TREASURE

Innovative solutions
for environnemental quality improvement in and around Mediterranean ports

TREASURE | Interreg Euro-MED

Co-funded by the European Union

TREASURE IN A NUTSHELL

TREASURE project, funded by the Interreg EuroMED programme, aims to improve environmental quality in and around Mediterranean ports by mitigating and reducing pollution.

9 PARTNERS

ASEV obiettivo sviluppo
CEI CENTRAL EUROPEAN INITIATIVE
utoriteti Portual Durrës DURRES PORT AUTHORITY
ISPRA Istituto Superiore per la Protezione e la Ricerca Ambientale
Sistema Nazionale per la Protezione dell'Ambiente
tm Transport Malta
LUKA BAR PORT OF BAR
ΟΛΠ PIRAEUS PORT AUTHORITY S.A.
FUNDACIÓN VALENCIAPORT
PÔLE MER MÉDITERRANÉE

Concerned by common challenges in the mediterranean area, the TREASURE partners have design an innovative approach merging **3** elements:

1. Identify an ecosystem with multiple stakeholders to create open pilot laboratories;
2. Define an integrated approach to environmental quality assessment;
3. Scout, test and experiment new techniques for the remediation of degraded and polluted port areas.

CALL FOR INTEREST

To scout these new techniques, **TREASURE** project has launched a Call for Interest in September 2024, calling all solution providers developing innovative technologies aiming to improve the environmental quality of port areas, in **6** specific environmental challenges Mediterranean port authorities are facing, to apply.

Based on their innovation and maturity, their relevance to the specific challenge and their impact for the environment, received applications have been reviewed and selected by a transnational committee comprising **TREASURE** project partners.

These solutions are compiled in this catalogue, aiming to support port authorities in the access to innovative solutions enhancing the environmental quality of their ports.

FACING THE CHALLENGES OF MEDITERRANEAN PORTS

The **51** selected solutions directly address **1** or more of the key environmental and operational challenges Mediterranean ports are currently facing.

Each challenge is associated with a color code and an icon.

Water management

Water management in ports involves sewages surveillance, regulation and treatment to ensure sustainable port operations while minimizing impacts on the marine ecosystem.

Sediment management

Managing sediment accumulation in ports is essential to ensure navigability and proper infrastructure functioning. This includes monitoring and conducting dredging operations when needed.

Protection and restoration of biodiversity

Protection and restoration of biodiversity in ports focuses on implementing measures to preserve coastal and marine ecosystems, and the species that depend on them, while limiting the negative impacts of port activities on these fragile environments.

Improvement of air quality

Improving air quality in ports addresses the reduction of air pollutants emitted by port operations, vessels, and cargo handling, to protect both public health and the environment.

