BLUE MISSION MED

Funded by the European Union

D2.2: OPERATIONAL IMPLEMENTATION ROADMAP

Work package	**WP2 Set up the LH**
Task	T2.2. Participative co-creation of the 'Operational Implementation Roadmap' for the LH
Due date	Version1 30/11/2023; Version2 07/07/2024
Submission date	05/07/2024
Deliverable lead	HCMR
Version	06
Authors	Christina Zeri (HCMR), Chrysa Efstratiou (HCMR), Antonia Giannakourou (HCMR), Erasmia Kastanidi (HCMR), Nikos Streftaris (HCMR), Fedra Francocci (CNR), Fabio Fava (CNR) Pablo Abaunza (IEO), Stefania Campogianni (WWF), Claudiane de Corbiac (IFREMER), Mari Carmen Garcia (IEO), Maria Garcies (CPMR), Nicky Guererro (MedCruise), Jordi Juarez (CPMR), Fantina Madricardo (CNR), Ignasi Mateo (MedWaves), Vanessa Moschino (CNR), Carolina Perez (MedCities), Vincent Rigaud (IFREMER), Maria Ruyssen (IFREMER).
Reviewers	Patrizia Busolini (UNEP/MAP), Jann Martinsohn (JRC), Celia Murcia (WestMED), Dimitra Otrhodoxou (Sea2Clear Project), David Poletta (Sea2Clear project), Adiana Salazar (UfM), Alesandra Sensi (UfM), Cecile Rodier (EEA).

Document Revision History

Version	Date	Description of change	List of contributor(s)
01	13/9/2323	Outline	Christina Zeri (HCMR), Fedra Francocci (CNR), Fabio Fava (CNR),
02	30/10/23	Inputs	Christina Zeri (HCMR), Chrysa Efstratiou (HCMR), Antonia

			Giannakourou (HCMR), Erasmia Kastanidi (HCMR), Nikos Streftaris (HCMR,)Fedra Francocci (CNR), Fabio Fava (CNR) Pablo Abaunza (IEO), Stefania Campogianni (WWF), Claudiane de Corbiac (IFREMER), Mari Carmen Garcia (IEO), Maria Garcies (CPMR), Nicky Guererro (MedCruise), Jordi Juarez (CPMR), Fantina Madricardo (CNR), Ignasi Mateo (MedWaves), Vanessa Moschino (CNR), Carolina Perez (MedCities), Vincent Rigaud (IFREMER), Maria Ruyssen (IFREMER), Ezgi Sahin Yucel (METU).
03	7/11/23	Consolidated Draft to reviewers	Patrizia Busolini (UNEP/MAP), Jann Martinsohn (JRC), Celia Murcia (WestMED), Dimitra Otrhodoxou (Sea2Clear Project), David Poletta (Sea2Clear project), Adiana Salazar (UfM), Alesandra Sensi (UfM), Cecile Rodier (EEA).
04	28/11/23	Revised version submitted	
05	15/06/24	Integration of the OIR survey results	Christina Zeri (HCMR), Antonia Giannakourou (HCMR), Chrysa Efstratiou (HCMR), Erasmia Kastanidi (HCMR)
06	03/07/24	FINAL Deliverable for submission	

Authors: Christina Zeri (HCMR), Chrysa Efstratiou (HCMR), Antonia Giannakourou (HCMR), Erasmia Kastanidi (HCMR), Nikos Streftaris (HCMR)

Fedra Francocci (CNR), Fabio Fava (CNR)

Pablo Abaunza (IEO), Stefania Campogianni (WWF), Claudiane de Corbiac (IFREMER), Mari Carmen Garcia (IEO), Maria Garcies (CPMR), Nicky Guererro (MedCruise), Jordi Juarez (CPMR), Fantina Madricardo (CNR), Ignasi Mateo (MedWaves), Vanessa Moschino (CNR), Carolina Perez (MedCities), Vincent Rigaud (IFREMER), Maria Ruyssen (IFREMER), Ezgi Sahin Yucel (METU).

Reviewers: Patrizia Busolini (UNEP/MAP), Jann Martinsohn (JRC), Celia Murcia (WestMED), Dimitra Otrhodoxou (Sea2Clear Project), David Poletta (Sea2Clear project), Adiana Salazar (UfM), Alessandra Sensi (UfM), Cecile Rodier (EEA).

Disclaimer

List of abbreviations

AIR Centre	Atlantic International Research Centre
ALDFG	Abandoned, Lost and otherwise Discarded Fishing Gear
ASPAPLAST	Asociatia Patronala a Prelucratorilor de Mase Plastice
BUSINESSMED	Union of Mediterranean Confederations of Enterprises.
CEPESCA	Confederación Española de Pesca
EN.I.R.I.S.S.T	Intelligent Research Infrastructure for Shipping, Supply Chain, Transport and Logistics
ENI-CBC	Cross-Border Cooperation (CBC) initiative under the European Neighbourhood Instrument (ENI).
EUROCORD	European Association of Rope, Twine and Netting manufacturers
EUROSTAT	European Statistical Office
EUSAIR	EU Strategy for the Adriatic-Ionian Region
FADN	Farm Accountancy Data Network
FAO	Food and Agriculture Organisation
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
GHG	Greenhouse Gas
GPA	Global Partnership for Marine Litter
HELMEPA	Hellenic Marine Environment Protection Association;
HoReCa	Hospitality Industry (Hotel / Restaurant / Café)
MAP	Mediterranean Action Plan
MESRI	French Ministry of Higher Education, Research and Innovation
MSFD	Marine Strategy Framework Directive
OFB	French Office for Biodiversity
REMPEC	Regional Marine Pollution Emergency Response Centre ()
SDG	Sustainable Development Goals
SDG4MED	Sustainable Development Goals for the Mediterranean
SUP	Single Use Plastics
UfM	Union for the Mediterranean
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization

List of Figures

List of Tables

List of Boxes

BlueMissionMed in a nutshell

The Mission Restore our Oceans and Waters by 2030 provides a holistic and coherent framework for developing a systemic approach to the depollution and regeneration of the basin hydrosphere, which is a striking need in the Mediterranean Sea (MED). In the BlueMissionMed project, a multi-actor, trans-sectorial and multidisciplinary consortium, consisting of 6 R&I public institutions, 5 NGOs, 3 industrial associations and 2 SMEs from 5 MS and 2 AC of the MED, will set up, structure and empower a MED Lighthouse supporting the development and deployment of transformative innovative technological, social, business and governance solutions for ensuring a 30-50% reduction of pollution of the basin hydrosphere by 2030. It will be an interactive multi-actors digital platform able to offer to all MED Countries/Regions and stakeholders access to the necessary knowledge and tools. It will build on, connect and structure existing initiatives and activities, including the 9 Pilot BLUEMED on plastics free healthy MED and will exploit the R&I and policy knowledge generated by the funded projects/initiatives on the MED decontamination and restoration, ultimately promoting basin-wide cooperation, commitment and deployment of solutions addressing the Mission objectives. The Lighthouse will also ensure i) coherence, alignment and monitoring of EU, national and local policies, initiatives and actions ongoing in the MED basin; ii) an effective provision of technical services, governance and business models to support and guarantee a sustainable socio-economic development of the basin; iii) a well-functioning basin scale innovation ecosystem attractive towards investors and businesses, iv) the required engagement of the society at large, thanks to a robust awareness raising and citizen science approach in its implementation in the sea basin and beyond, and, thus, v) the effective deployment of Mission Implementation Charter and piloting of the Mission objectives for the MED by 2025.

TABLE OF CONTENTS

1. INTRODUCTION

The Mediterranean people share not only a common heritage, culture and lifestyle but also common environmental and climate risks and impacts, such as urbanization of coastal areas, water scarcity, forest fires, coastal erosion and increasing tourism pressure. Despite these commonalities, the region faces some of the highest disparities globally in relation to demographic expansion, political stability, economic growth, access to natural resources and environmental protection (UNEP/MAP and PlanBleu, 2020). A recent study by the Sustainable Development Solution Network-SDSN (Sachs et al. 2019) has shown that the region as a whole demonstrates slow rates in achieving the UN SDGs and suggests that these will not be met by 2030 by the Mediterranean countries. In particular the SDG14: 'Conserve and sustainably use the oceans, seas and marine resources for sustainable development' is not met by any Mediterranean country. On the regional level, UNEP/MAP has developed the Mediterranean Strategy for Sustainable Development (MSSD) | UNEPMAP 2016/2025 which provides a unique and integrative policy framework and action plan for multi-level and multi sector stakeholders, to translate the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs) at the regional, sub-regional, national and local levels. The implementation of the MSSD is guided by the work of the Mediterranean Commission on Sustainable Development (MCSD) and it focuses 6 priorities: 1. sustainable development in marine and coastal areas; 2. Promoting resource management, food production and food security through sustainable forms of rural development; 3. Planning and managing sustainable Mediterranean cities. 4. Addressing climate change as a priority issue for the Mediterranean; 5. Transition towards a green and blue economy; 6. Improving governance in support of sustainable development. Another regional structured framework has been developed by the Union for the Mediterranean (UfM), the '2030GreenerMed'. The 2030GreenerMed is based on the coordination of regional initiatives, programmes, and projects and creates political and operational convergence to accelerate the transition of the Mediterranean region towards a green, circular and inclusive economy, preventing pollution on land, air and sea as well as protecting, preserving and restoring natural resources.

In this context, the European Mission Restore our Oceans and Waters by 2030 provides a holistic and coherent framework for developing a systemic approach to the depollution and regeneration of the hydrosphere, while its Lighthouse H2020-MISSION programme for the Mediterranean area provides an opportunity to address the specific challenges for the Region. The EU Mission 'Restore our Ocean and Waters by 2030' and the launch of its Mediterranean Lighthouse has already been adopted by the WestMED Ministerial Declaration in Malta 23rd June 2023. This declaration highlights the link between the WestMED Initiative and various European initiatives, including the Mission Ocean, and the Mediterranean Lighthouse. On this topic, the Declaration prioritizes stepping up efforts to tackle air and marine pollution, with a specific focus on marine litter, including macro and micro plastics. https://westmed-initiative.ec.europa.eu/publications/#official-documents. According to Mazzucato (2018) a mission-oriented innovation policy framework is a strategic framework for action – to give a long-term orientation to innovation support. Mission strategies and related roadmaps have a potential to improve the coherence of innovation policies, and to

create synergies between public, private and civil society initiatives and investments in high-impact mission-oriented innovations for the SDGs.

BlueMissionMed project aims to set up, structure and empower the Mediterranean Lighthouse area by supporting the development and deployment of transformative innovative technological, social, business and governance solutions for ensuring a 30-50% reduction of pollution of the basin hydrosphere by 2030. The present Operational Implementation Roadmap aims to serve as a planning and management tool – a compass- for achieving the Mission targets by 2030 in the Mediterranean Region. This involves a co-design process with key actors/stakeholders of the region to define a common vision and strategic priorities. The process includes the inter-relation of the technological/scientific, policy, economic and social ontology domains of the BMM project.

1.1. EU Missions- Objectives

The overarching objective of the Mission is to restore the health of the EU's Ocean and Waters by 2030 by reaching the European Green Deal targets for biodiversity, zero pollution and decarbonisation with greenhouse gas emissions reduction for 2030, across the ocean, seas and waters, thereby addressing the three principal drivers of degradation.

Specific objectives to be met by 2030 are:

Protect and restore marine and freshwater ecosystems and biodiversity, in line with the EU Biodiversity Strategy 2030

Prevent and eliminate pollution of our ocean, seas and waters, in line with the EU Action Plan Towards Zero Pollution for Air, Water and Soil.

Make the sustainable blue economy carbon-neutral and circular, in line with the proposed European Climate Law and the holistic vision enshrined in the Sustainable Blue Economy Strategy.

BlueMissionMed Lighthouse project deals with the Mission Objective 2 for zero pollution in the Mediterranean Sea basin, by addressing the 3 specific targets set by the Mission:

a. Reduce by at least 50% plastic litter at sea.

b. Reduce by at least 30% microplastics released into the environment.

c. Reduce by at least 50% nutrient losses, the use and risk of chemical pesticides.

1.2. The scope of the OIR

This document outlines a vision and roadmap for the strategic transformation of key sectors in order to reach the Mission 2 Objective in the Mediterranean basin for the 2023-2030 period. In recognizing that these are complex, wicked problems, BlueMissionMed adopts a systemic approach and the OIR goes beyond the single sectorial needs considering challenges, opportunities, and actors influencing the broader Mission

objectives. The OIR seeks to provide strategic planning for sectors agriculture, aquaculture, fisheries, tourism, transport and ports, wastewater and solid waste management in cities/regions and the plastic industry, with respect to the needs of the sectors for design and implementation of sectorial development strategies for achieving the Mission goals, taking into consideration all four domains of the BMM ontology (technological/scientific, policy, economic, social).

Specifically, the document provides a basis for the development of basin Strategic Plan for Sectorial Operational Program in line with the programming requirements established for the next EU budget period for the Mission (2025-2030). The 2020-2030 period covered by the vision and roadmap presented in this document has been defined to encompass both the next EU Mission budget period as well as others to follow.

The document incorporates inputs generated by sector, territorial, national, and EU strategic planning processes currently underway in the area. It integrates the outcomes of the extensive diagnostic work and stakeholder consultations regarding sector-specific challenges, drivers, priorities, needs, and potential interventions, in line with the Mission framework activities. In addition, the document considers the strategic directions and planning framework laid down in the most recent legislative proposals presented by the European Commission and the Barcelona Convention.

On the project level and during the course of the lifetime of the BMM, the present OIR will serve as a guide for the work undertaken under workpackage 3 (WP3) and workpackage 4 (WP4). In WP3 detailed solutions already in place and developed within EU funded projects and other International, Regional or national instruments will be investigated, and those better responding to the present OIR actions will be selected (Del. 3.3 & 3.4) for further upscaling in businesses under WP4 to drive systemic transformative changes (technological, social, business, governance) (Del. 4.3).

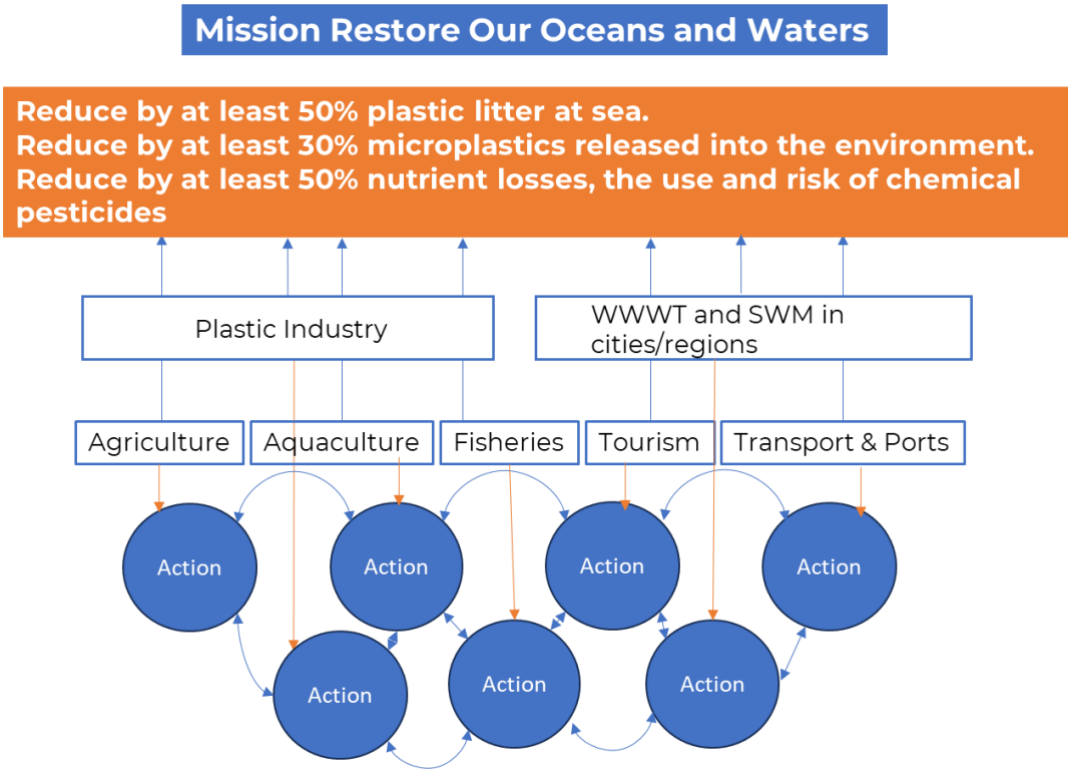


Figure 1-1 *The relationships of Mission overarching challenge, targets and sectors' response actions (adapted from Mazzucato, 2018).*

1.3 Synergies with other Initiatives and Actions for the Mediterranean Region.

In parallel to the work of the BlueMissionMed project, other Initiatives related to the EU Mission 'Restore our Oceans and Waters' are currently on going in the Mediterranean region. BlueMissionMed project will seek synergies with at least three of them namely the implementation process of the UNEP/MAP Mediterranean Strategy for Sustainable Development (MSSD), the UfM 2030GreenerMed and the activities of the EU WestMED Initiative.

A mutually beneficial cooperation between UNEP/MAP and BlueMissionMed is identified under the following specific actions:

-Engagement of the UNEP/MAP and BlueMissionMed project in the revision process of the present OIR and MSSD respectively. Considering the possibilities to jointly support and organize some of the MSSD renewal consultation events/workshops.

- Exchange information and identify concrete actions for the enhancement and replication/transfer of best practices with the MSSD flagship projects;

-Organise outreach actions towards South Mediterranean stakeholders, thus equally contributing to EU enlargement policy, especially on environment related chapters and green transition. These may include technical and policy regional events/capitalization/outreach/science to policy and foresight actions taking advantage of the MSSD dashboard which is regularly populated and updated with a living set of dedicated indicators, linked to SDG Indicators, to the monitoring of the MSSD implementation.

MED 2050 initiative whose objective is to confront several visions of the future of the Mediterranean in 2050 and to co-construct solid and realistic transition paths towards common objectives of sustainable development.

In addition, UNEP/MAP could support BlueMissionMed to liaise with thematic regional cooperation frameworks covering the whole Mediterranean region, namely the UNEP/MAP Thematic Regional Plans, developed in the framework of the Art 15 of the Land-Based Sources (LBS) Protocol such as the Regional Plan on Marine Litter Management whose implementation is supported, since 2016, by the EC and concretely provides assistance to the South Mediterranean Contracting Parties to the Barcelona Convention; the Regional Plan on Aquaculture Management and Regional Plan on Agriculture Management that will be submitted for endorsement to the COP 23 early December 2023 and whose objectives are supported also by the GEF financed MED Programme, under UNEP/MAP coordination.

Essential opportunities exist for reinforced synergies between the UfM 2030GreenerMed and BlueMissionMed, coordinated and complementary actions and for the convergence of technical and financial resources at regional/Mediterranean level. Cross-border and cross-sector approaches as well as linking local experience with decision making processes at national, regional, and international level are embedded in the overall mechanisms of cooperation. Sector specific synergies are identified between the present OIR and UfM's Sustainable Blue Economy Roadmap, which are described below in the sectors' chapters.

The WestMED Initiative is part of the Steering Committee of the BMM project. This collaboration is formulated with the implementation of concrete joint actions, primary with the participation of both projects in the respective Steering Committees and the Governance Bodies.

On the region level, organization of joint and/or back-to-back events on the dissemination and promotion, co-organisation of dedicated sessions, support on the proposal of topics and speakers, sponsorship etc. is very important to increase the impact of the event, allow higher networking among different sectors and improve the dissemination and awareness of the activities. For this purpose a shared and regularly updated calendar is recommended. Similarly on the National/local level connections will be established among the National Hubs developed within the framework of both Initiatives.

Finally, on the sector specific level it is foreseen that the BlueMissionMed project will establish regular communication with two Technical Groups (TG) of the WestMED. The AquaWest TG which focuses on aquaculture and in particular on creating permanent synergies between north and south shores of the Mediterranean in terms of creating a

platform to share information, to facilitate policy development but also to provide capacity building and knowledge exchange among the countries. The TG on Green Shipping and Ports, which is engaged and has provided support to several projects and ideas funded under the EMFAF Flagship related to Linking Ports, Industries, Investment and Innovation for Monitoring and Technology on Green Shipping in the Mediterranean as well as on the carbon neutrality in maritime transport, including fishing boats, commercial vessels and marinas.

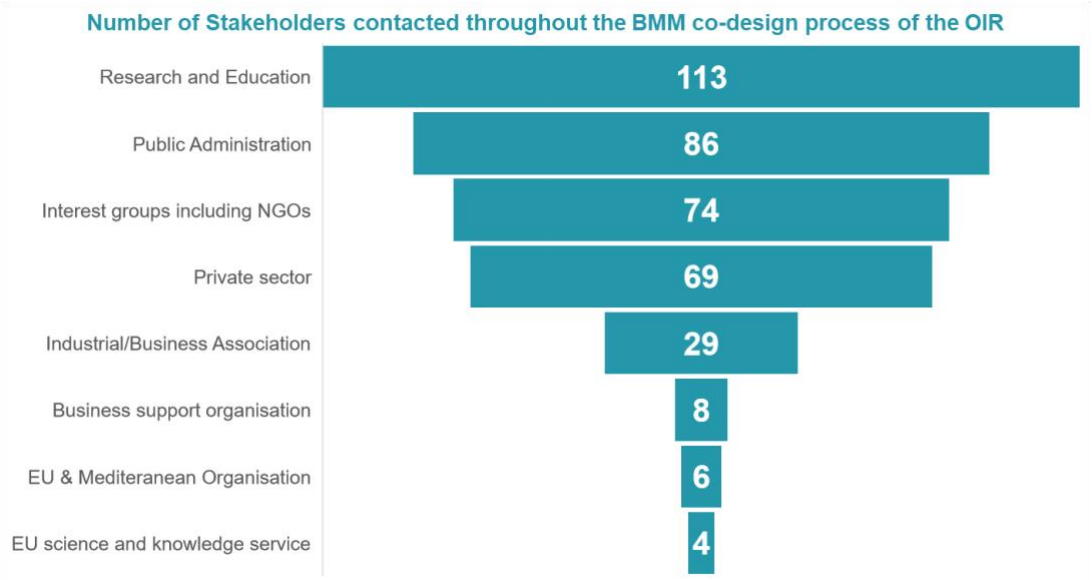
2. THE CO-DESIGN PROCESS ENGAGEMENT OF MULTI-STAKEHOLDERS IN THE MED LEVEL

A participative approach was followed for the co-design of the OIR in a two-stage process. Following the project's work programme a multi-stakeholder pool including public and private actors, civil society, academia and high -level policy makers was first identified. In total **382 individuals- stakeholders**- representing the aforementioned dimensions were engaged in the co-design process. During the first stage, a thorough consultation was organised including interaction with stakeholders through open events, online sectorial workshops and targeted interviews with key actors. Following a bottom-up approach, the initial interaction aimed to identify more broadly the governing ideas in each sector, subsequently focusing on details and thorough understanding of needs and vision by targeting key actors, in order to identify the leverage points of intervention aiming to more successful systemic changes. The OIR was communicated to higher level stakeholders, such as the governing bodies (**UfM, UNEP/MAP, EUSAIR, WESTMED, BLUEMED GSOs, JRC, EEA, IAEA, ESA**) of the BMM project during a dedicated 'compass workshop' for their revision in terms of alignment with EU and Regional strategies and priorities. This stage has led to the identification of priority actions in the Mediterranean basin needed for achieving the Mission Resrore our Oceans and Waters targets.

During the second stage, **a survey** was developed (Annex II) targeting mostly Mediterranean stakeholders engaged in **the 7 BMM national HUBs**. The survey gathered insights on the maturity of priority actions/solutions proposed to mitigate marine pollution in the Mediterranean. The survey was structured around the priorities and next steps identified for each sector during the first stage of the process, which the respondents were asked to classify according a 5-scale maturity level (Very mature, Rather mature, Neither mature or immature, Rather immature, Very immature).

Over the course of a month, the survey was disseminated in local languages via the BMM 7 national HUBs and BlueMissionMed communication channels. Out of **123 respondents**, significant contributions came from BlueMissionMed countries, with additional input from Slovenia, Croatia, and Morocco (5.2%), as well as from non-Med countries including Denmark, the Netherlands, Ireland, Germany, Canada, and Belgium (5.4%); while 6% of participants preferred not to disclose their country of origin. The country-wise participation was: Spain (18%), Greece (17%), Malta (15%), Tunisia (14%), Italy (10%), France (6%), Turkey (3%) and other countries (18%). Respondents represented sectors such as wastewater treatment and solid waste management (36%), ports and

transport (17%), plastic industry (16 %), agriculture (13%), aquaculture (13%), fisheries (13%), and tourism (9%). Participation included stakeholders from various domains: research and education (26%), public administration (16%), environmental organizations (11%), and others. Overall, the respondents covered many Mediterranean countries and sectors. **However, the fact that the survey was structured by sector, the sector specific number of respondents was marginal for obtaining robust results regarding the maturity level of the solutions in most cases, except the WWTP-SWM in cities & regions and the plastics industry sectors which were represented by a higher number of respondents (37 and 20 respectively)** (Figure 1-2 (b)).



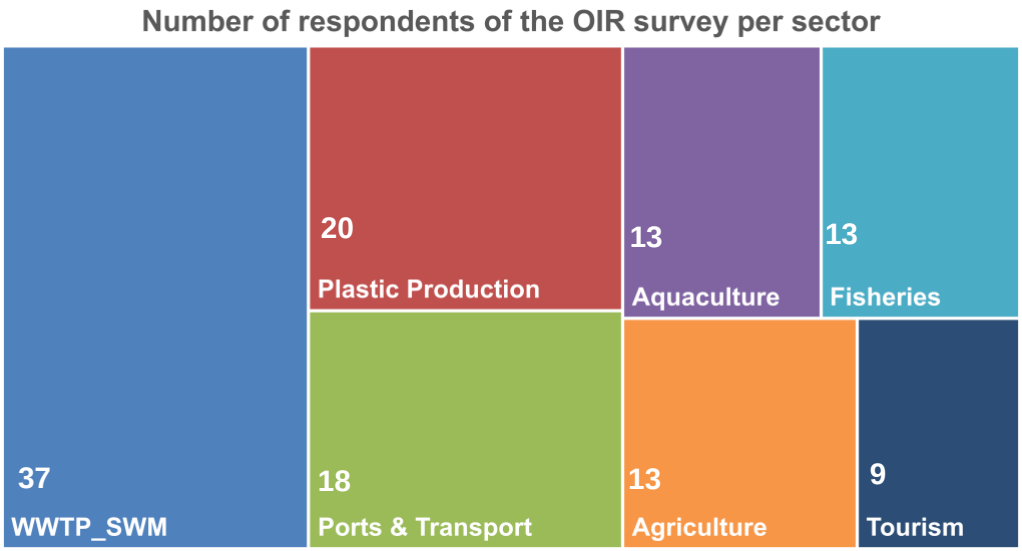


Figure 2-1 (a) The number and type of stakeholders engaged in the process of co-designing the OIR; (b) The number of the respondents per sector, of the BMM survey on the maturity of the OIR priority actions.

Concerning the endorsement of the Mission Ocean Charter, 36% affirmed their support, 12% were in the process of endorsement, while 52% had not yet endorsed it.

During the first stage of the process the main challenges and actions needed were collected by targeted Mediterranean stakeholders and were further refined by the BMM partners taking into consideration the alignment with EU and Mediterranean strategies as highlighted by the high-level governing bodies of the BMM. This process has crystalized the integrated priorities and next steps needed for each sector. During the second stage, the priorities were communicated to the 7 BMM national hubs in order to obtain their views on the maturity level and in an attempt for further prioritization in due course. In addition, the survey seeks to get insights on the domains (governance, financial, technological, societal) for which more efforts are needed towards implementation. All this information is integrated in Chapter 4 (Tables 4 -2, -4, -6, -8, -10, -12, -14).

