



DEPOLLUTING THE MEDITERRANEAN

A 2030 roadmap for key economy sectors to fulfil the EU Mission to Restore our Ocean and Waters through Innovative and Transformative Solutions



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EXECUTIVE SUMMARY

2030 is a landmark year for the European Union: it's the target date for member states to bring concrete solutions to some of the greatest challenges we face as a global society. To this end, five EU Missions are ongoing under Horizon Europe, the bloc's key funding programme for research and innovation. Mission 3 is to **'Restore our Ocean and Waters'**. This has three specific objectives, the second of which is to **'Prevent and eliminate pollution in our seas and ocean'**.

The Mediterranean basin has been chosen as the area-based 'Lighthouse' to drive the latter objective. By 2030, the goal is to reduce plastic litter at sea by 50%, cut microplastics entering the environment by 30%, and lower nutrient losses and the use of chemical pesticides by 50%. Efforts made over the last few years to tackle pollution in our seas and waters are already

producing some progress, as confirmed by a recent EU report showing that marine litter on the EU coastline has reduced by almost one-third compared to the 2015-16 baseline. But the same report highlights that more needs to be done, as marine litter still remains above the agreed threshold value in many European regions, especially in the Mediterranean basin.

BY 2030, THE GOAL IS TO:



50% reduction of plastic litter at sea



30% reduction of microplastics entering the environment



50% reduction of nutrient loss and use of pesticides



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Agriculture



Aquaculture



Fisheries



Tourism



Transport and ports



Plastics industry



Waste water treatment and solid waste management

The BlueMissionMed project has been created under the Mediterranean Lighthouse to drive change at scale in the fight against marine pollution. Run by a **multidisciplinary consortium of partners** and operating through **seven National Hubs**, it brings together initiatives and networks to align priorities and policies across countries, mobilizing stakeholders, fostering engagement, driving innovation, and spreading knowledge and best practices across seven key economic sectors.

- 1 **Agriculture**
- 2 **Aquaculture**
- 3 **Fisheries**
- 4 **Tourism**
- 5 **Transport and ports**
- 6 **Plastics industry**
- 7 **Waste water treatment and solid waste management**

Each of these sectors is vital to the regional economy, providing jobs and essential products and services – yet each is also a significant contributor to marine pollution, and much more needs to be done to reduce their impacts.

But there's a lot of work going on to turn the tide: BlueMissionMed collects, assesses and scales up **innovative transformative solutions** in and across all these sectors. The most promising have been brought together in the present **Operational Implementation Roadmap (OIR)** for the depollution of the Mediterranean basin. The OIR gives an overview of each sector, surveys their key pollution impacts, and highlights sectoral anti-pollution priorities under three headings: **Prevention, Minimization, and Elimination – Remediation.**



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While many of the actions detailed in the OIR are specific to individual sectors, some broad themes emerge. **Greater North-South cooperation** is critical, with more support for non-EU countries. Building **new networks of cities and regions** across the Mediterranean is a primary way to share knowledge and information; while creating more **public-private partnerships** will foster innovation and grow capacity. Increased **plastic recycling**, along with **refill and reuse** systems, is needed to drive a paradigm shift towards circular models. One of the features highlighted by the present analysis is the strong technological component of the solutions, that represent about two-thirds of the shortlisted solutions. However, to address the problem at its roots, preventive solutions and measures and the involvement of multiple actors will have to be prioritized to achieve replicability and long-term viability.

BlueMissionMed is actively seeking to **grow its networks and raise awareness** of the solutions it champions. There's more information in the following pages, and on the [project website](#).

HORIZON EUROPE: The 2030 Missions

2030 is a landmark year for the European Union: it's the target date for member states to bring concrete solutions to some of the greatest challenges we face as a global society.

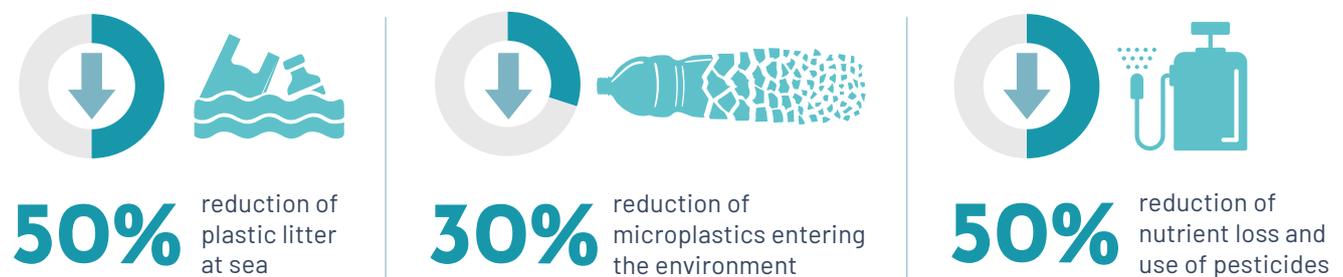
To this end, [five EU Missions](#) are ongoing under Horizon Europe, the bloc's key funding programme for research and innovation. The Missions have ambitious goals, and are set to deliver tangible results. This summary is focused on **Mission Restore our Ocean and Waters** and its [mission Charter](#).

