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MOBILES

D6.2 - MOBILES interaction and connection with other EU-funded projects

Project Acronym:	**MOBILES**
Project Title:	**Monitoring and Detection of Biotic and Abiotic Pollutants by Electronic Plants and Microorganisms Based Sensors**
Grant Agreement:	**101135402**
Project coordinator:	**prof. Evangelos Hristoforou** **dr. Angelo Ferraro** National Technical University of Athens (NTUA)
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Deliverable D6.2 – MOBILES interaction and connection with other EU-funded projects

Short summary: D6.2 has the scope to document and report the actives described in Task 6.3: *Collaboration and interaction with other relevant EU projects.* NTUA serves as task leader with the contribution of all MOBILES partners.
Three level of collaborations have been established since the beginning of the project. These collaborations involve ongoing and past EU-funded research projects as well as an EU project cluster.

Due date: 31/08/2025
WP, leader: [WP6, NTUA]
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[WP6, NTUA]

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List of MOBILES participants

Participant No	Participant organisation name	Country
1 Coordinator	NATIONAL TECHNICAL UNIVERSITY OF ATHENS (NTUA)	GR
2	CONSIGLIO NAZIONALE DELLE RICERCHE (CNR)	IT
3	INSTITUT NATIONAL DE RECHERCHE POUR L'AGRICULTURE, L'ALIMENTATION ET L'ENVIRONNEMENT (INRAE)	FR
4	UNIVERSITA DEGLI STUDI DI ROMA LA SAPIENZA (UR)	IT
5	EDEN TECH (EDEN)	FR
6	UNIVERSIDAD PUBLICA DE NAVARRA (UPNA)	ES
7	INSTYTUT UPRAWY NAWOZENIA I GLEBOZNAWSTWA, PANSTWOWY INSTYTUT BADAWCZY (ISSPC)	PL
8	THE AGRICULTURAL RESEARCH ORGANISATION OF ISRAEL - THE VOLCANI CENTRE (ARO)	IL
9	UNIVERSITE DE BORDEAUX (UBx)	FR
10	TECHNOLOGIKO PANEPISTIMIO KYPROU (CUT)	CY
11	HEMIJSKI FAKULTET, UNIVERZITET U BEOGRADU (UBE)	RS
12	MAT4NRG-GESELLSCHAFT FUR MATERIALIEN UND ENERGIEANWENDUNGEN MBH (Mat)	DE
13	TECHNISCHE UNIVERSITAT CLAUSTHAL (TUC)	DE
14	GRANT GARANT SRO (GG)	CZ
15	CENTRUM BADAN I INNOWACJI PRO-AKADEMIA STOWARZYSZENIE (RICPA)	PL

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Content

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D6.2 SUMMARY

As part of project management and coordination, MOBILES project includes in work package 6 (WP6) task 6.3 dealing with the interaction and cooperation with other EU-funded initiatives. NTUA is the leader of task 6.3 with the support of all MOBILES partners. Right after the project start in September 2024, NTUA initiated a search of past and current EU-funded projects that might share common interests and technologies with MOBILES. Since September 2024, three levels of interaction have been established:

First. From January 2025, MOBILES is part of the European project cluster named **Marine Shield**. So far (August 2025) preliminary online meetings have been successfully conducted, yielding valuable insights for the next stage of planning. The scheduled cluster actions are to prepare joint policy brief on biosensors and environmental protection, as well as organize an event to disseminate projects scopes and results.

Second. MOBILES project regularly interacts with **AquaBioSens** and **BioSensei** the other two sister projects funded under the same call (HORIZON-CL6-2023-ZEROPOLLUTION-01). So far (August 2025) several online meetings have been concluded where joint actions have been discussed. Furthermore, MOBILES representative participated to the internal AquaBioSens annual project meeting held on May 2025. The main forecast joint activities are to produce at least one policy brief with recommendations from the three projects; soil and water samples exchange; and merge target technologies in order to complement biosensors developed in the three projects frameworks.

Third. MOBILES project used materials and knowledge generated by the two EU projects **HYDROUSA** and **CARDIMED**. Specifically, these two projects are running an experimental filed in the Greek island of Lesvos. The NTUA team collected soil samples that will be used for metagenomics analysis. Furthermore, since the coordination of HYDROUSA and CARDIMED is in Greece at NTUA, the NTUA teams involved in MOBILES, HYDROUSA and CARDIMEED are willing to present a proposal in the 2026 EU call HORIZON-CL6-2026-01-ZEROPOLLUTION-01 in order to further strength their collaboration and leverage the knowledge of the previous actions.

D6.2 presents all interactions and contacts established in the first 12 months of MOBILES project implementation. The majority of such interactions are in the form of online meetings with projects' coordinators or their representative. There have been however in person meeting and visit to other project facilities. Additional teamwork is forecast in the next 2 and half years.

Here in, a brief MOBILES's description is provided to frame the project objectives along with a table that contains all actions completed. Subsequently, the Marine Shield Cluster is introduced along with a brief description of all cluster members. The document continues with the description of interactions among MOBILES, AquaBioSens and Biosensei and finally it reports the interactions with HYDROUSA and CARDIMEED. D6.2 also includes a table describing the forecast actins with Marine Shiled and all the other EU-funded projects described above.

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MOBILES

1. MOBILES project short description

The National Technical University of Athens (NTUA) is working with another 15 partners from academia, research, and industry to develop prototypes of electronic and organism-based biosensors to monitor organic chemicals, antimicrobial-resistant (AMR) bacteria, and pathogens in water, soil, and air.

