



## **POLICY BRIEF - Assessment of the Potential Benefits of iMERMAID**

Tackling pollution of Contaminants of  
Emerging Concerns (CoECs): A source-to-  
sea approach from water to ocean



## Tackling pollution of CoECs - A source-to-sea approach from water to ocean.

[iMERMAID](#) is an EU-funded project focused on protecting the Mediterranean Sea basin, its sensitive ecosystems and the ecosystem services it provides, which play a crucial role in a variety of different socioeconomic activities. It aims to address the growing threats of chemical contamination and pollution caused by human activities, with a particular focus on contaminants of emerging concerns. iMERMAID intends to integrate innovative strategies for prevention, monitoring, and remediation, particularly around the Mediterranean Sea. This project builds upon the research and innovation activities of 11 projects.

Bringing together [a consortium of 26 partners](#) from Europe and beyond, the project encourages collaborations to develop advanced sensor and remediation technologies, strengthen regulations to reduce contamination, enhance economic opportunities, and thereby improve the quality of life for EU residents.

This first policy brief aims to present the project's objectives. Two additional policy briefs will follow to provide recommendations on policy implementation and revision according to the conclusions of the research activities from the partners, including consideration of the sister projects' outcomes.

### Objectives of the Project

- Mature and develop innovative, reproducible technologies to monitor pollution from chemicals;
- Prevent water pollution at its source through educational plans and digital innovations;
- Create contaminant-free waters by effectively implementing the goals of Chemical Strategy;
- Expand the project outreach by calling for associated regions and stakeholders;
- Raise awareness of water-related challenges through school interventions;
- Develop relevant digital tools to prevent and tackle water pollution;
- Enhance multi-stakeholder cooperation.

### *Tackling Emerging Micropollutants in Three Steps*

Today, 80% of the global urban wastewater is released to the sea untreated<sup>1</sup>, increasing the risk of diffuse pollution and contamination of environment by toxic chemicals. The occurrence of emerging micropollutants (pharmaceuticals, pesticides, personal care products, industrial compounds, etc.) in the environment is considered a major threat to human health and aquatic ecosystems. This risk directly

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<sup>1</sup> UNESCO, Wastewater : the untapped resource, 2017. [https://www.unwater.org/sites/default/files/app/uploads/2018/10/WaterFacts\\_water\\_and\\_wastewater\\_sep2018.pdf](https://www.unwater.org/sites/default/files/app/uploads/2018/10/WaterFacts_water_and_wastewater_sep2018.pdf)

threatens 150 million people living by the coasts, a population that doubles during the summer season around the Mediterranean Sea. Moreover, it also threatens in various ways 2 million jobs in the blue economy in the EU Mediterranean Member-States, with an estimated €13 billion in combined output from fisheries and aquaculture fields<sup>2</sup>.

iMERMAID aims to protect the Mediterranean from the 100,000 types of anthropogenic chemicals available on the EU market. The majority of these chemicals have not been thoroughly investigated, and their effects on the ecosystem remain unclear. Many exhibit significant toxicity, long-range transport capacity persistence, and bioaccumulation potential.

iMERMAID strategy follows a three-step approach:

1. **Upstream: encourage a bold legislative framework regarding contaminant treatment for reused water and raise awareness regarding water-related issues through an educational programme.**
2. **At the Mediterranean doors: involve international stakeholders in assessing and developing pollutant-sensors to better separate contaminants from water.**
3. **Effectively remove micro-chemicals from the sea: honing existing tools and develop new innovations to better manage chemical pollution from the Mediterranean.**

### ***Benefits for the EU Legislation in a Source-to-Sea Approach***

iMERMAID builds upon the Green Deal agenda. It will contribute to the main strategic plans such as the [Zero Pollution Action Plan](#), and the [EU Climate Target Plan](#) by helping to mature and develop innovative, reproducible technologies to monitor pollution from chemicals.

The [iMERMAID White Paper](#) on upstream solutions stresses the importance of multi-stakeholder roadmap to tackle pollution from CoECs. It identifies regulation as the main driver for change and boosts the development of substitutes with less hazardous compounds. The main conclusions include three potential leveraging tools to be included in the EU policies:

- Fiscal incentives or financial support to enterprises, facilitating elements of the substitution process, such as funding for research, taxes, or subsidies.
- Networks and partnerships' development to disseminate information to stakeholders, including consumers, and fostering public-private collaborations for data and knowledge exchange.
- Demand stimulation to encourage environmentally benign product development in the nascent market, perhaps through public procurement policies or purchase subsidies.

Its *source-to-sea* approach will aim at developing a holistic approach through identifying synergies between different directives such as the [Bathing Water Directive](#), the [Drinking Water Directive](#), and the [Water Framework Directive](#)<sup>3</sup>. These directives are relevant for both freshwater and marine areas. In addition, tackling pollution at source will also feed into the debate on the [Sewage Sludge Directive](#).

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<sup>2</sup> According to the United Nations Environment Programme data basis out of the Mediterranean Action Plan from Barcelona Convention. See the link here: <https://www.unep.org/unepmap/resources/factsheets/blue-economy>.

