



MAELSTROM

MARinE Litter SusTainable RemOval and Management

D7.4

Unified Reports on Side-
events at the Business2Sea
and at the International
Venice Boat Show

17/12/2024



General Information

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Executive Summary

Each end of May to early June from 2021 to 2023, the Horizon 2020 sister projects InNoPlastic and MAELSTROM joined forces to organize and implement the international workshops titled "Removal of Marine Litter and Circular Economy: Challenges and Opportunities". In its second and third editions, the event was renamed "Marine Litter Monitoring, Removal and Circular Economy" to encompass marine and plastics litter monitoring and assessment. The latter are dimensions critically important for understanding the magnitude and seriousness of the problem from both human health and aquatic ecosystem perspectives. In 2024, a fourth edition of the workshop was co-organized together with the co-organized by [BlueMissionMed](#) CSA and the MAELSTROM projects, to showcase and demonstrate selected transformative innovative solutions to face marine litter and microplastics pollution. The workshop took place on May 30, 2024, at the CNR-ISMAR head-quarters in Venice within the Venice International Boat Show, with the title "4th International Workshop on ML Monitoring, Removal and Circular Economy: Solutions for the Mission Restore our Ocean and Waters - back2back with the BlueMissionMed Italian HUB Demonstration and Mobilization Workshop"

The workshop aim was to supporting the Mediterranean Sea Basin for the implementation of the [EU Mission Restore Our Ocean And Waters](#), by fostering an innovation ecosystem and accelerating the implementation of solutions—technological, social, business, and governance—to swiftly advance towards the objectives of protecting and restoring the health of our Ocean and Waters.

National Stakeholders from the Italian BlueMissionMed HUB and European and International key actors had been engaged in a *Multistakeholder Mobilisation and Mutual Learning* session to collect their feedback and input to facilitate the further solutions' adoption and implementation with the aim of achieving the EU Mission objectives.

The international workshops, co-organized by Venice Lagoon Plastic Free, CNR, the Venice Boat Show, the CIMA Research Foundation, and ISDI Group, were held at the historic Arsenale, in the World Heritage site in Venice and its lagoon. The Arsenal basins, once the hub of the naval power of the Republic of Venice, was, in collaboration with the Boat Show management, transformed into a premier showcase

for exhibiting and testing specialized vessels and innovative devices designed to detect, collect, and remove marine waste and pollutants from our rivers and seas.

For the first time, the workshops managed to integrate innovative sustainable technologies for monitoring, removing, and recycling marine plastics litter, fostering collaboration among large industrial entities, startups, research entities, and NGOs. This collaboration aimed to address this global scourge and transform it into an opportunity for blue economy growth.

The workshops served two purposes: (i) being InNoPlastic and MAELSTROM technical progress checking events to share with a broader public; (ii) provide an inclusive floor to representatives from others pioneering EU projects and independent entrepreneurs involved in designing and testing innovative vessels/devices for retrieving marine plastics litter, (iii) support the implementation of the European Mission "Restore our Ocean and Waters by 2030". These efforts supported sustainable growth through marine litter circular economy-oriented technologies, emphasizing the importance of enhancing inter-project cooperation and bridging the gap between the removal and management of marine litter.

Structured as a full-day event from 10:00 AM to 5:30 PM, the workshops comprised four sessions with round tables and Q&A moments. Starting amid COVID-19 concerns, they were conducted in a hybrid format, partly online and partly in-person, due to ongoing pandemic restrictions. The venue also transitioned from the Torre di Porta Nuova at the Arsenale of Venice to the premises of CNR ISMAR nearby.

The first part of the day typically focused on institutional introductions and the monitoring and assessing aspects of marine litter from macro to microplastics levels.

The second part highlighted ongoing or developed technologies for removing marine litter, from InNoPlastic, MAELSTROM projects and other initiatives, dealing with a broad spectrum of plastics-based polymers, materials, and sizes, from nano to macro. Each speaker detailed a specific technology that aids in intercepting and collecting plastic waste.

The third part of the day generally addressed the circular economy theme, emphasizing recycling marine plastic litter. This objective was crucial for both

projects and their technical and technological partners such as SINTEF, Nanobay, Tecnalia, EDF France, Makeen Denmark, and GEES Recycling, among others.

The workshops concluded with a fourth session dedicated to the societal dimension of marine litter, featuring examples of public mobilization and digital solutions that encourage citizen involvement in marine litter monitoring under European protocols and standards (EMODnet) and cleanup activities, and building communities of practice.

In conclusion, following the international workshops, partners from InNoPlastic and MAELSTROM, along with dozens of local organizations, participated in field cleanup and marine litter monitoring activities across various locations in the Venice Lagoon and its mainland. These initiatives employed smartphone applications developed by Venice Lagoon Plastic Free (VLPF) and GEES Recycling for MAELSTROM, and by EMPOWER from InNoPlastic, which were tested and utilized. These tools supported the ongoing development and refinement of methods designed to assist operators in monitoring marine litter, facilitating cleanups through incentives and gamification, and managing the disposal and recycling of collected waste.

Integrated into the workshops, these joined cleanup and beach litter monitoring initiatives effectively tested the digital solutions in real-world conditions, making them an operational component of the workshops themselves. The substantial amounts of marine litter collected during these initiatives were used as feedstock for Work Package (WP) 6, undergoing processing through chemical, thermal, and advanced mechanical recycling methods. Furthermore, the international workshops and their associated cleanup events gained official recognition as Partner Events of the EU Green Week and the UN World Environment/Ocean Days, highlighting their significant contribution and integration into global environmental efforts.

The MAELSTROM project has actively addressed Marine Litter (ML) issues through webinars, workshops, side events, and innovative stakeholder engagement strategies. Four MAELSTROM webinars have highlighted significant topics: inspiring action on marine litter under the UN Ocean Decade, building capacity for ML detection via the European Open Science Cloud, exploring the impacts of ML on biodiversity, and exploring ML's implications on both ecosystem and human health – One Health. These webinars fostered discussions among global stakeholders, showcased technological innovations, and contributed to EU policy deliverables.

Participation in international Fora as the Black Sea CONNECT Forum, the EU Mission Ocean and Waters Forum, and the Galway All-Atlantic Ocean Research and Innovation Alliance facilitated the dissemination of MAELSTROM's achievements, fostered international collaboration, and inspired actionable solutions for ML. Engagement at events such as the ECOMONDO Green Technology Expo and the Atlantic Stakeholder Platform Conference further highlighted MAELSTROM's pioneering approaches in ML removal and received recognition through awards like the Atlantic Project Award for contributions to healthy oceans and resilient coasts and the Sustainability Leadership Award in Robotics by the European Robotics Forum.

A strong focus on science literacy has enabled MAELSTROM to build awareness and inspire action against ML. Public engagement initiatives, including cleanups, citizen science activities, and technology demonstrations, have mobilized over 1600 participants and collected over 14 tons of marine litter. These actions also emphasized fostering Ocean Literacy, encouraging environmentally friendly habits, and leveraging citizen feedback for policy and technological advancements.

Through strategic partnerships with academia, policymakers, NGOs, and local entities, MAELSTROM has established a multidisciplinary stakeholder network that is central to co-designing ML removal technologies and influencing science-policy dialogues. Demonstrations of innovative ML removal technologies, such as a Bubble Barrier in Vila do Conde, Portugal, the Robotic Seabed Cleaning Platform in Venice, Italy and the MAELSTROM app during events like the UN Ocean Conference and the Portuguese Science Meeting and Business2Sea have showcased sustainable innovations while engaging diverse stakeholders, including youth and local communities.

Key outcomes of MAELSTROM's activities include advancing the EU Mission "Restore Our Ocean and Waters," promoting cross-sector collaboration, enhancing capacity building, and proposing actionable policies to combat ML. The project underscores the importance of institutional support and public-private partnerships to implement sustainable solutions, ensuring a clean and resilient marine environment.

The culmination of the MAELSTROM project was marked by participation in the Business2Sea 2024 event and the MAELSTROM Final Conference, showcasing cutting-edge ML management technologies and fostering cross-sectoral collaboration. At

Business2Sea, held in Matosinhos, Portugal, MAELSTROM demonstrated its Bubble Barrier and Robotic Seabed Cleaning Platform, aligning with the event's theme of "Digitalization and Oceanic Renewable Energies." The MAELSTROM Final Conference, held in Porto, featured a three-day program highlighting project achievements, challenges, and future opportunities. Activities included a workshop by the MAELSTROM Working Group on Marine Litter Management and policy framework discussions. Key technologies such as the Bubble Barrier, robotic platforms, and recycling innovations were spotlighted alongside contributions from stakeholders and partners.

The conference emphasized the project's legacy, presenting policy briefs, ecosystem assessments, and the MAELSTROM Legacy document, which provided actionable recommendations for scaling up ML solutions. Stakeholders underscored the need for institutional support, better waste-sorting technologies, and improved visibility of outcomes. The project was praised for its role in fostering environmental literacy and policy influence, creating a framework for future collaborations, and advancing sustainable ML removal and management. MAELSTROM's integrated approach leaves a lasting impact on the global ML science-policy interface.

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1. Introduction to the MAELSTROM project

MAELSTROM is a project funded under the Topic CE-FNR-09-2020 Pilot action for the removal of marine plastics and litter. MAELSTROM strives to provide answers and diversified solutions to the complex issues regarding the removal and sustainable treatment of marine litter legacy.

MAELSTROM contemplates the integration of complementary technologies for marine litter removal in different European coastal ecosystems, compounded with full-fledged circular economy and societal oriented solutions. In particular, the project (i) outlines a reliable multidisciplinary and scientifically sound approach for the assessment of marine debris distribution and impact on marine life in highly valuable ecosystems and protected areas; (ii) designs and manufactures scalable, replicable and automated technologies, co-powered with renewable energy and second generation fuel, to identify, remove and sort marine litter; (iii) evaluates over time the effectiveness of marine litter removal devices along with their impact on local ecosystems; (iv) integrates different technologies to track, sort and recycle all types of collected marine litter into valuable raw materials for future marketisation; (v) assesses the economic and societal impact of the MAELSTROM solutions while providing a comprehensive life-cycle assessment of the technologies and products; (vi) raises social awareness about the marine litter issue and engages citizens and stakeholders in MAELSTROM activities; (vii) interplays with similar projects to maximize innovation uptake for marine litter removal within and outside the EU.

2. MAELSTROM Consortium

The MAELSTROM project consortium consists of the following members:

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Table 1: partner's list and abbreviations

Part 1

Chapter 1

Removal of Marine Litter and Circular Economy: Challenges and opportunities

3rd June 2021

Workshop Notes

1.1 Introduction to Maelstrom

Presenter: Fantina Madricardo

Organisation: CNR ISMAR (Italy)

Topic: Introduction to Maelstrom



Fig.1: Introduction to H2020 Maelstrom Project

Notes: Maelstrom stands for Smart technology for Marine Litter susTainable RemOval and Management. This project involves 14 partners from 8 European countries, sees CNR ISMAR as coordinator and will last for 48 months, from January 1st 2021 to December 31st 2024. The objectives of the project are: removing marine litter from the seabed and both lower and upper column, assessing the effectiveness and impact of marine litter removal on coastal marine ecosystems, feeding the circular economy and sustainability, clustering of blue technologies for joint plastic strategy-

oriented efforts and engaging society for marine litter prevention, and circular economy.

The main concepts behind the project are marine biology, marine litter removal technology and the circular economy based on marine litter.

The first thing to do will be to localize and assess the condition of the marine litter, and to do this will be considered two demo sites: Porto and the Venice Lagoon. In the first case will be installed Bubble Barrier to collect marine litter before it reaches the sea, while in the second case will be implemented a cable-based robotic platform to clean polluted areas of the sea.

After the marine litter is collected, it will be differentiated with a sorting robot in order to separate different types of materials and use them as inputs for diverse types of recycling, such as mechanical recycling or low-temperature pyrolysis. This process will lead to new products, like marine fuel and other kinds of fuel that will be marketed, and will close the circle of the marine litter's circular economy.

1.2 Introduction to InNoPlastic

Presenter: Susie Jahren

Organisation: Sintef (Norway)

Topic: Introduction to InNoPlastic



Fig.2: Intro to H2020 InNoPlastic Project

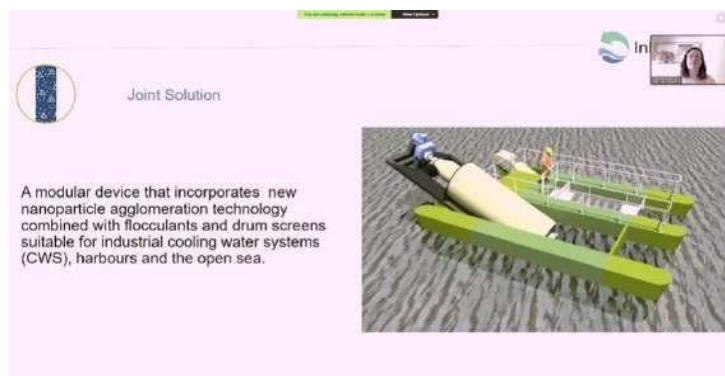


Fig.3: Joint Solution – InNoPlastic Project

Notes: InNoPlastic project belongs to the same programme and call as Maelstrom. It started 1st October 2020, will last 3 years and involves 17 partners from 10 different countries. It is coordinated by SINTEF from Norway.

The project's main goal is to develop nano, micro, macro-plastic clean-up technologies for the aquatic ecosystems, targeting industrial hot spots and natural sites.

Three clean-up technologies will be developed and tested: a robot beach cleaner, a social app and a joint solution. The robot beach cleaner called SEEKer is constructed to reach hard to access areas along the coast. The second implemented technology is a social app developed by Empower, that promotes social science through a rewarding system and supports handpicking and materials traceability via blockchain technology. The third, and last technology, is a joint solution that consists of a modular device that incorporates a new nanoparticle agglomeration technology combined with flocculants and drum screens, suitable for industrial cooling water systems, harbours and the open sea.

These technologies will be tested both at industrial sites like the Rotterdam Harbour and in the English Channel, and natural areas such as Venice Lagoon, Krk island in Croatia and the island of Saint Maarten in the Caribbean.

The last step of this process will be to recycle the litter and introduce it in the circular economy mechanisms. To do so, the project will use mechanical and chemical recycling solutions such as conventional mechanical recycling, purification process, decomposition or monomer recycling and conversion on PTF since these methods

have provided optimal results relating to the reuse of plastics in the circular economy.

1.3 Introduction to CLAIM

Presenter: George Triantafyllou

Organisation: HMCR (Greece)

Topic: Introduction to CLAIM

Resources: Powerpoint presentation



Fig.4: Pre-filtering system and Photocatalytic device

Notes: Claim (*Cleaning Litter by developing and Applying Methods in European seas*), is a project established in response to the growing problem of plastic pollution. CLAIM started in November 2017 and will last until the end of October 2021. It involves 21 partners from 16 countries and it concentrates on removing plastic litter from both the Mediterranean and the Baltic Sea.

The project's main objectives are to provide knowledge on the status of marine plastic pollution, to reduce its amount, set the basis for operational forecasting of the impacts of marine plastic litter pollution and eventually to change policy and public perception by providing advice for management decision making.

Technologies that CLAIM implements are various, depending on the type of litter and on the context. In particular, these are a photocatalytic device targeting micro-plastics, a pre-filtering technology that targets macro-plastics, floating barriers that help to prevent different kinds of plastics to enter the sea, a small-scale pyrolyzer that transforms solid waste into combustible and usable gas and finally a FerryBox flow-through filtering system.

CLAIM also developed innovative forecasting tools and models to assess the distribution of micro and macro plastic marine litter and plastic pollution, with the use of hydrodynamic ecological models.

1.4 Introduction to GOJELLY

Presenter: Jamileh Javidpour

Organisation: SDU (Denmark)

Topic: Introduction to GOJELLY



Fig. 5: GOJELLY Project Key Results

Notes: GOJELLY is a project based on the creation of a bio-based filter obtained from the jellyfish mucus, capable of absorbing nano and micro-plastics.

The Consortium has conducted diverse experiments on the possible use of jellyfish for cosmetics, nutraceuticals and medicine, as well as for food and fertilizers.

At the moment, GOJELLY has implemented new technologies to predict the presence of jellyfish blooms, has studied the possibility to create jellyfish aquacultures and improve the use of jellyfish mucus for creating fertilizer, cosmetics and other human products.

1.5 MAELSTROM Seabed cleaning platform

Presenter: Damien Sallè

Organisation: Tecnalia (Spain)

Topic: MAELSTROM Seabed cleaning platform

Resources: Powerpoint presentation



Fig.6: MAELSTROM Floating Platform

Notes: Within the Maelstrom project, Tecnalia develops a seabed cleaning platform for marine litter removal. Their role in the project consists of localising, characterising, collecting, sorting and transforming the marine litter into new products that can be marketed.