The MOBILES project is studying and developing biosensors for detecting heavy metals, antibiotics, pesticides, arsenic, microplastics, and nanoplastics. It is also developing genetically modified plants and bacteria for detecting heavy metals, antibiotics, and pesticides, and the use of marine diatoms for monitoring bioplastic degradation.

MOBILES aims are to tackle chemicals, including persistent and mobile (PMCs) pollutants and contaminants of emerging concern (CECs), that degrade the environment. Another severe global health risk is associated with increasing AMR in bacteria. Foodborne pathogens, including *Listeria*, *Salmonella*, and *Campylobacter*, pose significant public health risks and are already monitored. However, current bacterial detection methods for environmental control are slow and require specialized laboratories with trained personnel. Similarly, conventional pollutant detection methods, such as chromatography and mass spectrometry, are accurate but time-consuming and require specialized equipment. State-of-the-art detection methods are unsuitable for constant on-site and real-time monitoring. The long time between sampling and detection reduces the efficiency of public health and environmental protection authorities in implementing effective countermeasures. To tackle this problem, several electrochemical biosensors will be developed within the MOBILES project.

Biosensors are devices that combine biological elements with electronic systems to detect specific pollutants. The MOBILES project enhances these sensors with advanced nanomaterials, significantly improving their sensitivity and reliability. All biosensors will have common basic electronics and functional principles (e.g., an organic ligand able to recognize target pollutants), but they will differ in the biological element employed: (i) aptasensors based on aptamers that recognize bacterial cells or spore surfaces, (ii) electronic noses for detecting and quantifying volatile organic compounds (VOCs) produced by bacteria, (iii) genosensors for detecting genes involved in antibiotic resistance, and (iv) interdigital capacitors functionalized with aptamers for estradiol, a member of CECs family.

Continual threats (such as industrial pollution and the overuse of drugs and pesticides) to sources of drinking water require real-time solutions for wide-ranging water monitoring systems to detect toxicants such as heavy metals, pesticides, and antibiotics. Conventional methods are limited in their ability to detect sub-lethal concentrations of active antibacterial compounds. The damage caused by the activity of an antibacterial agent or pesticide may stimulate different biological mechanisms of bacterial repair. Each antibiotic and/or pesticide triggers specific cellular pathways, mechanisms, and targets within the bacterial cell. This specific biological response, enabling the detection of antibiotics and pesticides using microorganisms, is being investigated in the MOBILES project through the use of genetically modified bacteria to detect toxic pollutants in water. For detecting heavy metals (cadmium, chromium, lead, mercury) in water, MOBILES is developing a flow-through

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device for continuous monitoring using biological systems (genetically modified bacteria) combined with an optical sensor and flow unit.

Highly toxic arsenic pollution can come from various sources, including industrial activities, mining, and even natural processes. Water and food contaminated by arsenic can cause serious health problems, including cancer and heart disease. For detecting arsenic pollution in soil and groundwater, the MOBILES project is developing genetically modified plants that change colour when arsenic is present in the soil or water used to grow them. The project will conduct safety evaluations to ensure that the genetically modified organisms and developed devices have minimal environmental impact. A specific work package (WP4) is dedicated to evaluate the effects of genetically modified organisms on other organisms and the environment. Safety tests and environmental impact of MOBILES organisms are performed in laboratory using EFSA guidelines.

Microplastic and nanoplastic pollution is raising concerns about its potential impact on human health. The transfer of very small plastics through the trophic chain is a potential source of contamination at all trophic levels. Understanding the distribution, degradation, and life cycle of micro- and nanoplastics in the marine environment is limited by the intrinsic difficulties of current techniques for detecting, quantifying, and chemically identifying small particles in liquids. The MOBILES project is addressing this challenge by utilizing marine diatoms. Diatoms are known for their resilience and adaptability, making them ideal candidates for studying the biodegradation of bioplastics in marine environments. Preliminary studies have shown promising results, indicating that diatoms not only survive in environments containing bioplastics but also contribute to their biodegradation.

In addition to the development of sensors, MOBILES will undertake comprehensive metagenomic analysis, profiling the microbiota of polluted areas across Europe. This work will uncover gene clusters and reveal genetic diversity, enabling a deeper understanding of microbial functions. These insights will provide genetic markers to facilitate rapid evaluation n of soil and land health. Two annual sampling rounds are planned for at least two years, and sample collection will be conducted at different locations to target microbiota related to specific pollution types: Greece for urban wastewater contamination, Poland for heavy metal pollution, Cyprus for microplastics and plastics, France for agriculture and animal farming, Italy for arsenic, and Germany for chemicals and heavy metals from former mining activities. Genomic and transcriptomic data will be analysed, visualized, and interpreted using bioinformatic tools and soil metagenomic web-based platform specifically realized by MOBILES partners. The project's data storage, located in Spain, will be connected to other well-known genomic databases in order to provide a wide range of information.

The biosensors will be rigorously tested with real-world samples from polluted sites to validate their environmental performance.

MOBILES workplan is organized in 6 WP listed in Table 1. Management actions and collaboration with other EU funded projects are implemented within WP6 while disseminations, exploitation and communication (DEC) activities are grouped within WP5. WP1-WP2 deal with interconnected scientific and technological activities to develop electrochemical biosensors to detect specific pollutants, and organism-based biosensor to monitor other typology of selected pollutants. In WP3 an extensive metagenomic analysis will be performed in order to enable searches for diverse functionalities across multiple gene clusters in polluted and not polluted areas across Europe. In

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WP4 the safety of all genetically modified bacteria and plants will be tested using standard EU procedures (e.g., EFSA guidelines for genetically modified organisms), and a pre-industrial design of the various biosensors will be provided along with stability (shelf-life) tests.