<sup>3</sup> Daughters directives are: the Floods Directive, the Groundwater Directive, and the Environmental Quality Standard Directive.

Regarding the marine perspective, iMERMAID will also provide examples and best practices to reduce chemical pollution and hence contribute to the new objectives of the [Marine Strategy Framework Directive](#) in terms of quality status of the oceans and their litter.

Secondly, the monitoring of such contaminants will contribute to investing in *digital water*<sup>4</sup> and creating synergies with the other key priorities. Digitalisation constitutes one of the key objectives of the EU, offering increased predictability and flexibility in water management to achieve a Water-Smart Society.

Thirdly, the project will also contribute by providing recommendations for the Water Resilience Strategy and the Ocean Pact, as announced in the new [Guidelines of the European Commission 2024-2029](#). By focusing on ecosystem remediation through monitoring and decontamination from chemical pollution, the project will strengthen Europe's water security and enhance the competitive and innovative edge of our water industry. Moreover, it will benefit the blue economy and its sustainability. Finally, the citizen involvement actions will provide valuable recommendations on governance and offer tools to raise awareness about the importance of water and oceans.

### ***An opportunity for international cooperation in the context of the European Ocean Pact.***

The iMERMAID project can contribute to international collaboration in the Mediterranean area, especially through the case study in Tunisia which focuses on degrading over 95% of emerging pharmaceutical contaminants in industrial waste. This approach aims to cut pharmaceutical pollution at its source by more than 50%, aligning with EU standards.

Water management is one of the priorities of the [Euro-Mediterranean Regional and Local Assembly](#) (ARLEM), as well as for the [Union for the Mediterranean](#) (UfM). With its focus on the Mediterranean region, iMERMAID can easily suggest good practices for replication by other stakeholders in the region, through its [open calls](#) and its iMERMAID cluster as an integral component of the Mediterranean Sea basin lighthouse support facility.

## **The Barcelona Protocol**

*Protocol on the Prevention of Pollution of the Mediterranean Sea*

The Barcelona Convention, also known as the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, is an important legislative tool whose contracting Parties go beyond the EU. It adopts seven implementing Protocols to the Barcelona Convention, four of which are directly related to protection against contaminants of emerging concerns, namely:

- a. Protocol for the Prevention and Elimination of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft or Incineration at Sea
- b. Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities
- c. Protocol for the Protection of the Mediterranean Sea against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil

Protocol on the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal.


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<sup>4</sup> Digital Water: exploit the benefits of the extreme interconnectivity of people, devices and processes, and create capillary networks capable of monitoring the water system, starting at its multiple sources through to the individual end-user, thus generating continuous flows of valuable data for innovative decision-support systems at different governance levels. Water Europe, [the value of water](#), 2023.

At the global level, iMERMAID's efforts will also be valuable in the context of cooperation between water-related stakeholders of the [UN World Water Quality Alliance](#) and the [Water4All](#) partnership. It will particularly demonstrate solutions for the implementation of the [Barcelona protocols](#).


## Presentation of the five case studies


The tables below present the background, key facts and expected impacts of each case study of the EU project.

Location	Background	Key facts	Expected Impacts
San Esteban de Litera, Spain 	Agricultural chemicals, like pesticides, enter water bodies through runoff, causing significant pollution. In the EU, France, Spain, and Italy are major consumers. The Water Framework Directive sets pesticide quality standards in surface water; however, many areas exceed these limits.	A demonstration in San Esteban de Litera, Spain, introduces a wastewater treatment plant designed for 1,042 people, aiming to mitigate agricultural pollution by using a Pulsed Discharge Plasma system to eliminate pollutants without additional chemicals, reduce energy consumption, and treat contaminants at the source, thus reducing pollution upstream.	Demonstrate up to 95% efficiency in degrading agricultural pollutants with the PDP system.  Assess real-time pollutant sensor framework performance for wastewater monitoring.  Achieve over 50% reduction in transferring pollutants from agriculture to water bodies.


Location	Background	Key facts	Expected Impacts
Kalaat Al Andalouss, Tunisia 	Pharmaceutical industry effluents typically receive limited treatment before being discharged into the environment or municipal sewage systems, primarily through the conventional Activated Sludge Process (ASP). Trace amounts of active pharmaceutical ingredients may enter the environment post-use, posing potential risks by contributing to drug-resistant bacteria and fungi.	In a use case scenario, a remediation solution will be demonstrated at a pharmaceutical company in Kalaat Al Andalouss, Tunisia, to assess the removal efficiencies of pharmaceutical organic pollutants using both conventional ASP and an innovative microfluidic system, aiming to enhance treatment effectiveness.	Achieve >95% degradation of emerging pharmaceutical contaminants from industrial effluents.  Contribute to over 50% reduction in pharmaceutical pollutants at their source compared to conventional techniques, meeting EU permissible limits.  Evaluate the performance of the monitoring box for efficient measurements of selected relevant chemicals in real