EU MISSION: Restore our Ocean and Waters

Mission Restore our Ocean and Waters operates through four regional 'Lighthouses,' which are area-based sites to pilot, demonstrate, develop and deploy solutions. They're located in the four major basins across Europe: the Atlantic-Arctic, the Baltic-North Sea, the Danube-Black Sea, and the Mediterranean Sea. Each of these basins – each Lighthouse – is the focus of one of the Mission's specific objectives.

The EU chose the Mediterranean to be the Lighthouse for its efforts to meet **Objective 2: Prevent and eliminate pollution in our Seas and Ocean** (in line with the [EU Action Plan Towards Zero Pollution for Air, Water and Soil](#)).

To achieve this the following targets have been set by 2030:



Stakeholders – public and private organizations, national, regional and local authorities, philanthropists and investors, enterprises and businesses, civil society, research and academia – are encouraged to [sign up for the Mission Charter](#) and get involved in the growing community towards the depollution of the Mediterranean Sea.

THE MEDITERRANEAN LIGHTHOUSE: BlueMissionMed project

The Mediterranean – a semi-enclosed sea with high levels of development and human activity – is a pollution hotspot and a clear priority for action: while it makes up less than 1% of the global ocean, it's home to 7.5% of global marine biodiversity, while also hosting 15% of global marine traffic and generating 20% of global gross marine product. Urgent change is needed to redress the balance.

BlueMissionMed has been created to drive this change at scale. Run by a multidisciplinary consortium of partners, it brings together initiatives and networks to align priorities and policies across seven countries where the BMM Hubs for the depollution of the Mediterranean have been set up and operate. This is taking place across four domains:

- **Technology** – identify and promote tech solutions
- **Social** – promote structures for citizen engagement and education
- **Governance** – facilitate inclusive participatory processes and governance frameworks for systemic transformation
- **Business** – ensure local business development and participation

The BlueMissionMed approach to solutions follows the zero-pollution hierarchy:

- **Prevent** pollution in all stages for a clean and circular economy from extraction of natural resources, to production, service provision and recycling at end-of-life.
- **Minimize** releases of contaminants/(pollutants), through management, technological measures and information about releases.
- **Eliminate and remediate** as far as possible existing pollution of water and soils and apply measures to return to a 'good status'.

To reach the Mission targets, BlueMissionMed has created an Operational Implementation Roadmap.

The Operational Implementation Roadmap

Transforming seven key economic sectors to bend the curve on pollution by 2030 is an ambitious goal, and BlueMissionMed has been working with sector experts from around the Mediterranean to plot a strategic course to achieve it.

Over a two-stage co-design process, BlueMissionMed engaged with a multistakeholder pool of 382 specialists – public and private actors, civil society, academia, high-level policymakers – through events, online workshops and targeted interviews. Participants worked with BlueMissionMed project partners to identify priority areas for action in each sector, and co-designed the Operational Implementation Roadmap (OIR). They then surveyed the range of pollution solutions in place and in the pipeline, assessing their upscaling potential, and exploring areas for research and innovation. A total of 87 transformative sector-specific solutions were evaluated, with partners choosing to showcase 40 of them as Innovative Transformative Solutions.

The full-length OIR is available to read upon request. A summary of its recommendations for each of the seven sectors covered follows.

BlueMissionMed identifies and promotes a wide range of anti-pollution solutions split across seven key economic sectors:



Agriculture

Aquaculture

Fisheries

Tourism

Transport and ports

Plastics industry

Waste water treatment & solid waste management



AGRICULTURE

Agriculture is a highly important sector for the Mediterranean region, which is a chief global producer of many different products from olive oil and wine to fruit and vegetables. Agriculture, on the other hand, is a major source of nutrients, pesticides and plastic pollution in aquatic ecosystems.



**246m
hectares**

of land across the basin are farmed



25%

Pesticides found above thresholds in up to 25% of surface and 11% of ground water sites monitored in the EU

Some 246 million hectares of land across the basin are farmed (28% of the total land area). Small family farms are predominant, although richer northern countries tend to concentrate their agricultural land into large farms. Agricultural development in the EU Mediterranean has been shaped by the Common Agricultural Policy, which aimed to increase productivity through subsidies, including for agrochemicals and irrigation. Recent reforms like the European Green Deal have been introduced to promote more ecologically friendly farming practices, but these currently favour larger farms, significant challenges remain, especially for smallholders.

Aquatic impacts

Nutrient enrichment and water contamination

Deteriorating soil quality, due to the excessive use of fertilizers and pesticides, intensive farming and salinization, traps farmers in a cycle of increasing chemical dependency, with increasing environmental impacts. Nutrients leaching from fields enter local water

bodies, and are then carried to the ocean, creating eutrophication hot spots and harmful algal blooms at river mouths and enclosed areas such as the Gulf of Lions and the Adriatic Sea. Pesticides further harm aquatic life, and are responsible for significant contamination of surface and groundwater across the Mediterranean.