Table 1. MOBILES WPs list

WP	Work Package Title	Lead Name	Start Month	End month
1	Electronic biosensors for environmental monitoring	INRAE	1	36
2	Detection of pollutants via biotic sensors	UR	1	36
3	Metagenomics database and fully-sequenced polluted soil microbiota	CNR-ISAFOM	1	42
4	Environmental performance and safety of developed organisms, and packaging of sensor devices	RICPA	10	42
5	Dissemination, exploitation and communication of project outcomes	GG	1	42
6	Project Management and Coordination	NTUA	1	42

1.1 MOBILES interactions and connections with EU-funded actions

Table 1 summaries all the events that have been concluded within the first 12 months under task 6.3. The first event was organized by the Project Officer (PO) Sofia Pachini together with the PO Lukas Varnas. Sofia Pachini is the PO assigned to AquaBioSens and BioSensei, whereas Lukas Varnas is the PO assigned to MOBILES. The event was held on November 28th 2024 as an online meeting. Besides project representatives and POs, the meeting was also attended by Dr. Tomasz Calikowski and Dr. Silvia Maltagliati policy officers for DG RTD.B.1 as well as Dr. Helen Clayton policy officer for DG ENV.C.1. The meeting agenda and participant list is provided in the Annex 1.

Both POs highlighted key points that can increase projects impact such as the importance of joint policy recommendation, how the technologies will be applied in real life, technologies transfer from other project clusters and the need to join a projects cluster.
Policy officers introduced the fact the new policy frameworks are now being established by the EU. Such framework is focused on increasing competitiveness of EU and on the bioeconomy. Also, they discussed the fact that there is need to speed up detection technologies because the list of substances to monitor grows very fast and technologies are not engaging effectively.

On January 15th 2025, the coordinators of MOBILES and iMermaid projects met to discuss the possibility for MOBILES to join the Marine Schield cluster. Having verified common interests, on January 20th 2025, MOBILES officially enter the Marine Shield cluster. As part of the cluster MOBILES contributes and is included in all newsletters, articles, media and website realized by Marine Shield. More details about the cluster are presented in section 2.

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On February 21st 2025, the coordinators of AquaBioSens, MOBILES and BioSensei met online for the first "sister projects" meeting. It was decided that MOBILES will attend AquaBioSens annual project meeting that was scheduled for end of May 2025. In the following months MOBILES and AquaBioSens coordinators prepared a Non-Disclosure Agreement (NDA) to allow partners from both projects to attend and present project results and confidential information. The NDA documents was signed by the administrations of NTUA and FORTH (Foundation of Research and Technology Hellas, Greece), both located in Greece, at the beginning of May 2025. The same document is now (August 2025) under review by BioSensei coordinator and its administration at the Tyndall National Institute located in Ireland.

On May 21st 2025, a member of NTUA representing MOBILES visited the experimental site of HYDROUSA and CARDIMED in Lesvos Island in Greece. The visit was scheduled to collect soil samples which will be used by MOBILES partners for metagenomic analysis.

Other events reported in Table 2 will be discussed in details in section 3.

Table 2. Summary of clustering and networking events where MOBILES has been involved

Date	Meeting/Event/Visit	Organizer	Type
28/11/2024	Clustering kick-off meeting HORIZON-CL6-2023-ZEROPOLLUTION-01-6 Biosensors and user-friendly diagnostic tools for environmental services	Sofia Pachini, Lukas Varnas, Project Officers	online
15/01/2025	Mobiles & iMermaid introductory meeting	iMermaid	online
20/01/2025	MOBILES joins Marineshild cluster		
21/02/2024	AquaBioSens, MOBILES and Biosensei	Project coordinators	online
13/02/2025	1st Marine Shield Cluster Meeting	iMermaid	online
30/04/2024	Marine Shield Cluster: Progress Meeting Recap	iMermaid	online
21/05/2025	HYDROUSA and CARDIMED	MOBILES	In person Lesvos
26-27 05/2025	AquaBiosens annual meeting. MOBILES participated as guest	AquaBioSens	In person, Heraklion Crete
16/07/2025	Mobiles, BioSensei and AquaBioSens	BioSensei	online

2. MOBILES project is part of a European project cluster named Marine Shield.

2.1. Marine Shield cluster

The Marine Shield Cluster is a collaborative initiative uniting EU-funded projects with the shared goal of addressing water pollution through advanced monitoring, effective prevention, and innovative remediation strategies. The Marine Shield Cluster's mission is to create a vibrant network of

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collaboration by actively exchanging knowledge, insights, and expertise with similar research initiatives. A key part of its mission is to inspire and promote joint dissemination activities, ensuring that valuable insights and findings are effectively shared with broader audience and stakeholders.
As of the submission date of this deliverable (August 2025), Marine Shield cluster encompassed 11 ongoing EU projects: MOBILES; iMERMAID[1]; AquaBioSens[2]; CONTRAST[3]; DIGI4ECO[4]; REMEDIES[5]; Restore4Life[6]; RHE-MEDiation[7]; SUNBIO[8]; SUNDANSE[9] and ZeroPM[10]. A brief description of the projects united under Marine shield cluster is provided hereafter.