			wastewater treated directly at the source.
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Location	Background	Key facts	Expected Impacts
Turín Italy 	<p>Human activities and industrial processes often release effluents containing heavy metals such as cadmium, lead, and mercury. Many of the heavy metals are hazardous even in low concentrations and the accumulation of these pollutants poses a significant threat to the environment and water ecosystems. Once the metals have entered the environment, detecting, and eliminating the pollutants from water proves challenging. Thus, preventing any release into the environment is crucial, and recognizing this, the EU has established discharge limits for many of the heavy metals.</p>	<p>The iMERMAID project focuses on water quality monitoring and heavy metal removal from wastewater. Water quality monitoring is essential to assess changes and improvements within the EU. The metals to be included in monitoring are Cd, Pb, Hg, Ni and their mixtures. To remove heavy metals, an innovative 4D Scavenger® technology will be integrated into wastewater treatment plants. 4D Scavenger® can selectively extract heavy metals from water and reduce pollution.</p>	<p>Removal of at least 95% of heavy metals from wastewater.</p> <p>Implementation of a real-time pollutant sensor framework for monitoring heavy metals up to their Predicted No Effect Concentration (PNEC).</p> <p>Efficient treatment of pollutants ensuring a proactive approach to environmental protection.</p>

Location	Background	Expected Impacts
Limassol, Cyprus 	<p>Contamination of the marine environment by chemical pollutants is of considerable concerns as it may result in adverse effects on marine ecosystems and human health. Monitoring the health of the marine environment is essential not only for measuring the current state, estimating trends, and evaluating the impact of human activities on the marine environment, but also for understanding whether protective measures taken for the marine environment are effective.</p>	<p>Examine of the potential to replicate the Monitoring Box with an 80% chance of success.</p> <p>Evaluate the combined performance of satellite data and sensors for a specific pollutant, achieving a 90% match.</p>



Location	Background	Key facts	Expected Impacts
<p data-bbox="204 360 341 383">Crete, Greece</p> 	<p data-bbox="582 360 896 589">Sanitary landfill leachate is a strongly polluted wastewater with a variety of components. It is characterized by high organic and inorganic pollutant concentrations and is extremely toxic if it is disposed of untreated to the environment.</p> <p data-bbox="582 622 896 965">The Leachate Treatment Plant of Pera Galini Sanitary Landfill, Crete is a tertiary treatment plant that receives the leachate produced by the Sanitary Landfill of Pera Galini. The Municipal Sanitary Landfill of Pera Galini is the largest landfill of the island and receives &gt; 120,000 tons/year of municipal solid waste from the majority of Heraklion prefecture.</p>	<p data-bbox="919 360 1165 1346">The presence of a wide range of chemicals in municipal solid waste landfill leachates is expected and documented. The objective of the Use Case 5 is to demonstrate the feasibility at real scale of upstream organic CoEC pollution remediation as a solution for preventing chemical pollution in the Mediterranean basin. A Microfluidic water system which is an innovative solution for the removal of organic contaminants from landfill leachates will be deployed and will be tested for its efficiency in removing micropollutants for the final effluent. In the same use case, an electrochemical sensor will be developed for monitoring micropollutants in the effluent and its applicability will be demonstrated.</p>	<p data-bbox="1187 360 1431 499">Up to 95% efficiency of microfluidic system in the leachates micropollutant reduction.</p> <p data-bbox="1187 533 1431 645">Real-time pollutant sensors for the monitoring of the effluents</p> <p data-bbox="1187 678 1431 757">&gt; 50% reduction in pollutants transfer to the water bodies.</p> <p data-bbox="1187 790 1431 869">Removal of at least 95% of heavy metals from wastewater.</p> <p data-bbox="1187 902 1431 1104">Implementation of a real-time pollutant sensor framework for monitoring heavy metals up to their Predicted No Effect Concentration (PNEC).</p> <p data-bbox="1187 1137 1431 1272">Efficient treatment of pollutants ensuring a proactive approach to environmental protection.</p>



The Mediterranean Sea and its surrounding regions support a diverse variety of essential socioeconomic activities. It is one of the highly exploited water ways and the influence of anthropogenic activities on its marine habitats and ecosystems has grown significantly since the industrial revolution. Because of this, the Mediterranean Sea basin is very vulnerable to chemical contamination and build-up. To safeguard the Mediterranean Sea basin from contaminants for emerging concerns (CoEC), iMERMAID will integrate, coordinate, and synergize innovative preventive, monitoring, and remediation solutions. iMERMAID will build an evidence-based multidimensional framework that will guide policymaking and transform societal perceptions to reduce CoEC usage, emissions, and pollution. Furthermore, next generation sensor and remediation solutions will be developed within iMERMAID to monitor and remove prioritized chemicals from its source while reducing upstream pollution. iMERMAID builds an ideal interdisciplinary team by bringing together prominent SMEs, researchers, regulators, and innovation professionals who have been essential in improving the knowledge and awareness of CoEC. Beyond state-of-the-art techniques, iMERMAID will strive to strengthen regulations against CoEC, expand economic possibilities and competitiveness, improve the standard of living for EU residents, while preventing the accumulation of chemical pollution in the Mediterranean Sea basin. iMERMAID will empower the efforts to create a zero pollution, contaminant free waters by enabling the Chemical Strategy's goals to become a practical reality.



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