing economic activities with the preservation of natural and cultural heritage, the region is paving the way for a resilient and sustainable future,



addressing current challenges through innovation, collaboration, and a holistic understanding of sustainability pillars. For detailed insights into the actionable strategies underpinning this commitment, see tables: Table 1 Key Focus Areas, Insights, and Actions for Advancing the Green Economy and Table 2 Key Focus Areas, Insights, and Actions for Advancing the Blue Economy which outline the pivotal initiatives across both economies.

4.1. Green Economy

Table 1 Key Focus Areas, Insights, and Actions for Advancing the Green Economy

Focus areas	Key Insights / Facts	Key Actions
Circular Economy and Resource Efficiency	<ol style="list-style-type: none"> 1. Circular economy principles promote the reuse and recycling of materials, reducing waste and resource consumption (European Circular Economy Stakeholder Platform, 2023a)⁴². Circular business models for valorising olive oil waste contribute to environmental sustainability and economic growth (Donner et al., 2022)¹⁰¹. 2. Green logistics is a critical component in transitioning to a circular economy, requiring a comprehensive organizational and economic mechanism for implementation (Dzwigo et al., 2021)¹⁰². 3. Interconnection of water, energy, and food systems is critical, optimizing resource use and promoting sustainability (Donner et al., 2022)⁴. 	<p>Develop and implement circular business models: Focus on creating new models that valorise waste, such as turning olive oil waste into valuable products, to enhance environmental sustainability and stimulate economic growth. This action expands upon the insight of utilizing circular principles for waste valorisation and directly addresses the need for innovative economic models that contribute to sustainability^{42, 101}.</p> <p>Advance green logistics systems: Establish comprehensive strategies to overhaul logistics and supply chains, prioritizing resource efficiency, waste reduction, and the recycling of materials. While similar to your initial action, this version emphasizes a broader systemic change rather than the implementation of strategies, targeting the organizational and economic structures necessary for a circular economy¹⁰².</p> <p>Integrate and optimize the Water-Energy-Food (WEF) Nexus: Utilize the WEF Nexus framework to foster interconnectivity and synergy among water, energy, and food systems, aiming for enhanced resource efficiency and sustainability. This action is derived from the insight regarding the critical interconnection of these systems and proposes a specific framework (the WEF Nexus) as a tool for operationalizing this integration⁴.</p>