2.1.1. iMERMAID

iMERMAID is an EU-funded project focused on protecting the Mediterranean Sea and its surroundings, which play a crucial role in various socioeconomic activities. It aims to address the growing threats of chemical contamination and pollution caused by human activities. iMERMAID is project leading the Marine Shield cluster.
With a consortium of 26 partners from across Europe and beyond, iMERMAID aims to integrate innovative strategies for prevention, monitoring, and remediation. The project will encourage 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.
The project will test these innovations in five real-world scenarios across the EU and beyond: Spain, Tunisia, Italy, Cyprus and Greece, tackling everything from agricultural runoff and heavy metals to wastewater treatment and the open waters of the Mediterranean. But the project is not just about technology. iMERMAID is about people. iMERMAID is committed to training young minds through a dynamic capacity-building program, nurturing the next generation of water conservation champions. iMERMAID will also distribute a total of 800,000 EUR to third parties (via two OPEN CALLS) to engage local and regional authorities across associated regions. These calls aim to further demonstrate the innovative iMERMAID solutions and provide technical assistance to address the CECs challenges specific to the different regions.

2.1.2. AquaBioSens

AquaBioSens develops handheld devices to measure aquatic hazards and pollution, supporting the EU Mission to “Restore our ocean and waters by 2030”. The devices use novel analytics, such as immunoassays, environmental RNA quantification, and whole cell biosensors, coupled with advanced sensors, such as acoustic biosensors, fluorimetry, and organ-on-chip devices. The devices are low-cost, accessible, and connected to the web. They will be tested and validated in coastal and freshwater sites in the UK, Ireland, and Greece, and disseminated to the international community. AquaBioSens aims to commercialize the new technologies.

[1] https://imermaid.eu/
[2] https://www.aquabiosens.eu/
[3] ttps://www.contrastproject.eu/
[4] https://digi4eco.eu/
[5] https://remedies-for-ocean.eu/
[6] https://restore4life.eu/
[7] https://rhemediation.eu/
[8] https://sunbioproject.eu/
[9] https://sundanseproject.eu/
[10] https://zeropm.eu/

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2.1.3. CONTRAST

CONTRAST project will advance understanding on the properties, occurrence, fate and effects of the most relevant CECs in the marine ecosystem and deliver solutions for efficient integrated assessment and effect-based monitoring of marine environments. The project will deliver solutions for efficient integrated assessment and effect-based monitoring of marine environments, with a particular focus on three deep-sea case studies.

CONTRAST will design, demonstrate and deliver fit-for-purpose framework(s) for innovative monitoring of CECs in European seas, with the vision of significantly supporting policymakers at the EU and national levels and contributing to the implementation of relevant environmental policies.

2.1.4. DIGI4ECO

DIGI4ECO, Digital Twin-sustained 4D Ecological Monitoring of Restoration in Fishery Depleted Areas, is a pioneering initiative aimed at unlocking new discoveries crucial for addressing climate change and regulating human activities. The project recognizes the critical importance of these ecosystems for both environmental conservation and socio-ecological activities, and it is committed to harnessing digital innovation to address these challenges.

DIGI4ECO is dedicated to making past, current, and future data accessible to everyone. Through innovative tools and methodologies, the project will utilize relevant “sleeping” data collected by various institutions, including physical and chemical sensors and video cameras, across 4 demonstration sites.

2.1.5. REMEDIES

Co-creating strong uptake of REMEDIES for the future of our oceans through deploying plastic litter valorisation and prevention pathways. The REMEDIES project focuses on three key pillars: monitoring and detection of plastic litter, collection and valorization, prevention and zero waste solutions. Aligning with allies, we address plastic pollution’s impact on marine ecosystems. Our project tests four innovations per pillar across 8 demonstration sites in the Mediterranean and expands to 33 more locations. A significant part of the project is community building, involving stakeholders and turning those affected by plastic pollution into actors for a healthier ocean. We aim to create a plastic-conscious society, realizing 115 beach cleanups and engaging 2K citizens to collect more than 20t of plastic (#20tonneschallenge). With REMEDIES, we have launched two open calls for Associate Regions with financial support of 500K. Overall, we aim to map 170 km², engage 100,000 citizens, and reach more than 1 million people, collect 400 tons of plastic, and prevent 3,700 tons of plastic waste from entering marine environments.

2.1.6. Restore4Life

Restore4Life showcases the remarkable socio-economic benefits derived from a comprehensive and interdisciplinary approach to restoring freshwater and coastal wetlands in the Danube basin. By creating new blue-green infrastructure that bolsters regional climate change resilience and mitigation efforts, Restore4Life paves the way for a sustainable future.

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2.1.7. RHE-MEDiation

RHE-MEDiation “Responsive hub for long term governance to destress the Mediterranean Sea from chemical pollution (IA)”. RHE-MEDiation aims to establish a responsive governance hub to reduce chemical pollution in the Mediterranean Sea, targeting critical hotspots. The initiative is focused on testing and validating a remediation technology using micro-algae solutions, which will be integrated into existing water and wastewater treatment systems to improve the removal of heavy metals, pesticides, and PFAS (forever chemicals). Additionally, mobile and fixed sensing systems will be deployed to detect and quantify these pollutants in both terrestrial and marine environments, with data being contributed to the European Commission EMODnet platform to enhance the Digital Twin of the Ocean. Demonstration sites in Italy, Greece, and Turkey will lead the initiative, with plans to expand to five additional replication sites, empowering local stakeholders to drive this transformative effort.