Details on the methodology are included in Annex I.

3. HOW TO REACH THE MISSION OBJECTIVES TOWARD ZERO POLLUTION

The document addresses challenges and actions for pollution prevention, minimization, elimination and remediation as well as monitoring and control by analysing the technological, policy, business and societal needs and opportunities for achieving the Mission targets. **Prevention** of pollution confronts the problem at its source, requires thinking change, economy transition, business transformation and has the highest position in the hierarchy of innovation and is the most challenging way forward. **Minimization** of pollutants before entering the environment is the most widely adopted approach for decades, it requires innovation for keeping pace with emerging new types of pollution but does not lead to a system's change. **Eliminating** pollutants already in the environment and **remediating** natural spaces is challenging and requires innovation, yet it represents an ultimate way to tackle environmental pollution problems. All three levels of actions against pollution are needed and should be considered as complementary to each other. **Monitoring and control** is related to the acquisition and establishment of reliable baseline data on the stocks, flows, pathways, hotspots and time-dependent trends of different pollutants in different environmental compartments.

During the process of the co-design of the BMM OIR the challenges, actions and specific priority domains for next steps are identified for each sector separately. **Monitoring was identified by almost all sectors as a need for data acquisition on resources and generated wastes** throughout the value or service chain to better understand the points for interventions and accelerate the sector's performance to reach its zero pollution goals. In this respect **environmental monitoring is considered a cross-cutting activity** that relates all sectors' performance to the environmental status.

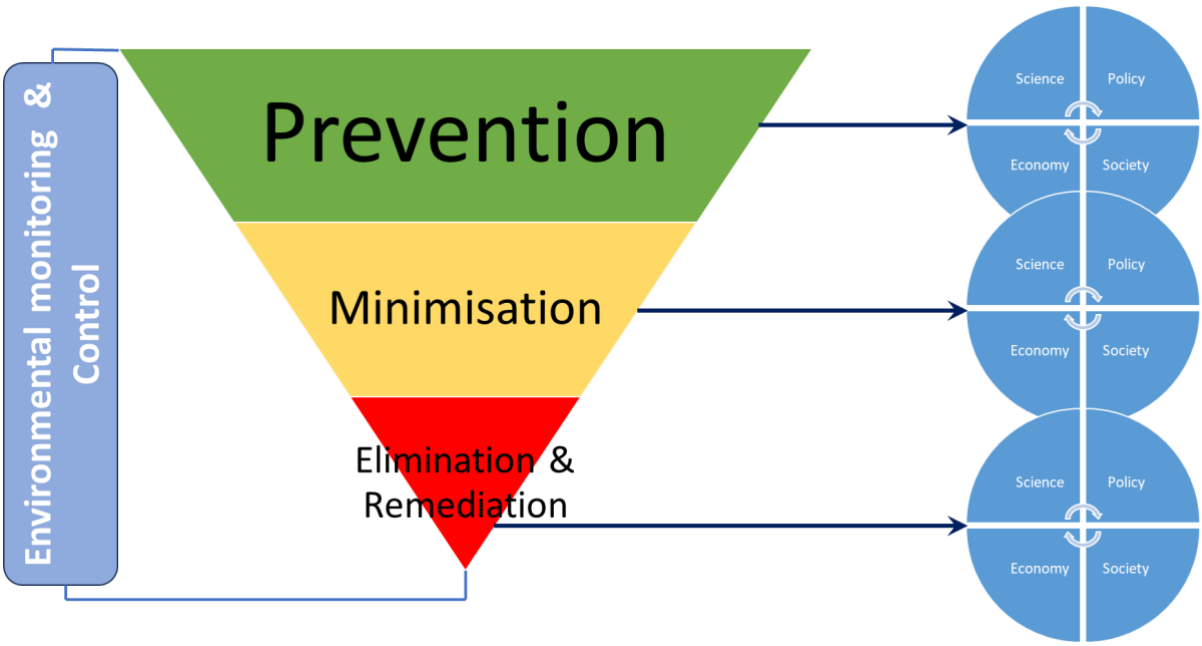


Figure 3-1 *The hierarchy of innovation actions and their relationship to the four ontology domains of the BMM project. Environmental Monitoring and is considered a cross-cutting action.*

Box 2 **Environmental monitoring and control**

Environmental monitoring of contaminants is crucial for the assessment of pollution status and environmental risk and also for underpinning measures and actions for prevention, minimisation, elimination & remediation of pollution. In other words, monitoring aquatic pollution is a way for measuring progress towards the Mission targets. On the Mediterranean level, the importance of cooperation between EU and non-EU countries for achieving the Mission targets is highlighted (JRC, 2022). National monitoring programmes of the aquatic environment stem from the Barcelona Convention and the implementation of two EU Framework Directives, the WFD and the MSFD. These are long lasting monitoring programmes in principle, harmonised and complementary to each other. Yet, results highlight a lack in compatibility during their implementation phases and major gaps are identified in terms of contaminants and matrices monitored, due to different capacities among the Mediterranean laboratories. Data acquisition, compilation, validation and harmonization is not ensured on a regular basis across the Mediterranean countries and differences exist in the interoperability of data centres such as the EMODNET and UNEP Info/RAC. Establishing and agreeing on contaminants thresholds seems to be a slow process that requires resources, harmonized and comparable analytical data and targeted experiments. It is also desirable to link monitoring programmes between the marine and the freshwater environments (EEA, 2022). Until now most national monitoring programmes deal with legacy pollutants and macro-plastics. Microplastics, are covered to a lesser extent while emerging contaminants are not yet included.

Modern monitoring tools based on state-of-the art approaches, need to be taken advantage of for a more accurate information on pollution (JRC, 2022). Some are listed below.

- Remote sensing
- Augmented observatories (low cost monitoring e.g. buoys)
- In situ sensors development incl. CoECs
- Drones
- eDNA
- Take advantage of New smart technologies (IoT, AI)
- Digital Twin Ocean
- Web based interface for end users
- Indicator based standardized monitoring

What has been identified as an important need for future monitoring activities, is the expansion of monitoring in such a way that specific sources of contaminants, i.e. sector specific, can be determined and their contribution to pollution can be assessed. In this way the efficacy of the adopted solutions on minimizing the sectors' pollution fingerprint will be made possible. This kind of activities need close collaboration between the economic sectors and scientific organisations so as to link environmental monitoring data with those related to materials flows within each sector. It is expected that such monitoring approach may increase businesses accountability and transparency of their environmental fingerprint which may also lead to a behavioural change by the consumers (JRC, 2022).

4. THE SECTORS

4.1 Agriculture

Mediterranean countries are estimated to have around 246 million hectares of agricultural land, that is 28% of the total land shared is allocated to different farming activities, ranging from only 4% of the land in Egypt to 76% in Syria (Mrabet et al., 2020, Atlas Mediterra). Agriculture is an important sector in the Mediterranean, as an important contributor to global food security, and for many products the Mediterranean is a chief global producer. These products include olive oil, and table olives; grapes and wine; vegetables such as apricots, almonds, figs, dates, strawberries, hazelnuts, clementines, beans and tomatoes. During the last decades the area experiences intensive urbanisation of the coastal areas that is detrimental to agriculture, as it replaces most fertile lands. (Burak et al, 2004; Smiraglia et al, 2023; Lagarias and Stratigea, 2023). Consequently, a steady decline of ~2 % per year in employment and productivity in almost all Mediterranean countries is observed (SoED). For some of the northern countries however, where agricultural modernization policies and technical innovations are being applied there is an increase in the productivity per worker, sustaining economic disparities within the region. For example, in France productivity of labour in the sector is ~52,000 USD per worker and in Morocco ~3,000 USD per worker (SoED).

Throughout the Region, diverse farm structures and agro-management strategies are practiced. In the EU and non-EU Mediterranean there are predominantly small family farms whereas in the North and West (Italy, France and Spain) small farms are marginal and agricultural land is highly concentrated (Mediterra Atlas). The use of agrochemicals (fertilisers and pesticides) and extensive irrigation schemes increase the productivity of farming systems in the short term yet producing environmental deterioration in both the soil and the aquatic environments. More than 60% of the farms in Cyprus and 40% of the farms in Greece are characterised as being of low input intensity, whereas in Spain and France 40% and 36% of the farms respectively, are characterised as high input intensity (EUROSTAT DATA 2019, Farm Accountancy Data Network (FADN)). Despite the presence of small farms in non-EU Mediterranean, data for 2021 fertiliser consumption per hectare in the Mediterranean region is higher in Egypt, Lebanon and Slovenia, in Algeria, Libya and Syria (FAO). Increased consumption of fertilisers could be attributed to direct fertiliser subsidies, that are in place in many of these countries (Kurdi et al, 2020). The northern Mediterranean countries rank in the middle of the list with consumptions ranging between 130 to 220 kilos per hectare, which could be related to the regulated policies implemented in these countries.

In addition to agrochemicals, the agrifood value chain (from production to consumption) uses immense amounts of plastics. Estimates from FAO reveal that globally this reaches 12.5 million tonnes of plastic materials. Most common plastic uses in the agriculture sector are mulch films and irrigation tubes; greenhouse films and nets; protective textiles; protective coverings i.e. bags, sheaths and nets; silage films; packaging bags, sacks and bottles for liquids. Plastic packaging materials are also being used to improve food security and maintain hygiene standards, whilst reducing food waste.

The different crops and farm management practices in the Mediterranean have created a mosaic of diverse agroecosystems interacting with the natural systems in the provision

of ecosystem services. Any effort in increasing the sustainability of the sector in line with the Mission Ocean and Soil Mission objectives needs to take into account this diversity and identify place-based solutions for plastic and chemical reduction in agriculture.

Environmental impact of the sector

Mission Ocean and Waters has set 3 main targets with regards to pollution which can be summarised in a 50% reduction of nutrients and chemical pesticides, a 50% reduction of plastics and a 30% reduction of microplastics in the marine environment by 2050. Agricultural activities are significant contributors of nutrients and chemical pesticides that reach the aquatic environment through soil leaching. In addition, agricultural activities contribute to the problem of plastic pollution in the marine environment, as plastic items are being used in different phases of the production process. These plastics are often badly managed or decompose due to sun exposure and turn into microplastics, polluting the soil and the aquatic environments.

Soil quality is the most critical component for achieving sustainable agricultural practices. As soil quality decreases, due to chronic misuse of chemical fertilizers, intensive management practices and salinization phenomena, the need for adding more chemicals to overcome the soil quality deterioration and support farm productivity increases (Zalidis et al, 2002). As a result, farmers enter in a never-ending negative loop of supply and demand. Besides soil, water quality is also impacted by the extensive application of agrochemicals at farm level and subsequent nutrient and pesticide leaching into the aquatic environments.

Although the Mediterranean is an oligotrophic environment several eutrophication hotspots exist at the mouth of large rivers, where agricultural activities are intensified in the respective catchments. A study published in 2019 shows that during 2003–2007, 1.87 Tg/y of total nitrogen (TN), 1.22 Tg/y of nitrates (N-NO3), 0.11 Tg/y of total phosphorus (TP) and 0.03 Tg/y of orthophosphate (P-PO4) were discharged in the Mediterranean Sea (Malago et al, 2019) and agriculture was the main contributor to total nitrogen and nitrate loads while for orthophosphate the dominant sources included wastewater and scattered dwellings. These inputs are causing eutrophication phenomena mainly in the Gulf of Lions, the Northern Adriatic and Aegean Seas and at some South Levantine areas (Karydis and Kitsiou, 2012), linked to estuaries and outlets of the Rivers Ebro, Rhone, Po, Axios/Vardar, Evros/Marica and the Nile.

In addition to fertilisers, agricultural production relies on high volumes of chemical pesticides to maintain crop yields, which, like nutrients, leach into the marine environment. Although, pesticide sales in all European countries had been on a downward trend up until 2020 (EUROSTAT data), between 2020 and 2021- there has been an increase of 2.7% in the volume of pesticides sold in the EU. Three Mediterranean countries (Spain, France and Italy) have reported the highest selling volumes among all EU countries. This increase in pesticide use could be linked to global increase of plant pathogens, associated with climate change (Singh, B. K., et al, 2023). In the aquatic environments pesticides are highly toxic to aquatic insects and other arthropods (Palma et al, 2021, Melendez-Pastor et al., 2021). Data from the EU monitoring activities reveal that 10% to 25% of all surface water monitoring sites and between 4% and 11% of groundwater monitoring sites, one or more pesticides has been detected to be above the threshold levels each year between 2013 and 2020. For the EU Mediterranean

countries this percentage for the surface water bodies ranges from 38% in Italy to 2% Cyprus.

The different agri-plastic applications (covers and films, netting and twine, irrigation systems, receptacles, bags and containers) have been useful to reduce the application of fertilisers and pesticides but at the same time the different types of plastic products can end up as waste in the environment when they finish their life-cycle, contributing also to microplastic generation. Their life span ranges between 2 (for polymer coated fertilisers) to 60 months (for tree guards) however, the majority of them are single use products, and have a life span of less than 1 year (FAO, 2021). No clear data are available on the tonnes of usage for each of the applications, at Mediterranean level, nor about quantity of waste generated and their final treatment. European Union estimates for 2018 report approximately 1.74 million tonnes of plastic used in the agricultural sector3. Out of these approximately 1 million tonnes are estimated to have been used for packaging purposes. Out of those used for non-packaging, it is estimated that 63% are films used for silage and mulch, 16% in greenhouses, 11% for twines and 6% for irrigation equipment (APE Europe 2019). The total plastic usage in the agricultural sector accounts for an estimate of 3 to 4 % of the total European plastic converter demand of 51.2 million tonnes according to Plastics Europe (2019). Agriculture-related litter is found on Mediterranean beaches, yet a direct source appointment cannot be made since many of the items found can be misinterpreted with construction materials (i.e. irrigation tubes, industrial plastic sheets). Five categories of identifiable items are included in the MSFD guidelines for monitoring of marine litter in the European Seas (Fleet et al., 2021), namely, plastic sheeting from greenhouses; plastic irrigation pipes; other plastic items from agriculture; plastic flowerpots; trays for seedlings of foamed plastic. Quantitative data on the contribution of agri-plastics to the overall marine litter problem are still not available for the EU countries, let alone for the Mediterranean region as a whole. As most of the agri-plastics are used outdoors their fast fragmentation into small particles and microplastics either during or after their lifetime is expected. This could be one of the reasons explaining the difficulties in identifying their sources from marine litter data. In addition, fragments and microplastics originating from the various types of plastic films and sheets may stay in the soil environment for long periods.

Gap analysis to determine how to achieve transformation of the sector

Agricultural activities in the EU Mediterranean countries have been developed as an outcome of the Common Agricultural Policy (CAP), which has had in its core to increase the productivity of the sector. This has resulted in a series of subsidy policies, through which farmers have been supported, and could sell their product in guaranteed prices. These types of subsidies have been the motivation for farmers to increase their productivity using fertilisers and intensive irrigation schemes. For example, although the CAP has identified the need to support environmentally friendly farming practices since 1999, fertilisers for increasing productivity are still being subsidised for several products (EC, 2022). Overall, the agricultural sector accounts for 35% of all subsidies that have been characterised as Environmentally Harmful Subsidies (EC, 2022). Many of the countries of the MENA region, have also adopted policies in support of an increase in agricultural production, and have increased their use of fertilisers, pesticides and other agricultural chemicals (Albanito et al., 2017).

The European Green Deal and its Farm to Fork, Biodiversity, and Soil strategy, provide clear policy objectives and targets to de-intensify production systems, making them less dependent on external inputs (Buckwell et al., 2022). Since their publication in 2019 and 2020, respectively there has been a significant change in the discourse supporting regeneration and reuse of products in the frame of a circular economy and an increase support to agricultural practices that protect and support ecosystem services. The more recent CAP reform, for the period 2023 -27, aims to help the sustainability transition needed to reach the Green Deal targets and strengthen the efforts of European farmers to tackle climate change and protect the environment. As a result, there is a transformation of much of the subsidies which are now being allocated to climate-relevant activities. In addition, a support is also provided for conversion and maintenance of organic farming to reduce the need for chemical fertilisers; the creation of buffer strips with management practices with and without pesticides; mechanical weed control; and increase the use of resilient pest resistant crop varieties. Although these are all important actions, they are more easily applied to large farmlands, as for example buffer strips are not easily applied to the many small farms found around the Mediterranean, and if transformation to sustainable agriculture is to be successful, smallholders must have access to the support for such eco-schemes (Viegas et al., 2023).

There is a continuous effort to directly tackle the most pressing issues of nutrients application at the farm level. Past and present EU policies have proven to be inadequate for the management of nutrients like nitrogen and phosphorus. To guide nutrient management action plans EU targets an integrated nutrient directive that regulates the combined agricultural use of nitrogen and phosphorus and goes beyond the current, inadequate regulations by taking into account nutrient balances and accounting for regional differences. These include measures adopted at different intervention points of the N and P cycles and range from technical measures for recovering and recycling nutrients in waste streams and improving nutrient use efficiency in agriculture, to policy measures at the EU level and to broad societal changes, such as changes in the human diet and the agricultural system (food production-consumption system). Relevant models suggest that the effect of different nutrient reduction measures on N and P losses to freshwater and sea, could reduce the nutrients load to the European seas by 32% for N and 17% for P (JRC, 2022).

In many of the non-EU Mediterranean countries the ability to increase agricultural productivity remains an objective, but at the same time there are efforts to maintain the quality of the soil and prevent water and soil pollution. Many countries (Egypt, Lebanon, Libya, Tunisia) have developed national agricultural strategies and specialised policies aiming to increase the sustainability of the sector and encourage environmentally friendly practices among farmers, such as crop rotation and water management, organic farming and antimicrobial resistance (FAOlex data; Lago-Olveira et al., 2023). It is important to point out that food and water security has played a major policy and political role in the region. However, it has been difficult to find reports in English on the measures identified within these strategies, as well as on their effectiveness. Regarding the adoption of organic farming data is still lacking on how different management practices affect yields and environmental impacts depending on local conditions (Avery, 2022). Despite these developments throughout the region, misuse of pesticides by farmers is still ongoing, due to a lack of knowledge on assessing pest pressure and a lack of confidence in the use of alternative methods coupled with a high interest in preventing yield loss (Lucchi and Benelli, 2018). Transitioning to sustainable practices is

knowledge intensive, and this is an area where international networking with academic institutions could play a significant role in supporting farmers. These efforts are supported by PRIMA and Interreg MED projects cooperation projects.

Less attention is given to the issue of plastics pollution from agricultural activities. In many countries throughout the Mediterranean Region there is still poor access to recycling facilities and/or disposal infrastructures for agricultural plastic waste (such as greenhouses and mulching plastics, silage films and protective covering or pesticides containers) and limited awareness of farmers. Plastics are stored for long periods (near farmer exploitations in open dumping) readily fragmented and becoming microplastics; burned-on site, contributing to global warming, as well as producing toxic emissions having a negative impact on human health; dumped or buried in landfills or being directly ploughed into the soil; collected with another waste stream (mixed with organic or municipal/industrial waste streams) (FAO, 2021).

Current challenges and actions for achieving the EU Zero Pollution Mission targets as defined by the BMM Mediterranean multi-stakeholders.

The following Table lists the major challenges and sustainable actions identified by Mediterranean stakeholders during the BMM co-design process of the OIR, for the 'green transition' of the agriculture sector in the region. Actions for the challenges of the agricultural sector should be addressed in close synergy with the Mission Soil activities. These are categorized following the projects' ontology domains and listed below.

Table 4-1 Challenges and actions identified by BMM stakeholders of the agriculture sector.

	Challenges	Actions in Synergy with Soil Mission
Technological/Scientific	Transition to a carbon neutral agriculture, - decreasing the nutrient and plastic pollution while shifting towards carbon neutral practices.	Interdisciplinary multi-stakeholder R&I actions for placed based practice – oriented approaches linking soil and land use and blue – economy sectors. Research on the effects of different nutrient management systems in combination with farming practices under different geomorphological and hydrographical conditions. Landscape connectivity and development of monitoring methods for increasing knowledge of how sediments and pollutants move from land to sea and the re-establishment of wetlands. Increase the land use efficiency (e.g. vertical agriculture practices). Increase the efficientcy of fertilizer and pesticide use. Increase data collection on pesticides fertilisers and plastic products application

Challenges		Actions in Synergy with Soil Mission
		through digital smart (AI) and citizen science schemes.
	Tackle nutrient and pesticide leaching.	Nutrient Action Plan and Farmers Pesticide Toolbox. Increase cooperation between EU and non-EU Mediterranean countries to transfer best practices for agrochemical reduction. Research into smart and precise agriculture to better understand plant needs for pest control. Research on the use of alternative organic fertilisers and animal feed from food and aquaculture waste and by products. Research on Nature Based Solutions for nutrient retention and remediation. Biorefinery Technologies, in which high value-added products such as fuel, heat, electricity, organomineral fertilizer, bioactive substances and biomaterials are obtained by recycling waste and residues in agricultural production and the food sector.
	Tackle plastics and microplastic contamination of soil.	Identify schemes for re-usability and recycling of plastics applying on farm treatment Improve waste collection schemes in farms. Research on alternatives and trully biodegradable plastics for use in agriculture.
Policy	Increase transition to integrated/organic agriculture.	Support smallholders in transitioning by direct financial support and promote co-operative participation in eco-schemes and similar schemes in the EU and non-EU countries. Create schemes of multi -level cooperation between small and large farmers and agronomic institutes for increasing know how in integrated/organic agriculture.
	Introduce an integrated end – of life management policy to improve waste management and increase re-usability of plastic products.	Commit to a comprehensive certification schemes allowing traceability and usage monitoring. Provide support to farmers and develop effective EPR Schemes. Create a value chain for collection and recycling – reuse agri-plastics.

	Challenges	Actions in Synergy with Soil Mission
Economic	Improve uptake of integrated and sustainable farming practices.	Economic support for farmers to adopt smart and precise agriculture methods using novel techniques and sensors. Economic support and incentives for enhancing transition.
	Optimise waste collection and increase circularity.	Economic Incentives to farmers like the deposit and return schemes. Provide incentives to farmers to remove plant residues and earth materials from used plastics.
Social	Increase awareness and knowledge of farmers.	Upskill the farmers to be able to make the transition to adopt sustainable farming practices but also serve as citizen scientists for monitoring use of agrichemicals and agri- plastics. Disseminate best practices from the farmers associations and cooperatives to increase their adoption.

Priorities and next steps for achieving the EU Zero Pollution Mission targets in the Agriculture sector in the Mediterranean Region.

For the successful transition of the agriculture sector in achieving the targets of the Zero Pollution under the Mission Restore our Oceans and Waters, synergies and cooperation among several economic sectors is needed. Key actors include the plastics industry; the solid waste management sector; research and development on organic farming, nature-based solutions and pest control.

The following priority domains of the agriculture sector along the EU Missions dimensions on prevention – minimization- elimination & remediation- monitoring and control of pollution have been identified. Next steps identified for the sector are related to prevention, minimization and elimination-remediation. Monitoring and control being a cross-cutting dimension is highlighted for specific priorities. For half of these priority actions the results of the survey showed that there is a rather moderate maturity level for implementation, while for the other half the responses were inconclusive.

Table 4-2 *Priorities and next steps related to prevention-minimization-elimination & remediation of pollution caused by the **agriculture sector**. The maturity level of the priority actions and the barriers per domain are based on the stakeholders' survey results (Maturity Level: H=High, M=Moderate, L=Low; Barriers: from light to dark green indicates the increase of barriers) (Annex I)*

	Agriculture	Maturity level	Finance	Governance	Society	Technology
PREVENTION	Acceleration in the implementation of **organic farming and pest control and best farming practices**. Cooperation with **research and development** in relevant fields, as well as **economic support and incentives for farmers** to adopt the transition.	*				
	Cooperation of farmers associations with the plastics industry in piloting/demonstrating **solutions for truly biodegradable agri-plastics.**	M L				
	Enhance the adoption of smart and innovative agricultural methods of small family farms by promoting collaborative and cost sharing governance or business solutions.	M L				
MINIMIZATION	**Recycle nutrients** from agricultural-waste to achieve fully circular, localised nutrients management.	*				
	Upscale traditional agroecological practices (crop rotations, mulching, and agroforestry) **with scientific backing** to replace routine pesticide and fertiliser use.	M				
	Upskilling and dissemination activities of farmers. to take advantage of relevant **guidelines and toolboxes**.	*				
	Monitoring of quantities used for agrichemicals will help on targeting interventions by promoting the use of **smart and digital precision systems**.	*				

	Agriculture	Maturity level	Finance	Governance	Society	Technology
	Separate waste collection systems for agri-plastics in parallel with financial incentives for farmers such as **deposit-return schemes**. In this respect, **EPR schemes** (for agri-plastics producers) can provide financial support for the establishment of such collection systems in farms and **in cooperation with the solid waste management sector**.	*				
ELIMINATION-REMEDIATION	More **research** is needed on the development of **nature-based solutions** for the remediation of impacted fields, such as wetland re-establishment for nutrient retention and denitrification, filters and bioreactors for phosphorous and nitrogen removal.	**M** **L**				
	Issues related to the **legal framework and responsibilities** for the implementation of such solutions are still a challenge. Territorial agreements for the application of **Integrated Pesticide Management techniques.** The role of catchment management plans under the WFD implementation is key for their adoption.	**M** **L**				

**Inconclusive results*

4.2 Aquaculture

Aquaculture is an active and growing sector in the Mediterranean Sea, with an increasingly important role in food production, employment and economic development, while also reducing pressure on the region's overexploited wild fish stocks. The economic demand for fish protein is increasing, however, capture fisheries production remains static or is diminishing during the last decades. Production of sea-food for human consumption is worldwide equally divided between aquaculture and fishery; similarly, a balanced activity between fishery (57%) and aquaculture (43%) is experienced in the Mediterranean. (IEMed, MEditerranean Yearbook 2021)

In 2021, the Mediterranean aquaculture sector produced 1.1 million tonnes of live weight, including inland and marine activities, representing a 5.5 billion Euro industry. Based on data from the latest STECF report (STECF, 2023) on the EU aquaculture sector, there are estimated 1,500 companies and 12,000 people (direct jobs) in the EU Mediterranean region. Considering that aquaculture in the EU Mediterranean countries represents slightly less than 40% of the total marine aquaculture in the Mediterranean and that the species cultured and techniques used by the big producers are rather similar, with perhaps the exception of Egypt, it can be assumed that the Mediterranean aquaculture production sector employs more than 30,000 people, generating a GVA of around 8,5 million Euro. (FAO, IEMed, Mediterranean Yearbook 2021)

Mediterranean marine aquaculture is dominated by finfish, comprising ~80% of the total production, followed by molluscs (11%). Egypt and Turkey are the largest fish producers with 340,000 and 315,000 tonnes, Greece and Italy follow with 145,000 tonnes, and Spain, France (Mediterranean territory) with 41,990 and 19,900 tonnes respectively. Among the EU Mediterranean countries, Greece, Italy, Spain and France, produce about 65% of the total EU's aquaculture output volume (Eurostat, 2023).

Environmental impact of the sector

Under the current production systems, achieving the sustainable development goals and the objective of pollution reduction in the Mediterranean is challenging, because raising yields creates detrimental effects on the environment. The main pollution sources from marine finfish aquaculture and their related effects on the surrounding environment, include nutrient pollution from uneaten feed and metabolic waste, chemical pollution from various substances used in the production process (such as medical treatments, including antibiotics and anti-parasites) as well as the spread of farmed fish genes, parasites, and diseases to wild populations. There are also other direct effects, such as noise, odor, and marine litter from intensively farmed areas.