Energy management

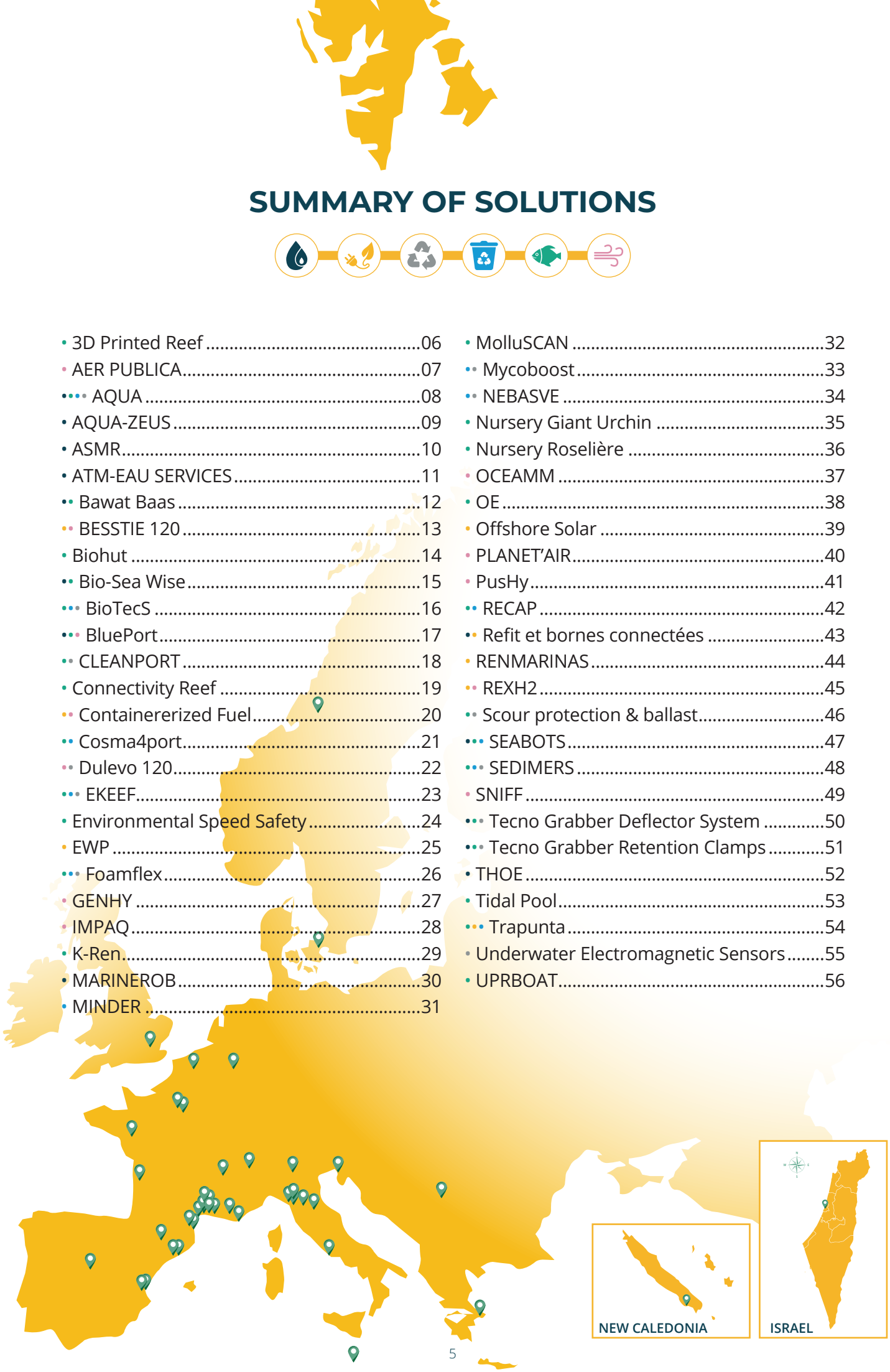
Energy management in ports involves optimizing the use of energy resources, such as electricity, fuel, and renewable energy to reduce consumption and greenhouse gas emissions related to port operations.

Waste management

Waste management in ports involves the collection, sorting, treatment, and disposal of waste generated by port activities, aiming to minimize pollution and comply with environmental protection regulations.


Emirates TEAM NEW ZEALAND

SUMMARY OF SOLUTIONS



SEABOOST

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Seaboost *is a pioneering ecological engineering company, working to restore key ecological functions in man-made areas in France and abroad. We have developed a comprehensive approach to ecological engineering in port environments. Part of the company's activity is centred on artificial reefs and artificial habitats and the declination of these concepts in different forms and applications, including nature inclusion of coastal and offshore marine infrastructures.*

3D PRINTED REEF

Protection and restoration of biodiversity

The **3D-printed** concrete reef modules aim at increasing habitat complexity and functionality within port ecosystems. They more specifically target hard substrate cryptic and benthic species.

The modules can be placed at the base of infrastructures to form ecological corridors or used as eco-designed mooring ballast. This offers both environmental and practical benefits.

3D printing allows the design of a variety of cavity shapes and sizes, inspired from natural rocky ecosystems, and creating spaces for many species and life stages. The rough surface of the concrete promotes quick colonization by marine organisms, boosting the reef's ecological and visual value.

From a sustainability perspective, the use of **3D printing** significantly optimises the ratio of material used per volume and surface of created habitat in comparison to more traditional precast techniques.


©Julien Dalle Seaboost

These modules also have strong aesthetic appeal, making them ideal for installation near recreational areas. They enhance the experience for divers and visitors while supporting marine biodiversity.


©AMP

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QUANTA is a Florence-based company with over 30 years of experience in the design and manufacturing of industrial automation technologies. Since 2011, we have specialized in environmental monitoring equipment, developing advanced solutions for air quality assessment in both industrial and public settings.