2.1.8. SUNBIO

SUNBIO is an innovative EU-funded project focused on developing and implementing an integrated triple-use system that combines renewable energy production, marine biodiversity support, and carbon sequestration to address pressing environmental challenges. By leveraging cutting-edge technologies such as marine floating photovoltaics, wave energy, and thermal gradient systems, SUNBIO’s Offshore Hybrid Renewable Energy System (OHRES) generates clean and renewable energy, paving the way for a more sustainable future. The project aims to address the urgent need for harmony between human development and the planet’s ecosystems by developing innovative systems that balance human needs with marine biodiversity and resource conservation. It runs from June 1, 2024, to May 31, 2027, with participating countries including Spain, Greece, the United Kingdom, and Cyprus.

2.1.9. SUNDANSE

SUNDANSE is a 48 months long initiative that brings together 20 innovation stakeholders and educational entities from 10 different European countries, who share a common vision to develop sustainable sediment solutions for the Danube – Black Sea system. The Danube River has been incredibly important for both people and wildlife for hundreds of years. However, human activities since the late 1800s have significantly changed how the river functions to better serve our needs. Unfortunately, these alterations, combined with the effects of climate change, have disrupted the river’s natural balance. This is where SUNDANSE plays a big role! SUNDANSE will conduct a survey of the configuration and dynamics of the Danube River via REXDAN, the newest and most advanced research vessel in Europe. With this, among other benefits, a complete map of the main characteristics of the Danube River from Vienna to the Black Sea will be gained and a Sediment Management Handbook for the Danube River basin, including intervention strategies will be created.

2.1.10. ZeroPM

Zero pollution of Persistent and Mobile substances, will interlink and synergize prevention, prioritization and removal strategies to protect the environment and human health from PMC substances. To do this, ZeroPM will establish an evidence-based multilevel framework to guide

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policy, technological and market incentives to minimize use, emissions and pollution of groups of PM substances.
To Prevent, ZeroPM will develop scientific, policy and market tools for the substitution and mitigation of prioritized PM substances to safer and sustainable alternatives To Prioritize, ZeroPM will identify the groups of PM substances requiring the most urgent action. To Remove, ZeroPM will explore real-word scale remediation solutions and find their sustainability limits. By taking this systemic approach, the EU will be better able to avoid regrettable substitution – substituting one problematic chemical for another – and regrettable remediation – investing in remediation efforts more that cause more damage than the substance itself.

2.2. Marine shield and MOBILES joint activities

MOBILES and the projects associated into Marine Shield cluster had two preliminary online meetings to discuss joint activities (Table 2). During these meetings (Figure 1) several collaborative options have been discussed. Among those, two resulted of particular interest for MOBILES partners.

The first activity that will be developed as project cluster, is the preparation and publication of policy documents about the new technologies for environmental remediation, pollution control and pollution detection. Such a document will be prepared at the end of 2026 (Table 3) when enough experimental work will be completed by all cluster members, thus providing scientific data supporting the suggestions and advices reported in the document. The policy document will be freely available for both scientific community and general public. It will be published in each project website belonging to the cluster as well as scientific repository such us Zenodo, which is the reference repository for MOBILES.

Figure 1. Marine cluster meeting where MOBILES coordinator participated.

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The second activity that will be developed inside the cluster (Table 3) is the organization of an international event where representative of each project belonging to the cluster will participate. In such event cluster members will share and present results about projects' topics. External stakeholders and general public will be invited as well. The event will be advertised on all projects' social media channels as well as through the marine shield website and newsletters. It will be open to general public with no registration fee.

3. MOBILES, AquaBiosens and Biosensei partnership

3.1. Sister projects description

3.1.1. BioSensei[11]

BIOSENSEI develops a real-time, multiplexed, end-to-end, tailored and reliable biosensor platform, using cellular responses, for detection of abiotic pollutants – Nutrients, Estrogenic endocrine-disrupting chemicals, and PFAS; and biotic pollutants – Microcystins. For that, different aspects will be covered:

- Cellular biosensors from bacterial variants will be genetically engineered using, RNA interactive and type III CRISPR-Cas-mediated transduction cascades.
- These biosensors are encapsulated and immobilised at bimodal transducers (nanoelectrochemical and optical) to provide highly reliable, tuneable and sensitive detection of the target pollutants.
- Bespoke ultra-low power analog front ends and autonomous IoT end-nodes will enable operation and data acquisition from biosensors and facilitate easy integration in existing LoRa networks enabling real-time data feeds.
- Neural computing algorithms are embedded on the edge to correct for sensor aging and interferents in the (bio)chemical transduction and improve sensor data accuracy.

BIOSENSEI will embed the whole R&D process within a safe-and-sustainable-by-design framework to guarantee environmental safety related to risks of potential release into the open environment. Biosensors will be scalable, adaptable to different applications in water & soil and will be deployed in four different use-cases.The consortium is vertically integrated bringing expertise in cellular biology, surface chemistry, nanoelectronics fabrication, hardware integration, regulatory and industrial sampling and artificial intelligence.