Plastic pollution

Plastic is widely used in agriculture, primarily in packaging and also in films for silage and mulch, greenhouses, twine and irrigation. Much agricultural plastic remains unaccounted for as waste, which implies that a large part enters the environment where much of it will eventually reach the coast. There is, though, no quantitative data for EU countries on how agri-plastics contribute to marine litter, let alone for the Mediterranean as a whole. Agricultural plastics often fragment rapidly due to ploughing activities in addition to their exposure to the elements, breaking down into microplastics which continue to multiply in the ocean.



SECTOR PRIORITIES

To align with the Mission goals, Mediterranean agriculture must balance productivity with environmental health. Improved soil management and reduced use of agrochemicals and plastic are paramount to the sector's future sustainability, as is improved waste handling. North-South cooperation, and a focus on smaller farms, are both essential elements in a regional transition.



PREVENTION

- Accelerate **organic farming** and pest control; cooperate with related research and development activity; offer economic support and incentives for farmers to make the transition.
- Bring farmers' associations together with the plastics industry to pilot solutions for truly **biodegradable agri-plastics**.
- Enhance the adoption of smart and innovative agricultural methods on small family farms by promoting **collaborative and cost-sharing** governance and business solutions.



MINIMIZATION

- Recycle nutrients from agricultural waste to achieve fully circular localized nutrient management.
- Upscale **traditional agroecological practices** (e.g. crop rotations, mulching, agroforestry) with scientific backing to replace routine pesticide and fertilizer use.
- Upskill farmers by disseminating **guidelines and toolboxes** in relevant areas.
- Use smart digital precision systems to **monitor agrochemical use** and ensure more targeted interventions.
- Build separate **collection systems for agri-plastics** in cooperation with the solid waste management sector, which could be funded by **extended producer responsibility (EPR)** payments from the plastics industry. In parallel, introduce financial incentives for farmers to use them, such as deposit return schemes.



ELIMINATION/REMEDIATION

- Step up research on **nature-based solutions** to recover impacted ecosystems, such as re-establishing wetlands for nutrient retention and removal.
- Work harder to strengthen the **legal frameworks** and governance structures through which solutions such as integrated pesticide management techniques can be applied.



BEST PRACTICES, SOLUTIONS

Most agricultural solutions that were evaluated deal with the development of zero plastic waste practices, including packaging based on bio-sourced raw materials, alternatives to pesticides, smart farming techniques, robotics, and novel soil management. Many of these solutions are in line with the principles of the circular economy, but none of them is ready for upscaling. Finally, more effort is needed to develop preventive solutions as highlighted in the above priorities.



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AQUACULTURE

Aquaculture is a fast-growing sector in the Mediterranean, with an increasingly important role in food production, employment and economic development. More than 43% of all seafood in the Mediterranean is now from farmed sources, with the proportion continuing to increase.



43%

of all seafood in the Mediterranean is now from farmed sources



70%
phosphorus

80%
nitrogen

from uneaten feed and fish waste reach the aquatic environment

Aquaculture needs high-quality water resources to operate effectively, so the sector has a clear interest in limiting its environmental footprint. In some instances, production can actually help to control water pollution: filter-feeding molluscs remove microscopic particles, improving local environmental conditions; while the emerging field of micro and macro algae multi-trophic aquaculture (where waste from one species is used as an input for another) is showing promise for minimizing potential eutrophication impacts. However, development in this area is being held back by restrictive EU legislation, despite its obvious value for circular economy strategies.

Aquatic impacts

Nutrient loading

Aquaculture is a source of nitrogen and phosphorus, which are released from uneaten feed and fish waste and accumulate in sediments – on average, 80% of the former and 70% of the latter reach the aquatic environment. As with agricultural run-off, this nutrient loading can cause localized eutrophication in the oligotrophic Mediterranean.

Chemical inputs

There is no accurate data on the levels of antibiotics used in Mediterranean fish farms. However, given that up to 80% of antibiotics delivered through medicated feeds are excreted into the marine environment, this is clearly an area that requires further scrutiny as the sector continues to expand: some of the chemicals may be toxic to other species in the ecosystem, while antibiotic resistance is of growing global concern. Another issue of concern is the use of copper-based antifouling paints for nets, and in-situ cleaning processes which release copper into the surrounding waters.

Plastic pollution

Uses for plastic in aquaculture operations include netting for cages, mesh bags/screens, drums, buoys, buckets and trays. While data that separates aquaculture from fisheries is inconclusive, the two sectors are thought to be responsible for about 12% of all litter found in the Mediterranean. The most common aquaculture-related plastic items are bivalve nets: for each kilo of mussels produced, a metre of polypropylene net is used. This would mean that for an annual production of 350,000 tonnes of Mediterranean mussels, 7,000 tonnes of plastic waste would be generated. How this waste is dealt with is key.



SECTOR PRIORITIES

For the Mediterranean aquaculture sector to achieve Mission targets, cooperation among several economic sectors is needed to minimize the release of waste (plastic, nutrients and chemicals), maximize the potential of circular economy strategies, and ensure compatibility with other economic activities.



PREVENTION

- Form public-private partnerships to promote **increased R&D in pharmaceuticals and biotechnology** to minimize antibiotic use in farmed species. Develop eco-friendly antifouling and remediation agents.
- Develop **reuse models for packaging** along the value chain, with enhanced waste collection and recycling facilities.
- Ensure **sustainable zoning of production sites**, with robust assessments of carrying capacity and coexistence potential with the surrounding environment.