AER PUBLICA

Improvement of air quality

AER Publica is an integrated solution designed to improve air quality monitoring in Euro-MED port environments. It combines the flexibility of **Aernode Pro**, a professional outdoor air quality monitor, with the data infrastructure of the **Asymmetrica** platform, offering a scalable and actionable system for pollution detection and management.
The solution supports compliance with the data quality objectives set by the EU Ambient Air Quality Directive 2024, offering real-time monitoring of key pollutants, including particulate matter (PM1, PM2.5, PM10), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_2), ammonia (NH_3), carbon monoxide (CO), hydrogen sulfide (H_2S), and total volatile organic compounds (TVOCs).

Aernode Pro features a compact, weather-resistant design suitable for installation in complex port and industrial areas. Its modular sensor architecture allows users to tailor each unit to specific monitoring needs and environments. Installation is fast and non-invasive, and the devices are fully operable in both on-grid and off-grid conditions, thanks to optional solar panel and battery kits.

The **Asymmetrica** platform ensures advanced data management, offering real-time visualization, threshold-based alerts, historical data access, and integration with third-party systems. The platform is compatible with the **Quanta AER Cloud** and the **Quanta AER Vue** web app, supporting secure data access through REST APIs and enabling automated reporting and spatial analysis.

The system is ideal for integration into smart port and urban planning frameworks, supporting environmental protection, health risk prevention, and informed policymaking. **AER Publica** empowers stakeholders to transition from reactive to proactive air quality management, in full alignment with EU policy goals.

Key Aspects

• Flexible and Modular Equipment
Aernode Pro supports a wide range of pollutants with its 8-slot modular sensor deck, allowing tailored configurations for PM, gases (NO_2, SO_2, H_2S, NH_3, CO, O_2), and VOCs.

• Easy Installation and Integration
Designed for rapid deployment on poles, walls, or urban fixtures, **Aernode Pro** supports 3G/4G and Modbus connectivity. Solar panel and battery options enable autonomous, off-grid operation.

• Scalable Data Management and Analytics
Compatible with **Asymmetrica** and **Quanta AER Cloud** platforms, the system enables real-time monitoring, secure API access, alerts, and advanced visualization.

• Streamlined Maintenance
Plug-and-play sensor decks allow fast on-site replacement, minimizing downtime. Calibration is supported through co-location, remote methods.
This combination ensures high-resolution, low-maintenance air quality monitoring—ideal for ports and complex industrial environments.

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*The **National Institute of Oceanography and Applied Geophysics (OGS)** is a public research body under the Italian Ministry of University and Research. It conducts national and international research in oceanography, geophysics, and marine sciences, and promotes a Sustainable Blue Economy while addressing environmental, geological, and climate-related risks.*

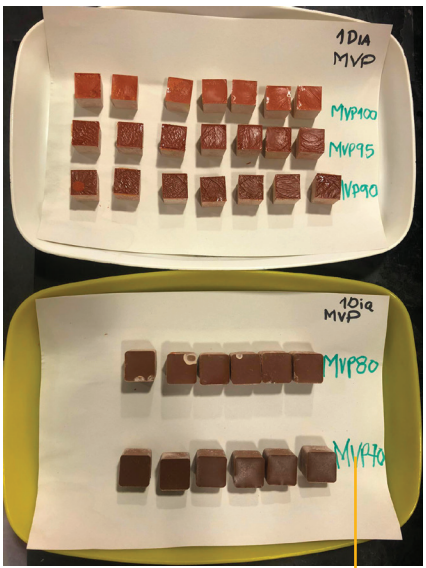
AQUA

Water management
Protection and restoration of biodiversity
Sediment management
Waste management

The solution presented in the **AQUA** project involves the use of geopolymers as sustainable alternatives for marine infrastructure. Geopolymers offer a wide range of properties that make them highly versatile in addressing multiple environmental and engineering challenges.

Geopolymers are cost-effective due to their reliance on industrial by-products, such as dredged sediments, which reduce raw material expenses and support circular economy principles.

These materials are particularly effective in sediment management, as they can immobilize contaminants through adsorption, preventing their release into marine ecosystems. This property is vital for treating dredged sediments and converting them into usable construction materials, thereby reducing waste disposal issues. Additionally, their high adsorption capacity enables applications in water management, such as the removal of heavy metals and other pollutants, contributing to cleaner waterways.