To collect the litter effectively, Tecnalía has implemented a new technology based on a robotic floating platform that can remove selected types of plastics from the seabed and the water column. In particular, this solution consists of a cable robot suspended from a floating platform that operates with different tools to retrieve the litter, such as a hook and a gripper.

The robot will be firstly teleoperated and then managed through artificial intelligence. The first trials will begin in 2022 both in San Sebastian in Spain and Venice and its Lagoon in Italy.

1.6 Maelstrom Bubble Barrier

Presenter: Veronique Lalain

Organisation: TGBB (The Netherlands)

Topic: Maelstrom Bubble Barrier



Fig.7: The Bubble Barrier

Notes: The bubble barrier technology proposed by TGBB works by pumping air into the water, through an underwater tube, so that the litter is sent to the surface. Then, thanks to the flowing water, the litter is conveyed into a catching system. In this way, ship traffic and underwater life are not compromised.

At the moment the bubble barrier is able to catch plastic litter with dimensions from 1 millimetre to 1 meter. The first pilot version was installed in Amsterdam in 2019.

The next goal for TGBB is to install a permanent bubble barrier in Portugal, and the full project is expected to be implemented by the summer of 2022.

1.7 InNoPlastic Archimedean Drum Screw/Flocculation

Presenter: Johan Beentjes

Organisation: Fish Flow (The Netherlands)

Topic: InNoPlastic Archimedean Drum Screw/Flocculation

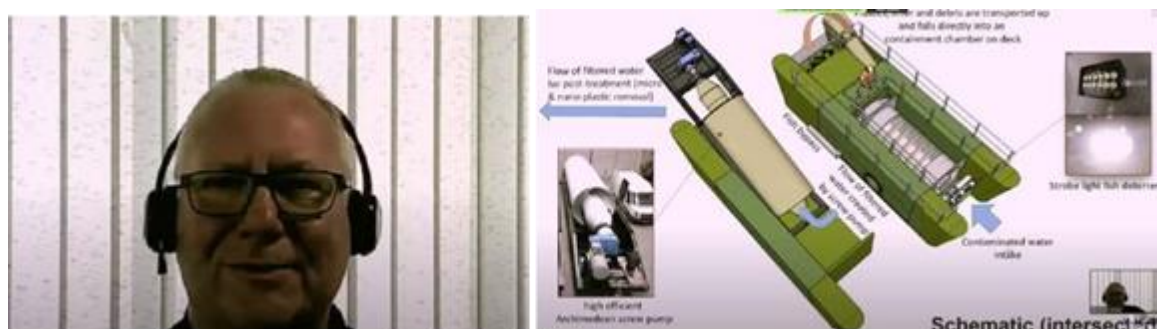


Fig.8: The Drum Screw

Notes: The drum screw implemented by Fish Flow filters debris and macro-plastics from the water flows. New drum screws for micro-plastics have been developed and tested lately.

This technology doesn't harm fish as it is constructed to let them enter and exit freely and safely.

The drum screw can also be transported and moved, making it possible to use it in harbours and other locations.

1.8 InNoPlastic SepaRaptor

Presenter: Gregor Luthe

Organisation: Nanobay (Germany)

Topic: InNoPlastic SepaRaptor

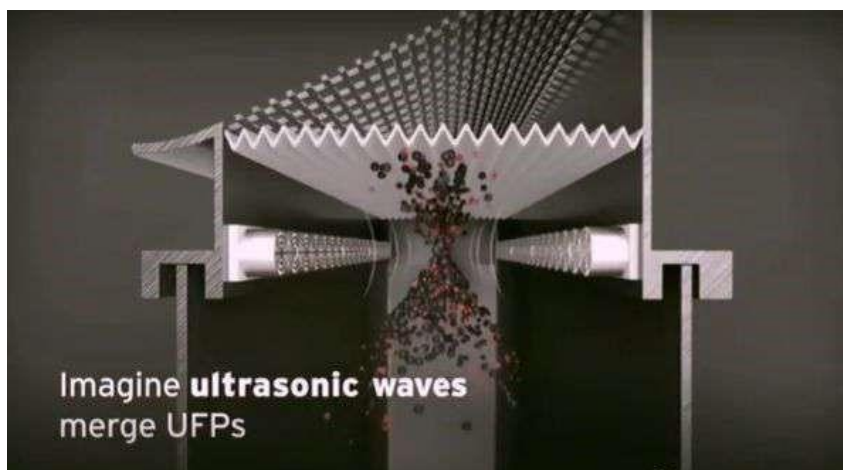


Fig.9: SepaRaptor

Notes: The technology implemented by Nanobay makes use of ultrasound to compress nano and micro-plastics together to make it easier to retrieve bigger pieces of plastics from the water and prevent them to enter in our food system.

Nanobay focuses on nano and microplastics, and not on macro-plastics since it is important to prevent the smallest parts of litter to enter the human body.

1.9 SEEker Robot

Presenter: Miljenko Hrman

Organisation: Probotica (Croatia)

Topic: SEEker Robot



Fig.10: The SEEKer Robot Software Development

Notes: SEEKer is a clean-up robot. It is an autonomous vehicle equipped with robotic hands that will be able to collect plastic litter from the beaches, from a minimum size of a cigarette's butt to up to 20/30cm of diameter.

Probotica designed both the software and hardware of this robot. The software is equipped with GPS, IMU and cameras capable of avoiding obstacles thanks to ultrasonic distance sensors. Moreover, the robot can also provide a depth map due to object localisation and a tracking process made by stereo cameras. It also has a docking station, charged with solar panels and equipped with a bin emptying mechanism.

Test clean-ups in a natural environment will be conducted in 2022 and the robot will be operative from 2023.

1.10 CLAIM Prefiltering System

Presenter: George Triantaphyllidis

Organisation: WnW & HCMR (Greece)

Topic: CLAIM Prefiltering System



Fig.11: Development of Microplastic Cleaning Devices

Notes: CLAIM project developed an automated filtering system prototype to treat wastewater and separate micro-plastics from it.

HCMR tested the efficiency of the filtering system, proving an effectiveness of 86%. This technology was also applied in wastewater treatment plant at Megara City, in Greece, filtering 1.8 cubic meters of water per hour for 23 hours per day. Until now, more than 1500 cubic meters of polluted water have been treated, preventing micro-plastics from entering in the sea.

This technology can be used in wastewater treatment plant, as well as in potable water refineries, in industries that use plastics for packing, in industrial laundry facilities, in hotels or small compact waste water treatment plants (WWTP) in residential areas for 150 equivalent population.

1.11 CLAIM Floating booms The Clean Trash System

Presenter: Tristan Owens

Organisation: NNL (Greece)

Topic: CLAIM Floating booms The Clean Trash System

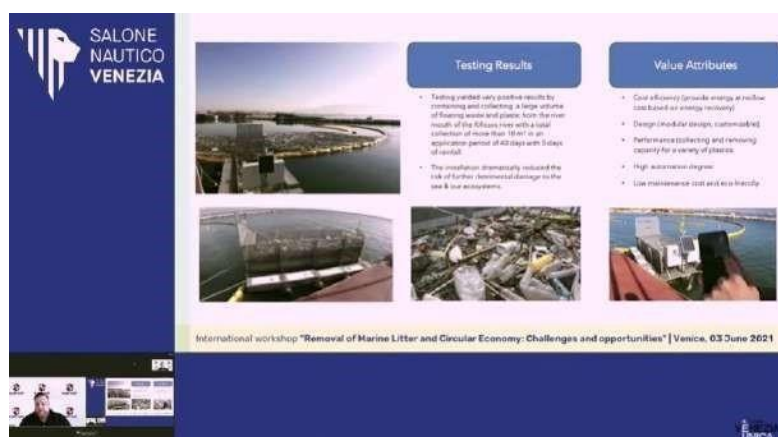


Fig.12: The Clean Trash System

Notes: The clean trash project has implemented a heavy-duty containment boom for CLAIM project to collect and remove macro-plastics and store waste in a collection cage.

The particularity of this project is that it contains a self-adapting control system to ensure the highest possible levels of efficiency.

The system is highly adaptable and can be modified depending on the context in which is applied.

NNL works with a second party that provides a pyrolyzer system to transform the collected garbage into reusable gas.

The system is highly scalable and modular and uses satellite technology to operate efficiently 24/7.

1.12 GOJELLY prototype microplastics filter

Presenter: Isam Sabbah

Organisation: ORT Braude College of Engineering (Israel)

Topic: GOJELLY prototype microplastics filter



Fig.13: Removing Micro & Nano Particles with Jellyfish Mucus

Notes: The idea of capturing nano and micro-plastics with jellyfish mucus comes from one of the latest and most famous works of Patwa and his group, published in 2015.

Different experiments made by GOJELLY prove that the usage of jellyfish mucus can remove almost the whole amount of nano and micro-plastics found in the wastewater. Compared to commercial flocculants, jellyfish mucus was by far the most effective substance in removing particles from suspension.

The strength of this project is that is a bio-based technology that comes from nature and is totally sustainable.

1.13 Collect X - HiveX

Presenter: Tilman Floehr

Organisation: Everwave (Germany)

Topic: Collect X – HiveX

Resources: Powerpoint presentation



Fig.14: Collect X and Hive X Devices

Notes: Everwave promotes a holistic approach to combat riverine and marine litter, focusing both on society and technology. This means that along with environmental education for society about a more sustainable lifestyle, Everwave implements new artificial intelligence, clean-up and recycling technologies to close the circular economy loop and prevent litter to enter the ocean.

Everwave uses drones with cameras to detect the presence of marine litter on the surface of the sea. Then, they proceed with the collection with unique boats that can collect up to 20 tons of plastic per day, in optimal conditions.

Once it is collected, the plastic is sorted and recycled. Everwave uses different kinds of recycling technologies, such as material recycling, thermochemical conversion and biotechnological upcycling.

1.14 EcoCat

Presenter: Alessandro Narduzzi

Organisation: OMD – VERITAS (Italy)

Topic: EcoCat

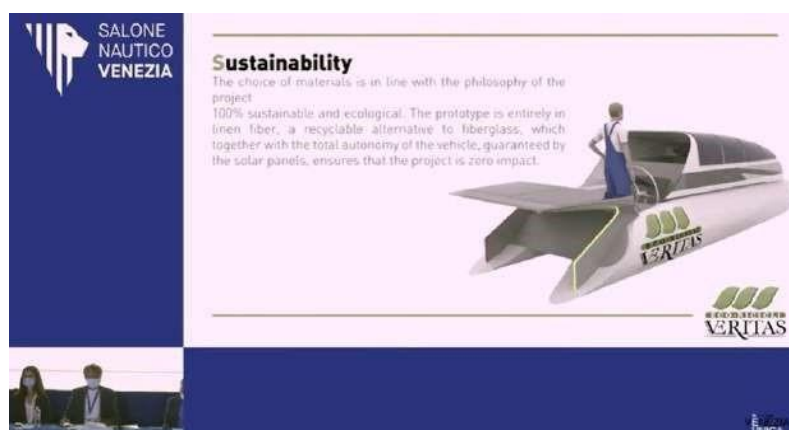


Fig.15: EcoCat Technology

Notes: EcoCat is a technology developed in the region of Veneto by OMD group, a small company specialized in recycling materials, in collaboration with local waste-management agency VERITAS Group.

EcoCat is a fully electric catamaran. It was designed to be efficient and easy to use. It is composed of a conveyor belt that can collect floating plastic from the water and transport it into a removable bin, that can be unloaded with a mechanism located on the top of the boat.

The catamaran is also equipped with 5 square meters of solar panels that can provide sufficient energy to move autonomously. The choice of the materials is completely ecological, too. In fact, the prototype is entirely in linen fibre.

As the demand for this type of boat is high and the design is highly appreciated so far, the OMD group is evaluating possibilities for making two new multi-purpose versions of this prototype. One able to transport people and another for transportation of light loads of goods.

The main objective of the OMD group now is to present the first prototypes next year.

1.15 River Cleaning

Presenter: Ludovica Pozza

Organisation: MOLD (Italy)

Topic: River Cleaning



Fig.16: River Cleaning Project

Notes: River cleaning is a project developed by MOLD to remove plastics from the river flows. It is a smart floating modular barrier designed for long term deployment in watercourses to stop pollutants before they reach the oceans.

This technology works 24 hours a day and does not compromise the navigability of small boats and ships. Due to its continuous rotation, this system maximises stopping capability and avoids any risk of clogging. River Cleaning is self-powered and works autonomously.

Moreover, since plastic materials are not the only pollutants present in the sea, the company has implemented the new River Oil Filtering System, capable of absorbing large amounts of oil from the water, while it collects floating plastic materials.

The two core features of River Cleaning are efficiency and navigability, ensuring a great service with no drawbacks on human activities.

1.16 MAELSTROM Marine thermoplastics

Presenter: Damien Sallè

Organisation: Tecnalía (Spain)

Topic: MAELSTROM Marine thermoplastics

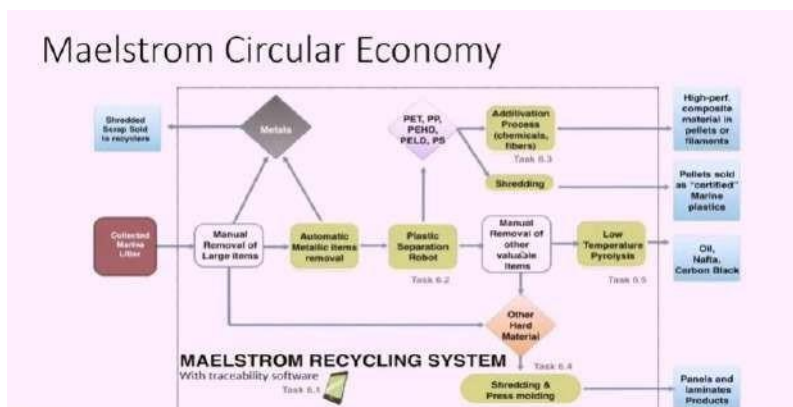


Fig.17: MAELSTROM Recycling System

Notes: For the Maelstrom project, Tecnalia will provide a plastic sorting robot and will also complete the plastic transformation process with an additivition and compounding phases.

Thanks to the support of Tecnalia, Maelstrom will strengthen its philosophy based on the circularity of marine litter. Products like high-performance composite materials in pellets or filaments, and pellets sold as “certified” marine plastics will be obtained by processing the collected marine litter.

Moreover, the support of an AI robot will help to identify and remove specific types of plastics from the collected marine litter thanks to 2D and 3D multispectral perception, deep learning capability and a pick and place robot.

1.17 MAELSTROM Mechanical recycling of hard-to-recycle plastics and organic waste

Presenter: Giorgio Bettetto

Organisation: GEES Recycling (Italy)

Topic: MAELSTROM Mechanical recycling of hard-to-recycle plastics and organic waste

Resources: Powerpoint presentation and samples demonstration



Fig.18: MAELSTROM Mechanical Recycling

Notes: Gees Recycling covers two important tasks for the Maelstrom project: the first one consists of processing the hard-to-recycle materials found in the Venice Lagoon while the second one refers to development a software called "Re-tracking" that permits waste tracing and understanding how it is used to produce composite recycled materials.

New products created from the recycled materials are used in various forms in construction and building environment.

Gees Recycling is also projecting to use this new material for new applications like benches and walkaways for beaches.

Gees Recycling gives another life to the waste retrieved in the Venice Lagoon and use it for different new purposes.

1.18 MAELSTROM Marine Litter low temperature pyrolysis

Presenter: Gian Claudio Faussone

Organisation: Sintol Srl (Italy)

Topic: MAELSTROM Marine Litter low temperature pyrolysis



Fig.19: Marine Litter Pyrolysis

Notes: Sintol has developed a low temperature pyrolyzer to synthesize marine fuels out of marine litter. It was created through the application of the integrated recycling process, using the raw materials to produce new products, and on the basis established by the marGnet project.

Sintol uses chemical recycling approach to find new use for the collected marine litter.