MINIMIZATION

- Promote **integrated multi-trophic systems** throughout the region to minimize nutrient and organic loading. New regulatory frameworks, training and skills development (including in non-EU countries), and financial incentives are all needed.
- Improve sector management efficiency through the promotion of **digitization tools**.
- Introduce **EPR schemes** for aquaculture sector packaging and management of the cage nets.
- **Foster cooperation** and build synergies among aquaculture companies to reduce and recycle sector waste.
- Develop **standards and sustainability certification schemes** to improve environmental performance – regular monitoring and reporting are an essential part of this.



BEST PRACTICES, SOLUTIONS

The solutions assessed for the aquaculture sector are preventive technological measures, addressing alternatives to the use of antibiotics with a high readiness level, and developing bio-based, recyclable mussel nets and ropes. A 'Minimization' solution targeting nutrients and organic wastes is the synergistic aquaculture scheme of integrated multitrophic aquaculture. All these solutions aim to change the business-as-usual scenario by targeting the problems at their roots.





FISHERIES

Fisheries have been at the heart of Mediterranean life for millennia, with dense coastal populations driving a constant demand for seafood: today, a fleet of 73,250 vessels (of which 82% are small-scale) produces about 900,000 tonnes of fish each year, generating revenues of €2.6 billion.



1-5%

Yearly EU fishing sector revenue reduced due to marine litter cost



0.6%

GHG emissions from the fishing sector have doubled since 2011, and now make up about 0.6% of total global emissions

Considerable efforts have been made in recent years to reduce overfishing in the Mediterranean, which – along with pollution – is one of the most serious threats to marine biodiversity. A regional governance framework incorporating science-based management plans and spatial and technical measures has begun to improve the status of some key commercial stocks, and will be further expanded to cover more resources in future. In the meantime though, many commercial stocks remain overexploited, and overall fishing pressure is still double the level considered sustainable. With stocks under pressure from overfishing, the good status of the hydrosphere is of even more importance.

Aquatic impacts

Plastic pollution

Problems related to marine litter cost the EU fishing sector between 1-5% of its revenues each year, due to reduced

catches and damage to vessels and gear. Abandoned, lost or discarded fishing gear (ALDFG) can have severe impacts on marine life, notably through 'ghost fishing': ALDFG can entangle fish, birds, invertebrates, marine mammals or sea turtles for as long as it remains present in the environment. Fishing gear also generates microplastics, with two major sources being plastic filaments which detach from deteriorating nets, and the loss of expanded polystyrene fish boxes which quickly fragment.

Greenhouse gases and other contaminants

The fishing fleet emits greenhouse gases (GHGs) which pollute the atmosphere, and oil which pollutes the hydrosphere. Global estimates show GHG emissions from the fishing sector have doubled since 2011, and now make up about 0.6% of total global emissions. The levels of pollution a vessel emits depend a great deal on its size, type and age.



SECTOR PRIORITIES

The actions that the fisheries sector needs to take are clear, and although strategic plans and provisions are already available, they are still at an early stage and not yet widespread. There's a lot of work to do before Mission goals are reached. Fishers' associations, port authorities, the waste management sector and the plastics industry need to come together to find synergies and develop tailored solutions to shared pollution challenges.



PREVENTION

- Develop and adopt **reuse systems** for fish boxes, nets and other items along the value chain, supported by legislative instruments.



MINIMIZATION

- Add **tracing tags** to nets and other gear to facilitate monitoring and control measures.
- Provide financial incentives to introduce **renewable energy sources** on board fishing vessels and at processing facilities.
- Expand systems for **collection and recycling** of fish boxes, nets and other gear in all Mediterranean countries, including EPR schemes.



ELIMINATION/REMEDIATION

- Form **participatory networks** for the collection and removal of ALDFG and create financial instruments to support them. Acquiring comprehensive and accurate **ALDFG monitoring data** is vital.
- Promote 'fishing for litter' schemes, **valorizing recovered marine litter** and providing guidelines and facilities for disposal of ALDFG and marine litter at EU and non-EU Mediterranean ports.



BEST PRACTICES, SOLUTIONS

All solutions in the Fisheries sector address the 'Elimination and Remediation' dimension. In cooperation with fishers and municipalities, the solutions set up a scheme, from collecting to upcycling and producing new products, leading to new business models. The latter span from production of ornaments to yarn or new fishing gear. Some are more advanced and have implemented business models while others are still in a premature stage lacking either the social or the financial aspect. Tags for fishing gear are being developed, either acoustic or satellite-traced, which promise the fast geo-localization of ALDFG, and its efficient recovery by fishers, also allowing the implementation of EPR schemes. Nevertheless, there are concerns over the ease of microplastics generation from the upcycling of nets to yarn or even recycling to new nets of presumably low quality. Most of these solutions have quite high maturity levels but their upscaling requires changes in policies and social acceptance.



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TOURISM

The Mediterranean is the most popular tourist destination in the world, hosting a substantial number of UNESCO's World Heritage sites. Accounting for up to 15% of regional GDP and 11.5% of total employment, tourism – including cruise tourism – is the most important economic sector in the region, especially in countries with limited agricultural or industrial development.