Plastic pollution from aquaculture is an issue of growing concern although the scale of plastic pollution does not match that from other sectors at the current time. Collected data on litter derived from aquaculture is not easily discernible from that originating from fisheries activities. In the Mediterranean Sea aquaculture and Fisheries litter correspond to ~ 10 % of total litter items collected on beaches, and ~14% on seafloor (UNEP/MAP, 2023). Litter items clearly identified to aquaculture activities include among others plastic netting for cages, plastic mesh bags/screens, plastic drums, buoys, buckets, oyster trays (Fleet et al., 2021). On almost 16% of the European monitored beaches, no aquaculture related debris has been reported. Yet in the rest of the beaches

the aquaculture related litter is estimated to vary between 2% to 10%. The most common item from aquaculture activities identified in the Mediterranean beaches is the bivalve nets/socks (Sandra et al., 2020). Basically, for each kg of mussels produced, about one linear meter of polypropylene (PP) net is used (Pietrelli L. 2022). Considering 20 g of PP/m of net, 7000 tonnes of plastic waste could be produced in one year for the production of 350,000 tonnes of the mussel *M. galloprovincialis* in the Mediterranean Sea.

It is estimated that about 80% of Nitrogen (N) and 70% of Phosphorus (P) contained in fish feed is lost to surrounding waters, with a large portion ending up in the sediment (Papageorgiou et al. 2023 and references therein). The values of N and P released for a fish farm with an annual production of 100 t can reach up to 7.5 T of N (<5% solid) and 1.3 T of P (approx. 50% solid) annually. Unlike the seas of northern Europe, the Mediterranean is an oligotrophic system based on small scale economic activities. The excessive amount of nutrients from aquaculture effluents may have positive external effects on the conservation of fish stocks and higher trophic level organisms boosting naturally their productivity.

In Mediterranean farming systems, antibacterials are mostly delivered through medicated feeds with a mean dose of 2g kg^{-1} feed (PERFORM FISH deliverable, Rigos 2020). The available information regarding the leaching of veterinary drugs during antimicrobial fish treatment is limited and although antibiotics can be partly digested by fish after ingestion, up to 80% of antibiotics are eliminated in the urine or feces. There is no accurate data about the amount of antibiotics used in Mediterranean fish farms so as to estimate the level of contamination from Mediterranean aquaculture. Similarly, sparse is the information about the occurrence of antibiotics in sediments below fish farms in the Eastern Mediterranean Sea and concentration levels are relatively low (Kalantzi, 2022).

Sustainable aquaculture is integrating three main principles: it must be economically profitable, environmentally friendly, and socially equitable (FAO, 2017). However, the main prerequisite for the optimal aquaculture production and profit is maintaining the optimal quality of the breeding environment.

Gap analysis to determine how to achieve transformation of the sector

Under EU law, the Green Deal ambitions, and the objectives of the Farm to Fork and Biodiversity Strategies (COM, 2020), require by the end of 2030 the EU aquaculture sector to reduce by 50% nutrient losses, the use and risk of antimicrobials and marine plastic litter in order to meet the Zero Pollution targets for 2050. The Common Fisheries Policy (CPF), the Water Framework Directive (WFD), the Marine Strategy Framework Directive (MSFD) and the Environmental Quality Standards Directive (EQSD) are the main legal instruments to tackle pollution in the EU aquaculture sector.

Diversification of aquaculture production can offer high value-added products and services to prevent, minimize and control water pollution. The EU circular economy strategy should support farms of low-trophic aquatic species and the valorization of aquaculture discards. Regulation (EC) No 767/2009 hinders the licensing and authorization of multi-trophic aquaculture with two or more animal species, as it prohibits under Article 6 the use of animal waste for animal nutritional purposes. Nevertheless, at the end of 2022 the EU published a communication document towards a strong and sustainable EU algae sector for the utilization of micro and macroalgae

cultures for the bioremediation of aquaculture, agriculture and urban wastewater receiving areas. It seeks to improve governance and regulation frameworks and calls on the EU countries to simplify national licensing procedures, in order to develop or improve industry standards for algae products and include algae cultivation in their national/regional spatial plans (COM, 2022 -592).

Regarding plastics, the European Strategy for Plastics in a Circular Economy is part of the EU's circular economy action plan that builds on existing measures for the reduction of marine litter, improving the potential for recycling plastic waste in aquaculture. According to Directive 2019/904/EU, EU Member States shall establish Extended Producer Responsibility (EPR) Schemes for aquaculture gears containing plastics by the end of 2024, however, it does not provide sufficient incentives for their collection and treatment.

The Directive 91/676/EEC or Nitrates Directive regulates the nutrient outputs of agricultural resources, including the residues from fish farms and sewage sludge. The REACH legislation addresses the risks on the environment by chemicals (Mercury, Arsenic and Organostannic compounds) existing in cages, floats, nets and any other appliances or equipment used for fish or shellfish farming. The Biocidal Products Regulation (EU) No 528/2012 (BPR) controls the use of antifouling biocides used on aquaculture equipment. The EQSD the main legislative framework for the release of chemicals into surface and groundwaters has established the limits of priority substances and other chemical pollutants of high concern, such as the antiparasiticides used in aquaculture (cypermethrin and the antifoulant cybutryne).

Moreover, FAO published in 2019 the Recommendations for prudent and responsible use of veterinary medicines in aquaculture to support aquaculture development and the FAO Action Plan on Antimicrobial Resistance. The EU Regulation no. 2019/4 of the European Parliament lays down the specific provisions regarding medicated feeds and intermediate products and the EU Regulation no. 2019/6 lays down rules for the authorisation, use and monitoring of veterinary medicinal products in Europe. In 2023, the European Parliament adopted a new resolution on EU action to combat antimicrobial resistance encouraging the use of alternatives to antibiotics in aquaculture and promoting the use of vaccination.

Aquaculture itself needs high quality water and is currently more engaged in zero-pollution practices as they depend on the highest water quality conditions. Mediterranean aquaculture is not a major source of pollution for the marine environment and is generally localized and on a limited area around the farms. In many cases, there is no consensus of opinion as to whether the ecological changes should necessarily be regarded as negative as any effort made to improve nutrient utilization has a positive effect on local productivity as well as on the protection of the environment .

The main problems concerning marine aquaculture are linked to the increased space required, especially relevant along coasts with a high population density, such as those in the Mediterranean. Aquaculture in competition with users of the coastal zone area may be forced to compete for space with other activities, particularly tourism. Legacy licenses can hinder planning and development as well as social acceptance of planning zones sometimes hinder modern spatial planning initiatives.

Mediterranean Aquaculture can build a sustainable and responsible food system, in

particular as a low-carbon footprint source of protein. Indeed, 'Sustainable food from the sea - Sustainable fisheries and aquaculture' is one of the 10 joint priorities agreed by the countries of the UfM in the framework of the 2021 UfM Ministerial Declaration on Sustainable Blue Economy. The Roadmap for its implementation (UfM Sustainable Blue Economy Roadmap[1]) adopted by the countries of the UfM in 2022, further points towards concrete opportunities (pilot actions/projects), for joint cooperation on sustainable fisheries and aquaculture moving forward – emerging from a gap analysis. As such, the aim is to further boost low environmental impact aquaculture, such as the production of low trophic species (micro and macro-algae), unfed production systems (such as filter feeders, e.g., molluscs), organic aquaculture and integrated multi-trophic aquaculture (IMTA). However, currently the total organic aquaculture production at EU level is estimated to account for 6,4% of the total EU aquaculture production. The main species produced are mussels accounting for more than half of the total organic aquaculture production, followed by the European seabass/gilthead seabream with only 2750 tonnes (EUMOFA 2020).

Although IMTA has received specific attention during the last two decades, it has not yet become a commercial reality in the Mediterranean region as a whole. Despite the fact that Europe represents a large fish market with consistently increased seafood consumption and a dynamic presence in the aquaculture sector, at present, integrated multi-trophic aquaculture is on a very small scale, mainly at experimental-research level. Probably the largest challenge faced is a short fall in 'know how'. A licensing framework for an IMTA system must include consideration of all components, therefore it must address the needs and potential impacts of the species from all trophic levels being farmed. There are several key knowledge gaps that must be addressed, and research is needed to determine whether large-scale commercial IMTA is a feasible and efficient system in Mediterranean coasts. Currently, there is relatively little incentive for the industry to invest in the development of IMTA. As such only the scalability of IMTA, or ability to start growing a new species at a small scale before investing lots of time, money, and resources can be seen as a positive factor .

As in all other food production sectors, the use of plastics by aquaculture, e.g. for equipment and packaging, is inevitably growing concurrently with the sector. Increased use of labelling and certification programmes (Marine and Aquaculture Stewardship Councils) also help to reduce the impact of the sector and promote consumer confidence in aquaculture products. In 2018, the Aquaculture Stewardship Council (ASC) recognized the importance of understanding the extent of plastic usage in aquaculture and the procedures for its management and disposal.

Finally, the diagnostic techniques and vaccines developed during the last years have improved the sector's capacity for identifying and treating the parasites and microbial infections. Vaccination-challenge trials are currently in use for bacterial and viral infections. However, they are applicable on a small- often experimental scale and several regulatory processes result in major complications as approval procedures vary among countries while many follow the Laws of the US Food and Drug administration (FDA).

[1] Accessible in EN/FR/AR on the Mediterranean Blue Economy Stakeholder Platform (MedMESP) : https://medblueconomyplatform.org/

Current challenges and actions for achieving the EU Zero Pollution Mission targets as defined by the BMM Mediterranean multi-stakeholders.

The following Table lists the major challenges and sustainable actions identified by Mediterranean stakeholders during the BMM co-design process of the OIR, for the 'green transition' of the aquaculture sector in the region. These are categorized following the projects' ontology domains and listed below.

Table 4-3 Challenges and actions identified by BMM stakeholders of the aquaculture sector.

Challenges		Actions
Technological/Scientific	Minimization of organic waste. Circular aquaculture and Restorative Aquaculture.	Reduction of fish feeding losses. Technological optimization, "smart" technologies and "tele-management" for biosecurity, control of water quality. Digitalization for the early detection of contaminants. Low trophic aquaculture as a restorative approach- "Zero impact farms". IMTA (Integrated Multi Trophic Aquaculture), including low environmental impact aquaculture practices and the production of low trophic species (e.g. Holothuria, micro and macro-Algae), for alternative feeding, water reuse and bioremediation. Adopt end-of-waste criteria for the promotion and reuse of aquaculture waste. Recycle aquaculture waste (e.g. use of by-products for added value products, convert fish sludge into fertilizers). Open ocean aquaculture cages. Improved physical and biogeochemical coupled models for the site selection for cages Regular monitoring, indicators of aquaculture sustainability and aquaculture interactions with ecosystems. Innovative data collection systems. Cooperation with research and development to adopt the transition to the concept of restorative aquaculture. Sustainable zoning of production sites (robust assessments of maximum carrying capacity and coexistence potential of the natural and physical environment).

	Challenges	Actions
	Minimization of plastic waste.	Alternatives to EPS boxes for re-use. Circular aquaculture nets and gears.
	Minimization of pharmaceuticals-Alternative practices.	Biotechnology solutions for the prevention of fish diseases as an alternative practice to the use of drugs.
	Minimization of antifouling products-Alternatives.	Development of eco-friendly antifouling and remediation agents (bio-based coatings, algal and enzymatic technologies).
Policy	Lack of regulation on waste management in aquaculture.	Development of policy tools and guidelines for waste management. Need for a common regulatory framework for the whole Mediterranean Region.
Economic	Achieve sustainability.	Support economic models for the transformation of waste into profit e.g. environmental compensation mechanisms. Provide incentives (e.g. green credits / tax regime) for adopting environmental best practices (habitat restoration, IMTA). Upscale and transfer successful examples of aquaculture practices and support public-private partnerships. Cooperation with the aquaculture industry in piloting /demonstrating solutions. Definition of plastic flows to assess input-outputs and management options under the Extended Producer Responsibility (EPR) framework. Regular monitoring and reporting of aquaculture performance, indicators of aquaculture sustainability and aquaculture interactions with ecosystems. Innovative data collection systems. Sustainability certifications.
Social	Engagement of all stakeholders.	Design a system of participative incentives for stakeholders. Cooperation and synergy among aquaculture companies for reducing & recycling waste.
	Knowledge increase - Awareness for new business opportunities for local communities.	Targeted training/capacity building and guidelines for aquaculture business. Upskilling the workforce in the aquaculture sector.

Challenges	Actions
	Cross sectoral consultations to minimize social obstacles and increase social acceptance (e.g. tourism, aquaculture, sustainable zoning of production sites)..

Priorities and next steps for achieving the EU Zero Pollution Mission targets in the Aquaculture sector in the Mediterranean Region.

For the successful transition of the aquaculture sector in achieving the targets of the Zero Pollution under the Mission Restore our Oceans and Waters, synergies and cooperation among several economic sectors is needed. Key actors include the plastics industry; research and development on IMTA systems; pharmaceuticals and biotechnology companies for the minimization of antibiotics. Besides an improved effort in national policies and management initiatives, a fundamental push could come from technological advancements, which could increase the worth of restorative aquaculture.

The following priority domains of the aquaculture sector along the EU Missions dimensions on prevention – minimization- elimination & remediation- monitoring and control of pollution have been identified. Next steps identified for the sector are related to prevention and minimization. Monitoring and control being a cross-cutting dimension is highlighted for specific priorities. Survey results for this sector clearly identified that the process of standards development and certification for sustainable practices is of high maturity for implementation in the short term.

*Table 4-4 Priorities and next steps related to prevention-minimization-elimination & remediation of pollution caused by the **aquaculture sector**. The maturity level of the priority actions and the barriers per domain are based on the stakeholders' survey results (Maturity Level: H=High, M=Moderate, L=Low; Barriers: from light to dark green indicates the increase of barriers) (Annex I)*

	Aquaculture	Maturity level	Finance	Governance	Society	Technology
PREVENTION	On the pollution **prevention dimension** the sector is highly **dependent** on advancements in **pharmaceuticals and biotechnology** R&D for solutions proposing **alternatives to drug use**; the **chemical industry** for the development of **eco-friendly antifouling**. **Public-Private partnerships** can support relevant research and demonstration activities.	**M L**				
	Reuse models for fish/mussels **packaging** and traceability along the value chain.	**M**			-	
	Sustainable zoning of production sites (robust assessments of maximum carrying capacity and coexistence potential of the natural and physical environment).	**M L**			-	
MINIMIZATION	**Minimization of nutrients and organic load** from aquaculture can be achieved by the **promotion of IMTA** throughout the Mediterranean Region. An **integrated strategy** is needed towards this direction that will include aspects such as the development of relevant **legislative/regulatory framework**; the **increase of competences** in the sector including **non-EU Mediterranean countries** and **financial incentives**.	**M L**				
	Promote **digitization tools for the management** of the sector.	**L**			-	
	Extending **EPR schemes** for the aquaculture sector related **packaging.**	**M L**			-	

	Aquaculture	Maturity level	Finance	Governance	Society	Technology
	Cooperation and synergy among aquaculture companies for reducing and recycling waste.	*				
	Cross sectoral planning to minimize conflicts and increase social acceptance (e.g. tourism, aquaculture)	M L				-
	Regular **monitoring and reporting of aquaculture performance** is required for the development of **standards** and promotion of **certification schemes for sustainable practices**. Certification schemes are expected to help in the adoption of sustainable practices by the aquaculture sector.	H				

**Inconclusive results*

4.3 Fisheries

Fishing has been very present in the way of life in the Mediterranean for millennia. Dense coastal populations and high demand for fish products have always made fishing a staple activity in the Mediterranean region. The Mediterranean is an enclosed sea with a diverse structure of the shelf distinguishing several sub-regions with their own geographical and environmental characteristics, hosting ~25,000 marine species characterizing the area as a biodiversity hotspot. The health of the marine ecosystem is vital for a healthy and productive fisheries sector and fisheries is a sector that may cause but also face pollution problems. For the achievement of the Grean Deal goals and Mission Restore our Oceans and Water targets the fisheries sector is challenged for taking actions mostly related to plastics and microplastics reduction and emissions from ships.

According to 2020 statistics (FAO/GFCM, 2022), the fisheries sector in the Mediterranean Sea encompasses a total of 83,278 vessels, generating an annual capture fisheries production of 1,189,200 tonnes (excluding tuna-like species), with an associated revenue of 2.55 million € and an estimated half a million jobs along the value chain, including 194,000 jobs directly on board fishing vessels. Small-scale vessels are the most abundant (>70%) throughout the Mediterranean countries, followed by bottom trawlers and beam trawlers (5-13 %), purse seiners and pelagic trawlers (3-8 %), and others (3%). Total landings in the Mediterranean reach 693,692 tonnes. The countries with the highest catches are Italy (20.9 %), Tunisia (12.9 %), Algeria (12.8 %), Greece (9.9 %) and Spain (9.7 %). The three species, herrings, sardine and anchovy represent 43.6 % of total landings. However, if we look at the economic value, the most profitable species are: European anchovy, sardine and European hake, followed by blue and red shrimp, common octopus, red mullet and surmulet. Trawlers and beam trawlers represent the greatest source of revenue in the western Mediterranean (39.9 %) and in the Adriatic Sea (49.5 %). On the other hand, in the central and eastern Mediterranean, small-scale vessels are equally important as trawlers and beam trawlers corresponding to ~36% and ~31 % respectively of total fisheries revenue in each sub-region. In terms of employment, small-scale vessels represent 59.3 % of on-vessel jobs, followed by purse seiners and pelagic trawlers (17.3 %) and then trawlers and beam trawlers (16.2 %). The workforce is ageing, highlighting the need for a generational turnover (FAO/GFCM, 2022).

The overexploitation of stocks is one of the most serious threats for coastal biodiversity that calls for sustainable management of the resources. In the Mediterranean however, it has decreased over the past decade, with an accelerated reduction of fishing pressure in the last two years, particularly for key species under management plans. However, most commercial species are still overexploited, and fishing pressure is still double of what is considered sustainable (FAO/GFCM, 2022). Despite the socio-economic and environmental problems of the sector, fisheries still represent an important pillar for the economic growth of the Mediterranean region. Regional governance frameworks based on management plans and spatial and technical measures are providing tangible results in reducing unsustainable fishing pressure in some commercial species. However, this framework needs to be extended to all commercial fisheries. A new strategy (2021) for the sustainability of the sector in the Mediterranean Sea and the 'green transition' has been adopted by the GFCM and the EU with clear targets for the next decade, including actions for pollution mitigation.

Environmental impact of the sector

Pollution caused by the fisheries sector in the Mediterranean Sea is mostly related to two activities: the fishing activity itself and the shipping/transport activity of the fishing fleet.

In relation to the fishing activity, of growing concern is the abandoned, lost or otherwise discarded fishing gear (ALDFG) due to the negative environmental and economic impacts (TGML Harm report). Most fishing gear are made of plastics and contribute to the general marine litter problem. Eight categories of fisheries related litter (i.e. plastic nets, tangled nets and cord, plastic string, rope-string-cord, plastic traps, plastic/styrofoam fish boxes; plastic floats; plastic fishing lines) are included the MSFD guidelines for monitoring of marine litter in the European Seas (Fleet et al., 2021). Fisheries related litter recorded on beaches and on the seafloor of the Mediterranean Sea represents on average ~10 % of total marine litter items recorded (Prevenios et al., 2018; Fortibuoni et al., 2019; Vlachogianni et al., 2019; UNEP/MAP, 2023). Although, this is not a very large contribution the specific nature of this kind of litter multiplies its impacts on marine life. ALDFG (lines, nets, traps) has direct impacts and causes damage to wildlife, by trapping and killing fish and other marine animals – a phenomenon known as "ghost fishing". Nevertheless, quantitative data on entanglement of biota are difficult to obtain and usually require the engagement of fishers and citizens. From the knowledge obtained so far in the Mediterranean, the main victims of entanglement in fishing gear are birds (35%), fish (27%), invertebrates (20%), marine mammals (13%) and sea turtles (UNEP/MAP, 2015). Fisheries related litter contributes also to microplastic generation. Two major sources of microplastic pollution from the fisheries sector are the deterioration of fishing nets (during use and when discarded) producing microplastic filaments made of nylon and the loss of expanded polystyrene (EPS) fishing boxes which are readily fragmented to smaller pieces.

Emissions of contaminants either as GHGs or oil from the fishing fleet in the Mediterranean region are currently neglected. Global estimates show that the fisheries contribution to GHGs has doubled since 2011 and reached about 0.6 % of global CO_2 emissions in 2016 (Greer et al., 2016). Regional differences in the size/type and age of fishing vessels seem to be critical for accurate determinations.

Gap analysis to determine how to achieve transformation of the sector

There is a clear awareness in the fishing sector of the problem of pollution in the Mediterranean Sea and of the role that fishing activity itself plays in the overall pollution problem. Fishers are conscious of the loss in economic revenue that pollution represents and see the future of sustainable fishing as compromised. For example, estimated costs of marine litter for the EU fishing fleet are between 1 and 5% of revenue, due to reduction in fish catch, damage to vessels or reduced seafood demand due to concern about fish quality. As it concerns the ALDFG problem, this is the result of several factors of natural and socio-economic origin such as the combination of the topography and the nature of the gear, the absence of onshore disposal channels involving port zoning, the absence of transitional measures when a gear is declared illegal, the absence of incentives accompanying normative measures (Gilardi et al, 2020). A regional survey organized by UNEP/MAP MEDPOL in 2015 through a questionnaire on derelict fishing gears indicated that 42% of the survey respondents consider ALDFG a serious problem in the Mediterranean. The results also demonstrated that (i) Proper port and other facilities for

effective management of derelict fishing gear, marine litter collected on board, etc. are insufficient; (ii) Relevant legislation exists but is not implemented or enforced; (iii) The majority of Mediterranean fishers claimed to be willing to participate in "Fishing for Litter" schemes. The transboundary nature of the problem means that regional and international cooperation to deter ALDFG is vital. International recognition of the ALDFG problem as one aspect of the larger global challenge of marine plastic litter is demonstrated through the large number of international organizations, activities and agreements that now focus on marine litter, as well as the numerous national and local level initiatives that are being implemented around the world. However, more facilities are needed for the collection of disused fishing gear or litter at sea, so that fishers include it as a daily activity, as well as further research into biodegradable materials in fishing gear and less impact on by-catch species, habitats and ecosystems in general.

Although fishing vessels are included in the resolution of the MEPC (IMO) 341(77) of November 2021, which sets out the strategy to address marine plastic litter from ships, the ALDFG problem is specifically addressed by targeted regulations. Among the most recent EU and international and regulations are (i) the Council Regulation (EC) No 1224/2009 that obliges fishers to retrieve and report ALDFG (ii) the EU 2019/904 Directive on Single Use Plastics which provides tools and incentives for the proper management of fishing gear and nets to facilitate recovery, re-use and recycling once arriving onshore following EPR schemes; (iii) the Voluntary Guidelines on Marking of Fishing Gear, (FAO, 2019). The latter consist of tools for the development of a gear marking system and its associated components, including reporting, recovery and disposal of ALDFG or unwanted fishing gear and commercial traceability of fishing gear. The guidelines are meant to assist countries in meeting their obligations under international law such as FAO's Code of Conduct for Responsible Fisheries.

An international initiative addressing the ALDFG problem is the 'Global Ghost Gear Initiative '(GGGI) (2015) with 125 members from around the world, representing civil society, the private sector, the fishing industry, public agencies, academia and intergovernmental organizations. The Mediterranean region is underrepresented with only one government signatory and about 10 from other organizations. Since its inception, GGGI has collaborated with partners around the world to deliver projects across a range of solutions, including data collection, recovery of fishing gear at sea, recycling of end-of-life gear, testing innovative technologies to improve gear tracking and prevent future gear losses, and strengthening local capacity to implement best practices and solutions on the ground.

In the Mediterranean region there are many initiatives ongoing, mostly on national level such as the Ghost-Med program initiated and managed by the French Office for Biodiversity (OFB) where fishers, divers and natural and marine parks collaborate to identify, locate and then remove localized lost fishing nets https://ghostmed.mio.osupytheas.fr/fr/; and the Blue Municipalities Network in Greece, whose purpose is to install ALDFG and fishing waste reception facilities in ports for further valorisation and recycling 'Blue Municipalities Network' - Aegean Rebreath. Similar activities take place also in France, Spain, and Italy (ports-propres.org) and in

Turkiye 'Cleaning the Seas of Abandoned fishing Gear'[2] and 'Ghost Gear Hunters'[3]. Efforts to effectively detect ALDFG and dispose of properly in adequate port facilities should be intensified along with efficient monitoring approaches for assessing the quantity and localization of ALDFG. Funding opportunities may be risen through regional cooperation instruments such as ENI-CBC and Interreg projects. In parallel to the collection of ALDFG, the development of biodegradable materials targeting specifically fishing nets appears a promising solution that requires cooperation with the plastics/bioplastics industry. Relevant research has been supported by EU research and cooperation funding instruments such as Interreg and Horizon 2020 (i.e. INDIGO, Glaukos, SeaLive) with several Mediterranean partners involved. However more scientific evidence is needed towards this direction and in line with the sustainable use of biodegradable plastics.

The De-carbonation of the fishing fleets is a real objective but complex to achieve due to economic models of the sectors and limited capacities of related private investment. Public support would help, but the accessibility to such funds is not uniform among Mediterranean countries.

Current challenges and actions for achieving the EU Zero Pollution Mission targets as defined by the BMM Mediterranean multi-stakeholders.

The following Table lists the major challenges and sustainable actions identified by Mediterranean stakeholders during the BMM co-design process of the OIR, for the 'green transition' of the fisheries sector in the region.

Table 4-5 *Challenges and actions identified by BMM stakeholders of the fisheries sector.*

	Challenges	Actions
Technological/Scientific	Tackle plastics & microplastics contamination from packaging.	Smart and reusable boxes. Traceable boxes for sanitary and origin certification (RF microchips). Eco-friendly compostable alternatives to polymer-based packaging. Sustainable zoning of production sites (robust assessments of maximum carrying capacity and coexistence potential of the natural and physical environment).
	Tackle plastics & microplastics contamination and impacts from fishing gear.	Development of fully biodegradable materials for fishing nets under marine conditions and in the short term. Tag & track nets and gear - find & recover.

[2] https://www.tarimorman.gov.tr/BSGM/Haber/238/Hayalet-Avcilarin-Temizlenmesiyle-17-Milyon-Su-Canlisi-Kurtuldu

[3] https://akdenizkoruma.org.tr/tr/calismalarimiz/projeler/b/hayalet-ag-avcilari-projesi

	Challenges	Actions
	Understanding entanglement in ALDFG.	Increase scientific evidence by generating data on areas of accumulation, types of gears and affected species in the Mediterranean. Design more selective fishing gears and with less impact on habitats.
	Expand and accelerate fishing for litter.	Valorise fishing nets as waste.
	Decarbonisation of the fishing fleet.	Renewable energy for fishing boats and/or onshore processing facilities. Piloting and experimenting with alternative energy sources with various types of vessels.
Policy	Accelerate and institutionalize the implementation of best practices for ALDFG recovery and disposal.	Development of action plans through port authorities, regional and local authorities and fishers organizations. A legal framework that encourages and facilitates the collection of ALDFG.
	Harmonize regulatory framework across the Mediterranean Basin.	Common framework for ALDFG management in the Mediterranean through cooperation and synergies with the Barcelona Convention (UNEP/MAP). Develop and propose incentives for the use of fishing gear that is more selective and made of biodegradable materials.
Economic	Make fisheries sustainable.	Provision of funds for ports and local authorities to provide marine litter and ALDFG collection systems. Financially sustain participatory removal networks. Provision of assistance funds to cover the need of the fishing sector during transition periods in the use of new fishing gear or in the work of collecting lost fishing gear or new “green” engine systems. Financial instruments for replicating best practices related to fishing for litter and ALDFG recovery in non-EU countries. Provision of funds for research and innovation in new, biodegradable materials for fishing gear. Determine and implement sustainable public-private financing frameworks for the decarbonization of the sector.

	Challenges	Actions
		Incentives (e.g. green credits / tax regime) of good environmental practice in fisheries.
Social	Increase awareness & knowledge of fishers.	Upskilling the fishing workforce to be able to make the transition toward a sustainable fishing by increasing the digital and technical competences required to adopt the existing supportive tools. Targeted trainings/capacity building on regulations and how to implement them. Co-design regulations with fishers in particular for MPAs.
	Increase awareness of the society on the reality of the fishing activity.	Dissemination and training in different social segments, from the fishers' associations themselves to society in general, including schools, universities, and social centres. Mediterranean wide citizen science programmes targeting entanglement in marine litter.