Sustainable agriculture	<ol style="list-style-type: none"> 1. Closed-loop irrigation systems and sustainable materials in urban agriculture are effective measures for addressing water scarcity and reducing environmental impact, particularly in densely populated areas (Refalo et al., 2017)¹⁴. 2. Bio-fertilizer products offer innovative solutions to enhance water use efficiency in agriculture, demonstrating the potential of circular approaches to sustainable farming practices (Chen et al., 2019)¹⁰⁰. 3. The abundance of agricultural waste biomass in Mediterranean regions presents untapped opportunities for sustainable greenhouse agriculture, highlighting the region's potential for eco-friendly farming practices (Duque-Acevedo et al., 2020)¹⁰³ 4. Reclaimed water utilized for irrigation purposes and hydroponic agriculture serves as a sustainable resource, contributing to the conservation of water and preservation of essential nutrients in agricultural ecosystems (Durand et al., 2021)¹⁰⁷. 5. The diversity in farm size and intensity observed in the Mediterranean region acts as a natural resilience factor against climate variability, mitigating the vulnerability of regional wheat yields to environmental fluctuations (Reidsma & Ewert, 2008)¹⁰⁸. 6. Recommended management practices (RMPs) significantly contribute to enhancing soil organic carbon (SOC) stocks in cropping systems, addressing soil fertility and sustainability concerns (Vicente-Vicente et al., 2016)¹¹⁰. 7. The transition from conventional to regenerative agriculture necessitates a fundamental shift in farmers' attitudes and cultural norms, emphasizing the importance of embracing sustainable farming practices for long-term agricultural resilience (Gosnell et al., 2019)¹¹¹. 	<p>Implement closed-loop irrigation systems and utilize sustainable materials in urban agriculture: Installing drip irrigation systems in urban rooftop gardens and using recycled materials, such as reclaimed wood or recycled plastic containers, for planters and infrastructure, reducing water usage and environmental footprint in urban agriculture^{102, 107}.</p> <p>Utilize bio-fertilizer products to enhance water use efficiency in agriculture: Integrating bio-fertilizers derived from organic waste materials, such as composted food scraps or agricultural residues, into farming practices to improve soil health, nutrient retention, and water absorption, thereby reducing water consumption in agricultural production¹⁰⁰.</p> <p>Explore opportunities for sustainable greenhouse agriculture utilizing agricultural waste biomass: Establishing biomass-to-energy facilities in Mediterranean regions to convert agricultural residues, such as crop stalks or olive pomace, into renewable energy sources, while utilizing the byproducts, such as biochar, as soil amendments in greenhouse farming, promoting circularity and resource efficiency¹⁰³.</p> <p>Implement reclaimed water systems for irrigation and hydroponic agriculture: Developing decentralized water treatment facilities to treat wastewater from urban centres, repurposing the treated water for irrigation in hydroponic greenhouses or vertical farming systems, ensuring efficient water use and nutrient recycling in agricultural production¹⁰⁷.</p> <p>Adopt recommended management practices (RMPs) to enhance soil organic carbon (SOC) stocks: Implementing no-till farming techniques, cover cropping, and crop rotation strategies in Mediterranean croplands to improve soil structure, increase carbon sequestration, and enhance soil fertility, mitigating the decline in organic matter and improving overall soil health¹¹⁰.</p> <p>Transition from conventional to regenerative agriculture by embracing sustainable farming practices: Transitioning from chemical-intensive farming methods to agroecological approaches, such as agroforestry, crop diversification, and holistic land management, to restore soil health, promote biodiversity, and build resilience against environmental challenges, fostering long-term sustainability in agricultural systems¹¹¹.</p>
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Strategies for Sustainable Development	<ol style="list-style-type: none"> 1. Cultivating effective waste management strategies along the Mediterranean is imperative, not only for preserving the environment but also for nurturing sustainable tourism practices, thereby safeguarding the region's natural beauty and ecological integrity (Voukkali et al., 2021)¹⁰⁴. 2. Effective eco-innovation is closely linked to sustainable business development, but disparities exist between countries due to varying levels of communication, coordination, and synergy among institutions, government, and SMEs (Domaracká et al., 2023)¹¹⁶, (Belokrylov et al., 2022)¹⁰⁵. 3. A comprehensive grasp of circular and GE principles is essential for fostering sustainable economic growth throughout the Mediterranean region, underlining the significance of holistic approaches that integrate environmental considerations into economic development strategies. 4. Despite the evident benefits of engaging in green infrastructure projects, their execution often encounters obstacles stemming from resource constraints, limited technical know-how, and the intricate nature of project complexities, underscoring the need for early-stage focus and strategic resource allocation (Adib et al., 2023)¹¹⁵. 	<p>Implementing effective waste management strategies: Establishing waste collection and recycling facilities in tourist hotspots, coupled with public awareness campaigns and investing in infrastructure for proper waste disposal along coastal areas to preserve the environment and promote sustainable tourism practices¹⁰⁴.</p> <p>Developing a regulatory framework for circularity of agricultural waste: Enacting policies that incentivize farmers to adopt composting practices and use organic fertilizers derived from agricultural waste materials, promoting circularity in agricultural practices and supporting sustainable economic growth¹⁰³.</p> <p>Enhancing eco-innovation for sustainable business development: Establishing collaborative platforms where businesses and research institutions share knowledge and resources to develop innovative sustainable solutions, addressing disparities in communication, coordination, and synergy among institutions, government bodies, and SMEs across Mediterranean countries^{116, 105}.</p> <p>Strengthening inter-country communication and collaboration: Establishing joint research programs and funding initiatives involving multiple Mediterranean countries to promote collaboration among scientists, innovators, and policymakers, addressing common sustainability challenges and enhancing collective impact¹¹⁶.</p> <p>Promoting green procurement policies: Mandating the procurement of goods and services from environmentally responsible suppliers, supporting local green businesses, and fostering sustainable development¹⁰⁵.</p> <p>Fostering long-term stewardship in green projects: Establishing dedicated project management teams tasked with overseeing the entire lifecycle of green infrastructure projects, from planning and implementation to monitoring and maintenance, overcoming obstacles related to resource constraints, technical complexities, and limited expertise¹¹⁵.</p>
Energy Transition and Environmental Protection	<ol style="list-style-type: none"> 1. Effective grid integration, leveraging advanced technologies like High Voltage Direct Current (HVDC), energy storage solutions, and smart grids, is essential for transitioning towards a low-carbon energy system in the Mediterranean, necessitating substantial investments in this sector to support sustainable energy development (Moretti et al., 2020)¹¹². 	<p>Enhance Mediterranean region connectivity through advanced grid integration technologies: Invest in and deploy advanced grid integration technologies such as HVDC, energy storage solutions, and smart grid systems to enhance the interconnectedness and efficiency of energy networks across the Mediterranean region, facilitating the transition towards a low-carbon energy system¹¹².</p> <p>Implement policies to promote renewable energy and urbanization: Enact and enforce</p>