In marine environments, geopolymers can be used to protect and restore biodiversity. They can be engineered into artificial reefs that provide habitats for marine organisms, supporting ecosystem regeneration and enhancing local biodiversity. Their durability and chemical stability make them suitable for long-term deployment in harsh marine conditions, ensuring sustained ecological benefits.

The production of geopolymers involves significantly lower costs compared to traditional materials, with a carbon footprint reduction of up to 80%. Required infrastructure includes specialized laboratories for material testing, facilities for geopolymer formulation, and pilot study setups in marine environments. Necessary equipment includes sediment characterization tools, durability testers, and marine field survey instruments.

Implementation requires expertise in sedimentology, geopolymer chemistry, structural engineering, marine environmental assessment, and stakeholder engagement. Skilled professionals will optimize formulations, conduct environmental impact assessments, and design pilot projects. Collaboration with academia, industry, and regulatory bodies ensures compliance and scalability. Integrating geopolymer infrastructures into redevelopment projects enhances resilience, supports waste and water management initiatives, and fosters biodiversity restoration, contributing to sustainable coastal and marine development.

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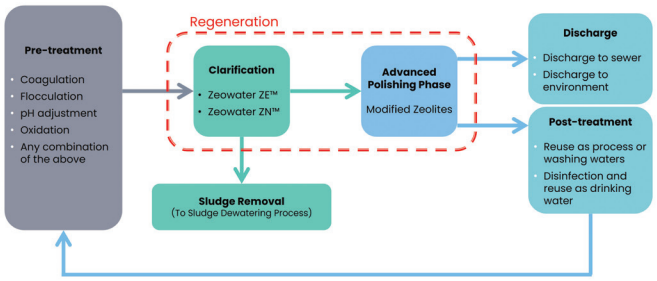
DND Biotech *develops sustainable environmental technologies for water and sediment treatment. Combining expertise in bioremediation, zeolite-based solutions and ecological restoration, we deliver innovative, nature-based approaches for port environments. We offer integrated systems designed to enhance environmental quality and promote circular economy principles.*

AQUA-ZEUS

Water management

DND Biotech proposes the development of a skid-mounted system designed for the treatment of port production waters. This approach is based on natural zeolite-based technology, which aims to provide a compact, adaptable, and sustainable treatment process, designed to integrate efficiently with existing port operations. Zeolites, cost-effective and eco-friendly minerals, have a porous crystalline structure and cation-exchange ability, making them ideal for water treatment applications.

Key components of the proposed system:
1. Pre-treatment phase: The initial phase focuses on removing coarse contaminants and suspended solids, optimizing conditions for downstream processes with operations like coagulation and pH regulation.
2. Clarification phase: Granular natural zeolites act as physical filters, clarifying water by capturing particles as small as 5 microns. Micronized zeolite is used in batch processes as chemical filters, targeting heavy metals, hydrocarbons, and pollutants in port production waters.
3. Advanced polishing phase: Modified natural zeolites with enhanced selectivity are used to eliminate residual pollutants, including trace organics, heavy metals, surfactants, and emerging contaminants like PFAS.
4. Regeneration: Modified and natural zeolites are regenerated using chemical treatments.
5. Post-treatment phase: The final polishing step optimizes water for safe discharge or reuse, with optional UV disinfection or reverse osmosis to meet specific requirements.



The equipment needed includes a skid-mounted framework, pre-treatment units (e.g., mechanical screens), filtration and regeneration units, monitoring sensors and automated control systems. Support infrastructures needed are power supply and backup systems, chemical storage and handling units, water storage tanks and waste-management facilities.

Benefits of the proposed system:
• **Modular and scalable design:** The skid-mounted system's modular construction allows for easy customization and scalability, accommodating varying treatment capacities and port-specific needs.
• **Circular economy integration:** Spent zeolites can be regenerated, reducing waste and enhancing sustainability. Treated water can be reuse as process, washing, or potable water.
• **Energy-efficient operation:** The system incorporates low-energy processes and intelligent controls to minimize energy consumption while maintaining high performance.
• **Real-time monitoring and automation:** advanced sensors and cloud-based controls provide real-time water quality monitoring, ensuring proactive maintenance and regulatory compliance.
• **Compact footprint:** The skid-mounted design facilitates rapid deployment and requires minimal space, making it ideal for constrained port environments.