1.19 InNoPlastic mechanical recycling:furniture manufacturing

Presenter: Susie Jahren

Organisation: Sintef (Norway)

Topic: InNoPlastic mechanical recycling: furniture manufacturing

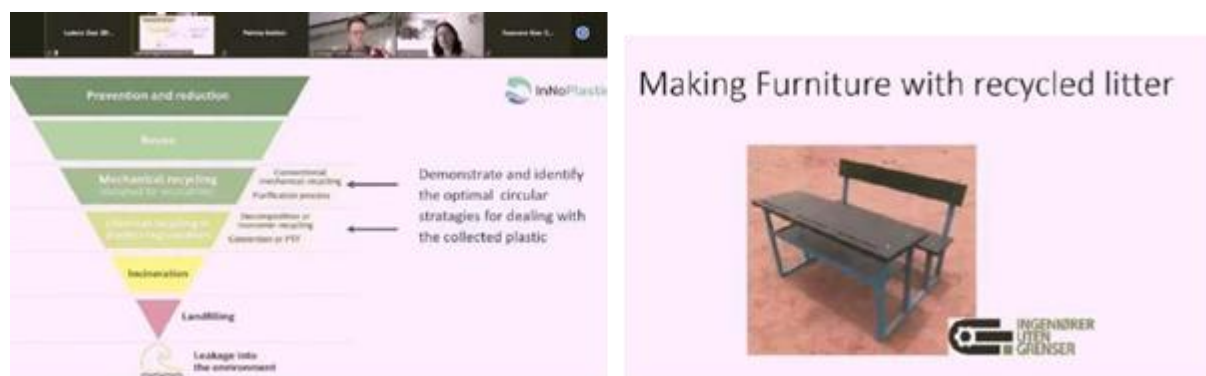


Fig.20: Furniture Manufacturing with Recycled Litter

Notes: Sintef will coordinate both mechanical and chemical recycling for InNoPlastic Project.

With the recycled plastic, Sintef plans to create new simple products, such as school benches or more sophisticated design furniture. Similar to this, Sintef is also working on new 3D printing objects made with recycled plastic materials. 3D printing is organised in collaboration with another InNoPlastic partner, Ponikve from Croatia.

When it comes to marine litter, there are a lot of challenges and recycling is not easy! The materials are mixed, in different stages of decomposition and contaminated. For this reason, we need to act when they still are processable.

1.20 InNoPlastic Syngas

Presenter: Cristian Dinca

Organisation: UPB/AM (Romania)

Topic: InNoPlastic syngas



Fig.21: Syngas Producing Process

Notes: Syngas is made through a process that involves direct gasification, indirect gasification and pyrolysis.

It can be used for producing both electrical and thermal energy in combined-cycles, engines, Stirling engines and H₂ separation.

UPB and AM use chemical recycling as a method to introduce marine litter into the circular economy loop.

1.21 CLAIM Pyrolizer

Presenter: Alessandro Gonzalez

Organisation: IRIS (Italy)

Topic: CLAIM Pyrolizer

Notes: The concept behind the GreenPlasma pyrolizer starts with the pre-treatment of marine litter and then continues with the use of a pyrolysis reactor with controlled conditions. In this way, the syngas is obtained and can be used to deliver energy.

This technology can be applied on boats, to make them energetically self-dependent, and can also be suited up in port areas to deliver energy for electric bikes or any other type of electric vehicle.

Right now, IRIS is developing the scale-up of a pyrolizer (GreenPlasma) design to treat up to 1 ton/day of marine litter.

Pyrolizer prototype has possibilities to treat great amounts of litter, while products can have a wide range of application in transportation.

1.22 InNoPlastic App

Presenter: Carl Nasset and Jessica Cao

Organisation: Empower (Norway)

Topic: InNoPlastic App



Fig.22: InNo Plastic Empower Platform

Notes: Empower runs a circular platform serving the whole value chain, providing unique tools for collectors, recyclers & brands.

They aim to create a complete digital toolset allowing increased value for clean-up and collection organisations, including live inventory data, easy digital tool adding value to recycled materials, issuance of Plastic Credits, verifications for increased traceability and access to more buyers.

Empower platform for InNoPlastic project provides essential digital tools to power circular economy.

Chapter 2

Removal of Marine Litter and Circular Economy: Challenges and opportunities

1st of June 2022

Workshop Notes

2.1 Introduction to H2020 MAELSTROM

Presenter: Fantina Madricardo

Organisation: CNR ISMAR (Italy)

Topic: Introduction to H2020 MAELSTROM

Notes: The MAELSTROM project (MARine Litter SusTainable RemOval and Management) is an ambitious Horizon 2020-funded initiative designed to develop and implement scalable, AI-powered technologies for marine litter removal. The project's pilot sites, including the Venice Lagoon and Porto, are hotspots for marine pollution, where plastic waste accumulates rapidly.

Key Technologies:

1. **Bubble Barrier System:** This system creates a curtain of bubbles in water, pushing floating debris toward collection points where it can be removed. The Bubble Barrier has already shown success in reducing marine litter in urban canals, and the Venice Lagoon is set to be the next testing ground.
2. **Seabed Cleaning Robot:** This robotic platform autonomously collects heavier debris that has settled on the seabed. The system is equipped with sensors and artificial intelligence to detect plastics and distinguish them from natural

seabed materials. Initial trials have shown promising results, and this technology is expected to play a major role in cleaning submerged areas where traditional methods are inefficient.

Circular Economy Integration: Once collected, marine litter is sorted using robotic sorting systems, which identify and separate recyclable materials. Mechanical recycling processes are used for plastics that can be repurposed, while non-recyclable waste undergoes low-temperature pyrolysis—a process that breaks down plastics into synthetic fuels. This approach helps transform marine litter into valuable resources, contributing to the circular economy.

Introduction to H2020 InNoPlastic

Presenter: Salman Shahzad

Organisation: BlueXPRT

Topic: Introduction to H2020 InNoPlastic



Fig.23: Marine Plastic Litter

Notes: The InNoPlastic project focuses on developing and demonstrating technologies to clean up both micro- and macro-plastics in aquatic ecosystems. With a budget of €7.4 million funded by Horizon 2020, the project is led by SINTEF and involves 17 partners from 10 countries. Its goal is to create social and technical

solutions to remove plastics from industrial hotspots such as cooling water systems, harbours, lagoons, and shallow seas.

One of the key innovations presented was the Robot Beach Cleaner, a robotic system designed to autonomously collect macro-plastics from beaches and hard-to-reach areas. Additionally, a social app was introduced, which incentivizes individuals to manually collect plastics. This app tracks and reports clean-up activities using blockchain technology, ensuring transparency and traceability.

Another solution demonstrated was a modular device targeting nano-, micro-, and macro-plastics in industrial water systems. This device combines nanoparticle agglomeration technology with flocculants and drum screens to capture plastics in critical pollution areas. Once collected, the plastics are sorted and repurposed into new products, such as circular furniture or recycled chemically into syngas for producing ethanol or basic chemicals.

The project has received significant media attention and support from figures such as Hollywood actor Liev Schreiber. Future activities will focus on demo testing the joint solution and conducting further clean-up events. Overall, the InNoPlastic project demonstrates a holistic approach to tackling plastic pollution through both technology and community engagement.

2.3 Introduction to H2020 SEACLEAR

Presenter: Stefan Sosnowski

Organisation: Technical University of Munich

Topic: Introduction to H2020 SEACLEAR

Notes: The SEACLEAR project focuses on tackling underwater marine litter by developing autonomous systems capable of identifying and collecting marine debris, particularly from the seabed where traditional clean-up methods are often ineffective. SEACLEAR employs a combination of aerial drones and underwater robots to locate marine litter on the ocean floor. The drones provide real-time aerial views of the affected area, while the underwater robots use sensors and machine

learning algorithms to detect and collect debris. These robots are designed to distinguish between marine litter and natural materials, such as rocks and vegetation, ensuring that only harmful debris is collected, thus minimizing their impact on the ecosystem. The project has conducted pilot trials in several locations, including Hamburg and Dubrovnik, demonstrating the system's effectiveness in collecting a wide range of debris, from plastic bottles to fishing nets

2.4 Introduction to ITA-HR INTERREG MARLESS

Presenter: Andrea Torresan

Organisation: ARPA Veneto

Topic: Introduction to ITA-HR INTERREG MARLESS

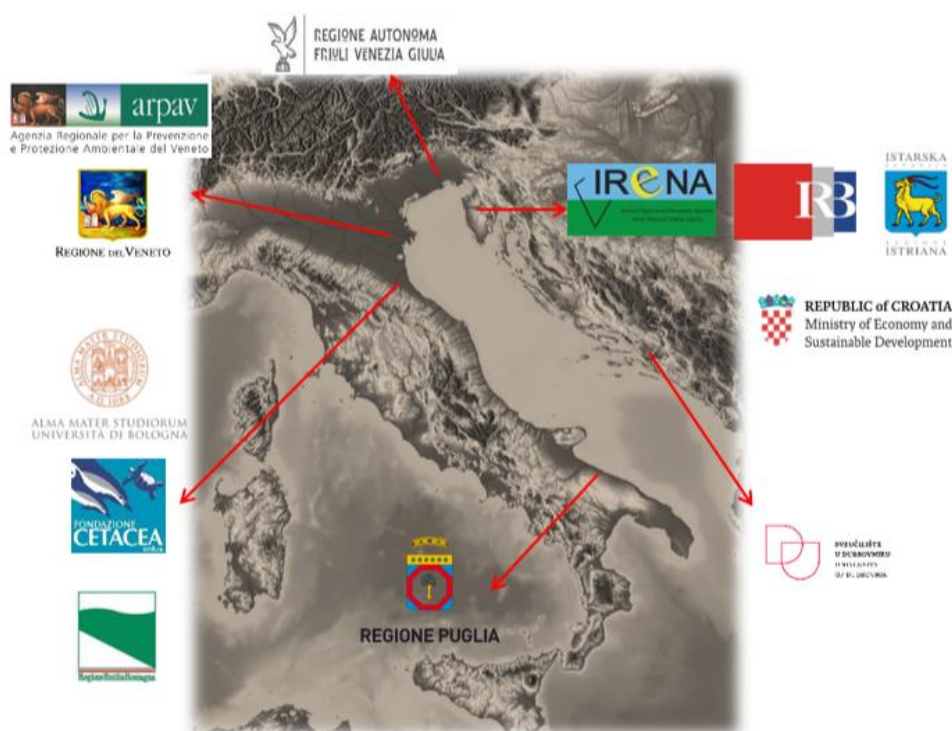


Fig.24: Marine Litter Cross-Border Awareness

Notes: The MARLESS project (Marine Litter cross-border awareness and innovation actions) focuses on addressing marine litter through various methods and

interventions. It aims to prevent, monitor, and treat marine litter while raising awareness across regions. Key project activities include monitoring optimization, where a harmonized monitoring plan is developed to address different types of marine litter, such as beach litter, floating litter, and microplastic litter. In collaboration with ARPA Veneto and other partners, the project also works on prevention through education, emphasizing the importance of educating the tourism sector on the negative impact of marine litter. In terms of intervention, pilot actions are implemented with the goal to prevent, recover, and process marine waste, focusing on the removal and treatment of collected litter. These actions are supported by an in-depth analysis of legislation related to marine litter, ensuring that the project operates within regulatory frameworks while pushing for legal harmonization across borders. Awareness-raising efforts include targeted campaigns aimed at both the public and specific sectors, helping to build a foundation for long-term behavioral change. By engaging local communities and stakeholders, MARLESS strives to reduce the ecological impact of marine litter and promote sustainable practices. With its comprehensive approach, the project exemplifies a multi-faceted strategy to combat marine litter and foster cross-border cooperation in tackling this environmental challenge.

2.5 Roundtable Discussion and Q&A:

Following the presentations, a roundtable discussion was held, allowing workshop participants to ask questions and explore the broader implications of the technologies presented. The key themes discussed during this session included:

- **Scalability of Technologies:** One of the primary challenges raised during the Q&A was the scalability of the technologies presented. Participants asked how these innovations, such as the Bubble Barrier and autonomous robots, could be scaled up for larger ecosystems, such as oceans, where plastic waste is more dispersed. The response highlighted that while these systems are initially designed for coastal and urban waterways, further research is underway to adapt the technology for more expansive marine environments.
- **Public-Private Partnerships:** Several participants raised the importance of public-private partnerships in funding and deploying marine litter removal technologies. The speakers emphasized the need for collaboration between governments, research institutions, and industries to create sustainable business models for marine litter collection and recycling. For example,

industries that contribute to plastic pollution could play a role in supporting clean-up efforts and recycling initiatives through corporate responsibility programs.

- Long-term Sustainability: Another important point of discussion was the sustainability of these projects beyond their initial pilot phases. Many participants expressed interest in how local governments and communities could be involved in maintaining the technologies, particularly in cities like Venice, where the risk of marine pollution remains high. It was noted that successful pilot programs often evolve into long-term initiatives through ongoing community engagement and support from local authorities.

2.6 Marine Litter Monitoring with the MAELSTROM App

Presenter: Davide Poletto

Organisation: VLPF/GEES Recycling

Topic: Marine Litter Monitoring with the MAELSTROM App



Fig.25: Beach Litter Monitoring App by Maelstrom

Notes: The GEES-VLPF presentation highlighted the innovative MAELSTROM App, designed to enhance marine litter (ML) monitoring, tracking, and recycling



operations. This app provides three core functions: characterization and localization of marine litter based on EU standards, data collection during clean-up operations by volunteers and waste managers, and sorting and transforming collected waste, tracking it from collection through to disposal and recycling. The app supports fieldwork by localizing and characterizing litter while allowing the collection of standardized data, including metadata, beach survey data, and photos.

The app has been customized to follow the EU Marine Litter Master List and supports multi-language capabilities, making it accessible for various users. It facilitates citizen science by allowing non-expert users to easily contribute to monitoring efforts. Monitoring campaigns in the Venice Lagoon have revealed alarming statistics, with an average of 477-834 items of litter per 100 meters on Italian beaches, far exceeding the European threshold of 20 items per 100 meters. Access to the MAELSTROM App is currently reserved for registered users, and data collected is available for further elaboration and analysis via the app's portal.

2.7 Underwater cable robot for the Seabed Cleaning Platform (MAELSTROM)

Presenter: Damien Salle

Organisation: Tecnalia

Topic: Underwater cable robot for the Seabed Cleaning
Platform (MAELSTROM)

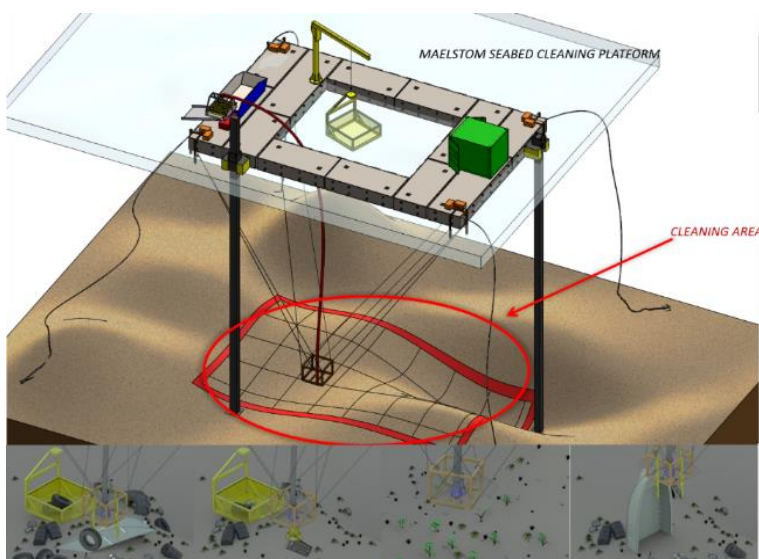


Fig.26: Seabed Cleaning Platform Project

Notes: The Tecnia presentation highlighted the Seabed Cleaning Platform developed as part of the MAELSTROM project, which is designed to efficiently and selectively remove marine litter (ML) from the seabed while minimizing ecological impact. The current available solutions for seabed cleaning are often inefficient and lack scalability. Tecnia's innovative solution involves a cable robot suspended from a floating platform equipped with various tools such as dredges, hooks, grabs, and grippers for litter removal.

This AI-driven robotic system is initially operated through teleoperation but will gradually transition to an autonomous "click-to-remove" system using visual servoing. The robot will eventually be capable of artificial intelligence-based operations, with deep learning enabling the robot to distinguish between marine litter and natural elements, improving its accuracy in identifying and removing debris. The platform's design allows it to function across various depths, making it versatile for different marine environments. First trials for the robot are planned for the summer of 2022, and the device's patented design is currently in production. This innovative technology aims to scale seabed cleaning efforts to combat marine litter more effectively.