3.1.2. AquaBioSens[12]

AquaBioSens aims to drive the decentralization of tools for the measurement of aquatic hazards and pollution. FORTH is leading the consortium of 8 partners, including 6 academic institutions and 2 SMEs. The consortium aims to produce and demonstrate new handheld devices to measure

[11] https://www.biosensei.eu/the-project/

[12] https://www.aquabiosens.eu/

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contaminants of emerging concern, microbial biohazards and heavy metals. The aim is to make monitoring more efficient and widely accessible, supporting the EU Mission to “Restore our ocean and waters by 2030” Mission, and specifically the Destination “Clean Environment and Zero Pollution”, as well the Water Framework Directive and Marine Strategy Framework Directive. We will achieve this by developing novel analytics based on cutting-edge techniques: i) immunoassays to measure organic contaminants (including pesticides, biotoxins, pharmaceuticals), ii) isothermal environmental RNA quantification for harmful microalgae and fecal coliform bacteria, and iii) two novel whole cell biosensors based on genetically modified diatom microalgae and fish gill epithelia for multiplexed heavy metals quantification and toxicity assessment. These will be coupled with state-of-the art sensors such as acoustic biosensors, multichannel fluorimetry and organ-on-chip microfluidic devices. Low-cost fabrication strategies will ensure that the developed technologies are accessible to end-users, such as industry operators and government inspection agencies responsible for environmental monitoring. New digital real-time data feeds will enable seamless data flows from sensors to the web, including a dedicated live dashboard. The prototype devices will be demonstrated and validated in potentially polluted coastal and freshwater environments in the UK, Ireland and Greece, with the support of local government inspection agencies. Together with measures to disseminate results widely to the international community, stakeholders and citizen science groups, we will maximize exploitation with a view to commercialize the new technologies in future.

3.2. MOBILES, AquaBioSens and BioSensei joint activities

Besides online meetings, MOBILES and AquaBioSens project had in person interactions. Three MOBILES partners (NTUA, CTU and RICPA) participated as guests at AquaBioSens annual project meeting (Figure 2). The MOBILES representative joined AquaBioSens teams on 26th and 27th May 2025 at the FORTH institute in Crete (Greece).

Figure 2. Interaction between MOBILES and AquaBioSens. Participants from the left: Łukasz Gontar (RICPA), Constantinos Varotsis (CTU), Martha Valialdi (FORTH-AquaBioSens) Angelo Ferraro (NTUA)

The two-day conference featured comprehensive progress reports from all AquaBioSens partners. The coordinator of MOBILES (Dr. Angelo Ferraro, NTUA) presented an overview of the project, followed by speeches from RICPA and CTU.

At the AquaBioSens meeting Dr. Lukasz Gontar (RICPA) discussed the importance of propaedeutic risk assessment for genetically modified organisms (GMO) that are intended for use as biosensors and consequently released into the environment. Prof. Constantinos Varotsis (CTU) presented the laser-based technologies that will be used to construct a diatom-based biosensor for the detection of micro- and nanoplastic pollution in seawater.

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During the two-day meeting, MOBILES and AquaBioSens found several opportunities for collaboration and expertise exchange. The most relevant are:

i) a collaborative interaction to utilize the pre-concertation device developed by AquaBioSens
ii) the sharing of RNA extraction methods, also developed by AquaBioSens.

The AquaBioSens partners were interested in the electrochemical devices developed by MOBILES and in particular the aptasensors since for the electrochemical biosensors developed by AquaBioSens are based on antibodies.

With AquaBioSens, a second topic of discussion was focused on water samples exchange from Southampton area to test biosensors sensitivity, crosscheck pollution quantification and validate devices performance. Water samples exchange is forecast to be executed by the end of 2025 (Table 3).

BioSenSei interactions have been only via online meetings. Nevertheless, it has been agreed to prepare a joined (all three projects) policy brief focused biosensors by the end of 2026 when enough results, validated performance and knowledge have been acquired by the three projects. Additionally, BioSenSei and MOBILES thanks to the preliminary discusses and info exchange on project topics and objectives have found common interests on containment/confining of GMO (different rules among member states) and on the standardization of EFSA methods to test and validate GMO to be used as biosensors. Indeed, at the present there are no EFSA guidelines specifically designed to evaluate the environmental impact of GMO developed to be used as biosensors. The three projects will include such recommendations in the policy document scheduled for the end of 2026. Furthermore, BioSenSei and MOBILES will exchange soil samples for metagenomic analysis on the first quarter of 2026 (Table 3).

Another important point of agreement among the three project is the reciprocal participation at the project annual meetings. As mentioned earlier, MOBILES and AquaBioSens already met on May 2025, such kind of interaction will continue within MOBILES annual project meeting scheduled for 5-6 November 2025 in Paris. Representatives of AquaBioSens and BioSenSei will attend the meeting either in person or remotely. All meeting participants will be allowed to follow presentations and join discussions concerning all technologies developed by the three projects.

Table 3. Forecast collaborative actions involving MOBILES and other EU-funded projects

Activity	Collaborative framework	Estimate due date	Dissemination channel(s)
Water samples exchange between AquaBioSens and MOBILES	Sister projects	End of 2025	Project meetings and conferences
Collection of soil samples	HYDROUSA and CARDIMED	October 2025	Project meetings, reports deliverables and conferences
AquaBioSens and Biosensei representatives as guests to MOBILES annual project meeting	Sister projects	5-6 November 2025	Projects social media and websites, newsletters
Proposal submission	HYDROUSA and CARDIMED	Q1 2026	Project website and social media
MOBILES will receive/collect soil samples from BioSenSei	Sister projects	Q1 2026	Project meetings and conferences

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Policy documents on technologies for environmental remediation, pollution control and pollution detection	Marine Shield cluster	End 2026	Zenodo, projects social media and websites, newsletters
Policy documents with suggestion, recommendation and use of biosensors	Sister projects	End 2026	Zenodo, projects social media and websites, newsletters
In person meeting	Marine Shield cluster	End 2027	Projects social media and websites, newsletters, conference
Comparative soil microbiota study	HYDROUSA and CARDIMED	End of 2027	Project meetings, reports deliverables and conferences