Priorities and next steps for achieving the EU Zero Pollution Mission targets in the Fisheries sector in the Mediterranean Region.

For the successful transition of the fisheries sector in achieving the targets of the Zero Pollution under the Mission Restore our Oceans and Waters, synergies and cooperation among several economic sectors is needed. Key actors include fishers associations, port authorities, solid waste management in ports-cities-municipalities and the plastics industry.

The following priority domains of the fisheries sector and in cooperation with other sectors along the EU Missions dimensions on prevention – minimization- elimination & remediation- monitoring and control of pollution have been identified. Stakeholders from the fisheries sector did not find any of the proposed priority actions in a relatively developed stage and are all characterized either as of moderate/low or low maturity, reflecting that their implementation is not expected in short time.

Table 4-6 *Priorities and next steps related to prevention-minimization-elimination & remediation of pollution caused by the **fisheries sector**. The maturity level of the priority actions and the barriers per domain are based on the stakeholders' survey results (Maturity Level: H=High, M=Moderate, L=Low; Barriers: from light to dark green indicates the increase of barriers) (Annex I)*

	Fisheries	Maturity level	Finance	Governance	Society	Technology
PREVENTION	**Adoption of reuse models**. **Cooperation** between the **fisheries and commercial sector** for the development of r**euse system for fish boxes along the value chain**. The action can be accelerated through legislative instruments and regulations such **the SUP Directive for EU countries** and other instruments to be developed under the Barcelona Conventions and UNEP/MAP.	**L**				
MINIMIZATION	Provide **financial incentives** for installing **renewable energy sources on board fishing vessels** and/or onshore processing facilities.	**L**				
	Tracing tags on nets can be used as tool for monitoring and control adopted measures.	**M L**				
	The role of the Barcelona Convention and the UNEP/MAP for the **expansion of the systems of collection and recycling of fish boxes and gear to non-EU Mediterranean countries is critical**.	**M L**				

	Fisheries	Maturity level	Finance	Governance	Society	Technology
ELIMINATION & REMEDIATION	**Removal of ALDFG lost at sea. Financial instruments** should include the support of participatory networks dedicated to the removal of ALDFG from the marine environment.	**L**				
	Acquisition of more accurate scientific data on **monitoring** the presence /accumulation areas and impacts of ALDFG in the Mediterranean.	**M** **L**				
	'Fishing for litter' activities. **Guidelines and provision of dedicated spaces for disposal of litter and /or ALDFG at Mediterranean ports**	**M** **L**				
	Characterization and valorization of ALDF and collected Mariem litter is indispensable for their recycling or proper disposal.	**M** **L**				

4.4 Tourism

In line with the EU Green Deal and Mission Objective 2 goals, the present chapter focuses on the actions needed by the tourism sector for achieving the zero pollution targets related to waste generation (including food waste and single-use plastics).

The Mediterranean is the leading tourism destination globally attracting one third of the world's coastal and maritime tourism. Along the Mediterranean coast, in a narrow strip (50-100 km) about 130 million inhabitants are increased seasonally by about 100 million tourists. The tourist market includes mostly cruises, recreational boating, sun – sea-beach and cultural holidays (UNEP/MAP and Plan Bleu, 2020; UNWTO, 2019; IEMed, 2003). In 2019, the Mediterranean region more than 400 million international tourist arrivals (ITAs) were registered with a forecast to reach 500 million by 2030 (UNWTO, 2019). The tourism sector accounts for up to 15% of regional GDP, and an average 11.5% of total employment and is the most important economic sector in the region especially for countries with limited industrial or agricultural development (UNEP/MAP and Plan Bleu, 2020). On the global scale, tourism is expected to grow at an annual rate of 4%, outpacing many other economic sectors. The countries of the Mediterranean basin are home to 212 of the 754 places listed as world cultural and natural heritage sites by UNESCO, comprising 28% of the world total. The Mediterranean cruise destination represents the second market globally for the industry, hosting 10% of the world's cruises, with an economic impact of € 57.3 billion and 8 million passengers, making the cruise sector an important pillar of the economies of Mediterranean countries (Plan Bleu, 2022). Although the region hosts a great variety of destinations, until now an unbalanced regional distribution of tourism is observed with 64% of ITAs in the northwestern countries and 17% in the southeastern ones. At the same time tourist flows may be affected by political insecurity and conflicts.

The quality of the environment is an asset for the development of tourism, yet tourism has several adverse environmental effects. During the last years, however, there has been a shift in the market towards nature- seeking and eco-tourism alternatives. With about 8% of its waters as Marine Protected Areas (MPAs), the Mediterranean is a growing hotspot for nature-based tourism which provides an opportunity for accelerating the green transition. In that sense, environmental resilience may benefit from tourism development through the protection of ecosystems, control on polluting activities, and greater understanding of the environmental issues by local communities.

Environmental impact of the sector

While tourism represents an important source of income and jobs, the sector poses pressures on the natural ecosystem, with unsustainable use of resources (water, food, energy), environmental deterioration and biodiversity loss. As a result, the sector contributes to several pollution problems such as marine litter incl. microplastics, urban wastewater and nutrient increases, oil and chemical spills, while GHG emissions related to tourist transportation are considered the most prominent (Lenzen et al., 2018).

During summer months, when tourists increase the total population by over one-third across the Mediterranean coasts, waste generated increases substantially: for example, Greece sees a waste increase of 23-26 %, while in Italy the increase is up to 30 % in coastal areas. Local waste management facilities are often overwhelmed by this additional

waste, which can lead to larger amounts of mismanaged waste and higher pollution risk. As a result, marine litter increases by up to 40 % on Mediterranean coasts during peak tourist season. This results in a cost for the sector that is estimated at €268 million each year on clean ups to ensure locations remain attractive for tourists. (Dalberg, 2019). Cruises also contribute to waste increases in ports where they arrive discharging large quantities of waste and in coastal municipalities due to high number of tourists reaching all at once at a specific area. The direct link of tourism to the transport sector makes tourism an important contributor to greenhouse gas emissions which in turn are known to have detrimental effects on the chemistry of seawater. Although data accounting for tourism contribution to this kind of pollution are difficult to acquire a study showing the seasonality from ships' emissions in the ports of Greece points to the cruise sector as an important contributor (Papaefthimiou et al, 2016).

Despite the economic importance of the sector for the Mediterranean and globally, pollutant emissions related solely to tourism are still not well quantified. Estimates for a 'business-as-usual' scenario, indicate that by 2050 tourism would generate an increase of 154% in energy consumption, 131% in greenhouse gas emissions, 152% in water consumption and 251% in solid waste disposal (UN Tourism | UNEP - UN Environment Programme). For this reason, sustainability for tourism development is already a priority for International Organizations such as UNWTO, UNEP, UfM and the European Commission.

Gap analysis to determine how to achieve transformation of the sector

The EU policy on tourism aims to turn Europe into a sustainable destination, bearing also its social and environmental aspects. Sustainable tourism takes into account current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities (Sustainable development | UNWTO). As part of the transition of the sector the Green and Digital transition is foreseen (Transition of EU tourism (europa.eu)). The process is complex as it involves a variety of businesses (hotels, restaurants, catering -HORECA, travel agents or digital platforms, destination managing organisations, attractions and passenger transport) national, regional and local authorities, and finally the tourist, that all need to share a common vision. To achieve green and digital transition, reducing the environmental footprint of tourism is one of the priorities on the EU level. Due to the complexity of the sector the EU transition prioritizes the development of synergies involving public and private stakeholders.

At the regional level, under the Mediterranean strategy for sustainable development (MSSD) (2016-2025), the Regional Action Plan on Sustainable Production and Consumption (IG 22/28) (Thematic regional strategies and action plans | UNEPMAP) sets specific operational objectives for the tourism sector. These address the efficient use of natural resources taking into account the carrying capacity of destinations; the development of measures for sustainable tourism development; raising awareness and capacity to support Mediterranean sustainable tourism. In addition, other initiatives and projects (UfM, ENI-CBC, Interreg, the MedCruise agreement with GSTC https://www.gstcouncil.org/collaboration-agreement-between-medcruise-association-and-gstc/) have demonstrated good examples and best practices of sustainable tourism including environmental issues. It must be noted that the cruise industry was pioneering

in waste management and an approach to cleaner energy. The sector is investing heavily in achieving all targets, yet the industry reputation suffers in respect to sustainability. Sustainable tourism, including maritime and coastal, emerges as a central priority across UfM GreenerMed and the UfM's Sustainable Blue Economy Roadmap. Based on a gap analysis, concrete opportunities (pilot actions/projects) for joint collaboration do emerge within both frameworks.

The problems currently facing by the sector are diverse and include fragmentation in governance, human pressure on the natural ecosystems, over tourism and seasonality (PlanBleu, 2022). Previous work under the 'Sustainable Tourism' Interreg Project following a consultation process with Mediterranean stakeholders has highlighted the need for a common vision among all actors of the tourism sector towards a Mediterranean Strategy for Sustainable Tourism. The main challenges faced concern water scarcity, beach regression and ecosystem degradation; lack of participation of local communities in governance processes; inefficiencies in resource use and lack of competitiveness; increasing urbanization as a threat to cultural heritage; lack of application of circular economy principles. Water pollution and waste management were addressed as two of the seven environmental challenges. In this regard, a transition of the tourism sector from a linear to a circular economic model is expected to affect and minimize energy and water demand, wastewater discharges and solid waste generation, as well as GHG emissions.

The present chapter focuses only on pollution problems such as solid waste discharges caused by the tourism sector. Pollution related to transportation from tourism is dealt with under the transport and ports sector chapter.

Current challenges and actions for achieving the EU Zero Pollution Mission targets as defined by the BMM Mediterranean multi-stakeholders.

Challenges and actions identified during the interaction with Mediterranean stakeholders within the framework of the BMM are listed below. These are categorized according to the project's ontology domains. Most of the challenges and actions listed are related to the HORECA businesses and are very much dependent to other sectors esp. the solid waste management in ports/cities/regions and the plastic industry.

Table 4-7 *Challenges and actions identified by BMM stakeholders of the tourism sector.*

	Challenges	Actions
Technological/Scientific	Reducing waste generation from the sector.	Develop digital tools for monitoring/measuring & control of waste generation along the services chain of tourism businesses. Explore existing best practices and tools (i.e. UN Global Plastic Tourism Initiative; EU EMAS scheme). Develop targeted interventions for minimizing waste incl. food waste along the services chain.

	Challenges	Actions
Policy	Facilitate the transition of the sector.	Certification for sustainable practices i.e. EU Ecolabel for Sustainable Tourism. Expand certification to businesses in non-EU Mediterranean countries.
Economic	Minimizing costs for proper waste management in the sector.	Expand EPR schemes for packaging and other plastic products directly linked to the sector. Fiscal incentives for businesses & SMEs for implementing Reuse /Refill systems, and non-plastic alternatives. Assist smaller ports in investment infrastructure for waste reception facilities.
	Cruise to reduce waste production and increase waste separation.	Promote waste separation systems in cruise ships.
	Harmonizing practices in the Mediterranean Region.	Financial instruments for piloting/replicating good practices in SMEs in non-EU countries.
Social	Social adoption of alternative commodities in the tourism sector.	Tourist information/awareness campaigns organised by municipalities and tourism companies targeting on reducing single-use products. Awareness raising on food overconsumption -food waste Marketing campaigns aimed at promoting the use of refilling/reuse systems (e.g., water bottles).
	Increase competences and skills of workforce on reducing wastes.	Develop trainings and make use of existing tools such as the EU Pact for Skills.
	Networking of businesses.	Networking provides an opportunity for replication of best practices and self-regulation and monitoring of the 'green transition'.

Priorities and next steps for achieving the EU Zero Pollution Mission targets in the Tourism sector in the Mediterranean Region.

The following priority domains of the tourism sector along the EU Missions dimensions on prevention – minimization- elimination & remediation of pollution have been identified. Next steps identified for the sector are related to prevention and minimization of pollution. Monitoring and control being a cross cutting dimension is highlighted for

specific priorities. BMM stakeholders of the tourism sector have clearly identified that the conditions are mature for the wide adoption of separate waste collection for recycling, in synergy with the plastics packaging sector and the municipalities, taking advantage of EPR schemes.

Table 4-8 *Priorities and next steps related to prevention-minimization-elimination & remediation of pollution caused by the **tourism sector**. The maturity level of the priority actions and the barriers per domain are based on the stakeholders' survey results (Maturity Level: H=High, M=Moderate, L=Low; Barriers: from light to dark green indicates the increase of barriers) (Annex I)*

	Tourism	Maturity level	Finance	Governance	Society	Technology
PREVENTION	Promotion of **reuse -refill systems in the HORECA businesses** can be facilitated by the process of **certification for zero waste** practices and relevant **data disclosing** in connection to financial incentives.	*				
	Awareness and information campaigns targeted to tourists for the wider adoption of the practices and **reducing of the use of single-use products.**	M L				
	Networking of businesses for the promotion and replication of 'green' practices.	L				
MINIMIZATION	Use of **digital-smart systems for monitoring waste generation.** Increase competences of the workforce by **targeted training of employees.**	L				
	In synergy with the plastics packaging sector and the municipalities, EPR schemes can enhance **separate collection for recycling,** and control waste generation by tourism.	H M				
	The acceleration of the transition in the sector can be facilitated by the process **of certification for zero waste practices and relevant data disclosing in connection to financial incentives**.	M L				

**Inconclusive results*

4.5 Transport and Ports

For the purposes of the BMM OIR, and in line with the EU Green Deal and Mission Objective 2 goals, the present chapter focuses on the actions needed by the transport and ports sector for achieving the zero pollution targets related to emission of air contaminants, oil spills, waste management and dumping.

Maritime transport is the backbone of trade and economic development. Maritime transport is essential for global trade. It ensures the functioning of the economy's supply chains. Despite covering less than 1% of the world's oceans, the Mediterranean Sea is among the world's busiest waterways, accounting for 15 % of global shipping activity by number of calls and 10 % by vessel deadweight tonnes.

The Mediterranean coastal fleet represents 17% of the world's oil tanker capacity, 13% of the total bulk carrier capacity, 10% of the General cargo ships and 11% of the worldwide container ships. Passenger transport also represents a major component of maritime traffic in the region, especially in the Aegean Levantine Seas. However, passenger transport follows seasonal patterns, unlike the transport of goods, and there's a general increase of traffic intensity in the summer.

Shipping activity in the region is growing in terms of the number of routes, traffic intensity and size of ships. The maritime transport sector is expected to grow at a rate of 4% per year for the next decades, yet with this growth come increasing environmental impacts. While the maritime sector brings significant economic and social benefits, meeting ever increasing demands, it also has a negative impact on the environment and contributes to global warming, affecting the health of citizens and the state of marine and coastal ecosystems.

The Mediterranean has more than 600 commercial ports and terminals (Nine of these being among the 20 largest cargo ports in the European Union. 36 ports in the Mediterranean are categorized as major ports (accommodating more than 120,000 cruise passengers each year), 25 of which are located in the Western Mediterranean area, 7 ports in the Adriatic and 4 ports in the Eastern Mediterranean area. Ports with fewer than 120,000 cruise passengers in 2017 include 15 Western Mediterranean ports, 11 Eastern Mediterranean ports and 6 ports located in the Adriatic (Med-Cruise Association, 2018).

The Mediterranean region has seen a significant and rapid rise in cruise ship movements over the last decades: the number of individual cruise passengers in 2017 was over 4% higher than the number of passengers that cruised the previous year and more than double compared to 2006, when 12 million passengers cruised (MedCruise Association, 2018). Today, the region stands as the second biggest cruising region in the world (15.8% of global cruise fleet deployment in 2017 (idem)), after the Caribbean. For three years in a row, Mediterranean cruise ports hosted, on average, more than 2,000 cruise passengers per cruise call. The increase from previous years is an indication of the continuous increase in the cruise shipping business in the Mediterranean region, but also of the increase in size of cruise vessels sailing in the Mediterranean (MedCruise Association, 2018). Because of this continuous growth, ports are facing the challenge of providing proper infrastructure to accommodate large cruise ships and upgraded facilities to be able to accommodate an ever-growing number of cruise passengers as well as to collect and dispose of related waste.

Environmental impact of the sector

Increasing shipping and maritime activities are significant drivers for anthropogenic pressure on the marine environment in the Mediterranean Sea. The sector has multiple environmental impacts which include: Air pollution in particular sulphur oxides (SO_x), nitrogen oxides (NO_x)and GHGs emissions; pollution from oil and other chemicals including hazardous and noxious substances; accidental and illicit discharges; marine litter; underwater noise; seabed disturbance; collision with fauna; introduction of alien species; water discharge and hull fouling; land take and artificialization of the coastline through port infrastructure. Here we focus on emission of air contaminants, oil spills, waste management and dumping.

Maritime transport affects the marine environment, both in the course of routine operations and through accidental events. Its impacts can be localized (e.g. the effects of anchoring or mooring) or far-reaching (e.g. air pollution) and they occur during offshore navigation as well as in coastal areas.

Shipping activities have increased significantly over the last century, and, as such, are a known contributor to the global emissions of air pollutants and greenhouse gases (GHG). Ship emissions contain toxic gases and particulates like sulphur oxides (SO_x) and nitrogen oxides (NO_x). These, when released into the atmosphere, have adverse effects on the human health and cause acidification of soil and aquatic environment, impairing the life of fauna and flora. The forthcoming application of the IMO global regulations establishing a sulphur cap in 2020 are expected to curve air emissions, fostering low-sulphur and alternative fuels and energy. GHG from ships, particularly carbon dioxides (CO_2) contribute to climate change.

In 2018, emissions from the maritime transport sector made up 13.5% of the EU's total transport greenhouse gas emissions; well behind road transport (71%) and slightly behind aviation (14.4%). Up to 57% of all emissions from international shipping in Europe occur in the Mediterranean Sea Over one third of this came from container ships. Approximately 40% of the EU population lives within 50 kilometres of the sea, so air emissions from ships are a particular concern for coastal communities. In common with other forms of transport, ships emit substances including sulphur oxides (SO_X), nitrogen oxides (NO_X) and particulate matter (PM), which can affect human health. In 2018, the maritime transport sector produced 24% of all NO_x emissions, 24% of all SO_x emissions and 9% of all PM2.5 emissions, as a proportion of national EU emissions from all economic sectors. In the same year ships calling at EU and the European Economic Area ports generated approximately 18% of all CO_2 emissions worldwide (being at a decreasing trend related to the renewal of the fleet and the increase in energy efficiency since new EU standards). National allocation by marine regions of shipping pollutant emissions in the Mediterranean Sea area in 2016 totalled 680,780MT SO_x, 1,332,800 MT NO_x and 58,074,560 MT CO_2.

Oil spills are one of the most serious causes of marine pollution. The Regional Marine Pollution Emergency Response Centre (REMPEC) estimated that the total input of oil from ships into the Mediterranean is between 100,000-150,000 tonnes per year. While major sea routes and the areas around key oil terminals are clearly most at risk, serious accidental oil spills could occur anywhere in the Mediterranean. Incident rates, especially incidents involving oil, have decreased globally, including in the Mediterranean, despite a steady increase in oil and other cargo volumes transported by ship. This can be

attributed to the adoption and implementation of international maritime conventions addressing the safety of transportation as well as preparedness and response to accidents.

One of the ways in which litter reaches the marine ecosystem is through lost containers at sea, which can either split open, discharging their contents, or can remain intact, causing a hazard for other ships. However, estimates suggest that the percentage of total waste released through lost containers at sea is negligible in the EU, with an average of 268 containers lost per year (i.e. one 1‰ of 226 million packed and empty containers worldwide shipped on average annually). Another way in which litter enters the oceans is through waste generated on-board ships. When vessels arrive at port, they unload the waste they produce at sea, in what are termed port reception facilities. In 2018, a comparison between the amount of expected ship-generated waste and the waste that was actually delivered in port reception facilities in the EU provided an estimate of the amount of potential ship generated waste which could be illegally discharged at sea. This estimate ranged from around 2.5% for oily waste, 10% for sewage and 7–34% for refuse (excluding plastic waste).

Gap analysis to determine how to achieve transformation of the sector

The shipping sector is a low-cost, energy efficient and safe mode of transportation and is working on achieving sustainable development and reaching the UN Sustainable Development Goals (SDGs) as well as towards the EU Zero Pollution targets.

To achieve these a number of actions are implemented or are in the pipeline on national and regional scale across the Mediterranean. The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It includes regulations covering oil pollution, chemicals in packaged and bulk form, sewage and solid waste and air pollution. On the EU level, a comprehensive package of rules addressing the environmental aspects of maritime transport exists, going beyond agreed international standards. These include the Regulation (EU) No 911/2014 4 on multiannual funding for the action of the European Maritime Safety Agency (EMSA) in the field of prevention and response to marine pollution caused by ships and oil and gas installations (and, where appropriate, to contribute to the overall efficiency of maritime traffic and maritime transport); the 2009 Maritime Transport Strategy, the 2011 Trans- port White Paper, the 2016 strategy for low-emission mobility and the 2017 Valletta declaration that contribute at defining the EU strategy for improving environmental sustainability of maritime transport.

On specific issues, the EU Regulation on monitoring, reporting and verification of CO_2 emissions from maritime transport (Regulation (EU) 2015/757) requires shipping companies to monitor their CO_2 emissions, fuel consumption and other relevant information during navigation to or from ports in the EEA, when they transport cargo or passengers for commercial reasons. The Directive (EU) 2016/802 relates to the reduction in the sulphur content of certain liquid fuels. Recently, the Proposal for a Council Decision on the position to be taken on behalf of the European Union by the Barcelona Convention contracting parties on the adoption of a Decision to designate the Mediterranean Sea as an emission control area for sulphur oxides ('MED SOx ECA'). The proposal calls for a plan for Mediterranean SECA (Sulfur Emissions Control Area) to limit

sulfur emissions to 0.10% mass by mass, pursuant to Annex VI of the MARPOL Convention (COM (2021) 669 final). To cope with pollution and emissions in seaports and adjacent areas, “Cold Ironing (CI) technology”, also known as “On-Shore Power Supply (OPS)”, “Alternative Marine Power (AMP)”, and “Shore Side Electricity (SSE)”, are some of the methods that are starting to be used to achieve sustainable maritime transport.

Regarding regulations on oil spill prevention and control, the Directive on Safety of Offshore Oil and Gas Operations (2013/30/EU), has put in place a set of rules to help prevent accidents, as well as to be able to respond promptly and efficiently should one occur. European Maritime Safety Agency (EMSA) plays an instrumental role in the prevention of pollution by ships and particular oil in the Mediterranean. Nevertheless, further development of transboundary oil spill contingency plans, early warning systems and decision support systems are needed along with initiatives aiming to increase surveillance at sea, using aerial surveys and radar satellite imagery.

In 2018 the Marine Environment Protection Committee (MEPC) adopted the IMO Action Plan aiming to address marine plastic litter from ships (IMO 2018). In the Mediterranean Region as a whole, the most important instrument to combat pollution from marine litter is represented by the updated Regional Action Plan for Marine Litter Management (UNEP, 2019). The EU has addressed the issue of waste (and subsequently marine litter) from ships by adopting the Port Reception Facilities (PRFs) as a specific regulatory tool. Across the Mediterranean PRFs are in place in some ports so that ships can dispose on shore of their wastes for further collection, treatment, if needed, and final disposal (and should be expanded across the area). The Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues and the subsequent Directive (EU) 2019/883 on port reception facilities for the delivery of waste from ships, aim to substantially reduce discharges of ship-generated waste and cargo residues into the sea. Furthermore, ‘Sustainable, climate-neutral and zero-pollution transport and ports’ is one of the 10 joint priorities agreed by the 43 member countries of the UfM in the framework of the 2021 UfM Ministerial Declaration on Sustainable Blue Economy. The Roadmap for its implementation further points towards concrete opportunities (pilot actions/projects), for joint cooperation on sustainable maritime transport and ports moving forward – emerging from a gap analysis.

What remains to be done is coordinated actions on the regional scale. Joint cross-border actions need to be further developed and implemented to ensure environmental impacts are avoided or minimized. The establishment of MPAs on the high seas (e.g. under the Specially Protected Areas and Biological Diversity Protocol of the Barcelona Convention) is a suggestion toward this direction. Integrated Ocean Management is essential, based on the implementation of ecosystem-based marine and coastal planning tools such as Marine Spatial planning (MSP) and ICZM as well as IMO’s Special Areas and Particularly Sensitive Sea Areas (PSSA) that should be prioritized across the whole region. Regional governance mechanisms should also be adopted to further support the designation of the Mediterranean as an Emission Control Area. From the regulatory perspective, stronger enforcement and compliance mechanisms should be established for relevant legal frameworks. These include the Barcelona Convention protocols concerning ‘Co-operation in Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea’ and the ‘Protocol on the Prevention of Pollution in the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal’.

In parallel to the implementation of the legislative framework described, several actions and pilot cooperation projects are already in place on the regional and /or national level providing good examples of sustainable solutions for the sector. The first shore power supply has been installed in the port of Killini, Greece, in 2018, providing a shore-to-ship (STS) electrical supply connection in Eastern Mediterranean; the development of Intelligent Research Infrastructure for Shipping, Supply Chain, Transport & Logistic (EN.I.R.I.S.S.T Enirisst) which provides a platform for the collection and processing of data, the development of innovative models, programming techniques, useful, secure and user-friendly applications and finally the digital observatories aimed at supporting public and private stakeholders. On the regional level, combating marine litter generation from ships is covered under the Marine Litter-MED Project supported by UNEP-MAP on better management of sea based litter in the ports through PRF or No-Special-Fee system, in synergy with other international initiatives (UNEP/GPA Global Partnership for Marine Litter; the (EU) Marine Strategy Framework Directive (MSFD); the UfM H2020 initiative for a cleaner Mediterranean; the EU SwitchMed Programme; the other European Regional Seas).

The abatement of the pollution from the sector has been addressed by several Interreg-MED projects which promote co-operation in the Region. To name a few: PHAROS4MPA (Blue economy and marine conservation: safeguarding Mediterranean MPAs to achieve Good Environmental Status); MEDOSMoSIS and SHAREMED (Strategic project on Maritime Surveillance); PSAMIDES (create a community of small and medium-sized ports (SPM) in the MED zone); SIROCCO (Sustainable Cruise Tourism Joint Action Plan).

The present chapter focuses on pollution issues such as air emissions and solid waste management related to the transport and ports sector. Waste generation related to strictly to cruise tourism is dealt with under the tourism sector chapter, however some overlaps exist.

Current challenges and actions for achieving the EU Zero Pollution Mission targets as defined by the BMM Mediterranean multi-stakeholders.

The BMM project, through the co-design process of the OIR with local stakeholders in the Mediterranean region, has recorded major challenges and sustainable actions needed on the regional level for accelerating the change. These are categorized following the projects' ontology domains and listed below.

Table 4-9 *Challenges and actions identified by BMM stakeholders of the maritime transport sector.*

Challenges		Actions
Technological/Scientific	Fill in the gap on data regarding the environmental impact from the sector.	Targeted academic research for more knowledge and data.
	Implementation of science-based tools and solutions.	Formally establish standards for sustainable practices in the sector (e.g. GSTC example).