2.8 Marine Litter Debris MARLESS Project

Presenter: Patrich Feretti

Organisation: University of Bologna

Topic: Marine Litter Debris MARLESS Project

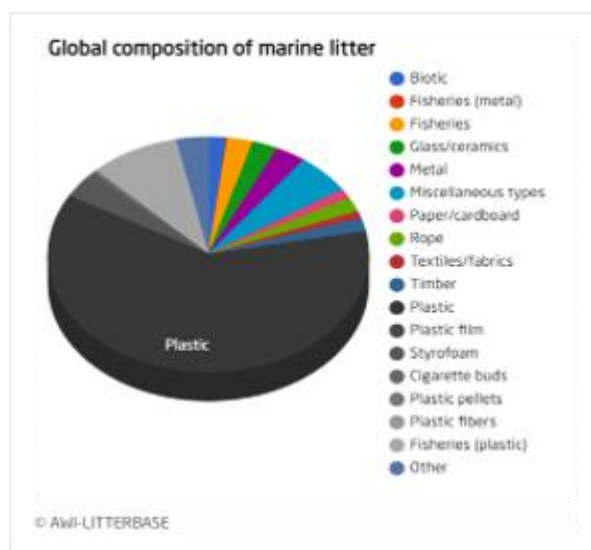


Fig.27: Global Composition of Marine Litter

Notes: The University of Bologna (UniBo) presentation discussed the extensive issue of marine litter (ML), particularly plastics, which make up around 85% of all marine litter. Plastics, due to their persistence in nature, break down into microplastics over time through physical processes such as wave action, currents, and contact with the seabed. These microplastics resemble plankton in size, posing a severe threat to marine ecosystems. The presentation also highlighted areas with the highest concentration of floating debris in the Mediterranean basin, noting the impact of marine litter on both environmental and human activities.

Various innovations for tackling marine litter were introduced, including interceptor barges and the Great Bubble Barrier, which work to prevent plastics from reaching open seas by capturing them in rivers. Additional technologies include Seabin, which filters seawater to capture floating waste, and WasteShark, an autonomous water drone designed to clean ports and harbours. These solutions aim to mitigate the input of plastics into the oceans and support broader clean-up efforts.

The presentation also showcased robots, such as Jellyfishbot and GENESEAS, which collect floating waste and oil spills. The Manta, a specialized catamaran, was introduced as an innovative vessel that not only removes waste but also converts collected plastic into fuel to power itself. These innovations represent significant advancements in addressing the growing challenge of marine plastic pollution.

2.9 SEEker Robot (InNoPlastics)

Presenter: Mario Bumbak, Daniel Bihar

Organisation: Probotica

Topic: SEEker Robot (InNoPlastics)



Fig.28: SEEker Cleaning Robot Project

Notes: The **Probotica** presentation centred around the development of the **SEEker clean-up robot**, designed to autonomously clean plastic waste from various environments. The project, which is currently on schedule, focuses on both **hardware and software development** for the robot.

2.10 MAELSTROM The Bubble Barrier

Presenter: Philip Ehrhorn

Organisation: Great Bubble Barrier

Topic: MAELSTROM The Bubble Barrier

HOW IT WORKS

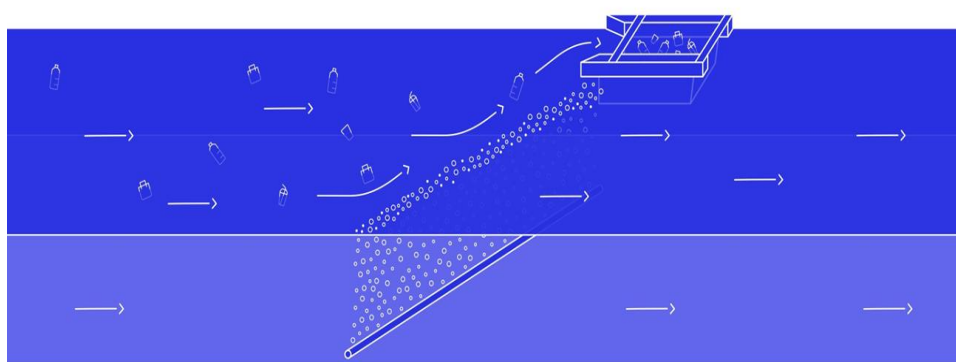


Fig.29: The Bubble Barrier Project

Notes: The Great Bubble Barrier presentation outlined a smart solution to plastic pollution in rivers and waterways by using a continuous bubble curtain to intercept plastic waste without disrupting boat traffic or fish passage. The system captures debris ranging from 1 millimetre to 1 meter in size. First tested in 2017 in the IJssel River and Berlin, the Bubble Barrier has since been implemented in cities like Amsterdam and is now expanding to Portugal in 2022. The system is designed to operate 24/7, providing not only effective waste interception but also serving educational purposes to raise awareness. By strategically placing barriers in densely populated areas, the solution addresses pollution at its source while integrating with existing waste management systems.

2.11 The River Cleaning Technology

Presenter: Nicola Rubini

Organisation: MOLD(River Cleaning)

Topic: The River Cleaning Technology

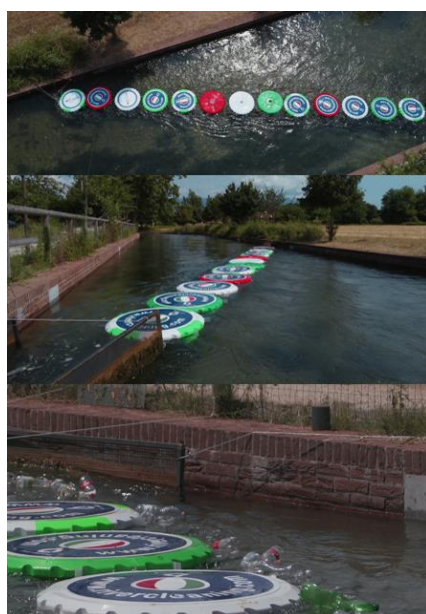


Fig.30: A Set of Barriers for River Cleaning

Notes: The MOLD River Cleaning presentation introduced a set of barriers designed to retain macroplastics and oil pollutants in flowing water systems. These barriers leverage the natural water flow to spin and direct debris toward a collection point without requiring external energy. This spinning motion offers several benefits, including a reduced risk of clogging and lower operation and maintenance (O&M) costs, as it minimizes the need for manual litter removal. The technology can integrate sensors for data collection, remote monitoring, and even electricity generation. The system is designed to allow small vessels to pass through by pushing aside the buoyant modules, while automatic openings accommodate larger vessels.

The first prototypes achieved an 80% effectiveness in litter retention, handling debris between 2.5 to 30 cm in size. The full-scale pilot improved this retention rate to 95%, handling debris up to 60 cm, and operating 24/7, with 200 kg of litter retrieved during testing. The River Cleaning system is now in development for several countries,

including Italy, India, and regions in Latin America and Southeast Asia. Future developments will focus on scaling up the system and testing the technology's capabilities for oil pollution removal.

2.12 Innovative Microplastics Filtration System for Washing Machines and Marinas

Presenter: Hakim El Khiair

Organisation: Clera.One

Topic: Innovative Microplastics Filtration System for Washing Machines and Marinas

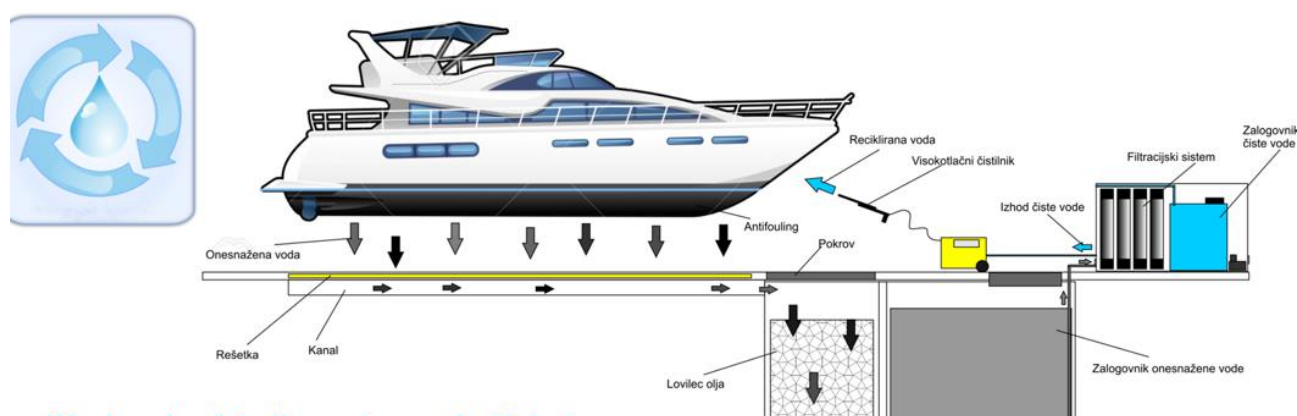


Fig.31: Hydrocyclone Filtering System

Notes: The CleraOne presentation focused on the Hydorecycler system, designed to address the environmental impact of vessel maintenance, particularly related to antifouling paints used to prevent marine organisms from accumulating on the submerged parts of boats. The common use of antifouling paints leads to the release of biocides and heavy metals into the sea during annual maintenance when old paint layers peel off. This creates significant pollution in marine environments.

The Hydorecycler system offers a solution by capturing the wastewater produced during vessel cleaning, treating it, and reusing it in a closed-loop system. This not only

prevents the discharge of harmful chemicals into the water but also saves water, especially during periods of scarcity. The Hydrorecycler can be adapted for various industrial applications, such as recycling wastewater from industrial washing machines, fish farms, and the dairy industry. By incorporating the principles of reduce, recycle, and reuse, the system provides an effective solution for multiple industries.

Additionally, the presentation proposed using recycled microplastic fibers from wastewater to create block modules for building sustainable housing. This innovative approach highlights the potential to transform waste into valuable resources, addressing both environmental and social challenges by creating affordable housing while reducing marine pollution.

2.13 The WasteShark Technical Specifications

Presenter: Richard Hardiman

Organisation: WasteShark

Topic: The WasteShark Technical Specifications



Fig.32: WasteShark Project

Notes: The WasteShark presentation showcased an innovative autonomous surface vehicle (ASV) designed to collect waste and monitor water quality in ports, harbors, and other aquatic environments. The WasteShark is a self-learning system capable

of navigating and collecting debris autonomously. It is equipped with sensors to gather water quality data alongside performing its trash collection duties.

The system operates using the SharkPod Docking Station, which allows for continuous autonomous operations, with the vehicle returning to the docking station for charging and emptying its collected waste. The entire solution is operated and configured via the cloud, providing remote monitoring and control. This cloud-based management system ensures that the WasteShark can efficiently remove waste while also contributing to environmental monitoring through data collection on water quality.

The WasteShark represents a sustainable solution for tackling water pollution in urban waterways, offering a combination of clean-up operations and environmental data gathering to support long-term water quality management.

2.14 MAELSTROM Marine Litter Low Temperature Pyrolysis

Presenter: Gian Claudio Faussone

Organisation: Sintol

Topic: MAELSTROM Marine Litter Low Temperature Pyrolysis



Fig.33: Converting Marine Litter with Pyrolysis System

Notes: The Sintol presentation focused on the application of low-temperature pyrolysis to convert marine litter (ML) into valuable products, such as fuels and chemicals. Pyrolysis, which involves the thermal decomposition of materials in an inert atmosphere, offers an efficient way to upcycle hard-to-recycle waste, like marine litter,

into new resources. Unlike mechanical recycling, which can only be done a limited number of times before the material degrades, chemical recycling through pyrolysis enables the recovery of essential building blocks from plastics.

The process is particularly advantageous for producing ISO8217-compliant marine fuels, including Ultra Low Sulfur MGO, helping to reduce carbon emissions by an estimated 0.5 to 0.75 tons of CO₂e per ton of MGO. Additionally, pyrolysis can convert marine litter into olefins for the production of new polymers, as well as platform chemicals that can serve as raw materials for various industries.

The presentation also highlighted the MAELSTROM project, where pyrolysis is being used to power marine litter collection operations through a portable pyrolysis unit. This unit allows for a closed-loop system, ensuring zero waste generation by converting collected litter into fuels, which can be used to power further collection efforts, thus creating a sustainable and circular approach to marine litter management.

2.15 MAELSTROM Floating Solar Panels

Presenter: Daniele Zingariello

Organisation: University of Malta

Topic: MAELSTROM Floating Solar Panels



Fig.34: Moelstrom Floating Solar Panels Project

Notes: The Institute for Sustainable Energy at the University of Malta has developed innovative floating solar panels as part of the MAELSTROM project, focusing on using renewable energy to power marine litter removal systems. These modular and scalable panels are designed to operate in a variety of aquatic environments, supporting the collection, sorting, and recycling of marine litter. The project aims to minimize the carbon footprint associated with waste management by integrating solar energy throughout the entire lifecycle of waste collection, enhancing efficiency while promoting a circular economy approach. Several prototypes of floating solar panels have already been deployed to assess their performance, with ongoing research aimed at optimizing design, efficiency, and cooling methods to improve energy generation. In addition to floating panels, rooftop photovoltaic (PV) systems are being explored to further contribute to sustainable solutions. The project exemplifies the potential of renewable-powered technologies to reduce the environmental impact of marine litter removal.

2.16 New Life to Upcycled Plastics with Large Format 3D Printing: The Beluga Case Study

Presenter: Violetta Nespolo

Organisation: Caracol

Topic: New Life to Upcycled Plastic with Large Format 3D Printing: The Beluga Case Study



Fig.35: 3D Printing Technology

Notes: The Caracol presentation highlighted their innovative work in large-scale additive manufacturing using 3D printing technology to recycle marine litter into functional products. The company focuses on converting collected waste plastics into raw materials that are then repurposed into industrial applications, contributing to the circular economy. By integrating robotic 3D printing technology, Caracol enables the creation of large and complex structures from recycled plastics, which can be used in various sectors, including construction, automotive, and design. The presentation emphasized the potential of 3D printing to transform waste into high-value products, reducing both environmental impact and material costs. Caracol's approach not only addresses plastic waste but also promotes sustainability and innovation in industrial production processes. The project exemplifies the use of advanced additive manufacturing technologies to tackle environmental challenges while promoting a closed-loop economy.

2.17 Potential Exploitation of Marine Litter for Fashion Accessories and Footwear Sector

Presenter: Carla de Carolis

Organisation: EMI-ISDI

Topic: Potential Exploitation of Marine Litter for Fashion Accessories and Footwear Sector



Fig.36: Converting Marine Plastics into Products

Notes: The EMI-ISDI presentation focused on the exploitation of marine litter to create added-value products. By recycling marine waste, particularly plastics, EMI-ISDI converts this waste into a variety of consumer goods and industrial materials. This approach aligns with circular economy principles, emphasizing the potential for turning marine litter into usable products, thus reducing environmental impact. Through advanced mechanical recycling techniques, EMI-ISDI transforms marine plastics into items such as pet accessories and other commercial products, demonstrating the economic viability of marine litter recycling. This innovative approach not only helps in mitigating the negative effects of marine waste but also showcases how marine litter can be a valuable resource, supporting sustainable development.

2.18 HAAS Synchronicity Resourcing Manufacturing: The Waste Value Makers

Presenter: Vincent Gay

Organisation: Synchronicity

Topic: HAAS Synchronicity Ressourcing Manufacturing: The Waste Value Makers



Fig.37: Non-recyclable Waste in Industrial Areas

Notes: The Synchronicity presentation introduced the Hub As A Service (HAAS) model, a comprehensive solution for managing non-recyclable waste in ports and industrial areas by transforming it into usable construction aggregates. The process begins with separate sorting to recover 50% of the waste collected from port operations, including debris from river flows, fishing activities, and industrial rejects. The remaining waste undergoes fossilization, a patented process that uses a low-carbon binder to turn waste into aggregates without requiring heating, resulting in a negative carbon footprint.

The system's simplicity allows for local waste processing, reducing reliance on landfills and incinerators while providing a sustainable source of aggregates for construction. The presentation highlighted the importance of short-circuit, local processing to improve waste recovery rates and decrease CO₂ emissions. With the capacity to process 10-50 tons of waste per day, the Fossilizer offers a scalable, low-tech solution that could significantly reduce the environmental impact of port and industrial waste.

2.19 InNoPlastic – Societal Awareness of Marine Litter Pollution and Remediation in Europe

Presenter: Lisa Zecchin, Davide Poletto

Organisation: Ca'Foscari University of Venice

Topic: InNoPlastic – Societal Awareness of Marine Litter
Pollution and Remediation in Europe

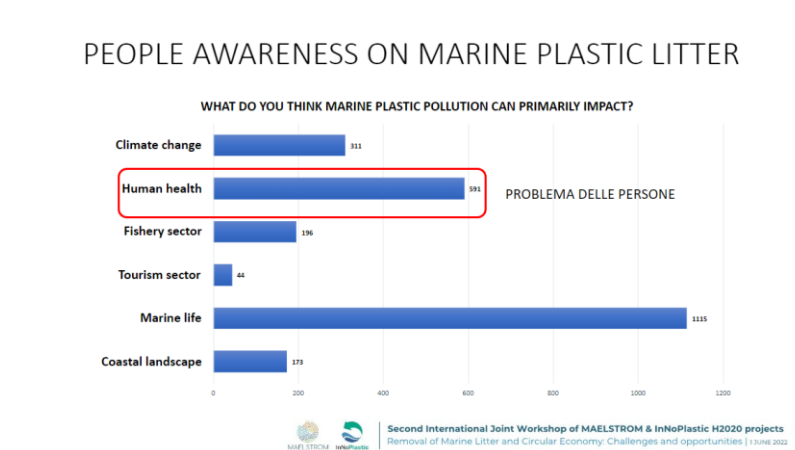


Fig.38: People Awareness on Marine Litter

Notes: The Ca' Foscari University presentation, in collaboration with Venice Lagoon Plastic Free (VLPF), provided insights into public awareness regarding marine plastic pollution based on a survey conducted as part of the InNoPlastic project. The survey aimed to assess the general public's awareness of the marine plastic litter issue and their perception of institutional responses. Distributed through online channels, including social media and newsletters, the survey featured 30 questions addressing topics like plastic litter management, pollution sources, and new technologies for removing and recycling plastic waste.