	<p>2. Economic growth and reliance on fossil energy sources contribute to increased CO2 emissions in the Mediterranean region, emphasizing the need for transitioning towards urbanization and renewable energy adoption to mitigate carbon emissions and promote environmental sustainability (Ulucak et al., 2021)¹¹³.</p> <p>3. By 2050, the Mediterranean fringe is expected to experience significant environmental degradation, influencing migration patterns and socioecological conflicts, underscoring the urgency of implementing sustainable development strategies to mitigate environmental pressures and foster resilience in the region (Salhi et al., 2022)¹¹⁴.</p>	<p>policies that promote the adoption of renewable energy sources and sustainable urbanization practices while effectively managing and reducing the impact of economic growth and fossil fuel consumption on CO2 emissions in the Mediterranean region, fostering a sustainable and environmentally conscious development trajectory¹¹³.</p> <p>Strengthen international cooperation and cross-cultural exchange: Foster international cooperation and cross-cultural exchange initiatives (joint research programs, capacity building workshops, joint policy development and cultural exchange programs) aimed at addressing environmental degradation and socioecological challenges along the Mediterranean fringe, promoting collaborative efforts to mitigate the adverse effects of environmental degradation and foster resilience in the region¹¹⁴.</p>
Community Engagement and Cultural Sustainability	<p>1. Green innovation is a growing focus for SMEs, though its implementation poses challenges due to macroeconomic scenarios and traditional business model (Rodrigues & Franco, 2023)¹¹⁷.</p> <p>2. Digital transformation significantly enhances green and clean aspects of the economy, with high digital-intensive sectors impacting regional development and eco-innovation (Pirciog et al., 2023)¹¹⁸.</p>	<p>Foster Collaboration Platforms: Establish collaborative platforms, such as industry clusters or innovation networks, where SMEs can share knowledge, resources, and best practices in green innovation. For example, create a regional green technology consortium that provides SMEs with access to research facilities, funding opportunities, and expert guidance¹¹⁷.</p> <p>Capacity Building Workshops: Organize capacity-building workshops and training programs to equip SMEs with the necessary skills and knowledge to leverage digital technologies for eco-innovation. Offer practical training sessions on topics like sustainable product design, digital marketing for green products, and implementing eco-friendly business processes¹¹⁷.</p> <p>Technology Adoption Support: Facilitate the adoption of digital tools and technologies among SMEs by offering technical assistance and support services. Develop user-friendly digital platforms or software solutions tailored to the needs of SMEs, making it easier for them to integrate digital technologies into their operations for eco-innovation¹¹⁸.</p>



4.2. Blue Economy

Table 2 Key Focus Areas, Insights, and Actions for Advancing the Blue Economy

Focus areas	Key Insights / Facts	Key Actions
Strategies for sustainable development	<ol style="list-style-type: none"> 1. Innovation in the blue bioeconomy requires a governance model that addresses both social and sustainable development challenges in a multilevel context. (David et al., 2022)¹¹⁹ 2. The Mediterranean region is embracing sustainable development in its BE, with a focus on integrating economic growth, environmental stewardship, and social equity. 3. There is a need for a protocol to investigate and define the current capacity and boundaries of coastal ecosystems in the context of industrial activity, cultural heritage, and environmental protection (Pournara & Sakellariadou, 2022)¹³³. 	<p>Develop and implement a multilevel governance framework for the blue bioeconomy: This framework should facilitate innovation by addressing social equity, environmental sustainability, and economic growth in a cohesive manner. Actions include creating policies that encourage sustainable practices across the BE, fostering cross-sectoral and cross-jurisdictional collaboration, and engaging a wide range of stakeholders — from local communities to international partners — to ensure comprehensive and inclusive approaches to sustainable development¹¹⁹.</p> <p>Enhance sustainable tourism models: Promote 'slow tourism' strategies that prioritize minimal environmental impact, cultural preservation, and community involvement. This approach involves developing infrastructure and services that encourage <i>longer stays, local engagement, and activities</i> that contribute to the <i>preservation of natural and cultural heritage</i>, thereby ensuring balanced economic growth alongside environmental and social equity.</p> <p>Establish a coastal ecosystem assessment protocol: Develop a comprehensive framework for assessing the impacts of <i>industrial activities on coastal ecosystems</i>. This protocol should balance development with conservation, involving stakeholder engagement, environmental impact assessments, and adaptive management strategies to protect ecosystems while supporting sustainable development.</p>