	Challenges	Actions
		Develop multi-stakeholders approaches based on research regarding Shipping, Transport and Supply Chain.
	Decarbonization of the sector.	Develop and Explore plans for decarbonization by 2040.
Policy	Policy and regulation requirements for addressing the different scales of ports in the Mediterranean.	Promotion of multi-level and inclusive governance. The issue of ports' scale and use (touristic, fishing, commercial) to be taken into consideration by local governments when implementing EU Directives (e.g. waste reception facilities).
	Fill the gap between legislation and its implementation.	Make use of guidelines already available (e.g. IMO guidelines on waste reception facilities). Harmonization of regulations, procedures, standards and framework on sustainability in the sector, among different countries including non-EU countries.
Economic	Foster sustainability and zero pollution from the sector.	Financial support for non-EU countries for the implementation of good practices. Improve synergies between ports and destinations to cooperate on innovative solutions and waste management, particularly encouraging cooperation within the public and private sector. Promote Onshore Power Supply (OPS) technology to reduce air emissions in Ports. Increase infrastructure for the collection and separation of waste in ports. Economic incentives for the development of smart ports infrastructure. Implementation of pay as you throw principle in cruise tourism. Setting up waste management programmes and circular systems for ports, including collecting and upscaling end of life gear, mapping and collecting ghost gear, and investing in gear marking. Promotion of alternative eco-sensitive tourism packages.

	Challenges	Actions
Social	Increase competences of the transport and tourism workforce.	Capacity building, training and education actions for the workforce & stakeholders of the sector on the impact and the tools, methods and framework of sustainable practices. Get support from already ongoing initiatives- Networking.
	Engagement and Adoption of good practices.	Engagement of crew members in citizen science actions. Encourage boat-pooling in the leisure sector for transfers and holiday use. Good practices in terms of eco-cruising; guidelines for the sustainability of the cruise sector and the recreational boat sector; stakeholder engagement and workshops to devise action plans for reducing plastic waste and optimizing waste management. Creation of a Sustainable Cruise Alliance Initiative. Targeted campaigns for passengers and tourists on increasing awareness of the impact of transport and cruise services and the value to the economy.

Priorities and next steps for achieving the EU Zero Pollution Mission targets in the Transport and Ports sector in the Mediterranean Region.

For the successful transition of the sector in achieving the targets of the Zero Pollution under the Mission Restore our Oceans and Waters, synergies and cooperation among several economic sectors is needed. Key actors include the tourism, solid waste management, fisheries and plastic industry sectors.

The following priority domains of the sector along the EU Missions dimensions on prevention – minimization- elimination & remediation- monitoring and control of pollution have been identified. Next steps identified for the sector are related to prevention and minimization. Monitoring and control being a cross-cutting dimension is highlighted for specific priorities. The results from the survey have shown that for the Ports & Transport sector of high maturity is the installation of Onshore Supply Systems (OPS) in terms of legislative measures and financial support.

Table 4-10 *Priorities and next steps related to prevention-minimization-elimination & remediation of pollution caused by the **transport & ports sector.** The maturity level of the priority actions and the barriers per domain are based on the stakeholders' survey results (Maturity Level: H=High, M=Moderate, L=Low; Barriers: from light to dark green indicates the increase of barriers) (Annex I)*

	Transport & Ports	Maturity level	Finance	Governance	Society	Technology
PREVENTION	Promotion through **legislative measures and financial support** for the establishment of Onshore Power Supply Systems **(OPS)** in ports is a first step towards prevention of air emissions in ports while encouraging **public-private partnerships.**	**H**				
	Intensification of efforts on **monitoring on air emissions from ships**. To that end **citizen science programmes** engaging crew members in acquisition of data is recommended.	*				
	The acceleration on pollution prevention in the Mediterranean region can be achieved by enhancing **networking on a multi-stakeholder level including EU and non-EU partnerships**. Ensuring a constant flow of information of guidelines and best practices within the networks for the facilitation of the **harmonization of regulations, procedures, standards**.	*				
	Decarbonization of the sector is a challenge targeting in preventing air emissions and GHG. More **research on technological developments and plans** is required.	**M** **L**				

Funded by the European Union

	Transport & Ports	Maturity level	Finance	Governance	Society	Technology
MINIMIZATION	More efforts are needed for the successful **management of solid waste in ports** in the domains of policy and economy. The needs and capacities of **small Mediterranean ports** should be taken into consideration on the **national/local level** through multi-level governance schemes.	*				
	Synergies among Mediterranean ports and for the cruise sector for the adoption and implementation of **'green' practices** related to waste management but also to minimization of resources.	M L				
	Succeeding in the minimization of pollution from the sector requires **social engagement**, increase awareness and adoption of change through targeted trainings of workforce, campaigns for passengers and cruise tourists.	*				

** Inconclusive results*

4.6 Plastics Industry

The plastic industry is an important economic activity in the Mediterranean region and one of the key sectors in achieving the EU Grean Deal and Mission 'Restore our Ocean and Waters' goals. The sector has a primary role in the prevention of pollution by plastics from the very first level of the value chain in support of a circular economy. The challenges for the transitioning of the plastics industry sector to a circular climate neutral economy are related to the minimization of losses during use and manufacturing of goods, and increase of reuse, recyclability and bio-degradability of materials.

Plastic is one of the most broadly employed material used for the production of a wide range of products covering all aspects of human life. Thanks to its versatility, durability, lightness, adaptability and low cost, since the middle of the last century plastics have become key materials in strategic sectors such as packaging, construction, transportation, agriculture, fisheries, renewable energy and medical devices. Plastics include a wide range of synthetic polymers, such as polypropylene, polyethylene, polyvinyl chloride, polystyrene, nylon, and polycarbonate, producing a large spectrum of different final products. Today, about 90% of plastics are still produced from non-renewable fossil-based feedstock (natural gas, oil or coal) with an increasing share of global oil use and GHG emissions. On the other hand, post-consumer recycled plastics and bio-based/bio-attributed plastics respectively account for about 8% and 1.5% of the world plastics production. In 2021, the world plastic production increased to 390.7 Mtonnes. Of this, 57.2 Mtonnes (15% of the global production) was produced in Europe, with a turnover of approximately 405 billion euros and with over 52,000 companies, most of them SME's, distributed across the European Union (incl. plastics manufacturers, converters, recyclers and machinery manufacturers). The packaging industry (39.1%) and building and construction (21.3%) by far represent the largest end-use markets for plastics, followed by the automotive sector (8.6%). Electrical and electronic equipment is approximately 6% and households, leisure and sports is 4% of the total use of plastics (Plastics Europe, 2022). On the EU level the three Mediterranean countries Italy, France, Spain share about 30% (~50 Mtonnes) of the total plastics converters demand (Plastics Europe, 2022). Other important actors of the plastics industry in the Mediterranean region are Turkey and Egypt, with 10 Mtonnes of plastic production in Turkey and a fast growing packaging industry in Egypt (UNDP, 2020). The Mediterranean region is the world's fourth largest producer of plastic goods while less than one third of plastic waste produced every year by Mediterranean countries is recycled (Dalberg Advisors, WWF,2019). At the same time increased coastal population and tourism, associated with linear economic models, are the main drivers of plastic waste generation in the area.

Environmental impact of the sector

The same properties that make plastics so useful, make them a significant environmental threat. Due to their fast dispersion and lack of biodegradability, plastics accumulate in the environment and are considered emerging contaminants of growing concern, potentially affecting human health. The problem of plastic pollution is aggravated by the overconsumption habits of modern society and the linear overproduction of plastic waste which produces obstacles for their appropriate management. Plastic litter can reach the marine environment due to poor waste

management systems and to accidental or voluntary release into the environment. It was estimated that the amount of mismanaged plastic waste entering the ocean is between 4.8 and 12.7 million metric tons in 2010 (Jambeck et al., 2015), thus becoming marine litter. Marine litter is defined as "any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment", including a wide range of materials. However, approximately 60 % to 80% of the world marine litter is made of plastic (Derraik, 2002). If mitigation strategies are not promptly adopted, global estimates for plastic input into aquatic environments can be 2.6 higher in 2040 than in 2016 (Lau et al., 2020). In addressing the marine litter issue, it is crucial to identify the sources (i.e. the economic sector or human activity from which litter originates) and pathways (i.e. the physical and/or technical means by which litter enters the marine environment, such as sewage systems and rivers) that lead to its presence at sea. The items most often collected from the environment, correspond to waste derived from consumer products or their packaging, such as food wrappers, drink bottles, bottle caps and grocery bags. Inputs can be either land based or sea based and may vary in magnitude according to different factors, such as the main economic activities of the region, the population density, the proximity of coastal areas to highly populated and/or industrial zones, the importance of fishery and aquaculture sectors, tourism, maritime traffic, the proximity of rivers and estuaries (Galgani et al., 2015). Despite this complexity in sources (economic sectors/activities) and pathways, which define the magnitude and distribution of plastic pollution, the root causes of the problem lay on the intrinsic properties of plastic materials as described above.

Plastics in the environment span a wide range of sizes from large plastic items (>25 mm) to meso- (5 mm < < 25mm), micro- (< 5mm) and nano-plastic (< 1µm) particles[4] with varying impacts on marine ecosystems. Microplastics can be produced either during the use and wearing out of products or by fragmentation processes of larger items when they become waste. The latter is caused by mechanical breakdown (sand abrasion, wave action), accelerated by UV light photochemical processes (Andrady 2011). Due to their small size, microplastics can be ingested by marine organisms, causing chemical and physical damage (Setälä et al. 2016), or interact with the natural biogeochemical processes affecting the carbon cycle in many ways (Romera-Castillo et al., 2018; Taipale et al., 2019; Vishnuradhan et al., 2019; Galgani et al., 2020). Moreover, the potential consequences for human health deriving from the consumption of seafood contaminated by microplastics should be considered (Sharma and Chatterjee 2017).

Due to its specific characteristics, the Mediterranean basin is particularly affected by the presence of marine litter, plastics and microplastics and, for this reason, it has been proposed as the sixth great accumulation zone for marine litter and plastics in the world. It is an enclosed basin, strongly influenced by human activities. It hosts approximately 10% of the global coastal population, represents one of the world's busiest crossroads for maritime navigation (UNEP/MAP-Plan Bleu 2009), and receives waters from rivers characterized by densely populated drainage basins (e.g., the Nile, Ebro, Rhone, and Po). Moreover, the Mediterranean has a water residence time (i.e. average residence time within the basin) of up to a century. Plastics account for 95 to 100% of total floating litter, and more than 50% of seabed litter (United Nations Environmental Programme, 2019).

[4] All three types of particles (meso-, micro-, nano-) are referred to as microplastics (MPs) throughout the present document.

The total plastic accumulated in the Mediterranean is estimated in the order of magnitude of 1,178,000 tonnes, with values ranging from 53,500 to 3,546,700 tonnes (Boucher and Bilard, 2020). Most of the plastic seems to be accumulated on the seafloor. Average yearly leakage of plastics in the Mediterranean environment is estimated at ~229,465 tonnes/y of which 6% (ranging from 3% to 16%) correspond to microplastic leakages. The three countries more contributing to plastic leakage are Turkey, Egypt and Italy (Boucher and Bilard, 2020), while several countries and areas are receiving significant plastic fluxes onto their coastlines Plastic hotspots tend to appear near the mouth of major rivers (e.g. the Nile and Po) and close to large cities or urban areas (Liubartseva et al., 2018). The analysis of 80 beaches conducted in 2016 (Addamo et al., 2017) indicated that only 10 types of items, mostly single-use plastics (cutlery/trays/straws, cigarette butts, caps/lids, plastic bottles, shopping bags) represent more than 60% of the total recorded marine litter on beaches. Of particular importance are the losses of microplastics during the manufacturing and use of products (i.e. industrial pellets, plastic shoes, synthetic clothes, automobile tyres, synthetic paints) as these have a high potential for release into the environment. Recent data have shown that the most prominent type is paint particles and tyre dust followed by industrial pellets and textile filaments (European Commission, Directorate-General for Environment, EU action against microplastics, Publications Office of the European Union, 2023, https://data.europa.eu/doi/10.2779/917472), a pattern followed on the regional level of the Mediterranean as well (Boucher and Bilard, 2020).

The impacts of plastic litter on marine life are variable. For example, it has been reported that 557 species worldwide, have experienced the deleterious effects and consequences of entanglement, consumption, and smothering (Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel—GEF, 2012). Several works have shown incidents of entanglement and microplastics ingestion by marine organisms in the Mediterranean Sea, ranging from large zooplanktonic species to marine mammals (Fossi et al., 2012;..).

Gap analysis to determine how to achieve transformation of the sector

It becomes clear that the use of plastic products contributes to environmental damage and that producers are to confront tighter regulations with regard to the production and pre- and post- consumer recycling of materials.

At EU level, environmental protection is a priority. In the period 2021-2030, the European environmental policy found its strategic framework in the 8th Environmental Action Program entered into force in May 2022. The program stresses the urgent need to build a climate-neutral, green, fair and social Europe and it represents the European basis for achieving the United Nation's 2030 Agenda and its Sustainable Development Goals. Plastic pollution in particular has been addressed for the first time by the Marine Strategy Framework Directive (MSFD; 2008/56/EC) which represents the tool of the EU's Integrated Maritime Policy to achieve Good Environmental Status (GES) of marine waters (Markus et al., 2011). Following the rationale of the Directive, marine data on plastics and microplastics are collected during 6-year cycles of monitoring and European marine regions are classified as having achieved the GES or not. This is based on threshold values that are currently developed for all environmental compartments targeting marine litter and microplastics. In addition, the Directive requires the

development and implementation of specific precautionary and remediation measures in order to achieve and maintain the GES. Owing to this process a substantial amount of data has been generated showing the magnitude of the problem in European Seas and leveraging further instruments targeting plastics production and use. These include the Plastic Bags Directive (EU) 2015/720, on the levy of plastic bags; the Directive (EU) 2019/904 on Single-Use plastics and the Directive 94/62/EC on packaging and packaging waste as well as policy initiatives addressing biobased, biodegradable & compostable plastics and the unintentional release of microplastics in the environment. The Directive (EU) 2019/904 on the reduction of the impact of certain plastic products on the environment, introduces several bans and restrictions on different uses and materials, in agreement with the "European Strategy for Plastics in a Circular Economy". The aim of the Directive is to reduce the amount of single-use plastic products most often found in Europe's beaches and seas, but also includes lost and abandoned fishing gears. It states that where alternatives are available, single-use plastic products must be banned from the market or alternatively their use has to be limited reducing their consumption. Currently (2023), the European Commission adopted a REACH restriction on microplastics intentionally added to products and a proposal for a Regulation on preventing plastic pellet losses to the environment targeting to a total reduction microplastics release to the environment by 30% until 2030.

On the regional level the United Nations Environment Program - Mediterranean Action Plan (UNEP/MAP) coordinates the implementation of environmental policies as decided by the 22 contracting parties of the Barcelona Convention. Policies such as Land Based Sources Protocol (LBS), the Dumping Protocol and the updated 'Regional Plan on Marine Litter Management in the Mediterranean'' have been adopted and implemented for more than a decade. All these instruments foresee legally binding measures to prevent and reduce marine litter and plastic pollution in the Mediterranean, following the Ecosystem Approach principles. The proposed reduction and prevention measures aim not only at removing marine litter through environmentally friendly methods, but also at raising awareness and effectively managing marine litter/plastic issues with respect to accepted international standards. Yet, the implementation of these measures is variable among the Mediterranean countries, while other instruments on fostering the circularity of materials are still lacking in the region despite the high level agreement in 2021 between the EU and UNEP on fostering the circular economy globally (European Commission and UNEP will foster the circular economy globally).

Tackling the Marine Litter crisis in the Mediterranean cuts across the three axes of UfM's GreenerMed. Furthermore, the 2021 UfM Ministerial Declaration on Sustainable Blue Economy includes for the first time ever a Ministerial priority dedicated to the interactions between Marine Litter and the sectors and activities of the Sustainable Blue Economy in the Mediterranean, within a wider circular economy approach, based on the principles of Sustainable Consumption and Production. The Roadmap for the implementation of the Declaration further points towards concrete opportunities (pilot actions/projects), for joint cooperation moving forward – emerging from a gap analysis.

The legislative framework described has acted as a driver for the transition of the sector, yet more efforts are needed especially in respect to clear policies on the uses of bioplastics, biodegradable and compostable plastics. Bioplastics development has been supported by EU R&D funding instruments (FP7, H2020, LIFE, etc) and more than 130 projects of public or joint public and private research projects have been performed in

the last decade. Research topics cover the complete life cycle of biobased and biodegradable plastics, including material and application development, recycling, circularity, and supplementary work on sustainability and communication. Industrial participation in the projects highlights the need for public and private research in the field of the biobased economy in Europe. Nevertheless, until now biodegradable plastics correspond to only 0.3% of total plastics production and the impacts of these projects are not fully realized. In the Mediterranean countries bioeconomy strategies are under development in Italy, France, Slovenia, Spain and Turkiye and the largest number of commercial & pilot plants are located in Italy (~18), France (~15) and Spain (~9) (Natrass et al., 2016), while very few projects have been developed on the regional level (i.e. ENI-CBC, Interreg). At the same time there is still wide-spread confusion among end-users on the benefits of bioplastics or biodegradable plastics. The production of bio-based polymer materials (i.e. from renewable resources) provides a solution for the independence of the sector from fossil-fuels demand and contributes to the minimization of GHGs, but does not provide a universal remedy to the problem of plastic pollution. There is a need for adoption of accurate definitions for bio-based, biodegradable and compostable plastics. Bio-based plastics do not necessarily biodegrade and both types of polymers can be either biodegradable or non-biodegradable (SAPEA 2020). The process of biodegradation is very much dependent on the chemistry of the original polymer material regardless of its source, (i.e. fossil-based or bio-based) and the presence of chemical additives. In addition, the process can vary largely in time and space under variable environmental conditions. Scientific evidence for biodegradation properties under specific environmental conditions is needed to demonstrate the benefits of the use of biodegradable plastics for specific uses.

The EU Strategy on Plastics (2018; 2019) prioritizes reuse, repair and recycle targeting to achieve recycling for half of the annually generated plastic waste by 2030. Indeed, recycling rates are increasing throughout Europe and key enabling factors such as the separate collection of recyclables have been identified. However, to achieve the EU Mission targets there is a clear need for acceleration of the sector's transition.

Current challenges and actions for achieving the EU Zero Pollution Mission targets as defined by the BMM Mediterranean multi-stakeholders.

The BMM project, through the interaction with local stakeholders in the Mediterranean region, has recorded the key challenges and actions needed on the regional level for accelerating the change. These are categorized following the projects' ontology domains and listed below.

Table 4-11 *Challenges and actions identified by BMM stakeholders of the plastics industry.*

	Challenges	Actions
Technological/Scientific	Development of bio-based plastics.	Improve production capacity of bioplastics in Europe. Development of new feedstock materials non fossil based (i.e. food waste, aquatic waste etc.), ensuring self sufficiency.

	Challenges	Actions
	Development of biodegradable plastics.	Research on biodegradable polymers in an environmental context and timeframe. Testing and certification standards for biodegradable plastics in controlled and open environments, incl. microplastic generation and chemicals leaching.
	Accelerating recycling rates.	Improving post-consumer recycling technologies Improving chemical recycling technologies. Improving bio-recycling technologies for compostable plastics. Upcycling technologies e.g. PET bottles to yarn.
	Minimizing losses.	Reduce the use and loss of plastics in industries. Develop projects such as the Operation Clean Sweep® (OCS). Adoption of advanced technology, such as artificial intelligence (AI), robotics, and the Internet of Things (IoT).
	Reuse-Refill.	Thorough assessment of reuse-refill systems acknowledging local specificities.
Policy	Support circularity.	Harmonization of regulatory frameworks throughout the EU Mediterranean countries in support of long-term investments. Legislative regulations for industries to increase recycled content. Legislative regulations for industries to monitor plastics use and loss during production of goods. Disclose data. Standardization/Certificate for validation of recycled content.
	Policy framework on bioplastics, biodegradable, compostable plastics.	National Bioeconomy strategies. Accurate labelling. Specifications for uses of biodegradable materials.
Economic	Realization of the circular economy.	Economic incentives for adopting innovative technologies.

	Challenges	Actions
		Increasing investment in automation and digitalization. Extended producers' responsibility (EPR) for infrastructures for collection and recycling. Prioritize sustainability through the whole value chain. Deposit return schemes. Incentives & Financial support for Reuse-Refill models.
	New business opportunities in the Med countries.	Increase R&D investment on new materials development. Foster regional cooperation. Economic incentives for the use of renewable feedstock materials. Piloting reuse-refill models.
	Harmonization of EU and non-EU targets.	Need for enhanced synergies among local stakeholders. Networking of associations.
Social	Overcome delays in the adoption of sustainable solutions by the sector.	Support SMEs by raising their awareness and implement actions for those which are already more conscious of R&D and innovation. Employees' training on monitoring plastic losses and on the efficiency of adopted practices.
	Changing consumer habits towards eco-friendly products.	Increase industry's accountability by disclosing data on recycling, on minimization of losses. Certification on recycled content. Increase awareness on the distinction between bioplastics and biodegradable plastics.
	Stimulate behavioural change for reuse-refill systems.	Expanding the systems to many products, increase availability & convenience of systems.

Priorities and next steps for achieving the EU Zero Pollution Mission targets in the Plastics Industry sector in the Mediterranean Region.

The transition of the plastics industry towards a circular economic model affect directly all other sectors due to the wide dependence of the sectoral economies on the use of plastic materials. This becomes particularly true for sectors such as agriculture, fisheries, tourism and solid waste management in port/cities/regions for which have been identified as plastic pollution contributors. The development of 'green' eco-friendly solutions in the plastics industry will act as a multiplier for the green transition of other sectors.

The following priority domains of the plastics industry sector along the EU Missions dimensions on prevention – minimization- elimination & remediation of pollution have been identified. Next steps identified for the sector are related to prevention and minimization. Monitoring and control being a cross-cutting dimension is highlighted for specific priorities. Under the Plastics Industry sector four priority actions seem to have a quite high maturity level, meaning that they are considered ready for acceleration in their implementation. These include synergies in new business opportunities for circular models, regional cooperation for the recycling businesses, cooperation with waste management sector for efficient separate collection of recyclables (e.g. door to door schemes).

Table 4-12 *Priorities and next steps related to prevention-minimization-elimination & remediation of pollution caused by the **plastics industry sector**. The maturity level of the priority actions and the barriers per domain are based on the stakeholders' survey results (Maturity Level: H=High, M=Moderate, L=Low; Barriers: from light to dark green indicates the increase of barriers) (Annex I)*

	Plastics Industry	Maturity level	Finance	Governance	Society	Technology
PREVENTION	Although **reuse- refill economic models** are a priority in the waste hierarchy and in the EU Plastics Strategy and the Green Deal Policy **more efforts are needed for the acceleration of their implementation on the knowledge, policy, economic and social dimensions**.	L				
	Bioplastics and biodegradable plastics. There is a need for **acceleration of the sector in the Mediterranean region**, in line with scientific technological improvements. To achieve this, **a clear regulatory framework** is needed to provide clear definitions and trigger research oriented to the biodegradability of materials under various environmental conditions and timeframe. At the same time, **citizens and end users should become aware of the differences** in materials properties and performance and their position in the waste hierarchy, i.e. that they do not constitute a universal substitute of fossil- fuel plastics.	M L			-	
	Strengthening **regional cooperation** in the sector and provide **new business opportunities on circular models.**	H M				

	Plastics Industry	Maturity level	Finance	Governance	Society	Technology
MINIMIZATION	Increase the **rate of recycling and amount of recycled content in plastic goods**.	M L				
	In addition, synergies with the solid waste management sector **for an efficient and wide adoption of separate and door to door collection schemes** (EPR, deposit-return), along with citizens awareness and **data disclosing on the fate of recyclables**. Policies and regulations setting targets on recycled content and the development of a **certification process** can further leverage successful results.	H M				
	Strengthening research into the **valorisation of waste collected from the environment.**	M L				
	Preventing and **minimizing losses during the manufacturing of goods**, by adopting best practices. SMEs and employees training in **monitoring and controlling the adopted practices** is essential to make decisions for interventions.	L				
	Strengthening **regional cooperation** in the sector and provide **new business opportunities for the recycling businesses.**	H M				

4.7 Wastewater and Solid Waste Management in regions/cities/municipalities

Wastewater treatment and solid waste management systems in regions, cities, and municipalities comprise an integral pillar for achieving the EU Mission and Green Deal goals. Following the Mission dimensions for achieving Objective 2 goals, Prevent-Minimize- Eliminate & Remediate – Monitor & Control, the overarching challenge is to transform regions, cities and municipalities from treating more waste to treating less.

Production of urban wastewater and municipal solid waste (MSW) is clearly linked to the increasing rates of coastal urbanization in the Mediterranean region. Around 70% of the Mediterranean population lives in urban areas, which has increased across the region in the last decade, with more than half of the population living in urban areas in 2017 in all countries except Egypt and Bosnia and Herzegovina, and one out of three people living in a coastal region (UNEP/MAP and Plan Bleu, 2020).

Waste generation and water use are closely linked to current consumption patterns and to different economic sectors. The annual average MSW generation per capita is ~ 500 kg for the EU Mediterranean countries and ~300 kg per capita for the non-EU countries of the region. Consumption growth is reflected not only in the amount but also in the composition of waste, including for example specific waste streams such as electronic and packaging waste (EEA, 2020). The exponential increase in municipal solid waste generation is a consequence of the established linear model of production, consumption, and disposal, which requires transformative change. To that end, strategies and policies have been adopted on the EU level (EU March 2020 circular economy, green deal) towards a circular economy model that encompasses materials circularity and water reuse. On the Mediterranean level, improving waste management, starting with waste collection, has been recognized as a priority under the Barcelona Convention and within the Union of the Mediterranean. Indeed, it was the first regional sea adopting legally binding measures for marine litter management (EEA, 2014)

The management of wastewater and MSW is primarily an issue of public concern due to their impacts on public space (environment) and public health. Policy strategies from the highest (International /EU) to the lowest local level need to be aligned yet recognizing local specificities. Although there is still some way to go, a positive trend can be seen in which recycling has increased and landfilling has been reduced in the EU Med. Even if municipal solid waste generation is higher in more-developed countries, other nations are following similar trends, with no evidence of distinguish between economic growth and population increase (EEA, 2020).

Waste management and wastewater treatment depend on national governments but operationalized through regions and municipalities. In this sense, municipalities have a crucial role since they are the local authority and directly deal with the waste generated. Municipalities usually hold the competence for solid waste collection while responsibilities for treatment and recycling usually lie in an upper level of governance. The disposal systems are very different in each Mediterranean country. Local and regional governments have also a crucial role in awareness raising and education. The connection between the private sector and national/local authorities is typically characterized by public-private partnerships and contractual arrangements. These partnerships are designed to achieve effective and efficient waste management. A

common framework for waste management practices among Mediterranean countries compromising local specificities including tourism and refugee influx, is still a challenge. At the EU level water and solid waste management policies set specific targets and further focus on promoting the prevention of waste generation and the re-use of water and products as much as possible, while for the non-EU countries, a harmonized waste management strategy framework is lacking (EEA, 2016).

Environmental impact faced by the sector

During the last decades, considerable improvements have been made regarding the wastewater treatment facilities, yet still nutrients discharges in the Mediterranean basin cause environmental deterioration in specific coastal areas (MedECC, 2020). The overall inputs of N and P in Mediterranean coastal areas are about 1.5-4.5 and 0.1-0.4 Mt yr-1, respectively, 45% of which are attributed to wastewater discharges. Although much has been done in reducing nutrient emissions, several coastal regions experience eutrophication problems, including hypoxia or anoxia, which may result in harmful algal blooms (HABs), with direct impacts on tourism, fisheries and aquaculture.

It is well recognized that citizens are exposed to 'micropollutants'- contaminants of emerging concern (CoEC) used in various products of everyday life. All these chemicals with harmful potential to human and aquatic life find their way to the environment via wastewater discharges. Treatment plants can retain these pollutants only to some extent. The varying degree of treatment and capabilities of the applied cleaning technologies have resulted in significant inputs of CoECs into the aquatic environment via the WWTP pathway. For example, in the marine environment in the vicinity of the Athens WWTP in the Saronikos Gulf, (Alygizakis et al., 2016), have shown the occurrence of 38 pharmaceuticals and drugs reaching a cumulative concentration of 200 ngL^{-1}. Similarly, the presence of pesticides and their transformation products appears ubiquitous in the influents and effluents of WWTPs in Spain and Greece (Kock-Schulmeyer et al., 2013; Rousis et al., 2021). It has been recorded that many of these substances are not removed sufficiently with current technologies to meet the environmental standards as set by the WFD (EEA, 2022; Gardner et al., 2012) and that the WWTP pathway is a considerable input source of CoECs in the environment (Kock-Schulmeyer et al., 2013; Comber et al., 2015). Several research works have shown the ubiquitous presence of CoECs (incl. pharmaceuticlas, pesticides, drugs, PFAS) in the Mediterranean seawater at concentrations ranging from the sub-ng to ngL^{-1} levels (Alygizakis et al., 2016; Brumovsky et al., 2016; 2017; Schmidt et al, 2019).