40%

increase of marine litter on Mediterranean coasts in peak tourist season



€268 million

estimated annual clean-up bill

The Mediterranean's natural beauty is a key attraction for tourists, but their presence places significant pressure on the environment. Unsustainable resource consumption (water, food, energy), environmental degradation, biodiversity loss, coastal development, and rising climate emissions all threaten the region's delicate ecosystem.

However, in recent years, there has been a noticeable increase in visitors pursuing nature-based alternatives to traditional beach resort holidays, and is becoming a growing hotspot for eco-tourism. Expanding new models for sustainable tourism and protecting the ecosystems it relies on will make an important contribution to environmental resilience and a swift green transition in the region.

Aquatic impacts

Marine litter

During the summer months when tourists swell coastal populations by more than a third, there's a huge increase in the waste that's generated. Under-resourced local waste management facilities are overwhelmed by the additional volume, which drives a spike in mismanaged waste and the risk of pollution. Indeed, marine litter on Mediterranean coasts increases by up to 40% in peak tourist season – which brings with it an annual clean-up bill of an estimated €268 million to keep locations looking attractive. Even so, much of this litter remains in the marine environment, gradually breaking down into microplastics.

As well as being responsible for high levels of air pollution and GHG emissions (see Transport), cruise ships discharge large quantities of waste in ports along with large numbers of tourists. Coastal municipalities often struggle to deal with the additional volumes of both.



SECTOR PRIORITIES

While the tourism sector's overall contribution to pollution in the Mediterranean has not been well quantified, it's estimated that by 2050 a 'business as usual' approach would see the sector generating an increase of 154% in energy consumption, 131% in GHG emissions, 152% in water consumption, and 251% in solid waste disposal. The creation of a Mediterranean Strategy for Sustainable Tourism with a focus on circular economy principles is an urgent priority.



PREVENTION

- Promote **reuse and refill systems** in the hotel, restaurant and catering sector; facilitated by certification for **zero-waste practices** and financial incentives for participation.
- Run **awareness-raising campaigns** targeted at tourists to promote sustainable practices and reduce dependence on single-use products.
- Build **business networks** to share and replicate 'green' best practices in the tourist sector.



MINIMIZATION

- Introduce **digital smart systems** to monitor waste generation and facilitate waste management; provide targeted training for employees to upskill the waste workforce.
- Work with municipalities and the plastics packaging sector to introduce **EPR schemes** to enhance collections for increased recycling and minimize waste generation.



BEST PRACTICES, SOLUTIONS

Identified solutions targeting the Tourism sector have more or less the same scope of minimizing cigarette butts and single-use plastics, and are implemented at local level by communities and tourist entrepreneurs. Yet they represent ways for transforming mentalities, needs and values. Specific solutions connected to sector priorities were not identified for Tourism, as needs and priorities for the sector's green transition are related primarily to financial and governance aspects. In addition, the 'greening' of the sector is highly dependent on the waste management and circular solutions implemented by cities and regions.



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TRANSPORT AND PORTS

Maritime transport is the backbone of trade and economic development, and the Mediterranean is among the world's busiest waterways, accounting for 15% of global shipping activity. Passenger transport and cruise tourism are also responsible for a great deal of maritime traffic, although unlike the transport of goods they follow seasonal patterns, with a general increase in intensity during the summer.



600

commercial ports and terminals, 36 of which are categorized as 'major' ports



57%

of all emissions from international shipping in Europe occur in the Mediterranean

Shipping activity including cruise traffic in the Mediterranean is still increasing in terms of the number of routes, traffic intensity and size of vessels, and is forecast to grow at a rate of 4% over the coming decades. With more than 600 commercial ports and terminals already in operation, 36 of which are categorized as 'major ports', it's a constant challenge for regional authorities to maintain the infrastructure and the facilities and waste management systems required to handle the increasing activity.

Aquatic impacts

Toxic emissions and greenhouse gases

Ship emissions contain toxic gases and particulates including sulphur oxides (SO_x) and nitrogen oxides (NO_x), as well as GHGs, that cause harm to marine fauna and flora when they are released. More than half (57%) of all emissions from international shipping in Europe occur in the Mediterranean. Cruise ships in particular pollute the air in port cities and contribute to ocean acidification, as well as emitting GHGs which alter ocean chemistry and increase sea surface temperatures.

Oil spills

The Regional Marine Pollution Emergency Response Centre (REMPEC) estimates that between 100,000-150,000 tonnes of oil are spilled by ships in the Mediterranean each year: this causes very serious pollution in coastal and ocean environments with sometimes irreversible impacts on wildlife and habitats. While major sea routes and the areas around key oil terminals are most at risk, accidental oil spills can occur anywhere – potentially on a catastrophic scale.

Waste and marine litter

When ships arrive at port, they're meant to unload their waste – sewage, bilge water and ballast water, oily waste and other refuse – at dedicated reception facilities. In 2018, the EU's impact assessment estimated that a significant portion of ship-generated waste was not being delivered to port reception facilities (PRFs) within the EU and is illegally discharged at sea, straight into the marine environment.