The survey revealed that many participants became aware of the plastic pollution issue through community clean-up events. A significant number of respondents identified land-based sources as the primary contributor to marine litter, particularly urban runoff and improper waste disposal. While most participants expressed support for increasing taxation to fund technology development for reducing plastic waste, there were mixed opinions regarding the commitment of local and national institutions to addressing the problem. The survey highlighted the importance of community engagement and institutional support in tackling marine litter p

Chapter 3

Marine Litter Monitoring, Removal and Circular Economy: Challenges and opportunities

1st of June 2023



Fig.39: Third International Workshop

Workshop Notes

3.1 Introduction to the H2020 MAELSTROM Project

Presenter: Fantina Madricardo

Organization: CNR-ISMAR

Topic: Introduction to the H2020 MAELSTROM Project



Fig.40: Intro to H2020 Maelstrom Project

Notes: The presentation introduced the H2020 MAELSTROM project, which focuses on developing smart technologies for the sustainable removal and management of marine litter. The project, involving 14 partners from 8 European countries, aims to assess the effectiveness of marine litter removal, remove debris from the seabed and water columns, and feed the circular economy by repurposing waste. Notable achievements include the installation of the Bubble Barrier in Portugal and the Seabed Cleaning Platform in the Venice Coastal Area. Additionally, the MAELSTROM App allows for tracking,

sorting, and recycling marine litter, contributing to the circular economy. The project has also held three international workshops on marine litter removal and circular economy, reinforcing the importance of clustering blue technologies and engaging society for sustainable solutions.

3.2 Introduction to H2020 InNoPlastic

Presenter: Ben Alcock

Organization: SINTEF

Topic: Introduction to H2020 InNoPlastic

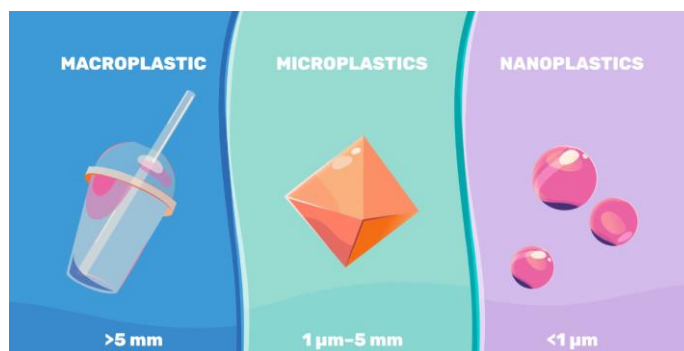


Fig. 41: Marine Plastics info Animation of InNoPlastic

Notes: The presentation provided an overview of the In-No-Plastic project, an EU-funded initiative under the Horizon 2020 framework. The project focuses on developing innovative clean-up technologies to tackle marine plastic pollution in industrial hotspots such as cooling water systems, harbors, lagoons, and shallow waters. Key technologies include ultrasound-clustering to agglomerate nano- and microplastics, a biodegradable flocculant formulation for capturing microplastic aggregates, and the Archimedean Drum Screw, a full-scale pilot system designed to filter debris from water flows. Additionally, the project involves social initiatives like the Empower Deposit App, which encourages community participation in litter collection through rewards. The project's pilot areas include the Venice Lagoon, Sint Maarten, Thames River, and Krk Island.

3.3 Introduction to HEurope SEACLEAR 2.0

Presenter: Davide Poletto

Organization: Venice Lagoon Plastic Free

Topic: Introduction to HEurope SEACLEAR 2.0

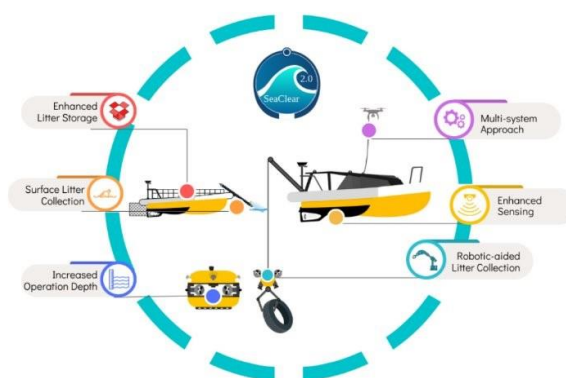


Fig.42: Intro to SeaClear 2.0

Notes: The presentation focused on the SeaClear2.0 project, which is co-funded by the European Union under the Horizon Europe Programme. The project aims to address the problem of marine litter, particularly the 94% of hidden plastic found on the seafloor, through the use of robotic systems for litter identification, classification, and collection. The project integrates UUV (Unmanned Underwater Vehicles) and UAV (Unmanned Aerial Vehicles) with an autonomous navigation system for surface and submerged litter collection. SeaClear2.0 also includes public engagement and citizen activation through clean-up campaigns and policy recommendations, with a focus on promoting the blue circular economy. The project's mission is aligned with the EU's Zero Pollution Action Plan, with a goal to reduce marine plastic litter by 50% by 2030.

3.4 Introduction to EMFAF WINBLUE

Presenter: Patrizia Grifoni

Organization: CNR-IRPPS

Topic: Introduction to EMFAF WINBLUE

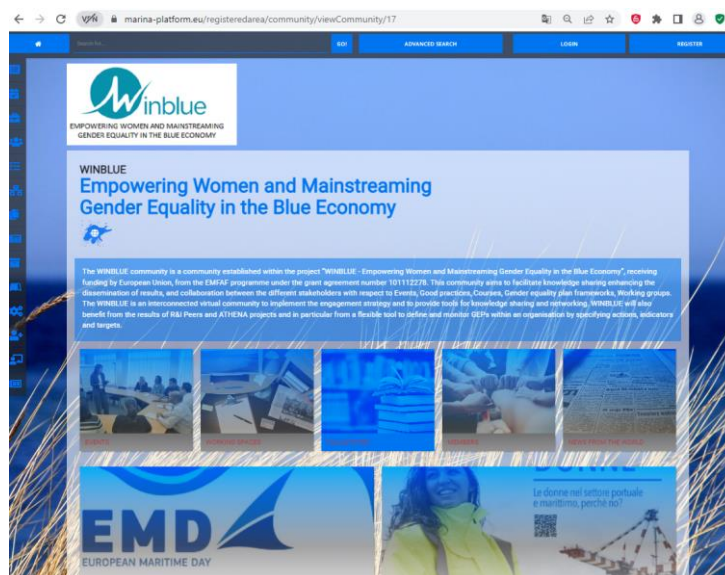


Fig. 43: Presentation on Gender-Equal Blue Economy Sector

Notes: The presentation outlined the initiative's goal of empowering women in the blue economy by facilitating their participation across five key sectors: circular blue bioeconomy and biotechnology, aquaculture and fisheries, offshore renewable energy, sustainable coastal tourism, and cutting-edge enabling technology for marine ecosystem protection and restoration. The project fosters a community-based approach, providing coaching tools, gender equality plans, and access to best practices. WINBLUE also builds on results from previous projects such as R&I Peers and ATHENA to promote gender equality in blue economy sectors, facilitating the participation of women in leadership roles and decision-making.

3.5 Introduction to LIFE DREAM

Presenter: Mariacristina Prampolini

Organization: CNR-ISMAR Bologna

Topic: Introduction to LIFE DREAM



Fig.44: Marine Life

Notes: The presentation focused on the LIFE DREAM project, which aims to restore deep reef (DR) ecosystems and remove marine litter from key areas in the Mediterranean Sea. The project targets habitats like coralligenous formations and cold-water coral reefs, where marine litter and abandoned fishing gear pose significant environmental threats. The restoration process involves both active and passive measures, utilizing ROV manipulators to remove entangled debris and establish artificial structures to support coral recolonization. The project also includes a circular economy experiment, utilizing low-temperature pyrolysis to recycle collected litter into valuable resources. Monitoring and evaluation of the project's impact are ongoing, focusing on the environmental and socio-economic benefits of deep reef restoration.

3.6 Introduction to the H2020 ENDURUNS Project

Presenter: Dr. Mayorkinos Papaelias

Organization: University of Birmingham

Topic: Introduction to the H2020 ENDURUNS Project

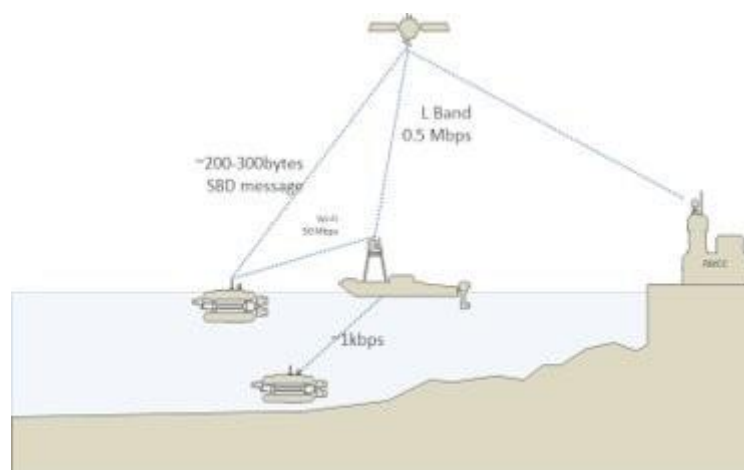


Fig.45: Intro to ENDURUNS Project

Notes: The presentation provided an overview of the ENDURUNS project, a €9 million H2020 European-Korean collaboration aimed at enhancing ocean exploration capabilities through the development of a hybrid autonomous underwater vehicle (AUV)-glider system. The project focuses on extending the endurance of unmanned vehicles using a combination of hydrogen fuel cells and Li-ion batteries, addressing the limitations posed by current battery technologies. The ENDURUNS system is designed for long-range ocean missions, with the ability to perform static observations and collect valuable data over extended periods. The project also includes the development of a support USV (Unmanned Surface Vehicle) to aid in deployment, retrieval, and positioning of the AUV-glider system. The system is equipped with multi-beam sensors, optical cameras, and anti-collision devices for efficient underwater operations.

3.7 Innovative Workflow Pattern for MPs and NPs Monitoring in Waters: The Case of the Venice Lagoon

Presenter: Maria Rapa, Teresa Cecchi, Davide Poletto

Organization: InNo Plastic

Topic: Innovative Workflow Pattern for MPs and NPs Monitoring in Waters: The Case of the Venice Lagoon

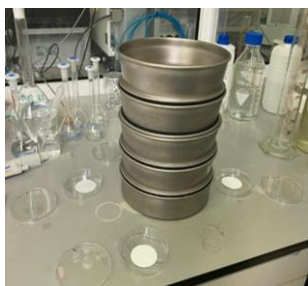


Fig.46: Cascade Sieving

Fig.47: Water Sampling

Fig. 48: MPs Detection

Notes: The presentation focused on developing a comprehensive and standardized methodology for monitoring microplastics (MPs) and nanoplastics (NPs) in aquatic environments, particularly in the Venice Lagoon. The workflow integrates multiple stages of water sampling, cascade sieving, and vacuum ultrafiltration to identify and quantify MPs and NPs. It also emphasizes the need for more standard operating procedures (SOPs) to ensure reproducibility and representativeness in data collection. Findings highlighted significant environmental risks posed by these pollutants, including their ability to absorb and release harmful chemicals, which affect aquatic organisms. The results contribute to a deeper understanding of the distribution and characteristics of MPs and NPs, calling for effective mitigation strategies.

3.8 Litter Monitoring in Venice: Main outcomes

Presenter: Giorgio Bagordo , Paolo Franceschetti

Organization: WWF Italy

Topic: Litter Monitoring in Venice: Main outcomes



Fig.49: Clean-up Activities



Fig.50: V/ P/ L Bin Tests

Notes: The presentation highlighted the critical issue of marine litter, focusing on its impact on the Venetian Lagoon. They emphasized the importance of local actions to address plastic pollution and the need for cross-sector collaboration. The presentation covered recent efforts to engage the community through clean-up activities and awareness campaigns, while also stressing the role of educational programs to promote sustainability. The discussion concluded with a call for stronger institutional support and comprehensive strategies to mitigate marine pollution.

3.9 Main Technologies for Marine Debris Collection (SeaClear2.0)

Presenter: Davide Poletto

Organization: VLPPF

Topic: Main Technologies for Marine Debris Collection (SeaClear2.0)

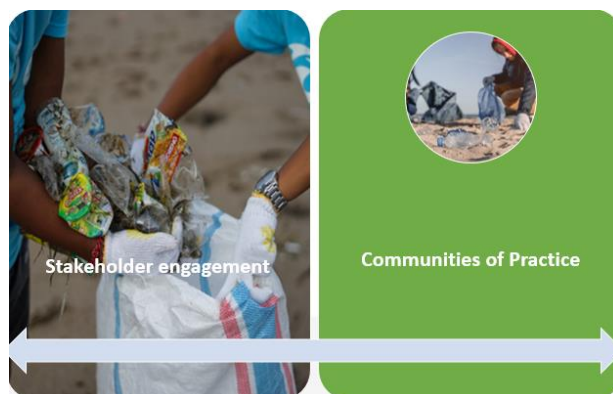


Fig.51: Public Engagement on Marine Litter Issues

Notes: The presentation introduced the SeaClear2.0 project, funded by the Horizon Europe Programme. This project focuses on scalable solutions for marine litter remediation in the Mediterranean Sea, combining robotic technology with community engagement. Key developments include enhanced marine robots equipped with improved sensing, gripping, and storage capabilities for effective litter collection, addressing both lightweight and heavy debris. The project emphasizes public engagement and citizen activation to foster collaboration and raise awareness on marine litter issues. SeaClear2.0 aims to deliver an end-to-end system that leverages autonomous navigation and robotic precision to efficiently tackle underwater and surface pollution.

3.10 The SEEKer Robot

Presenter: Jan Jakovljević
Organization: Probotica d.o.o
Topic: The SEEKer Robot



Fig.52: The SEEker Clean-up Robot

Notes: The presentation detailed the development of the SEEker clean-up robot designed for autonomous plastic waste removal. The project involves both hardware and software development, including integration of cameras, GPS sensors, and a robotic arm for waste collection. The robot's software development utilizes the ROS (Robot Operating System) to enable motion planning, localization, and environmental understanding through neural networks like YOLO for object detection. The SEEker robot can autonomously plan paths, avoid obstacles, and grasp plastic waste while avoiding natural debris or wildlife. The project has advanced to the third prototype, with a docking station prototype under development to facilitate solar-powered charging and bin emptying.

3.11 Archimedean Drum Screw Operational Achievements

Presenter: Johan Beentjes, Ludwin Daal

Organization: Fishflow, BlueXPRT

Topic: Archimedean Drum Screw Operational Achievements



Fig.53 and Fig.54: Thames Environmental Agency Testing

Notes: The presentation provided an update on the Archimedean Drum Screw, developed as part of the In-No-Plastic project under the Horizon 2020 framework. The drum screw functions as a water filter, allowing 90% of the water flow to pass through while capturing plastic debris. Testing took place at the Thames Environmental Agency, processing 3 million cubic meters of water, though some operational challenges were encountered, such as electricity connection issues and positioning constraints. The next phase involves combining the drum screw with a newly designed high-efficiency axial pump to improve water flow, and transport filtered water to the next stage, a modular joint solution for further processing. Upcoming tests are planned in both freshwater and brackish/seawater environments.

3.12 Low Temperature Pyrolysis: The Case of the Fiberglass and PET

Presenter: Gianclaudio Fausone

Organization: Sintol Srl

Topic: Low Temperature Pyrolysis: The Case of the Fiberglass and PET



Fig.55: Collecting and Sorting Marine Plastics

Notes: The presentation focused on advancing plastic waste management strategies through the use of innovative technologies and circular economy models. It highlighted the need for improved collection, sorting, and recycling processes to address the increasing challenge of marine and terrestrial plastic pollution. The use of sustainable technologies in waste management was emphasized, particularly those that can effectively reduce the environmental impact of plastics. The presentation also explored the role of public-private partnerships and community engagement in ensuring the success of these innovative approaches. Case studies were presented to demonstrate the feasibility of implementing such strategies on a larger scale, promoting long-term sustainability and environmental protection.