An issue of concern is the growing number of chemicals used in everyday products (EEA, 2019) which cannot keep pace with environmental detection and control (Hollender et al., 2023). For example, some regulated chemicals by the Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) are phased out while at the same time others of unknown environmental/health impacts are introduced into the market (EU, 2006). Similarly, environmental standards and technologies for retention/destruction of these chemicals in wastewaters are lagging.

Mismanaged waste on land is considered one of the main causes for the observed contamination of the Mediterranean Sea by plastics. The impact of plastic litter on the environment and the economy is well documented (Newman et al., 2015; UNEP, 2021). It is estimated that ~730 of tons of plastics enter the Mediterranean marine environment

every year (UNEP/MAP, 2015). Full waste collection coverage is not reached in several non-EU Mediterranean, where more than 50% of waste is disposed of in open dumps (UNEP/MAP). The magnitude of the problem is reflected on beach litter data which show that of the Mediterranean beaches monitored ~79% fall above the UNEP/IMAP threshold and ~90% above the stricter EU MSFD threshold, (Hanke et al., 2019; van Loon et al., 2020; UNEP/MAP, 2023). If current practices continue (business as usual), all models agree that the annual amount of mismanaged waste will more than doubled by 2040, while the cumulative mass of plastics in the oceans will increase exponentially by one order of magnitude (Lau et al, 2020). The terrestrial environment is also affected, yet more data are needed to better assess the terrestrial leakage of plastics.

A secondary effect of plastic waste dispersion and of plastic use is the generation of microplastics. In the Mediterranean Sea concentrations of floating microplastics are at places equal to those found at the oceanic gyres (~ 1 million items km^2) (Cozar et al., 2015; Adamopoulou et al., 2021), posing threats either on the organism (Fossi et al., 2012; Frias et al., 2014; Digka et al., 2018; 2020) or on the ecosystem level (Galgani et al., 2020) which are only starting to be understood. In addition, knowledge of their inputs to the environment is still lacking and in particular the relative magnitude of primary versus secondary[5] microplastics releases (Boucher et al., 2017). Microplastics releases originating from fragmentation of solid waste are directly related to the amount of mismanaged waste, while those included intentionally into products (i.e. cosmetics) can be regulated at source. On the other hand, microplastics originating during the use/lifecycle of products requires a multi-management and /or regulation approach. The latter types of microplastics may originate from synthetic textile washing, tyre abrasion, marine coatings, city dust (e.g. synthetic soles of footwear, synthetic cooking utensils, household dust, artificial turfs, building coatings). All these types of microplastics enter the marine environment via urban runoff and wastewater discharges (Ben-David et al., 2021; Pittura et al., 2021) making minimization of their inputs an issue of concern for the wastewater management sector, while prevention of their generation remains to be dealt by specific economic/production sectors.

Gap analysis to determine how to achieve transformation of the sector

Environmental policy on the EU level consists of strategies, laws, directives and regulations which cover not only issues related to the management of waste water and solid waste but also to the transition to a circular economy for the minimization of waste production. Within the framework of the European Green Deal Strategy a New Circular Economy Action Plan has been adopted in March 2020, which defines the priorities and actions needed for less waste and more value towards a transition to a circular economy. Other legal instruments supporting the minimization of wastes are: (i) The Urban Waste Water Treatment Directive (UWWTD) (Council Directive 91/271/EEC) is in force for more than 30 years and was revised recently (2022) to adapt to current standards; i.e. addressing among other issues micropollutants, microplastics, energy efficiency and

[5] Definitions of primary microplastics concern industrial plastic pellets and those intentionally included in products (e.g. cosmetics) and of secondary microplastics those produced during fragmentation of larger plastic waste when littered in the environment, after the end of their life cycle. Microplastics produced during the use/lifecycle of products (i.e. washing of synthetic textiles, erosion of tyres, etc.) are considered either as primary (IUCN, 2017) or secondary ones (GESAMP 2019) depending on literature sources.

circularity. (ii)The Waste Framework Directive (2008/98/EC) amended in 2023, sets the basic principles and targets for integrated waste management and it is complemented by laws and regulations for specific types of waste (i.e. construction & demolition, batteries & accumulators, end-of-life vehicles, packaging waste, mining waste etc.). (ii) Several laws targeting prevention of plastics dispersion (i.e Plastic Bags Directive (EU) 2015/720; Directive (EU) 2019/904 on Single-Use plastics; Directive 94/62/EC on packaging and packaging waste) including policy initiatives addressing biobased, biodegradable & compostable plastics as well as the unintentional release of microplastics in the environment. In addition, the Water Framework (2000/60/EU) and Marine Strategy Framework Directive (2008/56/EC) aim in protecting Europe's aquatic environment and ask for specific remediation measures to be taken on the country level. Nevertheless, all these policies are implemented to a varying degree by the EU Mediterranean countries while the harmonization of the legislative framework with the non-EU Mediterranean countries is behind.

In the Mediterranean EU countries, operate about 9,249 wastewater treatment plants, 65% of which apply biological treatment with nitrogen and/or phosphorus removal, 32% apply simple biological treatment and 3% operate only primary treatment. Regarding the quality of water produced, on average 60% of wastewater is in line with the EU regulations under the UWWTD (EEA/WISE). When including non-EU countries however, 18% of the plants operate only primary treatment (MedECC, 2020). Across the whole Mediterranean region, specifications for wastewater treatment facilities address varying conditions in terms of the magnitude of the population served, contaminants present in water, local climate and environmental standards of receiving waters. Monitoring of CoECs in the marine environment remains a challenge due to the numerous substances in the market with unknown environmental and health effects. The UN Stokholm Convention (1972) was first to prioritize a list of 12 chemical substances for environmental monitoring and control purposes, and has been updated since then to 22 substances (2023) (The New POPs). In parallel, the EU Water Framework Directive (2000/60/EC) has published a list of priority substances (2013/39/EC) along with a "watch list" of 45 contaminants, updated in 2022 (EU 2022/1307) that could pose a potential threat and for which monitoring in aquatic environment is needed. Despite these efforts environmental quality standards (EQS) have been set for only some of these substances (2013/39/EU) and most substances on the list are currently insufficiently monitored for an EU- or Mediterranean -wide risk assessment. This is mostly related to lack of harmonization in methods and tools of the environmental chemical monitoring approaches that would promote interoperability and reuseability.

Regarding micropollutants and microplastics, state of the art technologies for their minimization/elimination (ozonation, micro-fluidic oxidation, activated carbon, membrane bioreactors) in WWTPs exist and/or are currently developed and tested under several EU-Horizon Mission and Mediterranean Lighthouse projects yet their adoption is hindered by various barriers (financial, lack of coordination, lack of awareness).

In line with the circular economy concepts, the EU Waste Framework Directive (2008), adopts the 5- step hierarchy of wastes management (Prevention-Reuse-Recycle-Recovery-Disposal), and gives disposal in landfills the lowest priority. Today, fifteen years after the Directive was first published in 5 out of the 8 EU Mediterranean countries, more than 50% of total waste generated is still landfilled. Based on the European Commission

report on the implementation of the Waste Directive only 2 Mediterranean countries meet the main recycling targets for municipal waste and packaging for 2025 while for the rest 6 the circular material use rate is well below the EU average of 12.8% (Implementation of the Waste Framework Directive (europa.eu). For many countries, the collection of MSW remains particularly difficult in rural areas, where waste is usually illegally dumped or burned. At the same time, numerous EU projects have tested best practices and solutions in support of the European Environmental Policy in both EU and non-EU countries. Public awareness regarding the environmental impacts of plastics and marine litter has risen and implementation of pilot local citizen/policy schemes and/or technical solutions has been tested in many Mediterranean areas. Yet, the upscaling, adoption and/or institutionalization of these solutions remains a challenge, in particular those related to elimination of waste already in the environment.

On the regional level the 22 contracting countries of the Barcelona Convention decide on a series of policies and strategies under the coordination of UNEP/MAP, related to the minimization of wastes and contaminants in the Mediterranean environment. These include the land-based protocol (LBS), the hazardous waste protocol, the dumping protocol, the offshore protocol and the prevention and emergency one. Still these protocols have not been ratified by all contracting parties, while their implementation rate is variable. In addition, in 2021, the updated "Regional Plan on Marine Litter Management in the Mediterranean" and "Regional Plans on Urban Wastewater Treatment and Sewage Sludge Management" have been adopted by the Barcelona Convention Parties. The Plans, fully based on the Ecosystem Approach principles (Secretariat of the Convention on Biological Diversity, 2004), provide the basis for the adoption of legally binding measures to prevent and reduce pollution in the Mediterranean. Despite all the progress made so far on the policy, technology, and social dimension, practices such as unregulated burning and landfilling are still ongoing in some cases. In the EU Mediterranean countries these practices are reported, and an established mechanism of action for issuing fines ensures their minimization. Similar mechanisms or legal actions in non-EU countries do not seem to exist and in almost all cases there is a lack of data and reporting especially related to the enforcement measures and the need for improving capacity building has been identified (UNEP/MAP and PlanBlue 2020). For example in 2014, Algerian waste processing contained 60 to 65 % of discharging by landfill, 30 to 35 % of burning, 7 % of recycling and 1 % of composting (Global Recycling, 2019: https://global-recycling.info/archives/2620). Several initiatives through European Mediterranean Cooperation projects (e.g. Interreg, ENI-CBC Med) have resulted in successful paradigms. In the case of EU Mediterranean and non-EU Mediterranean the engagement and support to the "informal sector" has proven a valid system to assure the proper separation and canalization of e.g. plastic packaging. Good examples and best practices on the local level exist yet more efforts are needed for their capitalization and wider adoption (Zero Waste In The Mediterranean, 2021).

Current challenges and actions for achieving the EU Zero Pollution Mission targets as defined by the BMM Mediterranean multi-stakeholders.

From the interaction of the BMM project with relevant Mediterranean stakeholders specific challenges along the ontology domain of the BMM project and sustainable actions were identified and listed in the Table below.

Table 4-13 *Challenges and actions identified by BMM stakeholders of the wastewater and solid waste management sectors.*

	Challenges	Actions
Technological/Scientific	Exploitation of solid wastes collected from the environment.	Valorisation of waste collected from the environment. Upgrade collection technologies into collection and transformation of waste.
	Minimize micropollutants & microplastics releases to the aquatic environment.	Filters & biofilters for microplastics in WWTPs. Algae for capturing chemicals in WWTPs. Micro-fluidic technologies for micropollutants destruction. Improve technologies and nature - based solutions to be energy efficient.
	Improve recycling efficiency.	Develop upcycling technologies e.g. PET bottles to yarn. Improving recycling schemes on chemical, bio- recycling. Develop metrics and tools for efficient materials recovery. Acknowledge/adopt traditional practices.
	Minimizing losses.	Reduce the use and loss of plastics in industries. Develop projects such as the Operation Clean Sweep® (OCS). Adoption of advanced technology, such as artificial intelligence (AI), robotics, and the Internet of Things (IoT).
	Reuse-Refill.	Thorough assessment of reuse-refill systems acknowledging local specificities.
	Develop modern tools for the reuse-repair market.	Promote digital twins and networks for minimizing other types of waste except packaging (e.g. clothes, electronic devices).
	Monitoring and assessment strategies to address current/emerging pollution.	Improve analytic capabilities for chemicals and micro- nano-plastics detection in the environment.

	Challenges	Actions
Policy	Policy instruments for the transition on the national/local level.	Update & facilitate regulations (permits & approvals) by local authorities for adopting innovative technologies and solutions incl. collection technologies. Regulations for waste collected from the environment (based on waste typology, valorisation, recycle/disposal requirements). Develop a policy/legal framework for facilitating the repair-reuse market. Standardization/Certificate for eco-innovative businesses.
Economic	Accelerating the circular economy in cities/municipalities.	Increase landfill tax on municipalities. Reward on low waste production. Enforce pay as you throw principle for citizens and businesses. Deposit return schemes. Promote Refill- Reuse-Repair models in cooperation with enterprises (e.g. water refill stations in cities).
	Overcome financial barriers for adopting innovative technologies.	Extended producers' responsibility (EPR) for infrastructures for collection and recycling. Extended producers' responsibility (EPR) for infrastructures for destruction of micropollutants & microplastics in WWTPs.
	Accelerating market for secondary materials.	Levy on specific single use products esp. those not having adequate recyclable content. Levy for mandatory recycled content.
	Accelerate the repair business market.	Economic incentives and support to strengthen local repair markets to become viable and attractive for the citizens.
Social	To compromise all sectors interests.	Coordination of all actors - Need for an Integrated Social Engagement (participation) Strategy (incl. schools, business employees, civil servants, citizens).

Challenges	Actions
Change consumers' habits.	Awareness on products properties, i.e. eco-innovation, low carbon footprint, recycled content. Disclosing data on flows and quantities of recycled materials after segregation. Citizens' training to dispose of properly.
Increase awareness of local stakeholders on the adoption of solutions.	Networking of cities for the exchange of good practices. Engage municipalities to manage waste collection from the environment. Support door to door waste collection schemes. Awareness and training on multi-solutions approach. Increase capacity of municipalities' employees to monitor the management plants operators.

Priorities and next steps for achieving the EU Zero Pollution Mission targets in the wastewater and solid waste management sector in cities/regions in the Mediterranean Region.

The acceleration of the circular model in wastewater and solid waste management was highlighted as a priority and the following key messages were identified: Circular economy requires local/national initiatives and a bottom-up approach; tools and incentives for accelerating the transition are needed; networking and exchange of good practices across Mediterranean cities is crucial. Cooperation with the plastics packaging industry and local enterprises is an enabling factor.

The following priority domains of the wastewater and solid waste management sector in cities/regions sector and in cooperation with other sectors along the EU Missions dimensions on prevention – minimization- elimination & remediation- monitoring and control of pollution have been identified. Next steps identified for the sector are related to prevention elimination and minimization. Monitoring and control being a cross-cutting dimension is highlighted for specific priorities. Mediterranean stakeholders have highlighted that conditions are mature for the training of municipalities' employees on new developments on recycling and on wastewater cleaning technologies to request for such specifications from plant operators. Increase capacity to monitor the plants operators.

Table 4-14 *Priorities and next steps related to prevention-minimization-elimination & remediation of pollution for the **wastewater and solid waste management sector in cities & regions**. The maturity level of the priority actions and the barriers per domain are based on the stakeholders' survey results (Maturity Level: H=High, M=Moderate, L=Low; Barriers: from light to dark green indicates the increase of barriers) (Annex I).*

	WWTPs & SWM in cities and regions	**Maturity level**	**Finance**	**Governance**	**Society**	**Technology**
PREVENTION	Accelerate the adoption/establishment of **refill models** (e.g. water stations) by establishing **cooperations and agreements with local enterprises**.	**L**				
	Cities/Regions should seek **economic incentives** and support to strengthen **local repair markets** to become viable and attractive for the citizens.	**L**				
	Mediterranean networks of cities and regions are an effective tool **for the acceleration of circular practices** and a wider participation should be fostered.	**M L**				
MINIMIZATION	**increases in landfill taxes**	**M**				
	wider implementation of the **pay- as-you-throw principle to include citizens and businesses**	**L**				
	the promotion of **EPR schemes** for the implementation of **innovative technologies for plastics recycling and for retention/destruction of microplastic and CoECs from WWTPs**.	**M**				
	The **effectiveness of recycling** has proven to increase when using **separate collection schemes** esp. by **door-to-door**. The action requires citizens awareness and training to follow such schemes and a re-organization of the waste management strategy of the municipalities.	**L**				

	WWTPs & SWM in cities and regions	Maturity level	Finance	Governance	Society	Technology
	Enforcement of regulations regarding a **fixed percent of recyclables in new plastic packaging** is another tool for accelerating recycling and can be included in relevant **legislation/regulation on the national/local level** that will unlock the recyclables market.	**M**				
	Awareness and training of municipalities' employees on new developments on recycling and on wastewater cleaning technologies to **request for such specifications from plant operators**. **Increase capacity to monitor the plants operators**.	**H M**				
	Systematic data acquisition on all stages of wastewater and solid waste management to control the effectiveness of actions taken. Update the requirements to **include data on microplastics and CoECs**.	**-**				
ELIMINATION & REMEDIATION	**Adoption of collection technologies by the cities/municipalities/regions for** the elimination of **solid waste and litter found in the environment.**	**M L**				
	A crucial issue towards their proper management is their **valorization**, **characterization** in terms of typology and **development of related regulations**. The actions require further **scientific research and communication** among actors.	**M L**				

5. FINAL REMARKS

The BMM co-design process of the OIR has revealed a total of 62 priority actions for the de-pollution of the Mediterranean basin, several of them being shared by more than one economic sector. Furthermore, the BMM OIR survey provided some indications on the maturity of the identified priority actions. Out of the 62 priority actions, 24% have been characterised as quite mature for implementation (H, H/M, M) while most of them (58%) have been characterised of low (L) or medium- low (M/L) maturity level (Figure 5.1).

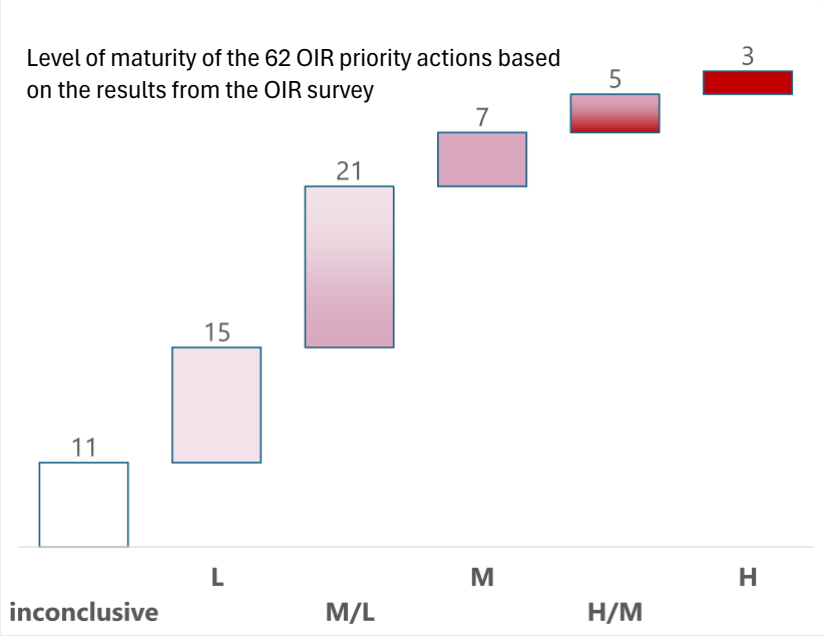


Figure 5-1. *Maturity level of the identified priority actions based on the results from the OIR survey.*

Below are briefly described common priorities among sectors and those of a relatively high maturity level. In Figure 5-2priority actions are clustered per sector including also cross-sectorial synergies. For some priorities the need for more research and scientific knowledge was highlighted by stakeholders, and these are clustered separately.

Of importance for the Mediterranean Region are those related to the **strengthening of cooperation among EU and non-EU countries** for increasing competences of workforce, harmonisation of regulations, and replication and testing of solutions through dedicated financial instruments. The role of UfM and UNEP/MAP is crucial in facilitating cooperation.

Despite the existence of a common EU legislative framework aiming and supporting **the Mission targets**, more efforts are needed on the **national/local level, to foster results**. **Cities and regions** are key actors in facilitating circularity, by employing **strategic plans**, regulations and incentives towards the realisation of the circular economy and the Green Deal **in cooperation with the private sector**.

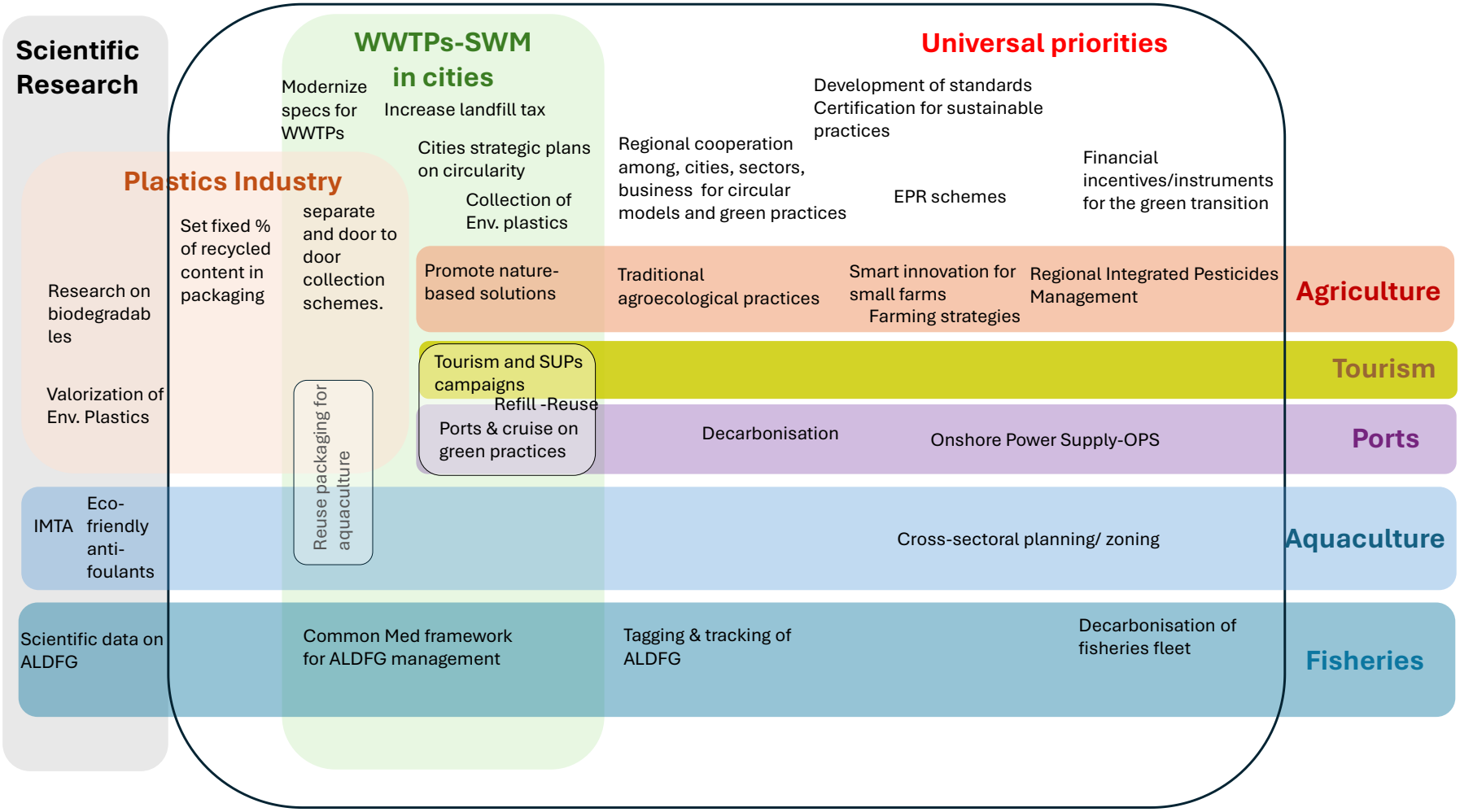


Figure 5-2. *The sectorial priority actions and cross-sectorial synergies as identified through the BMM OIR co-design process.*

Actions and solutions for the prevention, minimization, elimination & remediation of pollution need to be taken into consideration in an integrated way. Plans should be up to date and target to the minimization of plastics, microplastics and CoECs by fostering the adoption of **existing innovative technologies** for their **minimization** at input sources and **elimination** from the environment. **Networking** of Mediterranean cities/regions is crucial in the exchange of information and for **upskilling the employees**.

There is a need for **accelerating the implementation of refill and reuse models**. These can be applied to **sectors in direct link with citizens such as tourism, transport - ports and SWM in cities/regions** but also in the aquaculture and fisheries sectors. **Public private and private-private agreements** can help.

Accelerating recycling of plastics appears to be a shared vision for all sectors. For the increase in the recycling rate and the recyclables content in new packaging, the **plastics industry asks for higher quality recyclables**. **Separate collections schemes** (e.g. door-to-door) should be promoted **in all sectors** and along the value/service chain to support the acceleration in recycling of plastics. **Awareness raising, training of workforce and social engagemen**t are required for facilitating the action. **Regulations on the national/local level for fixed percent in recycled content** in new products/packaging can leverage the acceleration.

Tested schemes for alleviating financial barriers in the implementation of circular strategies such as the **EPR need to be widely implemented and beyond the packaging industry**, including aquaculture and fishing nets and agri-plastics producers, while targeting not only to plastics packaging but also the CoECs content in products.

To improve circularity and target interventions along the value/service chain, **all sectors** have pointed out the need for **more accurate data on the quantities and flows of materials and waste produced**. **Digital and smart tools,** making use of **AI developments** can support **accurate, fast and easy monitoring**, coupled with training and upskilling of the workforce.

Another action shared by all sectors is the development and establishment of sectorial **standards for eco-friendly 'green' practices** and the expansion of the **certification** process. Data disclosing on the use of plastics and on minimizing losses will improve the credibility of the businesses.

Networking of enterprises across the Mediterranean and exchange of 'green' practices was highlighted especially for **the tourism and transport & ports sectors**. For the latter it is essential to take into consideration **small ports** which are widespread in the Mediterranean, **for the development of policies, regulations, and incentives for the adoption of 'green' practices**.

On the prevention dimension there is a clear **dependence of the Agriculture and Fisheries sector** with the **plastics industry** in relation to the **development of truly biodegradable plastics**. Yet, bioplastics and biodegradable plastics need to be clearly defined based on scientific evidence that will guide regulations for use to avoid misunderstandings.

Nature-base solutions for the **remediation of agricultural land and river catchment**s from the excess of nutrients and/or pesticides are promising solutions that need **more development and testing under local conditions**. In parallel, **a clear policy framework** is required based **on scientific knowledge.**

For the ports & transport sector the **installation of OPS systems** appears to be of high priority and considered in a mature state for its wide implementation.

The BMM OIR survey provided some insights, based on the stakeholders' opinions regarding the domain (finance, governance, society, technology) that holds the greatest barriers for the acceleration of the implementation of the priority actions. Slight differences can be discerned based on the country of origin of the respondents (Figure 5-3), but overall stakeholders' responses indicate that for most priority actions more efforts are needed in the governance and finance domains.