4. MOBILES partnership with other past and ongoing EU-funded projects

In MOBILES WP3 it is forecast to collect soil samples from various European regions. As described in section 1, MOBILES consortium has identified 6 strategic areas within the participating countries. Greece is one of such areas and it was decided to collected soils that entered in contact with treated wastewater to verify, in the soil, the presence of CECs that may affect the microbial community and subsequently performed on such soils metagenomic analysis. Immediately after MOBILES started, the NTUA team identified a list of potential sites from where to collect such soil samples. It is worth noticing that land fields receiving directly treated wastewater are very rare not only in Greece, but also in other European countries. It is standard practice for wastewater treatment facilities to discharge treated effluent directly into natural water bodies such as rivers or coastal areas. Indeed, despite undergoing treatment, this effluent often retains significant concentrations of organic pollutants and inorganic compounds that may negatively impact the soil health.

Nevertheless, NTUA was aware of two EU actions dealing with such topic and most importantly running an experimental field where treated wastewater is used to irrigate not edible crops. Thus, the coordinators of such EU projects, HYDROUSA and CARDIMED, have contacted and a collaboration was established between two projects and MOBILES. Beside soil samples exchange that will be repeated twice in 2025 and probably also in 2026, other joint actions have been scheduled with HYDROUSA and CARDIMED.
The first is to prepare and submit a new proposal with selected partners from MOBILES, HYDROUSA and CARDIMED in the forthcoming HORIZON EUROPE call HORIZON-CL6-2026-01-ZEROPOLLUTION-01 in order capitalize all the results and knowledge acquired by three actions to further protect and decontaminate water.
The second is to perform a study that was not forecast in none of the three actions: compare the microbiota community among soil irrigated with treated wastewater and regular ground water (Table 3). The experimental field located in Greek island of Lesvos has two contiguous areas, one is used as control (irrigated with regular groundwater) and the second is the receiving the treated

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wastewater. Even though HYDROUSA and CARDIMED performed and are performing in-depth chemical and physical characterizations of both fields, the status of microbial community it is not evaluated. Therefore, during the first soil collection campaign on May 2025, MOBILES team collected two typologies of soil samples: one from the control field and one from the field irrigated with treated waste water (Table 3). It is worth noticing that only soil irrigated with treated wastewater was scheduled to be collected by MOBILES.
On these two soil samples a metagenomic analysis will be performed by MOBILES partners, results will be merged with the chemical analysis performed by HYDROUSA and CARDIMED. This combined approach promises remarkable insights into how organic and inorganic pollutants from wastewater effluent influence the local microbial ecosystem. Finding will be jointly published by the three projects on scientific journal as well as by all dissemination projects' channels.

A brief summary of HYDROUSA and CARDIMED is provided herafter.

4.1. HYDROUSA[13]

HYDROUSA was a Horizon 2020 Innovation Action project approved under the call topic CIRC-02-2016-2017, water in the context of the circular economy. HYDROUSA aims to revolutionize the water supply chain in Mediterranean regions by demonstrating innovative solutions for water/wastewater treatment and management, which will close the water loops and will also boost their agricultural and energy profile.

Water management in the Mediterranean is currently fragmented and there are several barriers, which need to be overcome in order to close water loops and contribute towards the environmental and economic development of these regions. Mediterranean regions, in particular, face significant challenges in terms of water management and conservation. Water reserves are scarce, while the high touristic activities during the summer months stress the limited water reserves.

To overcome these challenges HYDROUSA was launched in July 2018 to reimagine a water resilient economy, mitigate climate change and reform the agro-food system. HYDROUSA goes beyond the current water and wastewater management practices by adopting innovative, nature-based water management solutions for different types of water characterised by low energy footprint. Clear water loops are demonstrated, recovering added value products, while integrating and interacting with the local market.

These technologies and services are demonstrated at six demonstration sites at full scale in three Mediterranean islands (Lesvos, Mykonos and Tinos) whereas the transferability of HYDROUSA solutions will be assessed in 25 early adopter cases in Mediterranean coastal areas and islands and at several water-stressed rural or peri-urban non-Mediterranean areas in Europe and een beyond Europe.

[13] https://www.hydrousa.org/

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The additional services that will be provided with the innovative approaches will lead to a win-win-win situation for the economy, the environment, and the community. Comprehensive business models will be developed to demonstrate the economic viability of the aforementioned technologies and services as well as the resulting economic benefits from the recovered materials and energy.

The consortium of HYDROUSA consists of 27 highly competent organisations involved in water management, agricultural activities, ICT and, business/marketing, dissemination/ communication spanning throughout the whole water supply chain. The project was led and coordinated by Sanitary Engineering Laboratory of NTUA, not related to MOBILES coordination team.

4.2. CARDIMED[14]

CARDIMED, an acronym for Climate adaptation and resilience demonstrated In the Mediterranean region, aligns with the European Green Deal's core objective of the "twin digital and green transition." Recognizing the challenges posed by the sensitive and biodiverse Mediterranean biogeographical region, the project aims to establish a nature-positive economy and a climate-resilient society through innovative green and digital solutions.

The project introduces a comprehensive framework to build climate resilience in the Mediterranean by unifying individual efforts across regions and communities. This will be achieved through the deployment of digital infrastructure, harmonizing data collection and evaluation processes, and providing open data to all stakeholders involved in Nature-based Solutions (NbS) across the region.