Marine renewable energy	<ol style="list-style-type: none"> 1. Mediterranean Sea's unique wind and sea conditions are suitable for offshore floating wind turbines, suggesting that these turbines could be a viable and effective source of renewable energy for the region (Cottura et al., 2021)¹²³. 2. Renewable energy, particularly marine renewable energies (MREs), is becoming a cornerstone of the Mediterranean's energy strategy. 	<p>Develop offshore floating wind turbine projects: Capitalize on the unique wind and sea conditions of the Mediterranean by investing in and deploying offshore floating wind turbines. This action entails conducting comprehensive environmental impact assessments, engaging with local communities for support, and implementing the turbines in locations where they can maximize energy generation while minimizing ecological disruptions.</p> <p>Strengthen MRE infrastructure and policy frameworks: Enhance the integration of MREs into the Mediterranean's energy grid by establishing robust policy frameworks that encourage investment in renewable energy technologies, such as wave and tidal energy systems. This involves offering incentives for renewable energy projects, building partnerships between governments, industry, and research institutions to foster innovation, and ensuring that MRE development aligns with environmental and social sustainability goals (David et al., 2022)¹¹⁹.</p>
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Maritime spatial planning and Transport	<ol style="list-style-type: none"> 1. Maritime multi-use (MU) is expected to enhance the productivity of BE sectors and deliver additional socio-economic benefits related to the environmental and social dimensions of sustainable development in the Mediterranean Sea (Przedzimirska et al., 2021)¹²¹. 2. There are significant knowledge gaps in understanding how marine renewable energy devices, such as wind, wave, and tidal resources, impact benthic (seafloor) environments. Key concerns include hydrodynamic changes affecting primary production, the introduction of non-native species, and noise and vibration effects on benthic organisms (Dannheim et al., 2020)¹²⁶. 3. Advanced machine learning techniques can effectively utilize satellite imagery to accurately estimate coastal bathymetry, which is crucial for enhancing maritime navigation safety (Abdul Gafoor et al., 2022)¹³⁰. 4. The emergence of Maritime Autonomous Surface Ships (MASS) is poised to revolutionize maritime safety and security, though it raises new regulatory and technical challenges (Kim et al., 2020)¹³¹. 5. Maritime surveillance data, particularly from systems like Automatic Identification Systems (AIS) has great potential to significantly inform and enhance marine spatial planning processes (Dupont et al., 2020)¹³². 	<p>Implement co-located maritime activities: Design maritime spatial plans that allow for the integration of multiple uses, such as combining renewable energy generation with aquaculture. This action involves mapping and allocating zones where activities can synergize, like placing wind turbines alongside aquaculture farms, to optimize space, reduce conflicts among sea users, and enhance ecological benefits¹²¹.</p> <p>Enhance research and incorporate marine spatial planning: Prioritize research on the environmental impacts of marine renewable energy installations and integrate findings into maritime spatial planning. This action calls for collaboration between scientists, policymakers, and industry to ensure energy developments do not adversely affect marine ecosystems¹²⁶.</p> <p>Integrate machine learning into maritime navigation systems: Develop and implement advanced machine learning algorithms to analyse satellite imagery for accurate bathymetry estimation. This action involves collaboration between technology developers, maritime authorities, and navigational experts to ensure the data is effectively used to improve navigation safety, route planning, and to reduce the risk of maritime accidents¹³⁰.</p> <p>Address regulatory and technical challenges of MASS integration: Establish a regulatory framework that accommodates the safe and secure operation of MASS within existing maritime traffic. This requires technical standards for autonomous operations, safety protocols, and guidelines for human-machine interaction, ensuring MASS integration enhances maritime safety and efficiency while addressing potential challenges.</p> <p>Leverage AIS data for marine spatial planning: Utilize maritime surveillance data, especially from AIS, to inform marine spatial planning and decision-making processes. This involves analysing AIS data for traffic patterns, identifying potential conflict zones, and integrating this information into spatial planning to optimize maritime routes, enhance safety, and minimize environmental impact.</p> <p>Implement the Discrete Global Grid System for enhanced risk assessment: Adopt this geospatial analysis system to refine maritime risk assessment methodologies, leading to better prediction and mitigation of navigation hazards. This will involve</p>
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	<p>6. The application of sophisticated geospatial analysis using the Discrete Global Grid System can significantly improve maritime risk assessment, aiding in the prediction and prevention of ship groundings (Rawson, Sabeur, & Brito, 2022)¹³⁴.</p>	<p>training maritime safety personnel in the system's use and integrating it into maritime safety protocols.</p>