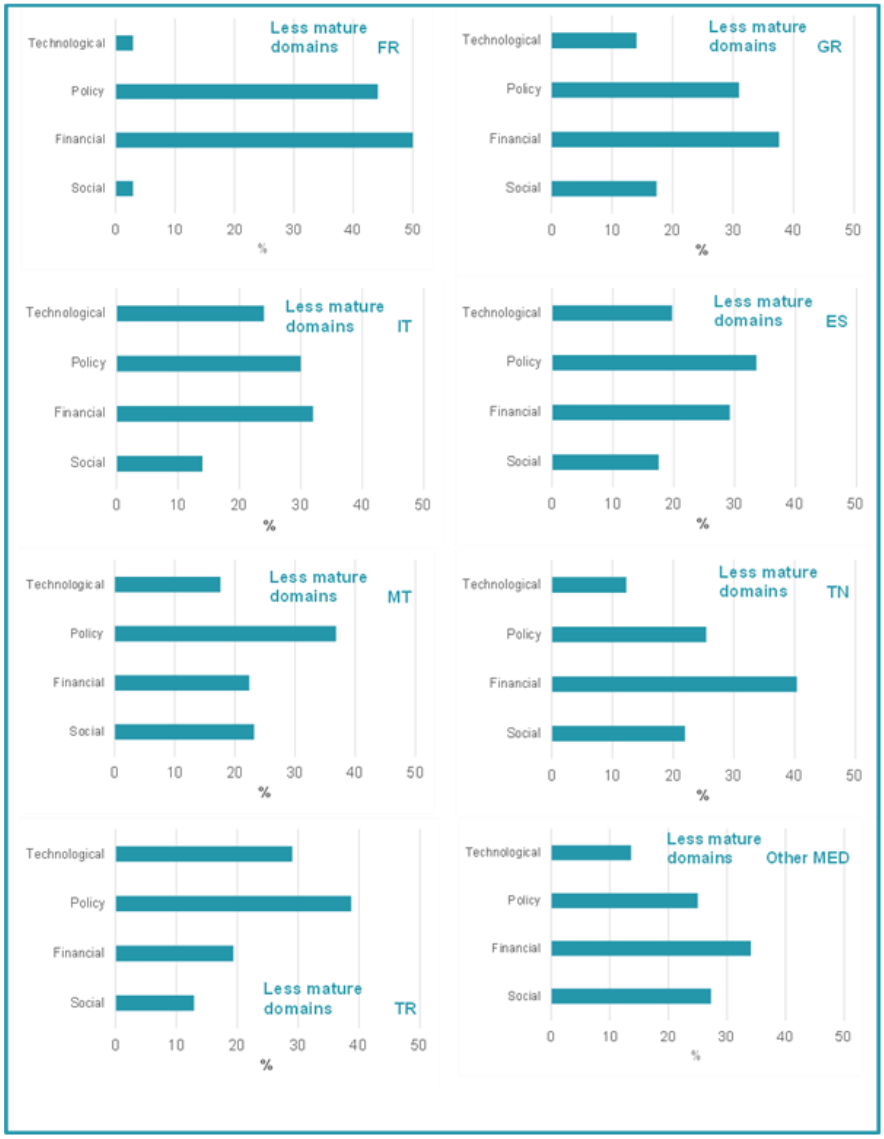


Figure 5-3. *Percentages of country specific responses on the domain which holds the greatest barriers for the implementation of the priority actions.*

REFERENCES

Adamopoulou A, Zeri C, Garaventa F, Gambardella C, Ioakeimidis C and Pitta E (2021) Distribution Patterns of Floating Microplastics in Open and Coastal Waters of the Eastern Mediterranean Sea (Ionian, Aegean, and Levantine Seas). Front. Mar. Sci. 8:699000. doi: 10.3389/fmars.2021.699000.

Addamo A.M., Laroche P., Hanke G. 2017. Top Marine Beach Litter Items in Europe, EUR 29249 EN, Publications Office of the European Union, Luxembourg, Joint Research Center, doi:10.2760/496717, JRC108181

Albanito, F., Lebender, U., Cornulier, T., et al., 2017. Direct nitrous oxide emissions from tropical and sub-tropical agricultural systems - a review and modelling of emission factors. Sci. Rep. 7 (1), 1–12. https://doi.org/10.1038/srep44235

Alygizakis, N. A., Gago-Ferrero, P., Borova, V. L., Pavlidou, A., Hatzianestis, I., Thomaidis N. S., 2016. Occurrence and spatial distribution of 158 pharmaceuticals, drugs of abuse and related metabolites in offshore seawater Science of the Total Environment 541 1097–1105. http://dx.doi.org/10.1016/j.scitotenv.2015.09.145

Andrady AL (2011) Microplastics in the marine environment. Mar Pollut Bull 62:1596–1605.

Ben-David, E.A.; Habibi, M.; Haddad, E.; Hasanin, M.; Angel, D.L.; Booth, A.M.; Sabbah, I. Microplastic distributions in a domestic wastewater treatment plant: Removal efficiency, seasonal variation and influence of sampling technique. Sci. Total Environ. 2021, 752, 141880.

Boucher, J. & Bilard, G. (2020). The Mediterranean: Mare plasticum. Gland, Switzerland: IUCN. x+62 pp

Boucher, J., Billard, G., Simeone, E. and Sousa, J. (2020). The marine plastic footprint. Gland, Switzerland: IUCN. viii+69 pp. https://doi.org/10.2305/IUCN.CH.2020.01.en

Brumovský, M., Becanova, J., Kohoutek, J., Borghini, M., Nizzetto, L., 2017. Contaminants of emerging concern in the open sea waters of the Western Mediterranean Environmental Pollution 229 976e983, http://dx.doi.org/10.1016/j.envpol.2017.07.082

Brumovský, M., Karaskova P., Borghini, M., Nizzetto, L., 2016. Per- and polyfluoroalkyl substances in the Western Mediterranean Sea Waters Chemosphere 159, 308e316 http://dx.doi.org/10.1016/j.chemosphere.2016.06.015

Comber, S., et al., 2015, 'Source apportionment of trace contaminants in urban sewer catchments', Environmental Technology 36(5-8), 573-587

Cózar, A., Sanz-Martín, M., Martí, E., González-Gordillo, J. I, Ubeda, B., Gálvez,J. Á, et al. (2015). Plastic accumulation in the Mediterranean Sea. PLoS One10:0121762.

Dalberg Advisors, WWF Mediterranean Marine Initiative , 2019 “Stop the Flood of Plastic: How Mediterranean countries can save their sea”

Dalberg Advisors, WWF Mediterranean Marine Initiative, 2019 “Stop the Flood of Plastic: How Mediterranean countries can save their sea”.

Derraik, J. G. B. (2002). The pollution of the marine environment by plastic debris: a review. Mar. Pollut. Bull. 44, 842–852. doi: 10.1016/s0025-326x(02) 00220-5

Digka N., Tsangaris C., Kaberi H., Adamopoulou A. and Zeri C., 2018. ‘Microplastic Abundance and Polymer Types in a Mediterranean Environment.’ Springer International Publishing AG 2018, M. Cocca et al. (eds.), Springer Water, https://doi.org/10.1007/978-3-319-71279-6_3

Digka, N., Bray, L., Tsangaris, C., Andreanidou, K., Kasimati, E., Kofidou, E., Komnenou, A., Kaberi, H., 2020. Evidence of ingested plastics in stranded loggerhead sea turtles along the Greek coastline, East Mediterranean Sea. Environ Pollut. doi: 10.1016/j.envpol.2020.114596.

EEA, 2014. Horizon 2020 Mediterranean report Toward shared environmental information systems EEA-UNEP/MAP joint report. EEA Technical report No 6/2014. ISBN 978-92-9213-430-3 doi:10.2800/13326

EEA, 2016 Municipal waste management across European countries

EEA, 2020 Technical assessment of progress towards a cleaner Mediterranean. Monitoring and reporting results for Horizon 2020 regional initiative. EEA-UNEP/MAP joint report. EEA Report No 08/2020 ISBN 978-92-9480-254-5. doi:10.2800/898759

EEA, 2022, From rivers to the sea- The pathways and the outcome https://www.eea.europa.eu/publications/european-marine-litter-assessment/from-rivers-to-the-sea

European Maritime Safety Agency European Environment Agency 2021, European Maritime Transport Environmental Report 2021. — 208 pp

FAO (2017). Aquaculture development. 7. Aquacult. governance sector Dev. FAO Technical Guidelines for Responsible Fisheries N. 5 Suppl. 7.

FAO (2021). Assessment of Agricultural Plastics and Their Sustainability—A Call for Action; FAO: Rome, Italy.

FAO lex database https://www.fao.org/faolex/country-profiles/en/

FAO/GFCM, 2022. The State of Mediterranean and Black Sea Fisheries 2022. General Fisheries Commission for the Mediterranean. Rome. https://doi.org/10.4060/cc3370en

Fleet, D., Vlachogianni, Th. and Hanke, G., 2021. A Joint List of Litter Categories for Marine Macrolitter Monitoring. EUR 30348 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-21445-8, doi:10.2760/127473, JRC121708

Fortibuoni T., Ronchi F., Mačić V., Mandić M., Mazziotti C., Peterlin M., Prevenios M., Prvan M., Somarakis S., Tutman P., Bojanić Varezić D., Kovac Virsek M., Vlachogianni

Th., Zeri C., 2019. A harmonized and coordinated assessment of the abundance and composition of seafloor litter in the Adriatic-Ionian macroregion (Mediterranean Sea). Marine Pollution Bulletin, 139, 412-426. doi.org/10.1016/j.marpolbul.2019.01.017.

Fossi, M. C., Panti, C., Guerranti, C., Coppola, D., Giannetti, M., Marsili, L., et al. (2012). Are baleen whales exposed to the threat of microplastics? A case study of the Mediterranean fin whale (Balaenoptera physalus). Mar. Pollut. Bull. 64, 2374–2379. doi: 10.1016/j.marpolbul.2012.08.013

Frias, J. P. G. L., Otero, V., and Sobral, P. (2014). Evidence of microplastics in samples of zooplankton from Portuguese coastal waters. Mar. Environ. Res. 95, 89–95. doi: 10.1016/j.marenvres.2014.01.001

Galgani L., Tsapakis M., Pitta P., Tsiola A., Tzempelikou E., Kalantzi I, Esposito Ch., Loiselle A., Tsotskou A., Zivanovic S., Dafnomili E., Diliberto S., Mylona K., Magiopoulos I., Zeri C., Pitta E. and Loiselle S. A. (2019). Microplastics increase the marine production of particulate forms of organic matter, Environ. Res. Lett. 14, 124085, https: // doi.org / 10.1088 / 1748-9326 / ab59ca

Galgani, F. (2015). Marine litter, future prospects for research. Front.Mar. Sci. 2:87. doi: 10.3389/fmars.2015.00087

Gardner, M., et al., 2012, 'The significance of hazardous chemicals in wastewater treatment works effluents', Science of the Total Environment 437, pp. 363-372 http://dx.doi.org/10.1016/j.scitotenv.2012.07.086

Gilardi, K.V.K., Antonelis, K.L., Galgani, F., Grilly, E., He, P., Linden, O., Permarini, R., Richardson, K., Santillo, D., Thomas, S., Van den Dries, P. et Wang, L. 2020. SeaBased Sources of Marine Litter - A Review of Current Knowledge and Assessment of Data Gaps. Second Interim Report of GESAMP Working Group 43.

Hanke G., Walvoort D., van Loon W., Addamo A.M., Brosich A., del Mar Chaves Montero M., Molina Jack M.E., Vinci M., Giorgetti A., EU Marine Beach Litter Baselines, EUR 30022 EN, Publications Office of the European Union, Luxemburg, 2019, ISBN 978-92-76-14243-0, doi:10.2760/16903, JRC114129.

IEMed. (2003). European Institute of the Mediterranean. IEMed Mediterranean Yearbook 2003. https://www.iemed.org/publication/tourism-in-the-mediterranean-trends-and-perspectives/ISBN 978-92-9213-854-7 doi:10.2800/475915

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., et al. (2015). Plastic waste inputs from land into the ocean. Science 347, 768–771. doi: 10.1126/science.1260352.

JRC, Joint Research Centre, Zero pollution outlook 2022, Publications Office of the European Union, Luxembourg, 2022, doi:10.2760/39491, JRC129655

Köck-Schulmeyer, M., Villagras, M., López de Alda, M., Céspedes-Sánchez, R., Ventura, F., Barceló, D., 2013. Occurrence and behavior of pesticides in wastewater treatment plants and their environmental impact, Science of the Total Environment 458–460 466–476, http://dx.doi.org/10.1016/j.scitotenv.2013.04.010

Krista Greer et al. Global trends in carbon dioxide (CO2) emissions from fuel combustion in marine fisheries from 1950 to 2016, Marine Policy (2019). DOI: 10.1016/j.marpol.2018.12.001

Lagarias, A., Stratigea, A. Coastalization patterns in the Mediterranean: a spatiotemporal analysis of coastal urban sprawl in tourism destination areas. GeoJournal 88, 2529–2552 (2023). https://doi.org/10.1007/s10708-022-10756-8

Lago-Olveira, S., El-Areed, S. R., Moreira, M. T., & González-García, S. (2023). Improving environmental sustainability of agriculture in Egypt through a life-cycle perspective. Science of the Total Environment, 890, 164335.Burak, S., Dogan, E., & Gazioglu, C. (2004).

Lau, W.W.Y., Shiran, Y., Bailey, R.M., Cook, E., Stuchtey, M.R., Koskella, J., Velis, C.A., Godfrey, L., Boucher, J., Murphy, M.B., Thompson, R.C., Jankowska, E., Castillo, A.C., Pilditch, T.D., Dixon, B., Koerselman, L., Kosior, E., Favoino, E., Gutberlet, J., Baulch, S., Atreya, M.E., Fischer, D., He, K.K., Petit, M.M., Sumaila, U.R., Neil, E., Bernhofen, M.V., Lawrence, K., Palardy, J.E., 2020. Evaluating scenarios toward zero plastic pollution. Science 369, 1455–1461. https://doi.org/10.1126/science.aba9475

Lenzen, M., Sun, YY., Faturay, F. et al., 2018. The carbon footprint of global tourism. Nature Clim Change 8, 522–528. https://doi.org/10.1038/s41558-018-0141-x.

Liubartseva, S., Coppini, G., Lecci, R., and Clementi, E. (2018). Tracking plastics in the Mediterranean: 2D Lagrangian model. Mar. Pollut. Bull. 129, 151–162. doi: 10.1016/j.marpolbul.2018.02.019

MedCruise Association 2019, Cruise Activities in MedCruise Ports | STATISTICS REPORT 2018 https://www.medcruise.com/news/3d-flip-book/2018-medcruise-statistics-report

MedECC (2020) Climate and Environmental Change in the Mediterranean Basin – Current Situation and Risks for the Future. First Mediterranean Assessment Report [Cramer, W., Guiot, J., Marini, K. (eds.)] Union for the Mediterranean, Plan Bleu, UNEP/MAP, Marseille, France, 632pp. ISBN: 978-2-9577416-0-1 / DOI: 10.5281/zenodo.7224821

Mediterranean Action Plan (MAP), Regional Marine Pollution Emergency Response Centre For The Mediterranean Sea (REMPEC) Thirteenth Meeting of the Focal Points of the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC) REMPEC/WG.45/8 Date: 10 May 2019. Data Sharing, Monitoring and Reporting

MEPC Resolution.2021. Strategy to address marine plastic litter from ships. MEPC. 341(77) (adopted on 26 November 2021). MEPC 77/16/Add.1 Annex 2

Natrass L, Biggs C, Bauen A, Parisi C, Rodriguez Cerezo E, Gomez Barbero M. The EU bio-based industry: Results from a Survey. EUR 27736. Luxembourg (Luxembourg): Publications Office of the European Union; 2016. JRC100357

Newman, S., Watkins, E., Farmer, A., Brink, P.t., Schweitzer, JP. (2015). The Economics of Marine Litter. In: Bergmann, M., Gutow, L., Klages, M. (eds) Marine Anthropogenic Litter. Springer, Cham. https://doi.org/10.1007/978-3-319-16510-3_14.

Papaefthimiou, S., Maragkogianni, A. & Andriosopoulos, K. (2016). Evaluation of cruise ships emissions in the Mediterranean basin: The case of Greek ports. International Journal of Sustainable Transportation, 10(10), 985-994.

Papageorgiou N, Dimitriou PD, Chatzivasileiou D, Tsapakis M and Karakassis I (2023) Can IMTA provide added ecosystem value services in the fish farms of Greece? Front. Mar. Sci. 9:1083099. doi: 10.3389/fmars.2022.1083099

PHAROS4MPAs Policy Brief April 2019, Safeguarding Marine Protected Areas in the Growing Mediterranean Blue Economy: Maritime Transport

Pietrelli L. (2022). Polypropylene Recovery and Recycling from Mussel Nets. Polymers 2022, 14(17), 3469; https://doi.org/10.3390/polym14173469

Pittura, L.; Foglia, A.; Akyol, Ç.; Cipolletta, G.; Benedetti, M.; Regoli, F.; Eusebi, A.L.; Sabbatini, S.; Tseng, L.Y.; Katsou, E.; et al. Microplastics in real wastewater treatment schemes: Comparative assessment and relevant inhibition effects on anaerobic processes. Chemosphere 2021, 262, 128415.

Plan Bleu (2022). State of Play of Tourism in the Mediterranean, Interreg Med Sustainable Tourism Community project.

PLAN BLEU Notes #42 Dec 2021, Maritime Transport in the Mediterranean: Status and Challenges

Plastic Europe, 2022. Plastics – the Facts 2022.

Prevenios, M., Zeri C., Tsangaris C., Liubartseva, S., Fakiris E., Papatheodorou, G., 2018. 'Beach litter dynamics on Mediterranean coasts: Distinguishing sources and pathways'. Marine Pollution Bulletin, 129, 448–457. http://dx.doi.org/10.1016/j.marpolbul.2017.10.013

Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (2021). Study on trends and outlook of marine pollution from ships and activities and of maritime traffic and offshore activities in the Mediterranean, Floriana.

Romera-Castillo, C., Pinto, M., Langer, T.M. et al. Dissolved organic carbon leaching from plastics stimulates microbial activity in the ocean. Nat Commun 9, 1430 (2018). https://doi.org/10.1038/s41467-018-03798-5

Sandra M., Devriese L., De Raedemaecker F., Lonneville B., Lukic I., Altvater S., Compa Ferrer M., Deudero S., Torres Hansjosten B., Alomar Mascaró C., Gin I., Vale M., Zorgno M., Mata Lara M. (2020). Knowledge wave on marine litter from aquaculture sources. D2.2 Aqua-Lit project. Oostende, Belgium. 136 pp

SAPEA (2020). Biodegradability of Plastics in the open Environment. https://www.sapea.info/topics/biodegradability-of-plastics/

Secretariat of the Convention on Biological Diversity (2004) The Ecosystem Approach, (CBD Guidelines) Montreal: Secretariat of the Convention on Biological Diversity 50 p.

Setälä O, Norkko J, Lehtiniemi M (2016) Feeding type affects microplastic ingestion in a coastal invertebrate community. Mar Pollut Bull 102:95–101.

Sharma S, Chatterjee S (2017) Microplastic pollution, a threat to marine ecosystem and human health: a short review. Environ Sci Pollut Res 24:21530–21547

Smiraglia, D.; Cavalli, A.; Giuliani, C.; Assennato, F. The Increasing Coastal Urbanization in the Mediterranean Environment: The State of the Art in Italy. Land 2023, 12, 1017. https://doi.org/10.3390/land12051017

Taipale, S. J., Peltomaa, E., Kukkonen, J. V. K., Kainz, M. J., Kautonen. P., Tiirola M. (2019). Tracing the fate of microplastic carbon in the aquatic food web by compound-specific isotope analysis. Scientific Reports, 9:19894, . https://doi.org/10.1038/s41598-019-55990-2

UNEP and GRID-Arendal, 2016. Marine Litter Vital Graphics. United Nations Environment Programme and GRID-Arendal. Nairobi and Arendal. www.unep.org, www.grida.no

UNEP/MAP, 2023, Mediterranean Quality Status Report (QSR): Marine Litter Ecological Objective (EO10) UNEP/MED WG.555/4.

UNEP/MAP, 2023, Mediterranean Quality Status Report (QSR): Marine Litter Ecological Objective (EO10) UNEP/MED WG.555/4.

UNEP/MAP. 2015. Marine Litter Assessment in the Mediterranean 2015 ISBN No: 978 -92 -807 -3564-2

UNEP/MAP-Plan Bleu: State of the Environment and Development in the Mediterranean, UNEP/MAP-Plan Bleu, Athens, 2009.

UNEP/MED IG.25/27 DecisionIG.25/16

United Nations Environment Programme/Mediterranean Action Plan and Plan Bleu (2020). State of the Environment and Development in the Mediterranean. Nairobi.

UNWTO. (2019). World Tourism Organization. International Tourism Highlights. https://www.e-unwto.org/doi/pdf/10.18111/9789284421152

Van Loon, W., Hanke, G., Fleet, D., Werner, S., Barry, J., Strand, J., Eriksson, J., Galgani, F., Gräwe, D., Schulz, M., Vlachogianni, T., Press, M., Blidberg, E. and Walvoort, D., 2020. A European Threshold Value and Assessment Method for Macro Litter on Coastlines. EUR 30347 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21444-1, doi:10.2760/54369, JRC121707

Vishnu Radhana R., Eldhoa T.I., Divya David T., (2019). Can plastics affect near surface layer ocean processes and climate?. Marine Pollution Bulletin 140 (2019) 274–280 https://doi.org/10.1016/j.marpolbul.2019.01.052

Vlachogianni T, Fortibuoni T., Ronchi F., Zeri C., Mazziotti C., Tutman P., Bojanić Varezić D., Palatinus A., Trdan Š., Peterlin M., Mandić M., Markovic O., Prvan M., Kaberi H., Prevenios M., Kolitari J., Kroqi G., Fusco M., Kalampokis E., Scoullos M., 2018. 'Marine litter on the beaches of the Adriatic and Ionian Seas: An assessment of their abundance, composition and sources.' Marine Pollution Bulletin 131, 745–756, https://doi.org/10.1016/j.marpolbul.2018.05.006

ANNEX I

METHODOLOGY

The participative co-design approach

The roadmap expresses a shared vision of Mediterranean stakeholders towards healthy ocean, seas and waters by 2030. A total of 259 multidisciplinary and multisectoral stakeholders were engaged in the co-design of the roadmap, representing 184 organizations, to ensure a robust planning of well-coordinated activities underpinned by a consistent monitoring framework (linked to T5.1) to contribute to the implementation of the LH.

To capture stakeholders' insights and generate information for drawing the roadmap, the following activities were conducted:

#1 "Stakeholder forum" (May, 2023) to investigate innovative transformative solutions for pollution prevention, minimization and remediation in Mediterranean countries. The forum stimulated a discussion and knowledge sharing among 200 stakeholders (KPI, #50 part), about the Mediterranean hydrosphere depollution and restoration methods and tools.

#3 "Sectorial priorities workshops" (July, 2023), involving more than 50 core stakeholders of the basin, to develop a system map based on the outputs of the forum and identify pathways towards zero marine pollution in the Mediterranean by 2030 (KPI #20 part.). BlueMissionMed priorities were defined to draft the OIR, according to sectorial stakeholders' interests and motivation. Related industrial sectors were addressed in three thematic workshops: Agriculture, fisheries and aquaculture; Plastic production, municipal solid waste, water management and treatment; Maritime transportation, and tourism. The workshops were organized adapting the methodology for system level change included the guidebook System Change: A Guidebook for Adopting Portfolio Approaches.by UNDP (2022)[6]. The workshops were online and lasted approximately three hours. During these, the participants were triggered into co-designing a systemic view of their sector by identifying, drivers, activities, and users as well as existing challenges to change. Following this discussion stakeholders were prompted to propose actions to achieve the required change.

#4 "Compass Workshop" (November, 2023) to draw on the outcomes of the above-mentioned activities, assess innovation capacity and infrastructure of Mediterranean countries and co-design a shared OIR in strict collaboration with the Mission Secretariat, the mission IAs under the topic HORIZON-MISS-2021-OCEAN- 03-01, PREP4BLUE, Mission Implementation Platform, BlueMissionMed Governing Bodies, and in particular the Technical Advisory Board (KPI #40 part.).

#Targeted Interviews with stakeholders supporting the identified innovation actions to fill in the gaps in information (July-October, 2023).

#A comprehensive survey to gather input from various actors across the Mediterranean basin regarding the needs, gaps, and priorities for preventing, minimizing, and eliminating pollution from chemicals, plastics, and microplastics.

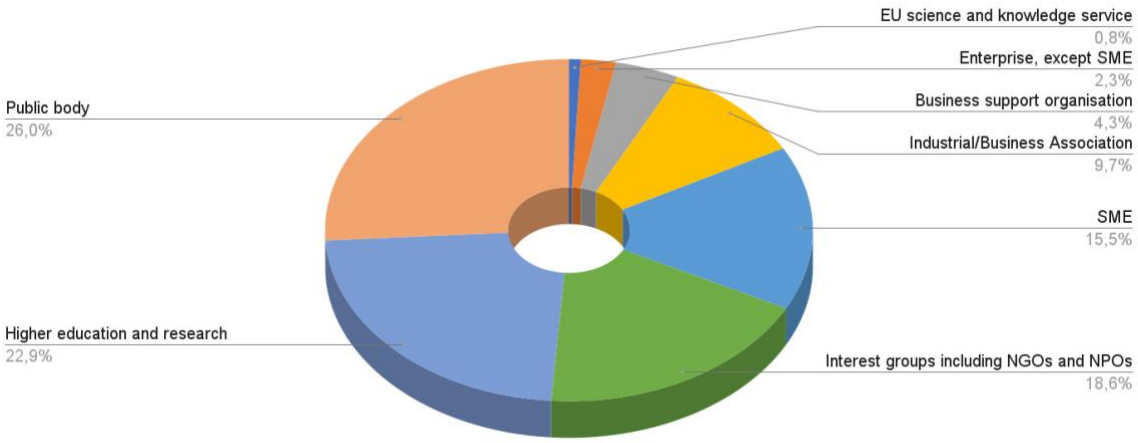
[6] UNDP (2022). System Change: A Guidebook for Adopting Portfolio Approaches.Bangkok, Thailand

The survey successfully engaged 123 individuals, whose valuable insights will be integrated into the BlueMissionMed OIR (April-May, 2024).

The outputs of the co-design process helped to:

Better understand and map major barriers to effective management and control.
Interlink causes, effects, and solutions for improving the coordination of response actions across governments, industries, and communities.
Identify and mobilize ecosystem enablers to support the establishment of national hubs in WP2 T2.3.
Identify and territorialize transformative innovations for protected and healthy oceans, supporting WP3 T3.3.
Identify challenges for innovation, providing useful information to WP3 T3.4.
Prioritize the future supporting activities, based on the impact pathway, setting the framework of WP3.

A representative number of organizations covering the four domains of science/technology, policy, economy and the society was involved in the process.