3.13 Give a Second Life to Plastic Marine Litter

Presenter: Dejan Kotic

Organization: Ponikve.krak

Topic: Give a Second Life to Plastic Litter



Fig.56: Recycle Bin Made of processed Marine Litter (InNoPlastic)

Notes: The presentation explored innovative methods to repurpose plastic marine litter into valuable, reusable materials. Focusing on the principles of the circular economy, the presentation emphasized the potential of recycling technologies to transform marine waste into a range of commercial products, such as construction materials and consumer goods. By giving a second life to plastic litter, these approaches aim to reduce the environmental burden of plastics in marine ecosystems while fostering sustainable business models. The presentation also discussed the challenges associated with scaling up these technologies and highlighted successful case studies demonstrating their feasibility.

3.14 The Ghost Boats Project 2.0, Identifying & Recycling Fiberglass Boats

Presenter: Gherardo Toso

Organization: Venice Lagoon Plastic Free

Topic: The Ghost Boats Project 2.0, Identifying & Recycling Fiberglass Boats



Fig. 57: The Ghost Boat Programme

Notes: The presentation focused on The Ghost Boats Project, an initiative by Venice Lagoon Plastic Free. This project aims to address the problem of abandoned boats—often referred to as "ghost boats"—in the Venetian Lagoon. These derelict boats contribute significantly to marine litter and pose environmental hazards by releasing microplastics and other pollutants into the water. The project works to remove these vessels from the lagoon, restoring the marine ecosystem while raising awareness about the broader issue of marine litter. The presentation also emphasized the need for community involvement and policy support to ensure long-term success in managing abandoned vessels and reducing pollution.

3.15 Smart Dashboard Aggregating & Featuring Multipurpose Data Analysis on Marine Litter Pollution

Presenter: Carl Nesset

Organization: Empower.eco

Topic: Smart Dashboard Aggregating & Featuring Multipurpose Data Analysis on Marine Litter Pollution

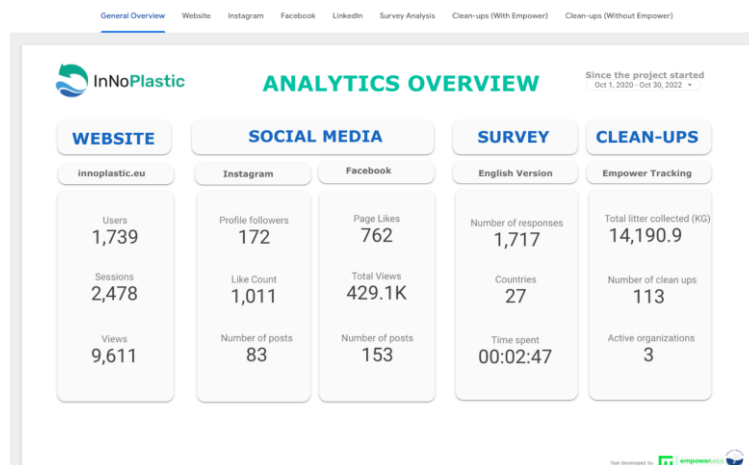


Fig. 58: The Smart Dashboard Implemented in the InNoPlastic Project

Notes: The presentation introduced a Smart Dashboard developed by Empower.eco for marine litter data aggregation and analysis. The dashboard provides real-time insights into various metrics, including cleanup data, social media engagement, and survey results, helping users visualize trends and patterns. This tool aims to support decision-making by offering a comprehensive view of marine litter pollution, from collection to public perception. The dashboard's automated features make data management more efficient, and its business intelligence (BI) tools condense large data sets into actionable insights, enhancing the overall understanding of marine litter issues.

3.16 Societal Awareness and Perception Analysis on Marine Litter Pollution and Remediation in Europe

Presenter: Lisa Zecchin

Organization: Ca' Foscari University of Venice

Topic: Societal Awareness and Perception Analysis on Marine Litter Pollution and Remediation in Europe

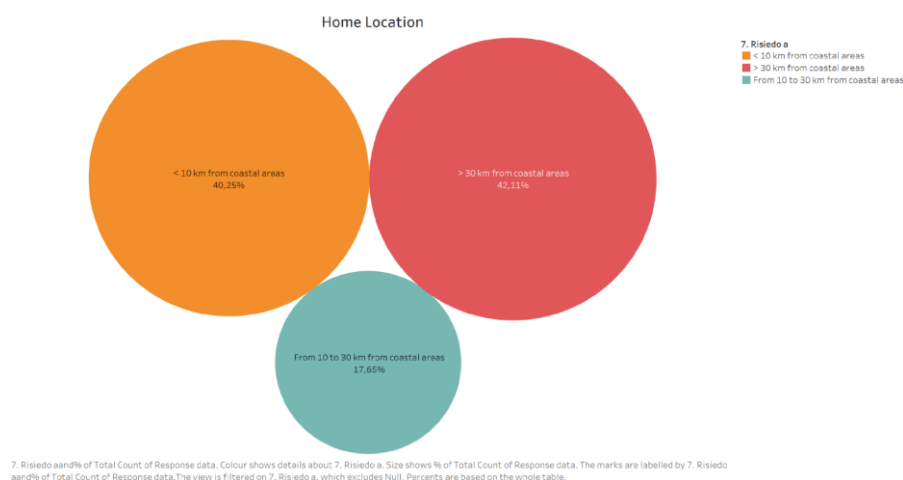


Fig.59: Extrapolations from Marine Litter Pollution Awareness Survey

Notes: The presentation highlighted the findings from a societal perception survey on marine litter pollution and its remediation across Europe. The survey aimed to gauge public awareness of the sources of plastic pollution in the sea and the perceived impacts on marine ecosystems. Participants were also asked about their views on the commitment of local and European institutions to reduce plastic pollution. The presentation revealed that while clean-up events have significantly raised awareness, there remains a mixed perception of the effectiveness of institutional efforts. The study also emphasized the importance of new technologies in tackling marine litter, with respondents expressing a willingness to support technological advancements financially.

3.17 Private Funding of Fishing for Litter Initiatives: The Case of Sea the Change

Presenter: Francesco Suzzi

Organization: Sea the Change srl

Topic: Private Funding of Fishing for Litter Initiatives: The Case of Sea the Change

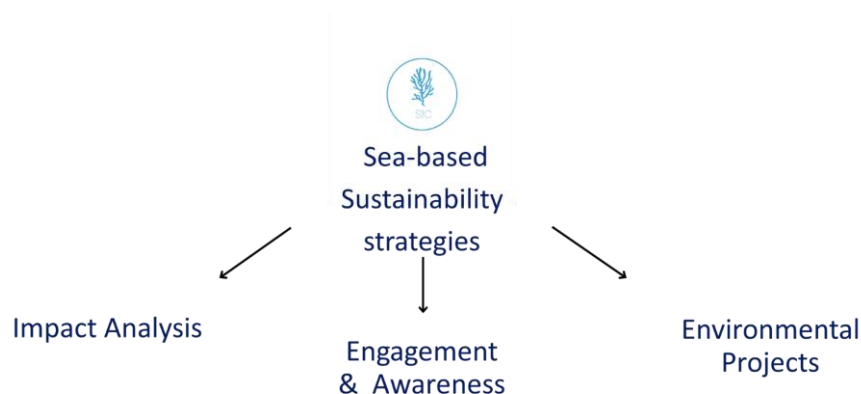


Fig.60: Sea-the Change Sustainability Strategies

Notes: The presentation focused on the role of private funding in supporting Fishing for Litter initiatives, with a specific case study on Sea the Change Srl. The urgency of addressing marine litter, biodiversity loss, and climate change was emphasized, noting that 8 million tons of plastic end up in the oceans each year, with significant impacts on ecosystems like the *Posidonia oceanica* in the Mediterranean. Suzzi highlighted the importance of private investments in ocean protection projects, which can generate significant economic benefits for local communities. The presentation advocated for a Win-Win-Win approach, creating opportunities for collaboration and sustainable solutions for marine ecosystem regeneration.

Part 2

The main focus of this section is to describe actions which were designed and implemented to support the transfer of marine scientific research, innovation and knowledge at the EU level, focusing on diminishing, eliminating, and responsibly handling ML along coastal regions, while also supporting the European Strategy for Plastics in a Circular Economy. This objective was actively pursued by establishing connections and aligning strategies with pertinent projects and initiatives, advocating for the recognition and dissemination of effective approaches, and engaging in collaborative demonstrations, all through a concerted networking endeavour across the entirety of the MAELSTROM project's lifespan.

The primary activities designed to complete this task include organisation and participation in events of various types, such as webinars, workshops, multidisciplinary clean ups, technology demonstrations and key-societal stakeholder meetings, conferences and other events. Throughout these, emphasis was placed on actions which contributed to raising the awareness of citizens and stakeholders about the importance of ML prevention and removal to avoid environmental damage and to the sustainable management and protection of marine and coastal ecosystems, also through the production of specific policy strategies and documents. The collaboration and expertise exchange with other EU projects led to an increase in the scientific knowledge and to the development of the research capacity and to the transfer of marine technology, increasing as well data sharing and data integration. The expansive, multisectoral network brings a level of engagement and cooperation to the MAELSTROM project, allowing for impactful communication, dissemination, and input with a broad geographical, multisectoral, interdisciplinary reach, thus facilitating the principles of co-design, co-implementation, and community within the broader European research framework.

Chapter 4. Organization of MAELSTROM webinars

The first MAELSTROM webinar was organized within the United Nations Ocean Decade Laboratories, under the call "A Clean Ocean," and entitled "Inspiring Science and Society to tackle Marine Litter". The event was held on November 18th, 2021, during a one-day online seminar and saw the participation of fifty participants representing multiple sectors from academia, the private sector, environmental NGOs and Civil Society Organisations (CSOs). In the first part, the webinar representatives of

worldwide multi-scale (local, national, regional and international), marine litter initiatives, including World Wildlife Fund Global, BlueMed Initiative, The Portuguese Plastics Pact, World Wildlife Fund Philippines, Open Science Hub and MarGnet project presented the outcomes and the challenges experienced during the implementation of their initiatives. The second part of the webinar was dedicated to a participatory approach with discussions among panellists and participants on gaps and opportunities regarding marine litter within four clusters: i) Civic Engagement, Networking and Communication; ii) Stakeholder Coordination; iii) Governance; and iv) Funding. The main outcomes and conclusions of this webinar contributed to Deliverable 7.3. (Task 7.3.) and to Task 7.2.



The figure consists of two parts: a poster for the webinar and a screenshot of the webinar interface.

Webinar Poster:

- Logo:** MAELSTROM WE BIN AR
- Tagline:** Inspiring Science and Society to tackle Marine Litter
- Date and Time:** 18.11.2021 • 09.30 – 16.00 CET
- Program:**
 - 09.30 | Welcome**
Fantina Madricardo (CNR-Ismar)
Isabel Sousa Pinto (CIIMAR)
 - 09.45 | Keynote**
Thomas Vlachogianni (MIO-ECSDE)
 - 10.00 - 12.15 | Linking targets to effectiveness in fighting marine litter pollution: global to local perspectives**
Moderators: Luis R. Vieira (CIIMAR) | Isabel Gomes (CIMA)
 - 10.00 - 10.15 | Giorgio Bagordo | World Wildlife Fund (WWF)**
 - 10.15 - 10.30 | Fedra Francocci | BlueMed Initiative**
 - 10.30 - 10.45 | Break**
 - 10.45 - 11.00 | Pedro São Simão | The Portuguese Plastics Pact**
 - 11.00 - 11.15 | Czarina Constantino | WWF Philippines**
 - 11.15 - 11.30 | Maria Vicente | Open Science Hub - Portugal**
 - 11.30 - 11.45 | Gian Claudio Faussone | The marGnet project**
 - 11.45 - 12.15 | Q&A with the audience**
 - 12.15 - 13.30 | Lunch Break**
 - 13.30 - 14.45 | Past, Present and Future Marine Litter Challenges Participatory SWOT Analysis**
Moderators: Davide Poletto (VLPP) | Luis R. Vieira (CIIMAR) | Isabel Gomes (CIMA)
 - 14.45 - 15.00 | Break**
 - 15.00 - 16.00 | Round Table**
SWOT Analysis Discussion
Contributions for transformative changes in the next decade
Moderator: Thomas Vlachogianni (MIO-ECSDE)
- Registration Link:** www.maelstrom-h2020.eu/webinar-registration/

Webinar Interface Screenshot:

- Shows a grid of participants in a video conference.
- Participants include: Fantina Madricardo, Isabel Sousa Pinto, Thomas Vlachogianni, Giorgio Bagordo, Fedra Francocci, Pedro São Simão, Czarina Constantino, Maria Vicente, Gian Claudio Faussone, Davide Poletto, Luis R. Vieira, Isabel Gomes, and Thomas Vlachogianni.
- The CIIMAR logo is visible in the bottom right corner of the interface.

Fig. 61: Poster created to advertise the "Inspiring Science and Society to tackle Marine Litter" webinar.

The **second MAELSTROM webinar** was organized on May 10th, 2022, entitled *Building Capacity in Detecting, Tracking and Modelling Marine Litter through European Open Science Cloud*, together with InNoPlastic and RELIANCE projects. The webinar addressed the scientific marine litter community and presented operational tools to produce collaborative scientific work on Marine Litter pollution using the European Open Science Cloud (EOSC) digital services. The webinar highlighted the need for more international collaborative work, sharing scientific data through bigger datasets, and making Open Science more accessible, reusable and transparent.



Fig. 62: Poster created to advertise the “Building Capacity in Detecting, Tracking and Modelling Marine Litter through European Open Science Cloud” webinar

The **third MAELSTROM webinar**: The “*Marine Litter and Biodiversity: Co-detection and Impacts*” was held in collaboration with the AIR Centre programme of Marine Biodiversity Networking Fridays, on February 10th, 2023. This was a significant event dedicated to exploring the intricate relationship between ML and biodiversity. Organised by the CIIMAR partner, in collaboration with The Atlantic International Research Centre (AIR Centre) and the Group on Earth Observations Marine Biodiversity Observation Network (GEO-MBON), the webinar served as an international collaborative effort addressing global challenges and local priorities in the Atlantic Ocean. Furthermore, it is recognized as a UN Ocean Decade affiliated event.



Fig. 63: Poster created to advertise the "Biodiversity and Marine Litter: Co-detection and impacts" webinar

The webinar delved into innovative solutions brought by the MAELSTROM project to tackle the ML issue in coastal areas, emphasising the connection between citizens, science, and policy. Specific topics included the co-detection of microplastics with biodiversity, the effects of plastic additives on marine plankton, the impact of nanoplastics on various fish species, and the presence and impacts of ML on Mediterranean marine megafauna. The session concluded with a round table discussion addressing ways to enhance the detection, reduction, and removal of ML in oceans. The discussion encompassed crucial topics such as standardisation of methodologies, the need for new solutions, and the formulation of effective policies.

More information: <https://www.aircentre.org/netfridays-marine-biodiversity-11/>

On March 20th, the CIIMAR partner organized MAELSTROM's fourth webinar, titled "One Ocean, One Health: Current Perspectives on Marine Litter in Ecosystem and Human Health". This webinar was a thought-provoking and action-oriented event. It provided a platform to explore our current understanding of ML's impact on ocean ecosystem health, and human well-being, and, at the same time, analyse the innovative solutions that hold promise for a more sustainable future. This event brought together experts from environmental psychology, human health, and ecosystem health to engage in insightful discussions, share perspectives, and inspire action. Presentations aligned to cover the One Health initiative and understand the

role of ML and MP pollution in human and ecosystem wellbeing. These were followed by a roundtable discussion with input from audience members and a question-and-answer segment to allow targeted and insightful knowledge gains.



Fig. 64: Poster created to advertise the “One Ocean, One Health: Current Perspectives on Marine Litter in Ecosystem and Human Health” webinar.