Key features of CARDIMED include smart digital tools for citizen participation and capacity building, a multi-stakeholder engagement strategy focused on knowledge translation, and the integration of the Water-Energy-Food-Ecosystems (WEFE) Nexus approach for holistic modeling. These elements will contribute to addressing socio-ecological challenges, along with issues of valuation and low-investment rates in NbS.

The project will unfold across 9 demonstration sites, encompassing 10 regions, 20 locations, and 28 communities, involving 47 NbS directly linked to 83 interventions and supporting units. The culmination of these efforts will establish the CARDIMED Resilience Alliance, functioning as a pivotal vehicle for expanding the network through the upscaling of existing sites and the addition of new ones. CARDIMED also includes 5 transferability cases, with an additional 10 to be defined during the project's implementation phase.

I-SENSE Group will be leading the efforts to create and optimize digital tools facilitating NBS uptake for climate resilience and adaptation, which include the creation of a citizen engagement app.

CARDIMED is coordinated by the Sanitary Engineering Laboratory of NTUA and consists of 50 partners.

[14] https://www.cardimed-project.eu/about-us/

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5. List of Tables and Figures

6. List of Abbreviations

Abbreviation	Abbreviation for
AMR	Antimicrobial-Resistant
CECs	Contaminants of Emerging Concern
D6.2	Deliverable 6.2
DEC	Disseminations, Exploitation and Communication
DG ENV	Directorate-General Environment
DG RTD	Directorate-General Research & Innovation
EFSA	European Food Safety Authority
EU	European Union
FORTH	Foundation of Research and Technology Hellas
GMO	Genetically Modified Organism
NDA	Non-Disclosure Agreement
OHRES	Offshore Hybrid Renewable Energy System
PFAS	Per- and Poly-fluoroalkyl Substances
PMCs	Persistent and Mobile Chemicals
PO	Project Officer
SMEs	Small and Medium Enterprises
VOCs	Volatile Organic Compounds
WP	Work Package

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7. Annex 1

Clustering kick-off meeting
HORIZON-CL6-2023-ZEROPOLLUTION-01-6
Biosensors and user-friendly diagnostic tools for environmental services

Description and objectives:

This meeting will gather the coordinators of three sister projects (AquaBioSens, BIOSENSEI and Mobiles) funded under HORIZON-CL6-2023-ZEROPOLLUTION-01-6 topic, as well as policy officers from DG RTD and DG ENV and the project officers from REA.

The objectives of this meeting are to identify synergies and potential joint action points between the three projects in order to maximize the outreach and impacts; and to propose some initial feedback to policy (F2P) priority points between the *cluster* and the DGs.

Date: 28th of November, 2024 *Time: 11:00 – 13:00* *Venue: WebEx*

11:00 – 11:10	**Introduction and round table**	**Sofia Pachini, Lukas Varnas, project officers, REA.B.3**
11:10 – 11:20	**Policy context and expectations DG RTD**	**Dr. Tomasz Calikowski & Silvia Maltagliati, policy officers, DG RTD.B.1**
11:20 – 11:30	**Policy context and expectations DG ENV**	**Helen Clayton, policy officer, DG ENV C.1**
11:30 – 11:50	**AquaBioSens Project** *(presentation and Q&A)*	**Dr. Martha Valiadi, project coordinator**
11:50 – 12:10	**BIOSENSEI Project** *(presentation and Q&A)*	**Dr. Alan O'Riordan, project coordinator**
12:10 – 12:30	**Mobiles Project** *(presentation and Q&A)*	**Angelo Ferraro, project coordinator**
12:30 – 12:55	**Discussion**	
12:55 – 13:00	**Wrap-up & Conclusions**	**Sofia Pachini, Lukas Varnas, project officers, REA.B.3**

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List of participants to the Clustering kick-off meeting of 28.11.2024

Martha Valiadi – AquaBioSens coordinator, FORTH, Greece

Celine Rabe – AquaBioSens DEC partner, INSP, Austria

Alan O'Riordan - BIOSENSEI coordinator, Tyndall National Institute, Cork, Ireland

Angelo Ferraro – MOBILES coordinator, National Technical University of Athens, Greece

Marketa Simkova – GrantGarant – MOBILES DEC partner, Prague

Sofia Pachini – Project Officer for AquaBioSens and BIOSENSEI

Lukas Varnas – Project Officer for MOBILES

Tomsz Calikowski - Policy officer DG RTD.B.1

Silvia Maltagliati - Policy officer DG RTD.B.1

Helen Clayton - Policy officer DG ENV.C.1

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8. Project Consortium links

	www.ntua.gr/en/
Italian National Research Council	www.cnr.it/en
INRAE	www.inrae.fr/en
SAPIENZA UNIVERSITÀ DI ROMA	www.uniroma1.it/en/pagina-strutturale/home
eden tech	www.eden-microfluidics.com/
upna Universidad Pública de Navarra Nafarroako Unibertsitate Publikoa	https://www.unavarra.es/home
IUNG	www.en.iung.pl/
	www.agri.gov.il/en/home
université de BORDEAUX	www.u-bordeaux.fr/en
Cyprus University of Technology	www.cut.ac.cy/?languageId=1
University of Belgrade Faculty of Chemistry	www.chem.bg.ac.rs/index-en.html
mat4nrg	www.mat4nrg.de/
TU Clausthal Clausthal University of Technology	www.tu-clausthal.de/en/
GRANT GARANT	www.grant-garant.cz
Research and Innovation Centre PRO-AKADEMIA	www.proakademia.eu/en/

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