List of the 262 Organizations involved in the OIR co-design process

Organizations
ACCEDA - Autoridad Portuaria de Málaga
Asociación Nacional de Empresas Naúticas
Asociación Vertidos Cero
Chambre Nationale des Femmes Chefs d'Entreprise - UTICA
CITEO
Municipalité de M'saken
Acció / Catalogna Trade & Investment
Aegean Rebreath
Agence Nationale de Protection de l'Environnement
Agencia Estatal de Investigación (AEI, Spain)
Agenzia regionale per la protezione dell'ambiente (ARPA SICILIA)
AIR Centre
Aitiip Centro Tecnológico
Aix-Marseille Université
AMP Isole Ciclopi
AMP Plemmirio
AquaBiotechGroup
Área de Playas del Ayuntamiento de Málaga
Aristotle University of Thessaloniki
Asociación Vertidos Cero
ASPAPLAST Plastics Europe association
Association of Hellenic plastics industries (A.H.P.I.)
Association Tipaza
Association Wings of the Ocean
ATHENA Research Center
Athens Water Supply & Sewerage Company S.A. (EYDAP)

Atlantic International Research Centre (AIR Centre)
Avvocato
AZTI
BETA Technological Center, UVic-UCC
bio-mi
Bioterramar IKE
Bureau d'etudes et consulting CYCLAMEN
BUSINESSMED
C.S. des activités socio-culturel - éducation national
Calabria Region
Camoz recycled sail design
Capo di Gabinetto Assessore Turismo, Sport e Spettacolo
Casa Mediterráneo
Catalonia Trade & Investment
CBE-JU
CCIC Abbaye de Lérins
CCIC Abbaye de Lérins
CDTIoficial Centro para el Desarrollo Tecnológico Industrial
Center for Euroregional Studies Galicia - Northern Portugal (CEER)
Centre National de Recherche et de Développement de la Pêche et de l'Aquaculture (CNRDPA)
Centro Oceanográfico Baleares
CEPESCA - Confederación Española de Pesca
CETA/CID
CGPM - FAO
Chamber of the Economy of the Federation of B&H
Chimica Verde Bionet
CIBOS Innovation

City of Dubrovnik
City of Marseille
Clera.One
Cluster Marítimo Marino de Andalucía
Clúster Marítimo-Marino de Andalucía
CMCC Foundation
CNR - DSSTTA
CNR - IAS
CNR - IPCB
CNR - IRBIM
CNR - ISMAR
CNR - IPCB
CNRS, Ocean Sciences Institute, Aix-Marseille University
Cofradia de Pescadores
Communications Consultant Freelance Professional
Communications Consultant Freelance Professional (Individual)
Comune di Balestrino
Comune di Borghetto Santo Spirito
Comune di Garlenda
Comune di Laigueglia
Comune di Lampedusa
Comune di Loano
Comune di Stella
Comune di Zuccherello
Confindustria
Conseil Bancaire et Financier - Tunisie
Consejería de Sostenibilidad, Medio Ambiente y Economía Azul
Consiglio Nazionale delle Ricerche

Consirzio di Ricerca Corissia
Consorzio Interuniversitario Nazionale per la Scienza e Tecnologia dei Materiali (INSTM)
Consorzio Plemmirio
Corissia
Corsair Group
CPMR Islands Commission
Cruise Line International Association CLIA
Cubexlab
Çukurova Development Agency
Demarcación de Costas en Andalucía-Mediterráneo
DESMI Ro-Clean
Distretto della Pesca e Crescita Blu - COSVAP
DuWo srl
EATiP - European Aquaculture Technology & Innovation Platform
ECOCEAN
Ecorys
Eco-Union
Eden Tech
EG Consulting
ENALEIA
Enalia Physis Environmental and Research Center
Energ+ d.o.o. (Clera.one)
Environment and Resources Authority (ERA) Malta
EUROCORD
EuroMarine Network
Europe Jacques Delors
European Climate, Infrastructure and Environment Executive Agency (CINEA)
European Commission

European Commission, DG RTD
European Commission, Joint Research Centre
European Environment Agency
European Marine Science Educators Association EMSEA Med
Express Innovation Agency
F.G.M. DOMOTICA E SERVIZI SOCIETA COOPERATIVA
F6S
Federchimica - PlasticsEurope Italia
Federpesca
FishFlow Innovations
Fondation Diane
French higher education and research ministry (MESR)
French Ministry of Higher Education, Research and Innovation (MESRI)
Fundación Ecoalf
Genoa City Council
Geomatys
Global Sustainable Tourism Council (GSTC)
Good Karma Projects
Government of Balearic Islands
Government of Catalonia
Greek Management authority of OP of Fisheries, Aquaculture and Maritime - Ministry of Agricultural Development and Food
Grupo Iberostar
H2O-People
Hamza Fatnassi consulting
HAW Hamburg
Hellenic Aquaculture Producers Organization (HAPO)
Hellenic Centre for Marine Research (HCMR)

Hellenic Marine Environment Protection Association - HELMEPA
Hellenic Solid Waste Management Association (HSWMA)
Heritage Malta
I Tetragonauti
IBO/CERTH
IFREMER
Indigo Med
Infordata Sistemi Srl
Institut Français de Recherche pour l'Exploitation de la Mer (Ifremer)
Institut national de recherches archéologiques préventives
Institut OCEAN (AMU)
Instituto de Turismo de la Región de Murcia
Instituto Español de Oceanografía (IEO CSIC)
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS)
Juplas Plastic Association
KDM
La Saison Bleue
LABPLAS, University of Vigo
Lazio Innova-Regione Lazio
Leancubator
Legambiente
LMOP à l'Université Tunis EL Manar
CIIMAR- Interdisciplinary Centre of Marine and Environmental Research
Malta Council for Science and Technology/MEYR
Malta Enterprise
Malta Maritime Forum
Malta's National Aviation Conference
MaREI UCC

MARIS BV
Maritimo Recycling
MedCities
MedCruise Association
Mediterranean Advisory Council
Mediterranean Advisory Council (MEDAC)
Mediterranean Protected Areas Network (MEDPAN)
MedPAN
Medwaves
Mersin Metropolitan Municipality
Mersin University
METU Institute of Marine Sciences
MINDS Technologies & Environmental Sciences PC
Ministère de l'Enseignement Supérieur et de la Recherche Scientifique [MESRS]
Ministerio de Ciencia e Innovación
Ministero dell'Università e della Ricerca
Ministry for Gozo
Ministry of Environment Lebanon
Ministry of Foreign Affairs of Italy
Ministry of Industry and Technology, General Directorate of Development Agencies Türkiye
Mohammed Premier University
Municipality of Figueira da Foz
Municipality of Montegrosso Pian Latte
MY Danışmanlık ve Belgelendirme
National and Kapodistrian University of Athens
National Institute of Chemistry Slovenia
National Institute of Oceanography and Fisheries (NIOF) Egypt

Next Technology Tecnotessile
NIRD GeoEcoMar Bucharest
Noria Sustainable Innovators
Notre Grand Bleu Association
PA3-EUSDR
PAEB - Parc d'activités économiques de Bizerte
PAGEV Plastics Europe association
Philosofish
Plant Health Directorate
Plant Protection Directorate - MAFA
PNO Consultants Spain
Polygreen
Posidonia Surveillance Service of the Balearic Islands and the Med Netwok
Private company
Real Liga Naval Española
Region of Crete
Regione Calabria
Regione Puglia
Regione Siciliana
Ricercatrice presso il Consiglio Nazionale delle ricerche, Istituto per i Polimeri, Compositi e Biomateriali
Sanitary Engineering Laboratory, National Technical University of Athens
Saveyourhood
School of Naval Architecture and Marine Engineering, National Technical University of Athens
Science & Technology Regional Fund , Azores Goverment
SDG4MED
Sea Shepherd Italia
SeaBasin AM

Seas at Risk
Seavo
SGMer
SMILO
Sociedade Portuguesa de Inovação (SPI)
Spanish Institute of Oceanography-CSIC
Stop Plastic Invasion!
STRATEGIS - Maritime ICT Cluster
Sustainable islands Observatory
Tangier City Port Management Company
Technology Cluster Blue Italian Growth
Technopolis Group
TECNOPACKAGING
The Foundation for Innovation and Research - Malta
The Great Bubble Barrier
The North Tyrrhenian Sea Ports System Authority
The Office of Merchant Marine and Ports (OMMP)
TIME Sustainability
Turkish Plastic Industry Foundation PAGEV
UNEP/MAP
United Nations Conference on Trade and Development
University College Cork
University of Crete
University of Dubrovnik
University of Jaén
University of Malta
University of Maribor
University of Murcia

University of Palermo
University of Trieste
Utica College
V2O Marine
Veldo Makine ARGE A.Ş.
Venice Lagoon Plastic Free
VITO NV
Wasser 3.0 gGmbH
Waste Agency of Catalonia - Gencat
Westmed National Hub Malta
World Ocean Council
WWF Greece
WWF Italy
WWF Mediterranean
Youth4Ocean Forum

The OIR survey – Methodology for the interpretation of the results

The survey is appended in the present document as Annex II. The methodology for the interpretation of the results is described herewith. The survey is structured based on the OIR economic sectors and for each sector about 8 to 10 questions were included. The questions reflect the identified priorities of action during the first stage of the OIR development. In figure below is given an example of the first question for the Agriculture sector.

Please give us you opinion on the degree of maturity for the implementation of the following actions on scale from 1 (Very Immature) to 5 (very mature), for each the 4 dimensions (technological, financial, social, policy)

	Degree of maturity	If you find the solution immature (Degrees 1-3) please state which of the four dimensions is the less mature
Accelerating the implementation of organic farming and pest control by providing additional economic support and incentives to farmers	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Financial ☐ Policy ☐ Social ☐ Technological

The stakeholders were asked to classify each of the priority actions based on its maturity for implementation and further indicate the domain (financial, policy, social, technological) for which they think most barriers exist. For this second step they could indicate up to two domains.

Only maturity levels that have been selected by more than 25% of total responses were considered significant. The final classification of the priority actions was done according to 3 level of maturity H: high, M: medium, L: low. The very mature and rather mature levels were merged to H: high, similarly the rather immature and very immature ones to L: low. The 'neither mature nor immature' were kept as M: medium maturity level. In most cases, more than one levels of maturity have received >25% of responses. When the selected levels of maturity were sequential (for ex. 30% 'Rather mature' and 40% 'neither mature nor immature') then both levels were indicated for the particular priority action (e.g. H/M). In cases where levels of maturity were contrasting (for. Ex. 30% 'Rather mature' and 40% 'rather immature') then the priority action was not classified since the results were found inconclusive.

The indication of the less mature domains (financial, policy, social, technological) provides some insights on the barriers which hinder full implementation of the priority actions, and more efforts are needed towards this direction. The stakeholders' responses were clustered according to three degrees of increasing barriers (shown as an increase in green colour shades in the Tables of Chapter 4)., The number of responses for each domain was classified according to a 3- level scale based on the total number of responses for all the domains. For example, if all domains were selected 21 times, the domain selected by <7 times was classified as of low barrier (light green shade), the domain selected by 7< and < 14, was classified as of medium barrier (medium green shade) and finally if the domain was selected by >14 times it was classified as of high barrier (dark green shade).

ANNEX II

THE OIR SURVEY

BlueMissionMed Operational Implementation Roadmap Survey

Fields marked with * are mandatory.

Introduction and Scope

This questionnaire was created to complement the activities of the seven National Hubs of the BlueMissionMED CSA project. The aim of the questionnaire is to enhance the exchange of views by all actors and to contribute to the selection of the most appropriate solutions for the prevention, minimization and mitigation of marine pollution in the Mediterranean.

Please Download Data Privacy Statement before proceeding with the questionnaire

BMM_Privacy_Data_protection_statement.pdf

☐ I accept your Terms

General Information

(personal data are collected for statistical reasons only and will not be disclosed to anyone beyond the person responsible for the survey. – personal data will be destroyed once all analysis has been completed as described in the above data privacy statement)

Full name

Affiliation (Professional Body / Institution)

Country

- AF - Afghanistan
- AL - Albania
- DZ - Algeria
- AD - Andorra
- AO - Angola
- AG - Antigua and Barbuda
- AR - Argentina
- AM - Armenia
- AU - Australia
- AT - Austria
- AZ - Azerbaijan
- BS - Bahamas
- BH - Bahrain
- BD - Bangladesh
- BB - Barbados
- BY - Belarus
- BE - Belgium
- BZ - Belize
- BJ - Benin
- BT - Bhutan
- BO - Bolivia
- BA - Bosnia and Herzegovina
- BW - Botswana
- BR - Brazil
- BN - Brunei Darussalam

- BG - Bulgaria
- BF - Burkina Faso
- BI - Burundi
- CV - Cabo Verde
- KH - Cambodia
- CM - Cameroon
- CA - Canada
- CF - Central African Republic
- TD - Chad
- CL - Chile
- CN - China
- CO - Colombia
- KM - Comoros
- CG - Congo
- CR - Costa Rica
- CI - Côte D'Ivoire
- HR - Croatia
- CU - Cuba
- CY - Cyprus
- CZ - Czechia
- CD - Democratic Republic of the Congo
- DK - Denmark
- DJ - Djibouti
- DM - Dominica
- DO - Dominican Republic
- EC - Ecuador
- EG - Egypt
- SV - El Salvador
- GQ - Equatorial Guinea
- ER - Eritrea
- EE - Estonia
- SZ - Eswatini
- ET - Ethiopia
- FJ - Fiji
- FI - Finland
- FR - France
- GA - Gabon
- GM - Gambia
- GE - Georgia
- DE - Germany
- GH - Ghana
- GR - Greece
- GD - Grenada
- GT - Guatemala
- GN - Guinea
- GW - Guinea Bissau
- GY - Guyana

- HT - Haiti
- HN - Honduras
- HU - Hungary
- IS - Iceland
- IN - India
- ID - Indonesia
- IR - Iran
- IQ - Iraq
- IE - Ireland
- IL - Israel
- IT - Italy
- JM - Jamaica
- JP - Japan
- JO - Jordan
- KZ - Kazakhstan
- KE - Kenya
- KI - Kiribati
- KW - Kuwait
- KG - Kyrgyzstan
- LA - Laos
- LV - Latvia
- LB - Lebanon
- LS - Lesotho
- LR - Liberia
- LY - Libya
- LI - Liechtenstein
- LT - Lithuania
- LU - Luxembourg
- MG - Madagascar
- MW - Malawi
- MY - Malaysia
- MV - Maldives
- ML - Mali
- MT - Malta
- MH - Marshall Islands
- MR - Mauritania
- MU - Mauritius
- MX - Mexico
- FM - Micronesia
- MC - Monaco
- MN - Mongolia
- ME - Montenegro
- MA - Morocco
- MZ - Mozambique
- MM - Myanmar
- NA - Namibia
- NR - Nauru

- NP - Nepal
- NL - Netherlands
- NZ - New Zealand
- NI - Nicaragua
- NE - Niger
- NG - Nigeria
- KP - North Korea
- MK - North Macedonia
- NO - Norway
- OM - Oman
- PK - Pakistan
- PW - Palau
- PA - Panama
- PG - Papua New Guinea
- PY - Paraguay
- PE - Peru
- PH - Philippines
- PL - Poland
- PT - Portugal
- QA - Qatar
- MD - Republic of Moldova
- RO - Romania
- RU - Russian Federation
- RW - Rwanda
- KN - Saint Kitts and Nevis
- LC - Saint Lucia
- VC - Saint Vincent and the Grenadines
- WS - Samoa
- SM - San Marino
- ST - Sao Tome and Principe
- SA - Saudi Arabia
- SN - Senegal
- RS - Serbia
- SC - Seychelles
- SL - Sierra Leone
- SG - Singapore
- SK - Slovakia
- SI - Slovenia
- SB - Solomon Islands
- SO - Somalia
- ZA - South Africa
- KR - South Korea
- SS - South Sudan
- ES - Spain
- LK - Sri Lanka
- SD - Sudan
- SR - Suriname

- SE - Sweden
- CH - Switzerland
- SY - Syrian Arab Republic
- TJ - Tajikistan
- TZ - Tanzania
- TH - Thailand
- TL - Timor-Leste
- TG - Togo
- TO - Tonga
- TT - Trinidad and Tobago
- TN - Tunisia
- TR - Turkey
- TM - Turkmenistan
- TV - Tuvalu
- UG - Uganda
- UA - Ukraine
- AE - United Arab Emirates
- GB - United Kingdom
- US - United States of America
- UY - Uruguay
- UZ - Uzbekistan
- VU - Vanuatu
- VE - Venezuela
- VN - Viet Nam
- YE - Yemen
- ZM - Zambia
- ZW - Zimbabwe

* In which professional category does your professional body belong?

- Industry (Plastics)
- Industry (Chemicals)
- Hotel
- Restaurant
- Catering Services
- Public Administration (State)
- Public Administration (Region)
- Public Administration (Municipality)
- Shipping
- Port Authority
- Agriculture
- Fishing
- Aquaculture
- Water Supply, Wastewater Treatment, Waste Management and Sanitation Activities
- Environmental Organisations
- Academia (Research and Education)
- Other Category

If you answered other in the question above please state at which category your professional body belongs

Years of experience in the sector (can also include other professional bodies of the same sector)

Only values between 1 and 50 are allowed

Activities of professional body

(The next sections of the questionnaire relate to actions implemented by the different professional or governance sectors)

* Please select one of the sectoral categories you are more familiar with in order to be directed to the relevant questions)

- Agriculture
- Aquaculture
- Fisheries
- Plastic Production
- Ports and Shipping
- Solid Waste and Wastewater Management (Companies, Cities, Municipalities, Regions)
- Tourism and HORECA services

* Has your professional body/initiative/organisation/action endorsed the Mission Ocean Charter?

- Yes
- No but we are processing it
- No

Do you know of a good practice that is being implemented/performed or tested by your sector responding to the Mission Ocean Objectives for reducing pollution in the Mediterranean Sea?

(Please elaborate on the practice and please inform us if it is an action by your organisation or a different one but you are interested in implementing this or something similar)

In your opinion which of the following activities in the agricultural sector create the biggest contributions to aquatic pollution?

Maximum 2 selection(s)

- Intensive farming system
- Chemical fertilisation
- Unregulated pest control
- Product plastic pacaging
- Synthetic soil and crops covering (mulch films)
- Solid waste collection practices

- [ ] Other

If you answered other in the question above please state at which practice you refer to

In your opinion which of the following practices in the aquaculture sector cause the biggest pollution problems?

- [ ] Intensive farming systems
- [ ] Feeding practices (if uncontrolled for example)
- [ ] Chemicals used for disease control
- [ ] Product plastic packaging
- [ ] Waste management practices in the facilities
- [ ] Other

If you answered other in the question above please state at which practice you refer to

In your opinion which of the following practices in the fisheries sector cause the biggest pollution problems?

Maximum 2 selection(s)

- [ ] Lost or otherwise discarded fishing gear
- [ ] Plastic/polystyrene fish packaging
- [ ] Green House Gas pollution from fishing fleets
- [ ] Small boats end of life management practices
- [ ] Waste management practices
- [ ] Other

If you answered other in the question above please state at which practice you refer to

In your opinion which of the following practices related to ports and shipping activities cause the biggest pollution problems?

Maximum 1 selection(s)

- [ ] Solid waste management practices onboard and in ports (for example lack of separate collection practices)
- [ ] Onboard wastewater management practices
- [ ] Energy consumption
- [ ] Other

If you answered other in the question above please state at which practice you refer to

In your opinion which of the following practices in your sector are the face the biggest difficulties in successfully implementing solutions to mitigate pollution?

Waste collection systems
- ( ) Wastewater cleaning technologies
- ( ) Recycling technologies
- ( ) Other

If you answered other in the question above please state at which practice you refer to

In your opinion which of the following practices related to tourism cause the biggest pollution problems?

Maximum 2 selection(s)

- [ ] Beach waste management practices
- [ ] Food waste losses
- [ ] Single use packaging
- [ ] Solid waste collection practices in HORECA businesses (e.g. lack of separate collection schemes)
- [ ] Other

If you answered other in the question above please state at which practice you refer to

In your opinion which of the following practices related to the plastics industry cause the biggest pollution problems (sector's contribution)?

Maximum 2 selection(s)

- [ ] Single use plastic production
- [ ] Insufficient biodegradability of plastics
- [ ] Insufficient recycling
- [ ] Over-packaging
- [ ] Pellet transfer and loss
- [ ] Other

If you answered other in the question above please state at which practice you refer to

Would you like to add more details in regards to the difficulties posed when attempting to manage pollution from the above selected activities?

Proposed Actions

Agriculture

Please give us you opinion on the degree of maturity for the implementation of the following actions on scale from 1 (Very Immature) to 5 (very mature), for each the 4 dimensions (technological, financial, social, policy)

	Degree of maturity	If you find the solution immature (Degrees 1-3) please state which of the four dimensions is the less mature
Accelerating the implementation of organic farming and pest control by providing additional economic support and incentives to farmers	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Financial ☐ Policy ☐ Social ☐ Technological
Upscale traditional agroecological practices (crop rotations, mulching, and agroforestry) with scientific backing to replace routine pesticide and fertiliser use	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Enhance the adoption of smart and innovative agricultural methods of small family farms by promoting collaborative and cost sharing governance or business solutions	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Engagement of farmers in monitoring the use of agrochemicals with the help of new technologies and smart agriculture	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Cooperation of farmers associations with the plastics industry in piloting /demonstrating solution for truly biodegradable agri-plastic	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Recycle nutrients from bio-waste to achieve fully circular, localised nutrients management	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
	○ 1 (Very Immature)	

Development of separate waste collection systems for agri-plastics in parallel with financial incentives for farmers such as deposit-return schemes	○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Set up territorial agreements that include the application of Integrated Pesticide Management techniques	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Implement nature-based solutions for the remediation of impacted fields at farm or catchment scales	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy

Aquaculture

Please give us you opinion on the degree of maturity for the implementation of the following actions on scale from 1 (Very Immature) to 5 (very mature), for each the 4 dimensions (technological, financial, social, policy)

	Degree of maturity	If you find the solution immature (Degrees 1-3) please state which of the four dimensions is the less mature
Development/Use of eco-friendly antifouling agents (bio-based coatings, with the use of algal and enzymatic technologies)	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Financial ☐ Policy ☐ Social ☐ Technological
Promotion of IMTA (Integrated Multi Trophic Aquaculture) for the minimization of nutrients and organic load through the development of relevant regulatory frameworks and financial incentives	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
	○ 1 (Very Immature) ○ 2 (Rather Immature) ○	*Maximum 2 selection(s)* ☐ Social

Reuse models for fish/mussels packaging and traceability along the value chain.	3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	Technological Financial Policy
Cooperation and synergy among aquaculture companies for reducing & recycling waste.	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy
Extending EPR (Extended Producers Responsibility) schemes for the aquaculture sector related packaging.	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy
Promote digitization tools for monitoring for example for the prevention of food loses	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy
Development of standards and promotion of certification schemes for sustainable practices.	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy
Cross sectoral planning consultations to minimize conflicts and increase social acceptance (e.g. tourism, aquaculture)	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy
Sustainable zoning of production sites (including robust assessments of maximum carrying capacity and coexistence potential)	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy

Fisheries

Please give us you opinion on the degree of maturity for the implementation of the following actions on scale from 1 (Very Immature) to 5 (very mature), for each the 4 dimensions (technological, financial, social, policy)

	Degree of maturity	If you find the solution immature (Degrees 1-3) please state which of the four dimensions is the less mature
Use of smart and reusable boxes which are traceable and sanitary with origin certification	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Financial ☐ Policy ☐ Social ☐ Technological
Adoption of separate collection systems of used nets and gear in ports for the purpose of their efficient recycling and transformation, by providing financial support on the local /national level through EPR schemes (for plastic nets' producers)	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Enhancement of dedicated multi-actor networks for the removal of ALDFG from the marine environment through financial instruments and citizen science programs.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Tagging and tracking of nets and gear to enhance traceability and recovery of lost gear.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Characterization and valorization of ALDFG (Abandoned, Lost or otherwise Discarded Fishing Gear) for enhancing recycling or proper disposal of ALDFG (and other litter found at sea)	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Acquisition of more accurate scientific data on monitoring the presence /accumulation areas and impacts of ALDFG (Abandoned, Lost or otherwise Discarded Fishing Gear) in the Mediterranean.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Development of a common framework for ALDFG (Abandoned, Lost or otherwise Discarded Fishing Gear)	○ 1 (Very Immature) ○ 2 (Rather Immature) ○	*Maximum 2 selection(s)* ☐ Social

management in the Mediterranean through cooperation and synergies.	3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	Technological Financial Policy
Financial instruments and incentives (e.g. green credits / tax regime) for replicating best practices related to fishing for litter and ALDFG recovery.	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy
Provide financial incentives for installing renewable energy sources on board fishing vessels and/or onshore processing facilities.	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy

Ports and Transport

Please give us you opinion on the degree of maturity for the implementation of the following actions on scale from 1 (Very Immature) to 5 (very mature), for each the 4 dimensions (technological, financial, social, policy)

	Degree of maturity	If you find the solution immature (Degrees 1-3) please state which of the four dimensions is the less mature
Accelarate research on technological development for the decarbonisation of the sector	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Financial Policy Social Technological
Systematic monitoring on air emissions with the engagement of crew members for data acquisition.	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy
Promotion of Onshore Power Supply (OPS) systems in ports	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy
	1 (Very Immature)	*Maximum 2 selection(s)*

Networking of EU non-Eu partnerships for the harmonisation of regulations procedures standards	2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	Social Technological Financial Policy
Promoting solid waste management in small Mediterranean ports, though multi-level governance schemes.	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy
Synergies between Mediterranean ports and the cruise sector for the adoption of green practices.	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy
Promote social engagement through awareness campaigns on passengers and targeted trainings of workforce.	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy

Plastics Industry

Please give us you opinion on the degree of maturity for the implementation of the following actions on scale from 1 (Very Immature) to 5 (very mature), for each the 4 dimensions (technological, financial, social, policy)

	Degree of maturity	If you find the solution immature (Degrees 1-3) please state which of the four dimensions is the less mature
Stimulate reuse and refill systems by increasing their availability and convenience	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Financial Policy Social Technological
Accelerate production of truly biodegradable material through clear regulatory frameworks	1 (Very Immature) 2 (Rather Immature) 3 (Neither Mature / nor Immature) 4 (Rather Mature) 5 (Very Mature)	*Maximum 2 selection(s)* Social Technological Financial Policy

Educate citizens and users of the differences in material properties and performance.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Strengthening regional cooperation in the sector and provide new business opportunities on circular models.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Implementation of legal framework for minimum recycled content in plastic packaging	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Minimising losses in the plastic industry through monitoring and controlling the adopting practices	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Create synergies with the solid waste management sector for wider and more efficient adoption of separate and door to door collection schemes	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Valorisation for recycle/upcycle of plastics found in the environment	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Introduction of thresholds for progressively limiting global plastic production	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy

Tourism and HORECA Businesses

Please give us you opinion on the degree of maturity for the implementation of the following

actions on scale from 1 (Very Immature) to 5 (very mature), for each the 4 dimensions (technological, financial, social, policy)

	Degree of maturity	If you find the solution immature (Degrees 1-3) please state which of the four dimensions is the less mature
Develop digital tools for monitoring/measuring & control of waste generation along the services chain and data disclosing in the HORECA businesses.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Financial ☐ Policy ☐ Social ☐ Technological
Implementation of certification for zero waste practices i.e. promotion of reuse -refill systems	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Networking of businesses for the promotion and replication of ‘green’ practices.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Enhance separate collection for recycling and control waste generation by tourism in synergy with the plastics packaging sector and the municipalities, through Extended Producers Responsibility (EPR) schemes.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Promote waste separation systems on board cruise ships.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Tourist information/awareness campaigns organised by municipalities and tourism companies targeting on reducing single-use products.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
	○ 1 (Very Immature)	

Awareness raising on food overconsumption and food waste	○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Financial incentives for replication of best practices for the 'green transition'.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy

Solid Waste and Wastewater Management

Please give us you opinion on the degree of maturity for the implementation of the following actions on scale from 1 (Very Immature) to 5 (very mature), for each the 4 dimensions (technological, financial, social, policy)

	Degree of maturity	If you find the solution immature (Degrees 1-3) please state which of the four dimensions is the less mature
Strengthen and promote networking of cities for the exchange of good practices as an effective action to accelerate the implementation of the circular economy	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Financial ☐ Policy ☐ Social ☐ Technological
Implementation of Extended Producer Responsibility Principles in combination with green business certifications	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Implementation of return and refill systems through partnerships and public-private sector agreements	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Increase landfill taxes to maximize the effectiveness of existing waste management legislation.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy

Extended Pay-As-You-Throw principle in waste management to include businesses and citizens	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Adoption of separate recyclable waste collection systems and door to door schemes	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Regulations on fixed percentage of recyclables in new packaging at national level.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Economic incentives of regions/cities to support and enhance the viability and attractiveness of local repair and maintenance markets	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Adoption of waste collection systems from the environment (river & stream estuaries)	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Strengthening research into the valorisation of waste collected from the environment.	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy
Modernize the specifications of new wastewater treatment plants to include contaminant of emerging concern	○ 1 (Very Immature) ○ 2 (Rather Immature) ○ 3 (Neither Mature / nor Immature) ○ 4 (Rather Mature) ○ 5 (Very Mature)	*Maximum 2 selection(s)* ☐ Social ☐ Technological ☐ Financial ☐ Policy

Is there something else you would like to add?

Would you like to receive information on future BMM Stakeholder events?

- Yes
- No

Would you like to register for receiving the BMM newsletter and learn about the progress of the project?

- Yes
- No

If you answered yes to any of the above questions please give us your email so we can inform you of the relevant events

---

Thank you very much for your participation!