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Fisheries and aquaculture	<ol style="list-style-type: none"> 1. The need for major changes in production and consumption patterns is urgent to progress towards inclusive sustainable development in the Mediterranean, focusing on climate change, biodiversity protection, ecosystem restoration, pollution prevention, and the circular economy (State of Environment and Development in the Mediterranean, 2022)¹²⁰. 2. The cultural and economic importance of fisheries and aquaculture in the Mediterranean and Black Sea is emphasized, underlining the need for sustainable practices (GFCM, 2021)¹³⁵. 3. Seaweeds in the Mediterranean represent a sustainable resource for bio-based products, supporting the objectives of the Sustainable Blue Economy (Armeli Minicante et al., 2022)¹²⁴. 4. A functional trait-based approach for selecting suitable areas for aquaculture is vital for environmental sustainability and species performance optimization in the Mediterranean (Giacoletti et al., 2021)¹³⁶. 5. Innovative approaches like the functional trait-based mechanistic approach, leveraging the Dynamic Energy Budget (DEB) theory, are critical for optimal site selection in Mediterranean aquaculture, especially for species like the European seabass¹³⁶. 6. Statistical modelling of fisheries and aquaculture products reveals significant growth and evolving market dynamics in the EU26 (Nwaubani et al., 2020)¹³⁷. 	<p>Advance sustainable aquaculture practices: Transition from conventional aquaculture methods to systems that reduce environmental impact, such as integrated multi-trophic aquaculture (IMTA). This approach uses the waste from one species as feed for another, creating a closed-loop system that enhances water quality, increases biomass production, and contributes to the circular economy, thereby addressing climate change and biodiversity protection¹²⁰.</p> <p>Promote sustainable fisheries and aquaculture practices: Develop and implement guidelines and regulations that ensure the sustainability of fisheries and aquaculture: This could involve training programs for fishers and aquaculturists on sustainable methods, promoting the use of eco-friendly feed and gear, and establishing marine protected areas to conserve critical habitats¹³⁵.</p> <p>Expand sustainable seaweed aquaculture: Support the growth of seaweed farming as a sustainable sector within fisheries and aquaculture, focusing on the development of eco-friendly cultivation methods and market expansion for seaweed-based products, thereby contributing to the BE and ecosystem health¹²⁴.</p> <p>Adopt a functional trait-based approach for aquaculture site selection: Integrate the Dynamic Energy Budget theory into the site selection process for aquaculture operations, focusing on optimizing environmental sustainability and species performance. This could involve collaborative research projects to refine these approaches and develop tools and guidelines for their application in the industry¹³⁶.</p> <p>Utilize statistical modelling for market analysis and strategy development: Apply statistical models to analyse trends and dynamics in the fisheries and aquaculture markets, informing policy development, investment decisions, and strategy formulation for sustainable growth. This action would likely involve the establishment of a data-sharing platform to facilitate access to market data and trends analysis¹³⁷.</p> <p>Integrate small-scale fisheries into local development plans: Recognize and support the role of small-scale fisheries in the Mediterranean by incorporating their needs and potential into broader local development strategies. This could include measures to enhance market access for small-scale fishers, support for sustainable practices, and initiatives</p>
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	<p>7. Small-scale fisheries in the Mediterranean have significant social and economic impacts, and their integration into local development strategies is crucial (Kyvelou & Ierapetritis, 2020)¹³⁸.</p>	<p>to increase their resilience to environmental and economic changes¹³⁸.</p>
Community engagement and Governance	<p>1. The relationship between tourism and economic growth in the Mediterranean region highlights challenges in developing and developed countries and emphasizes the need for sustainable tourism approaches, like 'slow tourism', to preserve natural environments and cultural heritage (Grasso & Schilirò, 2021)¹²².</p> <p>2. Community-based ecotourism supports the sustainable use of marine resources and offers an entry point for low-resource coastal communities to participate in the BE (Phelan, Ruhanen, & Mair, 2020)¹²⁷.</p> <p>3. BE strategy emphasizes connections, innovation, sustainability, and community involvement, underlining the importance of integrating sustainable technologies (Seisdedos & Carrasco, 2020)³⁶.</p> <p>4. Coastal communities are crucial for a sustainable BE, with various risks and opportunities identified for these communities. There is a need for new approaches to ocean governance that better meet the development aspirations of coastal communities while ensuring healthy oceans (Evans et al., 2023)¹²⁹.</p>	<p>Empower community-led coastal management: Facilitate the establishment of governance models that include community participation in the sustainable development of coastal areas. This can involve creating platforms for stakeholder engagement in the planning and implementation of projects, such as marine protected areas (MPAs) or sustainable tourism initiatives, ensuring that the benefits of the BE are equitably shared and contribute to the preservation of cultural and natural heritage¹²².</p> <p>Promote community-based ecotourism initiatives: Foster the development and implementation of ecotourism projects that are managed and operated by local communities, ensuring these initiatives contribute to the conservation of marine resources and provide sustainable livelihood opportunities. This includes providing training and resources to communities, establishing sustainable tourism standards, and facilitating partnerships between local stakeholders and the tourism industry.</p> <p>Implement a blueprint for sustainable port management: Establish policies and practices that highlight sustainability, innovation, and community involvement in port operations. This action entails adopting clean energy solutions, advancing environmental stewardship, and creating partnerships with local stakeholders to ensure that port activities bolster the BE's positive impact³⁶.</p> <p>Develop inclusive ocean governance strategies: Create governance mechanisms that actively involve coastal communities in decision-making processes, addressing their development needs while ensuring ocean health. This involves assessing and mitigating risks to these communities, identifying opportunities for sustainable economic activities, and ensuring that governance models are adaptable and responsive to community aspirations and environmental changes.</p>