SECTOR PRIORITIES

A number of initiatives, laws and regulations to reduce pollution from the transport and ports sector are already in place or in the pipeline, both at international and at EU level. The priority in the Mediterranean is to coordinate the response on a regional scale, including through joint cross-border actions. Stronger enforcement and compliance mechanisms are also required to reach Mission goals.



PREVENTION

- Use legislation and financial support to establish **onshore power supply systems** to reduce toxic emissions in ports; encourage public-private partnerships.
- Intensify efforts to **monitor emissions** from ships; engage crew members in citizen science programmes to gather more data.
- Increase **multistakeholder networking** on pollution prevention across the region, including between the EU, non-EU partners and the IMO. Ensure a constant flow of guidelines and best practices across the networks to harmonize regulations, procedures and standards.
- Step up regional **research and development** to decarbonize the sector and prevent other harmful emissions.



MINIMIZATION

- Increase efforts to improve **management of solid waste in ports**. The needs and capacities of small ports, in particular, should be taken into account.
- Build synergies between regional ports and the cruise sector to **promote green practices** on waste management and resource use.
- Drive **social engagement** on minimizing pollution through awareness-raising campaigns for passengers and targeted training for the workforce.



BEST PRACTICES, SOLUTIONS

The solutions identified for the Transport and Ports sector deal with the 'Minimization' of pollution from the shipping industry and the 'Elimination and Remediation' of accidental pollution from ships. The technological solutions identified address alternatives for low carbon fuels, whereas the governance solutions address the problem without making fundamental system changes. The decarbonization of the sector is one of the priorities highlighted.



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PLASTICS INDUSTRY

The plastics industry plays a significant economic role in the Mediterranean region, which is the world's fourth-largest producer of plastic. 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.



1,178,000 tonnes

estimated plastic pollution accumulated in the Mediterranean Sea



230,000 tonnes

additional thought to be leaking into the marine environment each year



6%

of this is in the form of microplastics

The use of plastic products, in particular single-use plastics and packaging, contributes to environmental damage; producers will need to confront tighter regulations with regard to the production and pre- and post-consumer reuse and recycling of materials. Currently, less than one-third of the plastic waste produced in the Mediterranean each year is recycled. The EU's Plastics Strategy focuses on reusability, repair and recycling, and has set a target to ensure that all plastic packaging is recyclable or reusable by 2030. A range of measures are in place across the Mediterranean, but attitudes to implementation vary widely and faster progress is needed.

Aquatic impacts

Plastic pollution

The Mediterranean is a global hotspot for plastic pollution. Estimates of the total volume that has accumulated in the Mediterranean

vary widely, although 1,178,000 tonnes is a commonly quoted figure. An additional 230,000 tonnes is thought to be leaking into the marine environment each year, with Türkiye, Egypt and Italy being the three largest contributors. Some 6% of this is in the form of microplastics from sources such as paint particles, tyre dust, industrial pellets and textile filaments.

Plastic waste varies in size, from larger pieces of debris which can entangle or otherwise harm marine life, to micro- and nanoplastics which can be ingested by marine animals and enter the food chain, potentially ending up inside humans and posing a risk to health. Plastic on the beaches of the Mediterranean, meanwhile, directly harms the region's vital tourist sector, not to mention reducing the quality of life of its permanent residents.

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PLASTICS AND BIODEGRADABILITY

To avoid confusion among end-users on the benefits of bioplastics or biodegradable plastics clear definitions are needed:

Biodegradation of plastics is the microbial conversion of all its organic constituents to carbon dioxide (CO₂), new microbial biomass and mineral salts under oxic conditions (in the presence of oxygen) or to CO₂, methane (CH₄), new microbial biomass and mineral salts under anoxic conditions. Biodegradation involves enzymatic/chemical transformation of plastic polymers. Chemical additives can influence the biodegradation behaviour of plastic and should therefore be taken into account when assessing its biodegradability.

Biodegradable plastics should demonstrate the successful completion of the polymer chemical transformation, which requires that testing conditions reproduce as closely as possible those of the open environment in which the plastic is most likely to enter, and ideally should be done in the real environment where feasible. As part of a circular economy, materials should be designed with the intention that they will be recaptured and not littered into natural ecosystems.

Biodegradable plastic can be valuable when coupled with appropriate collection, separation and composting or anaerobic digestion infrastructure, but it is not a solution to litter or marine debris.

Compostable plastics are those which biodegrade successfully under the controlled conditions of composting facilities. Yet differences in composting conditions between industrial and home composting affect biodegradability. Compostability can play a potentially beneficial role in a responsible material system, but it must be paired with the right infrastructure and applications.

If the infrastructure is in place to collect and process compostable plastic through industrial composting or anaerobic digestion, potential environmental, social and economic benefits could be realized. Currently, these systems are not available in much of the world and reduction and reuse of plastic should be prioritized first.

Bio-based polymers (or biopolymers) such as cellulose, starch and lignin are composed of carbon derived from renewable biological sources such as plants, in contrast to fossil-based polymers. The fact that these plastics are bio-based, however, does not necessarily mean they are biodegradable, and both bio-based and fossil-based polymers can be either biodegradable or non-biodegradable.