More Information: <https://bluemissionaa.eu/2024/03/atlantic-arctic-lighthouse-weekly-hour-s02e05-with-maelstrom/>

Chapter 5. Active Participation in other Workshops, Meetings, and Side Events

5.1 Black Sea CONNECT Marine Litter Action Forum

MAELSTROM was invited to actively participate, with a dedicated talk and roundtable discussion, at the Good Practices session at the Black Sea CONNECT Marine Litter Action Forum (Connect Black Sea), organised under the Horizon 2020 funded Black Sea CONNECT CSA on 14 and 15 November 2022 in Istanbul (Türkiye). The event promoted actions, initiatives and projects already in place for existing and new initiatives and projects in order to best coordinate all efforts toward paving the way for future cutting-edge actions on marine litter pollution in the Black Sea (<http://connect2blacksea.org/wp->

content/uploads/2022/11/Black_Sea_CONNECT_Marine_Litter_Joint_Action_Forum_-_Draft_Agenda_11.11.2022.pdf)



Fig. 65: MAELSTROM is presented at Black Sea CONNECT Marine Litter Action Forum by the CIIMAR partner in Istanbul, Turkey

5.2 EU Mission Ocean and Waters Forum, Palermo, Italy |30/05/23 – 01/06/23 |partners: CNR and CIIMAR

MAELSTROM participated in the EU Mission Restore our Oceans and Waters – The Mediterranean Lighthouse in Action, a high-level event held in Palermo, Italy, on May 30-31. Organised by the European Commission in collaboration with the Italian government, the Sicily Region, and the University of Palermo, and supported by the BlueMissionMed Coordination and Support Action, the event aimed to showcase political commitments from Mediterranean countries and present initiatives contributing to the Mission's goals. MAELSTROM's representation, led by the CIIMAR partner, played a pivotal role in the Research & Education Table which featured two interactive sessions. The first session was dedicated to showcasing inspirational case studies from MAELSTROM's achievements in research, ocean literacy, outreach, and social engagement. The second session focused on identifying key aspects and concrete actions for implementing the Mission Lighthouse. Both sessions provided a platform to share insights with the EU Commission, foster networking, and strengthen the international stakeholder community dedicated to the EU Mission "Restore our Ocean and Waters". Stakeholders attending the event represented a diverse spectrum, including the Mediterranean basin, international and sea basin intergovernmental organisations, regions, cities, ports, islands, shipping, industries, academia, education, researchers, investors, NGOs, citizens, and youth. The event facilitated engaging discussions and collaborative efforts toward the shared vision of restoring and preserving our oceans and waters.

Link: https://www.maelstrom-h2020.eu/mission-restore-our-ocean-and-waters-by-2030-the-mediterranean-lighthouse-in-action/?fbclid=IwAR1Tu_TknAJnr0Uhs1FtpFGwUmLPs6t6Aoqg-oeqJHnBS4xLqqw_dG1jiQ



Fig. 66: MAELSTROM is presented - EU Mission Ocean and Waters Forum, Palermo, Italy

5.3 2013 – 2023: 10 years of the Galway Statement, Galway, Ireland | 5-6/07/2023 | partner: CIIMAR

The All-Atlantic Ocean Research and Innovation Alliance (AAORIA) event marked a significant milestone in Atlantic Ocean collaboration, bringing together a diverse array of stakeholders, researchers, policymakers, and youth ambassadors. Hosted by the Irish Government, the European Commission, the Marine Institute, and the University of Galway, the event drew participants from various sectors, including High-Level representatives from the EU, USA, Canada, Brazil, South Africa, Argentina, Morocco, Norway and the UK, ministers, international ambassadors, scientists, educators, NGOs, students, and civic and industry representatives. MAELSTROM scientists from the CIIMAR team disseminated key project achievements and outcomes to the wider All-Atlantic Research and Innovation community, and engaged in capacity-building workshops. An intergenerational dialogue session, which brought local and international students together with senior academics in the field of plastic pollution and technological innovation in an innovative, solutions-focused think-tank, used MAELSTROM as a key example of sustainable technologies and bridging science with society and policy. Overall outcomes of the event included the proposal of actionable ideas for addressing ML and other major ocean issues at local and global levels, and a renewed capacity for youth and stakeholder engagement with the MAELSTROM project. The event demonstrated the success of a decade-long collaboration contributing to the All-Atlantic community's efforts in eliminating

pollution, restoring biodiversity, and fostering international engagement and cooperation.



Fig. 67: MAELSTROM is presented at the All-Atlantic Ocean Research and Innovation Alliance by the CIIMAR partner in Galway, Ireland.

Link: <https://allatlanticocean.org/events/10-years-of-the-galway-statement/>

5.4 10th Atlantic Stakeholder Platform Conference - All Atlantic Award | 18-19/10/2023 | partners: CNR, CIIMAR

The 10th Atlantic Stakeholder Platform Conference (ASPC 2023) took place on October 18th and 19th, 2023 in Matosinhos, Portugal. This conference focused on the blue economy challenges and objectives in the Atlantic Sea Basin. Under the theme "Atlantic Future: New Synergies and Innovations for a Sustainable Ocean Economy," the conference aimed to foster collaboration among stakeholders, uniting existing and new players to unlock opportunities and accelerate AAP 2.0 implementation. This contributes to an impact-driven, networked innovation ecosystem in the Atlantic. During the conference the MAELSTROM project received the prestigious Atlantic Project Award in the category "Healthy Oceans and Resilient Coasts." The award recognized initiatives working towards stronger coastal resilience and combating marine pollution. The award ceremony was a highlight of the conference, emphasising outstanding contributions to a clean and healthy ocean. The award recognizes MAELSTROM's dedication to sustainable blue growth, fostering territorial cooperation, and promoting synergies across European ML projects.

Link: <https://atlantic-maritime-strategy.ec.europa.eu/en/news-and-events/events/atlantic-stakeholder-platform-conference-2023>



Fig. 68: Atlantic Project Award Certificate awarded at the Atlantic Stakeholders Platform Conference 2023

5.5 ECOMONDO – The Green Technology Expo “Sustainable technologies for Marine litter removal and recycling: the experience of the H2020 MAELSTROM project

ECOMONDO - The Green Technology Expo is the reference event in Europe for the ecological transition and the circular and regenerative economy. It is an international event with an innovative format that brings together all sectors of the circular economy on a single platform. The MAELSTROM workshop took place on November 7, 2023, in Rimini Expo Centre, Italy, and illustrated the experience of the successful implementation of sustainable technologies for the removal of ML from coastal environments. Innovative approaches to involve stakeholders and citizens in the efforts against ML were also presented. The MAELSTROM results represent a pilot in

the implementation of the EU Mission "Restore Our Ocean and Waters by 2030", so the main lessons learnt were shared and discussed during the workshop. The session was organised by ECOMONDO Scientific Technical Committee & BlueMissionMed CSA, CNR.

Chapter 6. Mobilizing Science and Society to Tackle Marine Litter

Stakeholders have been involved from the beginning of the project as core actors, each with particular and dedicated levels of communication and involvement. Actors such as environment management entities; waste management and remediation companies; local enterprises and commercial entities; local, regional and national governments; industry partners; civil society; and local schools and community groups, have been closely collaborated with in the design, coordination, and implementation of the project, demonstrating enthusiasm and support for MAELSTROM's contribution to the ML problem. Local management entities such as those in Vila do Conde, Portugal and the Venice municipality, Italy, have been involved from early stages as core stakeholders for the co-design and co-implementation of the ML removal technologies. The academic community is an integral part of the MAELSTROM stakeholders, through strategic networking, event participation, conference proceedings, and other engagement activities, the project has developed both its status and built an important community of knowledge-holders, experts, and esteemed professionals. This community, strategically designed to demonstrate an unbiased, multidisciplinary, and active participation in the knowledge-sharing of diverse schools of thoughts, has been the central foundation for the MAELSTROM network. It is through this network that the project is forming a Working Group of experts which will be crucial to both the production of advisory publications for the EU Plastic Strategy, and in the Best Practices database. The multidisciplinary and multisectoral key-stakeholders database will also be crucial for science policy, civil society involvement, capacity-building events, and other activities foreseen in the implementation of both MAELSTROM removal technologies.

Outreach initiatives can inspire individuals to adopt environmentally friendly habits and participate in local cleanup efforts. By fostering a sense of stewardship and responsibility, communities can significantly contribute to reducing ML.

To celebrate World Clean up Days and the EU Campaign ActNow, in 2021, 2022, 2023 and 2024 four multidisciplinary beach clean ups were organised in Porto and Vila do Conde. Other clean ups and citizen science initiatives were also organised with

schools and local and regional associations. These events were organised within the scope of WP7 and WP9 and included the support, co-organization and active participation of local and national authorities and entities, organisations, and other key multisectoral stakeholders. Actions included multidisciplinary clean-ups, educational talks, and participant-feedback surveys revealing insights into public awareness and attitudes towards ML. These initiatives also included the demonstration of the MAELSTROM technologies, side games, and other interactive activities widely available for all ages, inspiring participants to protect and restore our oceans.

More than 20 public demonstrations of the MAELSTROM ML removal technologies, 45 talks and more than 30 cleanups, were organized (the latest by VLPF on December 10th 2024), providing an engagement and education platform for citizens to improve awareness around the issues of ML and the tools used in addressing the problem. More than 14 tons of litter were collected during cleanup actions, with the participation of around 1600 people; the identified items demonstrate the significant influence of urban pressure, tourism and the impacts of leisure activities. Public participation feedback surveys revealed valuable insights into public perceptions around local beach and riverbank cleanliness, understanding of risks and impacts of ML and MP pollution, and the onus of responsibility for tackling ML (Highest for EU and national governments). Outcomes highlight the value of citizen-science activities in driving support for innovative and sustainable solutions to be implemented by local, national, and European decision-makers. Engagement efforts also enhanced Ocean Literacy within communities and stakeholders to build awareness, adopt good practices, behaviours, and consumer choices. These, alongside institutional facilitation and resourcing of technological and societal ML solutions are vital for a sustainable, clean, and healthy society.

6.1 International Conferences Side Events:

The MAELSTROM teams from CIIMAR, TGBB and VLPF promoted international action to tackle ML, organizing several demonstrations of MAELSTROM technologies (MAELSTROM smartphone application and the Bubble Barrier) and providing networking moments in four side events in the UN Ocean Conference (UNOC):



Fig. 69: MAELSTROM researchers at the Special Local and Regional Governments Special Event-2022 United Nations Ocean Conference.

On June 25th, MAELSTROM participated in the “Special Local and Regional Governments Special Event-2022 United Nations Ocean Conference”, held in Matosinhos, Portugal.



Fig. 70: Presentation of MAELSTROM app by VLPF at the UN Ocean Conference, Lisbon, 2022.

On June 28th 2022, MAELSTROM was presented at the “One Sustainable Ocean-Ocean Science & Business2Sea Side Event”, Portugal Pavilion, Park of Nations, Lisbon (Portugal Implementing an Innovative Technology to Tackle Plastic Pollution with a Bubble Barrier; Tackling the Marine Litter Management Cycle with the Maelstrom App). (<https://onesustainableocean.forumoceano.pt/>)



Fig. 71: MAELSTROM researchers at the EU4OceanObs side event in Cascais, Portugal.

On June 29th 2022, some of the MAELSTROM technologies were presented at the “Integrating Marine Litter Monitoring to Inform Action” Official Side Event, Cascais, Portugal (<https://www.eu4oceanobs.eu/marine-litter-monitoring-to-inform-action/>).



Fig. 72: The “Mini-Bubble Barrier” being presented at One Sustainable Ocean-Ocean Science & Side Event and in the RTP Portuguese Television.

6.2 Session “Ocean and Health: Impacts of microplastics on ecosystems and human health” Portuguese Science Summit 2024 - July 3rd to 5th, Porto, Portugal

The Portuguese Science Summit (Ciência) is an initiative promoted by the Foundation for Science and Technology (FCT), in collaboration with Ciência Viva and, this year, with the University of Porto, at the Alfândega Congress Centre. The motto of Ciência 2024 was “+Science for One Health and Global Well-being”, bringing together researchers, guests and the public for three days filled with thematic sessions and moments of dialogue, knowledge and conviviality. The Portuguese Science Summit is the largest event dedicated to Science in Portugal. The 2024 Summit, co-organized with the University of Porto, had more than 3000 participants.

The MAELSTROM team from CIIMAR organised, in collaboration with the Faculty of Sciences of the University of Porto (FCUP) and Abel Salazar Institute of Biomedical Sciences (ICBAS), the session “Ocean and Health: Impacts of microplastics on ecosystems and human health”, exploring the current knowledge of marine litter and microplastic pollution and its impact within the framework of the One Health framework. Build on insights and experience of MAELSTROM, the session focused on the interconnectedness of human, animal, and environmental health, and addressing the sources, impacts, and solutions for MP pollution.

The event was introduced and moderated by Professor Isabel Sousa-Pinto (CIIMAR), with the intervention of Luis R. Vieira (CIIMAR), Joana Correia Prata (CESPU/ICBAS), Filipa Bessa (Centre for Functional Ecology - Science for People & the Planet) and Patrícia Carvalho (Portuguese Pact for Plastics - Smart Waste Portugal). The initiative also had the participation of the EB Infanta D. Mafalda School (Plastic Pirates). A Q&A session with the audience, moderated by Luis R. Vieira, fostered the interaction and promoted multidisciplinary knowledge sharing and creating a platform for insightful dialogue and collaboration. By addressing the impacts and sources of microplastics, and presenting strategic societal and technological solutions, this session drove engagement and positive action while aligning with national and international goals for pollution reduction and improved health and well-being.

Session information: <https://app.encontrociencia.pt/session-details/12255>

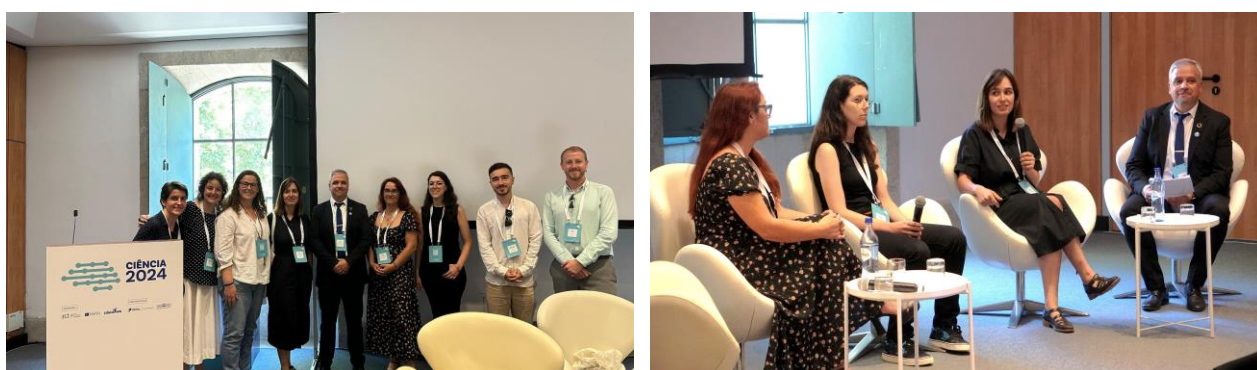


Fig. 73: MAELSTROM organizers and invited speakers at the Session "Ocean and Health: Impacts of microplastics on ecosystems and human health", organized by CIIMAR partner at the Portuguese Science Summit 2024, Porto, Portugal

6.3 Restoring our Ocean and Waters by 2030 - The power of the young generations' visionary solutions. 03/10/2023 – 04/10/2023, Milan, Italy.

Organised by the University of Milan Bicocca and the Vittorio Veneto Liceo Scientifico, in cooperation with the European Commission, this event was designed to foster and develop dialogue and debate with the next generation of ocean professionals, researchers, innovators, and leaders around new scientific advances and sustainable solutions to shared problems in support of implementing the European Mission Restore our Ocean and Waters by 2030. MAELSTROM played an important role in this event, CIIMAR partner was invited to engage the local youth with ideas and inspiration from the sustainable ML removal technologies developed within the project. A short presentation was given on the opportunities and diversity within ocean-related careers before the students were split into breakout groups to

brainstorm and design solutions that could be adopted within the Vittorio Veneto Liceo Scientifico institute. MAELSTROM co-led the group on “Marine Pollution and Solutions”, alongside REMEDIES, Plastics Europe, and BlueMissionMed. The two-day event allowed for thoughtful, comprehensive, and inspiring dialogues between adolescent students, Early Career Ocean Professionals, and experienced policymakers.

Link: <https://en.unimib.it/events/restoring-our-ocean-and-waters-2030>



Fig. 74: CIIMAR partner presents the MAELSTROM project and career opportunities in the marine sector during the intergenerational dialogue of “Restoring our Ocean and Waters by 2030” in Milan, Italy.

In addition to these international side events, MAELSTROM engagements were also secured at several info days, and beach cleanups which included demonstration and capacity-building sessions on MAELSTROM's technologies (App, Bubble Barrier and Seabed Cleaning Platform), with the active involvement of authorities, schools, NGOs, citizens, the scientific community and other key-multisectoral national and international stakeholders.

Some examples:

- Demonstration of the MAELSTROM Technologies at the Portuguese Science 2023 Meeting (Ciência 2023; 5-7th July 2023; <https://www.encontrociencia.pt/2023/pt>)

- Invited Talk and Participation for the Circular Economy Round Table and Demonstration of the MAELSTROM Technologies at The Portuguese Conference on Marine Litter (3CPLM; 21-22th September 2023; <https://aplixomarinho.org/3cplm/>)
- June 30th and July 1st – Demonstration of MAELSTROM technologies – CIIMAR stand (Park of Nations), Lisbon, Portugal.
- CIIMAR's open days (2022-2023)
- Talks and Hands-on activities with the Public and Schools (2022-2024)
- EU Mission Ocean and Waters Intergenerational Dialogue workshops (4th - 5th October 2023)
- Clean ups and Citizen-Science activities (2021-2024).