4.3. Future Outlook

The future outlook for the ISE in the MED is poised at a pivotal juncture, characterized by the dynamic interplay of emerging trends, challenges, and opportunities. The MED 2050 foresight exercise, with its comprehensive analysis and forward-looking perspectives, underscores climate change as a central and systemic issue, unanimously recognized as a primary driver of transformation within the Mediterranean system. This acknowledgment of climate change's acceleration sets the stage for addressing the environmental, political, and socio-economic shifts that the region faces.

As the Mediterranean navigates the complexities of a rapidly changing environment, the decline in biodiversity and the scarcity of natural resources, particularly water, emerge as critical systemic risks with the potential for irreversible consequences. The foresight exercise highlights the necessity for Mediterranean countries to implement multilateral, sustainable, integrated, and democratic policies. Such strategies are essential to minimize these risks and enhance the region's capacity for adaptation and resilience, ensuring a sustainable transition that aligns with the principles of an ISE.

The sea, with its associated activities, is placed at the heart of considerations, reflecting its integral role in shaping the economic and environmental landscape of the Mediterranean. This focus on maritime dynamics emphasizes the potential for sustainable BE initiatives to drive regional development while preserving marine ecosystems.

Economic and technological developments are identified as significant forces that can either support sustainable policies or pose obstacles to progress. The integration of innovative technologies and sustainable practices presents a unique opportunity to foster economic growth that is environmentally responsible and socially inclusive.

The visions and scenarios developed through the MED 2050 exercise will further elaborate on these themes. These components will lay the groundwork for constructing future scenarios and transition paths, marking the next stages of exploration in 2022 and 2023. These endeavours aim to map out a comprehensive strategy for realizing an ISE in the Mediterranean, balancing economic development with environmental stewardship and social equity (Plan Bleu, 2022)¹³⁹.