Bio-based plastics may offer environmental advantages over their fossil-based counterparts, but they must be sourced and managed responsibly to realize this potential. Metric-based decision making should be used to assess bio-based plastic on a case-by-case basis.



SECTOR PRIORITIES

The transition to a circular economic model is the most important goal for the plastics industry – and this will have a bearing on almost all other sectors too, given their near-universal dependence on them. In other words, the development of eco-friendly solutions in the plastics industry will act as a multiplier for the green transition of other sectors. Progress on reuse, repair and recycling is increasing, but a decisive acceleration is needed to achieve Mission targets.



PREVENTION

- Step up efforts to develop and implement **reuse and refill models** (for EU countries under the EU Plastics Strategy and Green Deal).
- Support the development of a clear regulatory framework to address confusion and guarantee the development of bioplastics and **truly biodegradable plastics**, creating the conditions for a circular economy and mitigating risks.
- Strengthen regional cooperation in the sector, and provide new business opportunities based on truly circular models.



MINIMIZATION

- Increase recycling rates and levels of recycled content in plastic goods. A **certification process for recycled content** could help facilitate success.
- To increase recycling rates, work with the solid waste management sector to drive wide adoption of separation and door-to-door collection schemes (EPR, deposit return etc.), gather more data on what happens to recyclables, and raise awareness among citizens.
- **Strengthen research** into valorizing plastic waste recovered from the environment in parallel with developing the necessary legislative framework.
- Spread and monitor the implementation of best practices to prevent and minimize losses during the manufacturing process.



BEST PRACTICES, SOLUTIONS

Several solutions related to the Plastics sector deal with the development of bioplastics and biodegradable polymers using low-cost bio-wastes as raw materials. Some examples are food packaging materials from fish, potato and organic waste that have hygienic properties, and are industrially and home compostable. Other solutions propose the production of bio-based plastics, mostly targeting the agriculture and fisheries sectors, with the development of biodegradable mulching films, fishing nets or even yarn for the textile industry. These solutions claim that they target the problem at its source and can be considered preventive. But the biodegradability of the developed materials in soils and waters is still under testing, and in all cases the new materials do not biodegrade in the open environment; rather, they behave similarly to conventional plastics regarding the generation of microplastics. Other approaches promote the circularity of waste by exploring the valorization of side streams (discards) from the fishing industry with subsequent transformation into valuable materials (cosmetics, food supplements, fertilizers and soil improvers, car components), also developing corresponding circular value chains. Solutions related to alternatives to chemicals used by the plastics industry, in particular PFASs, have a low maturity level and are still under experimental investigation.



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WASTEWATER AND SOLID WASTE MANAGEMENT

Production of urban wastewater and municipal solid waste (MSW) is clearly linked to increasing rates of coastal urbanization across the Mediterranean, with around 70% of the population now living in urban areas. However, of more than 9,000 wastewater treatment plants in the EU Mediterranean, only 60% meet EU regulations – and non-EU countries face greater challenges.

When it comes to MSW, consumption has been rising exponentially in recent decades: the annual weight of MSW generated in the EU Mediterranean now averages out at 500kg per capita, while the figure for non-EU countries is 300kg. How this waste is managed, starting with its collection, has been a regional priority for some time, as there's a high risk of mismanaged waste eventually polluting the ocean. In practice, though, disposal systems vary a great deal between Mediterranean countries. National governments tend to set policies, while operational responsibility is devolved to regions and municipalities. Public-private partnerships are common, designed to achieve effective and efficient waste management, although there is a conspicuous lack of a common framework across the region. Specific wastewater and MSW targets at EU level focus on the prevention of waste generation and the reuse of water and materials, so as to achieve a transition to a circular economy model. While the EU Mediterranean is beginning to see some positive trends, the non-EU countries lack any harmonized strategic instruments and there's still a long way to go for the region as a whole.

Aquatic impacts

Nutrient and chemical pollution

Despite recent progress in the treatment of wastewater, wastewater discharges are still thought to be responsible for 45% of the nitrates and phosphates that enter the

Mediterranean Sea, contributing to local eutrophication problems. Wastewater also contains micropollutants that can harm aquatic life – inputs of these 'contaminants of emerging concern' (CoECs) have been detected in the vicinity of treatment plants in several Mediterranean countries, and research confirms that CoECs are now ubiquitous in Mediterranean waters. What's more, it's a constant challenge for scientists and regulators to keep up as new chemicals with unknown impacts are introduced to everyday products.

Plastic pollution

Poor management of MSW is one of the main causes of marine plastic pollution, with more than 50% of waste in non-EU Mediterranean countries disposed of in open dumps. Beach litter data shows that most monitored beaches in the Mediterranean fall below the UNEP/ MAP threshold for good status (79%), with about 90% falling below stricter EU MSFD limits. If business-as-usual practices continue, models project that the annual volume of mismanaged waste will more than double by 2040, leading to an exponential increase in marine litter. Microplastics, too, are released from mismanaged MSW as fragments; while urban run-off and wastewater discharges can contain microplastics from deterioration of materials during usage including synthetic textiles, cooking utensils, building coatings, artificial turfs and many other products.