Fig. 75: MAELSTROM was invited to participate in the Circular Economy Round Table and to demonstrate the implemented technologies at The Portuguese Conference on Marine Litter (3CPLM), Lisbon, Portugal.



Fig. 76: Poster from the joint initiative with The Trash Traveller influencer where the MAELSTROM app was demonstrated.

Together, these events showcased the work done within the MAELSTROM project, highlighted results, expanded and strengthened the project's network of stakeholders, and advanced efforts in Ocean Literacy. The joint demonstrations have aided the understanding of blue technologies for ML removal amongst local stakeholders, students, and communities. Initial surveys carried out amongst public participants showed that people had a good understanding of the ML problem, and all respondents supported the development of blue technologies within their communities, with many calling for increased institutional support from local, national, and European governments to facilitate the implementation of ML removal technologies.

The multiple-scale and multisectoral key-stakeholders database will also be crucial for science policy, civil society involvement and key-stakeholders capacity-building events and activities foreseen the implementation of both MAELSTROM removal technologies.



Fig. 77: Selection of images showcasing the poster for the Sunset Beach Cleanup event 2024 and the demonstration of CIIMAR technologies at the CIIMAR Open Day 2023.

Chapter 7. Culmination of the Project with Business2Sea 2024 and MAELSTROM Final Event

7.1 Business2Sea Networking Event

On the 14th – 15th November 2024, MAELSTROM participated in, and demonstrated the models of both the Bubble Barrier and the Robotic Seabed Cleaning Platform at the Business2Sea networking event for marine research and innovation. The event was organized by Forum Oceano and supported by Matosinhos Municipality and APDL (Administration of the Ports of Douro, Leixões and Viana do Castelo) and held at the Porto de Leixões Cruise Terminal, Matosinhos, Portugal. This event serves as the anchor event for the Portuguese Sea Cluster and the Ocean Forum mobilizing all sectors of the maritime technology value chain. The theme of this year's event was "Digitalization and Oceanic Renewable Energies" which allowed for seamless integration of MAELSTROM technologies which attracted attention from a wide variety of stakeholders, institutions, funders, and public administration entities.

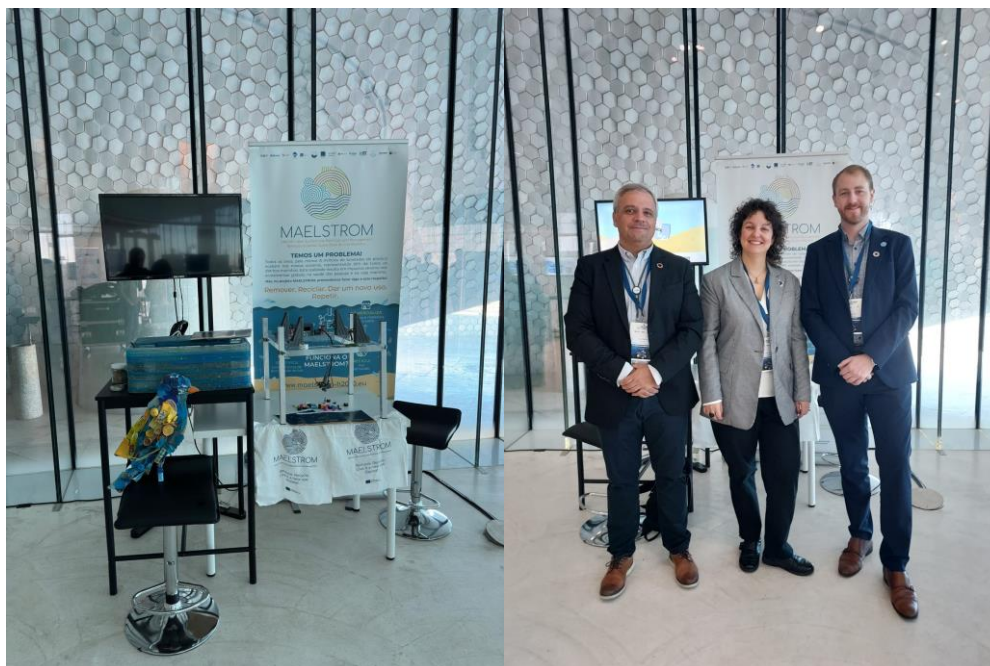


Fig. 78: MAELSTROM representation at the Business2Sea networking and stakeholder event, Matosinhos, 2024.

7.2 MAELSTROM Final Conference

The MAELSTROM Final event celebrated the culmination of the Project by showcasing multiple storylines of results, giving the platform to stakeholders who've engaged with the project to express their feedback and opinions, and emphasizing the future legacy of the project in the ML Science-Policy framework, passing on advice for similar initiatives, and reflecting on the many achievements and successes, including challenges and opportunities which were overcome and availed of.

The full event lasted over three days from 20th – 22nd November 2024 and was held in the NEYA hotel, Porto, Portugal. In total 45 people attended in person.



Fig. 79: MAELSTROM Final Conference Group Photo, Porto, Portugal.

The first day involved the MAELSTROM Working Group on Marine Litter Management (WG-MLM) organizing a hybrid side event titled “Exploring Priority Areas and Pathways to Implementation of Sustainable Solutions in Marine Litter”. 12 members of the WG-MLM participated in the preparation of a “scientific recommendations for policymakers” booklet which highlights the primary knowledge gaps and priority areas which need to be addressed in order to better mitigate ML across three thematic areas: Science-Policy-Society, Monitoring & Detection, Removal & Recycling. Furthermore, the participants conducted a deep-dive analysis into the resources, tools, and synergies which would be needed to address the identified knowledge gaps. The second part of the WG-MLM workshop focused on effective and sustainable environmental management measures (i.e. the Ten Tenets of Effective Management) with a specific focus on ML and the opportunities and challenges which face local, national, and international administrations and decision-makers in their efforts to combat ML pollution.

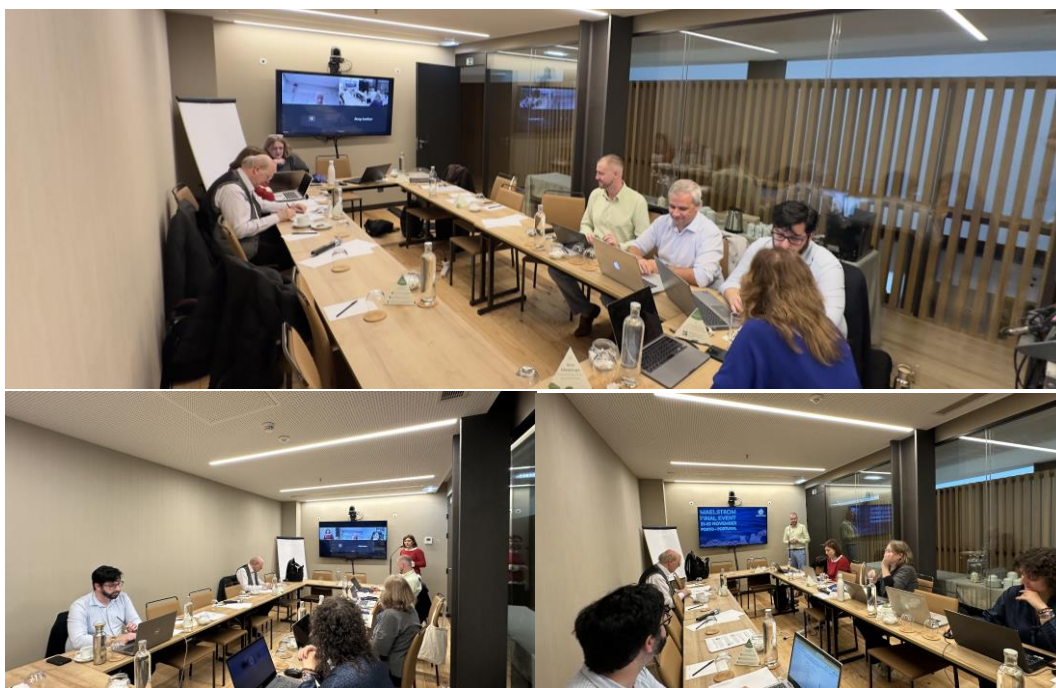


Fig. 80: MAELSTROM Working Group on Marine Litter Management (WG-MLM) working session selected images, Porto, Portugal.

The 21st November entailed the story-telling narratives of the MAELSTROM technologies, their results, ecosystem assessments, LCAs, and the engagement of stakeholders who supported the project throughout. The morning section explored “How we collect ML in coastal areas” with partners working collaboratively to tell the narratives in chronological order. Following an opening presentation by Project Coordinator Fantina Madricardo and a welcome note by Isabel Sousa Pinto, The Story of the Bubble Barrier Vila do Conde was told by partners CIIMAR, TGBB, UoM, TECNALIA, and Deltares.



Fig. 81: Selected images from the first day of the MAELSTROM Final Conference, Porto, Portugal.

Following this was the Story of the Robotic Seabed Cleaning Platform in Venice coastal area as told by CNR, TECNALIA, CNRS, and ST. Then the story of Smart Beach Cleanups showcasing the MAELSTROM App and collaborative Citizen Science initiatives was told by VLPF, CIIMAR, GEES, and CIMA. In the afternoon session, stories were told of the AI-

driven sorting robot by TECNALIA, followed by three stories of recycling innovations and new products as told by TECNALIA, GEES, MAKEEN, VLPF, and ISDI.



Fig. 82: Presentations and sessions discussions during the first day of the MAELSTROM Final Conference, Porto, Portugal.

The third and final day of the event, on 22nd November focused on the policy framework and future legacy of MAELSTROM. An opening statement was given by Ms. Elisabetta Balzi, Head of Unit Ocean, Seas and Waters, Deputy Director Healthy Planet at European Commission, DG Research and Innovation, acknowledging the exemplary

work of MAELSTROM and the vital role of such projects in securing a clean, safe, and healthy Ocean and Waters in the EU. Continuing the theme of Mission Ocean and Waters, the next presentations showcased the Mission Lighthouses BlueMissionMED and BlueMissionAA by the respective CSA Project coordinators Fedra Francocci (CNR) and Valerie de Liedekerke (AIR Centre). The MAELSTROM Legacy document was presented by partner CIMA highlighting the successes, lessons learned, challenges, and opportunities which has the aim of strengthening similar current and future projects as they design, implement, and test new technologies and build lasting and effective relationships with local stakeholders, followed closely by CIIMAR presenting the two policy briefs produced within the project and the outcomes of the WG-MLM including a third policy brief in preparation and the knowledge acquired from the involvement of external expertise. The future opportunities were presented by partner ALPHA highlighting the capacity for technology transfer and business development. The afternoon culminated in an engaging and fruitful roundtable of local stakeholders to give their feedback and share experiences of working with MAELSTROM. Speakers included:

Speaker name	Affiliation	Engagement with MAELSTROM
Dália Vieira	Vereadora da Câmara Municipal de Vila do Conde	Key stakeholder in the entire process of Bubble Barrier Vila do Conde
Cristina Calheiros	Centre for Environmental Monitoring and Interpretation (CMIA)	Supported the social engagement and educational activities in Vila do Conde
Maria do Céu Silva	LIPOR	Managed the ML removal and treatment in Vila do Conde
Nuno Coelho	DOCAPESCA	Supported the installation of Bubble Barrier Vila do Conde
Patricia Carvalho	Portuguese Pact for Plastics	Network affiliate for national stakeholders in plastic management
João Frias	Atlantic Technological University, Portuguese Association of Marine Litter (APLM)	Member of the MAELSTROM Working Group on Marine Litter Management

Simonetta Franschetti	University of Naples	External Advisory Board
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Fig. 83: Presentations during the second day of the MAELSTROM Final Conference, Porto, Portugal.

Outcomes:

The stakeholders' roundtable at the MAELSTROM Final Event yielded insightful reflections and discussions that highlight the challenges, opportunities, and collaborative value of the project. Speakers expressed a sense of pride in their involvement with MAELSTROM, emphasizing its alignment with other initiatives like Fishing4Litter and other regional and local activities. Speakers shared the positive reception of MAELSTROM, especially in the fishing community of Vila do Conde. They noted the success in raising awareness and improving waste management, although concerns about financial sustainability and the long-term funding for technologies remained.

Challenges discussed included the difficulty of waste sorting due to contamination from materials like fishery and sanitary waste. It was emphasized that better sorting technologies and greater integration of municipal waste into circular economy practices are needed, although these challenges also pointed to opportunities for future collaboration with MAELSTROM partners developing the technologies to address this. There was also a call for improved visibility of outcomes and more scientific support to upscale technologies in urban areas. The project was praised for its success in fostering environmental literacy and engaging schools. The value of the collaboration among partners and the enthusiasm shown by local communities in adopting solutions was highlighted. Speakers spoke about the importance of policy briefs and global platforms, such as the UN and EU, to influence policy and reduce plastic production at the source.

A recurring theme from many speakers was the call for more institutional support to upscale technologies, particularly in urban settings, to further amplify the project's effectiveness. It was also highlighted that there is a need for better visibility of the project's outcomes, particularly demonstrating the impact of ML collection and the technology's traceability. The overall sentiment was one of optimism and commitment to continuing to engage with scientific projects and similar work, as stakeholders recognized the significant impact it had on building a collaborative network, shaping policy, and advancing sustainable solutions for ML in their community. The discussions

affirmed the value of the project's legacy, reinforcing its role in future initiatives and improved ML sustainable removal and management.



Fig. 84: The stakeholders' roundtable at the MAELSTROM Final Conference, Porto, Portugal.

Chapter 8. Main Conclusions

The diverse, and far-reaching events organized by or involving as participants the MAELSTROM project have played a critical role in ensuring a lasting impact on the ML research and innovation landscape, in particular for knowledge transfer and Science-Policy. High-profile events such as the UN Ocean Conference, the enlisted EU Mission Ocean and Waters, namely three years editions of the the International Workshops on Marine Litter Monitoring, Removal and Circular Economy held in Venice, direct participation and contribution to ECOMONDO, the All-Atlantic Ocean Research and Alliance Forum, the Portuguese Conference on Marine Litter, and Business2Sea have been essential for demonstrating MAELSTROM's innovative technologies and fostering cross-sectoral collaboration. These engagements allowed the project to showcase monitoring, removal and recycling technologies that were not self-confined within the range of the demo cases gravitating around MAELSTROM. Indeed, the Bubble Barrier, the Robotic Seabed Cleaning Platform, the proof of concept MAELSTROM app to perform basic functionalities of ML monitoring tracking and clean up, catalysed a wider array of other solutions from different sources, first among all, those deriving from the H2020 sister project InNoPlastic (<https://www.innoplastic.eu/>) and beyond.

The cluster of organised events, facilitated networking opportunities, encouraged the integration of MAELSTROM's technologies into policy and industry solutions, and created an important platform for knowledge exchange and collaboration. This deliverable has highlighted the way in which MAELSTROM actively engaged society, innovators, policymakers, stakeholders, and academia to encourage sharing of scientific insights and actionable recommendations, and along with other project activities, has helped to create a framework for collaboration at the EU and global levels.

MAELSTROM has demonstrated an insightful emphasis on legacy, collaboration, and community engagement to ensure the sustainable impact of its outcomes. Finally, The MAELSTROM final conference in Porto on 21-22 November 2024 was a key moment for reflecting on the project's achievements, lessons learned, and future opportunities. Presentations on the project's many successes, technological innovations, ecosystem monitoring campaigns, and policy recommendations served to showcase the value of multi-sectoral and multidisciplinary efforts to not only the project consortium but also the diverse guests present in person and online. The Legacy document presented at



the MAELSTROM Final Conference was pivotal in compiling achievements and obstacles, lessons learned, and discussing future opportunities for effective European research and innovation projects. MAELSTROM has paved the way for future initiatives, and the helped shape the European and global response to ML and its sustainable removal and management. The legacy of the project is already uptaken in other Mission Ocean and Waters funded projects such as SeaClear2.0, REMEDIES and INTERREG such as JOINABLE under the IPA ADRION Programme.

Annex 1 – First International Workshop – 3 June 2021

Venue: Torre di Porta Nuova dell'Arsenale di Venezia – Venice (Italy)



Venue: CNR-ISMAR, Arsenale, Tesa 104 Castello 2737/F, 30122 – Venice (Italy)



Fig. 86: Programme of the second International Workshop

Annex 3 – Third International Workshop – 1 June 2023

Title: Marine Litter Monitoring, Removal and Circular Economy: Challenges and Opportunities

Venue: CNR-ISMAR, Arsenale, Tesa 104 Castello 2737/F, 30122 – Venice (Italy)



Fig. 87: Programme of the third International Workshop



Fig. 88: Programme of the fourth International Workshop