Following the comprehensive overview provided by the MED 2050 foresight exercise, the subsequent sections delve deeper into the specific domains critical for realizing an ISE in the Mediterranean. By addressing these areas through the lens of sustainability's core pillars—technological innovation, environmental stewardship, societal shifts, economic development, and governance—we aim to explore the intricate dynamics that will shape the region's path towards resilience and sustainability. These focused discussions are designed to build on the foresight exercise's foundational analysis, providing detailed insights and strategies within each domain to navigate the challenges and leverage the opportunities identified. The sequence of the subsections is deliberately arranged to reflect a logical progression from technological advancements to governance frameworks, illustrating a holistic approach to sustainable development in the Mediterranean.



4.3.1. *Technological Innovation and Digital Transformation*

In the realm of sustainable technologies and practices, the Mediterranean region is poised for significant advancements. While the integration of cutting-edge technologies in agriculture, such as precision farming and smart irrigation systems, holds the promise of enhanced productivity while optimizing resource use, future perspectives may be even more closely related to regenerative agriculture business models and carbon credits. These innovative approaches can not only boost agricultural sustainability but also contribute to carbon sequestration and financial incentives through carbon credits.

Concurrently, a robust expansion in renewable energy sources, especially solar, wind, and marine energies, is set to radically transform the region's energy landscape. However, it is crucial to highlight the importance of recycling batteries and efficiently managing resources to expand these technologies, such as the recovery of silicon for solar panels. Ensuring a circular economy approach in the renewable energy sector will be essential for long-term sustainability.

Additionally, the development and implementation of innovative water management strategies remain crucial, encompassing desalination, water recycling, and the adoption of more efficient irrigation methods. While these strategies can address the persistent challenges of water scarcity in the region, it is important to avoid repetition and emphasize their role in achieving sustainable water resource management.

The trajectory of the MED towards a sustainable future is significantly bolstered by the increasing adoption of digital technologies. [The integration of advanced systems](#) such as Artificial Intelligence (AI), the Internet of Things (IoT), and big data analytics stands as a cornerstone in optimizing resource management and enhancing environmental monitoring. This digital transformation promises to revolutionize various sectors, from agriculture to energy, by [enabling more efficient and precise approaches to sustainability](#). As these technologies evolve, they offer promising avenues for addressing complex environmental challenges and fostering more resilient and sustainable communities in the region (Sadjadi & Fernández, 2023)¹⁴³.

Collectively, these advancements represent a holistic strategy towards achieving a sustainable and resilient future for the Mediterranean region, illustrating the potential of innovative solutions to address environmental challenges and promote sustainability.

4.3.2. *Addressing Climate Change and Environmental Challenges*

In addressing climate change and environmental challenges, the Mediterranean region is strategically emphasizing climate resilience and biodiversity conservation amidst significant societal and economic shifts. The urgent need to fortify resilience against climate impacts, especially in coastal and agricultural zones, and to shift focus towards actively restoring biodiversity underscores the vital role of healthy ecosystems in sustaining life and economic activities. Crucially, there is an urgent need to designate and protect areas that are off-limits to exploitation (Aguilera et al., 2020)¹⁴¹. This imperative action aligns with the broader ISE approach, incorporating SCP and CE principles as central strategies for mitigating climate change and fostering sustainable business models.



The integration of CE and Sustainable Business Models (SBM) plays a crucial role in climate change mitigation within the Mediterranean context, offering insights into the relationship between CE, SBM, and climate change mitigation. This includes benchmarking climate change mitigation policies, identifying key domains for SBM, and emphasizing CE's regenerative role while exploring the social dimensions within these strategies.

The potential of sustainable business models in mitigating climate change is underscored by the necessity for metrics and impact measurement, alongside a sustainable taxonomy. These models not only generate economic value but also foster environmental and social benefits, transforming products and underlying business structures.

However, transitioning to a circular economy presents challenges such as inertia within existing companies, the complexity of funding and insurance options, and the scarcity of inspiring precedents. This highlights the need for a systemic approach, possibly led by green/social entrepreneurship, demanding political choices that prioritize action for substantive transformation (MedWaves, 2023)¹⁴².

Integrating CE principles into climate change mitigation efforts is essential for achieving substantial environmental benefits and emission reductions. This strategic alignment with climate change mitigation efforts highlights the potential for significant environmental benefits, emission reductions, and a socially just transition, ensuring a sustainable future for the region.