SECTOR PRIORITIES

Accelerating circular models in the management of wastewater and MSW is a clear priority for the sector. This requires initiatives on regional, national and local levels, with an emphasis on a bottom-up approach. Innovation, tools and incentives will be needed, which can be facilitated by promoting networking and best practice exchanges among cities and municipalities across the Mediterranean.



PREVENTION

- Work with local enterprises to accelerate the establishment of **refill models** (e.g. water stations).
- Create economic incentives to strengthen local repair markets and make them attractive to citizens.
- Foster wider participation in regional and city networks to boost circular practices.



MINIMIZATION

- Raise landfill taxes, and implement the 'pay-as-you-throw' principle more widely to include businesses and citizens.
- Promote **EPR schemes to implement innovative technologies** for plastics recycling and treatment of CoECs in wastewater treatment plants.
- Introduce and raise awareness of separate recycling collection schemes, especially door-to-door.
- Introduce and enforce national and local regulations on percentages of recyclables in new plastic packaging to unlock recyclables markets.
- Work with plant operators to **upskill municipal employees** on the latest recycling and wastewater treatment technologies; step up monitoring of plant operations.
- Increase systematic data collection on all stages of wastewater and MSW management to assess their effectiveness; update requirements to include microplastics and CoECs.



ELIMINATION/REMEDICATION

- Adopt new collection technologies for the elimination of solid waste and litter in the environment.
- Step up research and regulation to characterize and valorize different types of waste.



BEST PRACTICES, SOLUTIONS

Technologies and strategies in the wastewater treatment plant (WWTP) and solid waste management sector, are mostly related to pollution minimization, elimination and remediation, since the sector deals with waste. Several solutions focus on recovering products and energy from urban waste, while others target the removal or destruction of micropollutants and/or microplastics in WWTPs through innovative technologies. Efforts to collect litter from aquatic environments include manned vessels with advanced pumping and separation systems, robotic platforms for seafloor litter collection, and river-based solutions like floating traps and barriers that skim waste while allowing water flow. These solutions are needed in parallel to preventative ones, for the depollution of the Mediterranean. They also engage policymakers and communities to shift attitudes toward waste management. While significant progress has been achieved in advancing litter collection technologies, the valorization of collected materials remains underdeveloped, hindering the establishment of a complete value chain aligned with circular economy principles.



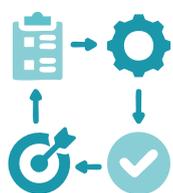
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FINAL RECOMMENDATIONS

To ensure these solutions deliver their full potential for the protection of the Mediterranean and its people, the following actions are required. The OIR brings together a total of 87 priority solutions for the depollution of the Mediterranean basin, many of which run across more than one economic sector. Of these, 24% are assessed to be at a reasonable level of maturity, while the majority (58%) require significantly more development.


87
 priority solutions for
 the depollution of the
 Mediterranean basin


58%
 require significantly
 more development

24%
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 level of maturity

Greater cooperation between EU and non-EU countries – between North and South, broadly speaking – is vital for the region as a whole. Upskilling workforces, harmonizing regulations, and replicating successful solutions through dedicated financial instruments are all key to achieving the Mission targets.

Networking Mediterranean cities and regions, in cooperation with the private sector, is a primary way to exchange information and foster circularity, and Union for the Mediterranean (UfM) and UNEP/MAP have a central role to play in facilitating this cooperation.

There are existing **innovative technologies** for the prevention, minimization, elimination and remediation of pollution whose integrated adoption must be

promoted. However, upscaling and adopting technological solutions necessitates the integration of financial, governance and societal factors and it appears that most solutions identified were weak in these domains.

All sectors share a vision to accelerate the **recycling of plastic** – though for the plastics industry, higher-quality recyclables are needed to increase recycling rates and the recycled content in new packaging. Separate collection schemes (e.g. door-to-door) are required along the value chain in all sectors, facilitated by awareness-raising, training and social engagement campaigns. National and local regulations on the percentage of recycled content required would boost efforts.

Refill and reuse models should also be implemented much more widely. Financial barriers to such schemes can be overcome through strategies such as EPR, which can be widely implemented beyond the packaging industry to take in producers working in agriculture, aquaculture and fisheries. Cutting down on **contaminants of emerging concern (CoECs) content** is another cross-sectoral area to target, as is the development of **truly biodegradable plastics** – along with clear definitions to guide regulations on their use.

Circular models can be improved, and targeted value-chain interventions identified, with **more accurate data** on the quantities and flows of materials and waste produced. Digital and smart tools, making use of AI developments, can support effective, swift and easy

monitoring across all sectors.

Disclosing data on the use of plastics improves business credibility, and is a key requirement in establishing **sectoral standards** for eco-friendly practices, as well as for **certification** processes – which should be expanded and harmonized across the region with the help of supportive policies, regulations and incentives.

Finally, there are a growing range of promising **nature-based solutions** for the remediation of agricultural land and river catchments from excess nutrients and pesticides. These need further development and testing under local conditions, along with a science-based policy framework to manage their use.



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JOIN THE MISSION

If you're interested in learning more about the innovative solutions and priority actions identified in the OIR, then the BMM team can help. Contact them here:



E: coordinator@bluemissionmed.eu

If you have a solution to share, then please sign up to the [BMM Charter](#) and become part of our network.



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