4.3.3. *Societal Changes and Economic Shifts*

In the coming years, the MED is set to witness substantial societal and economic transformations, encompassing a broad spectrum of changes. A key factor in this transition is the growing environmental awareness among consumers, which is expected to drive demand for sustainable products and services. This shift towards eco-conscious consumer preferences will not only bolster eco-friendly business practices but also necessitate the support of consumer-oriented policies, such as the EU directive on consumer and corporate disclosure. The GE, with its focus on environmental sustainability, encompasses sectors such as renewable energy, sustainable agriculture, and eco-tourism. It represents a move towards an economy that is in harmony with the environment, creating jobs that contribute to conserving or restoring the ecosystem (Karmoh Sowah Jr. et al., 2021)²².

Simultaneously, there is a burgeoning interest in the BE, which complements and expands the scope of the GE by emphasizing the sustainable use of ocean resources. The BE includes maritime industries like sustainable fishing, aquaculture, and marine biotechnology, all of which aim to promote economic growth, improved livelihoods, and jobs while ensuring the health and sustainability of ocean ecosystems. This aspect of the economy is crucial for the Mediterranean region, given its extensive coastline and reliance on marine resources (Cisneros-Montemayor et al., 2021)¹⁴⁰.

Together, the integration of green and blue economic sectors offers a holistic approach to sustainability. This approach is not only about balancing terrestrial and marine conservation efforts with economic development but also about ensuring that the region's economic landscape is



reshaped in a way that aligns with a deeper societal commitment to sustainability. The synergy between the green and blue economies thus presents a unique opportunity for the MED to lead in sustainable economic practices, setting an example for other regions to follow.

4.3.4. *Policy framework, Collaboration and Education*

Looking ahead, the Mediterranean region is poised to witness a significant strengthening of policy frameworks and collaborations in the context of upcoming events such as the European Commission (EC) elections, the Union for the Mediterranean (UfM) efforts, and the inclusion of the UNEP/MAP Mediterranean Strategy for Sustainable Development (MSSD) revision process, signal a collective movement towards more integrated and sustainable governance. Additionally, the initiative to establish a Blue Deal marks a pivotal shift towards prioritizing the BE, emphasizing the importance of marine and maritime resources in the region's sustainable development agenda. Future policies are anticipated to align more closely with sustainability goals, weaving together environmental, social, and economic considerations in decision-making processes. This enhanced policy alignment aims to foster a more holistic approach to development, ensuring that sustainability is at the core of strategic planning and implementation.

Moreover, cross-border collaborations are set to play a crucial role in effectively addressing transnational challenges. Issues such as climate change, marine conservation, and resource management are inherently interconnected across national boundaries, necessitating a cooperative and coordinated effort. By bolstering these international partnerships, the region can leverage shared expertise, resources, and strategies to tackle these complex challenges more efficiently and effectively. The upcoming EC elections, UfM initiatives, and the Blue Deal represent significant opportunities for the MED region to forge stronger policy frameworks and enhance collaborative efforts in pursuit of a more sustainable and resilient future.

The MED is poised to embrace a transformative shift towards circular economy models across various industries, a move that emphasizes waste reduction, resource efficiency, and sustainable consumption patterns. This evolution in economic models is underpinned by an increased focus on education and training initiatives, which are essential for equipping both current and future generations with the necessary knowledge and skills for sustainable development. Through these educational efforts, individuals and communities will be better prepared to engage with and contribute to the emerging circular economy, fostering a culture of sustainability that supports long-term environmental, economic, and social well-being in the region.

These initiatives are key to bridging identified knowledge gaps, such as the need for specialized strategies in specific supply chains like olive oil production (Stempfle et al., 2021)¹⁴⁴, the development of circular business models, and the integration of social dimensions into circular economy practices. Additionally, understanding the barriers and incentives for business transformation towards circular models, enhancing 'circular literacy' to include political and sociocultural aspects of sustainable development, and leveraging digital technologies for a digital-enabled circular economy are essential areas of focus. By addressing these gaps through targeted educational efforts, individuals and communities in the Mediterranean will be better equipped to engage with and contribute to the emerging circular economy.



Looking ahead, the MED is poised to become a leading example of how diverse economies can transition towards sustainability. By harnessing innovative technologies, strengthening policy frameworks, and fostering collaborative efforts, the region can achieve a sustainable and resilient future, balancing economic growth with environmental stewardship and social well-being.



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