The total cost for a skid-mounted water treatment system may range from €200,000 to €500,000 (CAPEX), with annual operating expenses (OPEX) between €10,000 and €60,000, depending on system size, complexity, and customization.

ACQUA. ECOLOGIE
Traitement et Réutilisation de l'eau

ACQUA Ecologie
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Leader in water treatment and reuse for both land and marine environments.
***ACQUA Ecologie** design the sanitation of the future through innovative, high-performance solutions capable of eliminating pollutants from wastewater, making water reuse possible.*
Fully certified, modular, robust, and compact, our solutions contribute to environmental and ecosystem preservation, as well as to the development of tomorrow's Smart Cities, Smart Ports, Green Buildings, and Green Ships.

ASMR

Water management

Acqua SMart Reuse® (ASMR) solution revolutionizes on-site water management by offering complete treatment and reuse of wastewater, rainwater, and industrial water. It prioritizes simplicity, cost-effectiveness, and sustainability while complying with stringent regulations.

Key Aspects
1. Costs Involved
• Initial Costs: Compact system installation, tailored to site-specific needs, significantly lower than traditional treatments.
• Operational Costs: Energy-efficient processes reduce energy usage by up to 50%. Maintenance is minimal, further lowering expenses.
• Return on Investment: Rapid payback due to water and energy savings, reduced operational expenses, and compliance with environmental regulations.

2. Required Infrastructure
• Modular, scalable, and adaptable systems that can be installed underground, above ground, or in mobile containers.
• On-site integration eliminates the need for extensive piping or centralized treatment facilities.
• Compatible with existing SmartPort infrastructures and regulatory frameworks.

3. Necessary Equipment
• Treatment Systems: Patented ultrafiltration membranes and biological degradation technologies certified for water reuse (NSF/ANSI 350).
• Energy Recovery Modules: Capture and reuse 50% of thermal energy from wastewater for preheating purposes.

• Automation Controllers: Ensure autonomous, real-time operation and adaptability to fluctuating loads.

4. Expertise Required
• Engineering: Expertise in integrating compact, modular treatment units.
• Operations: Knowledge of SmartPort systems and water reuse regulations.
• Environmental Management: Ensuring compliance and optimizing ecological impact.

Unique Benefits
• Treats and recycles 100% of wastewater locally, eliminating pollution and the need for extensive transport.
• Cuts water consumption by up to 100%, achieving Net Zero Water goals.
• Reduces CO_2 emission, contributing to energy and climate targets.
• Modular design ensures scalability, durability (50+ years), and rapid deployment for diverse applications.

The **ASMR** solution is ideal for SmartPorts aiming to enhance sustainability, autonomy, and cost-efficiency while adhering to global water management standards.

ATM-EAU SERVICES

N-EAU LIMIT

ATM-EAU SERVICES
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Founded by a team of experts of marina and water management, based in South of France, aiming at addressing core environmental issues led by climate change, our purpose is to offer services and solutions that will enable sustainable water development for all private and public activities impacted by seasonal draught or restricted use.

ATM-EAU SERVICES

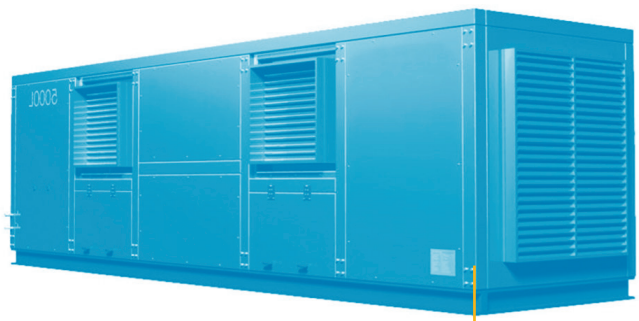
Water management

ATM-EAU SERVICES proposes a sustainable and scalable solution to non-potable freshwater scarcity through the deployment of an innovative autonomous atmospheric water generation (AWG) system.

The first phase of the project consists in funding and operating a demonstrator unit designed to extract potable water directly from atmospheric humidity. This unit will be installed in the technical area of a port located in the western Mediterranean, a region increasingly affected by droughts, saline intrusion, and overexploitation of traditional water sources.

The demonstrator integrates a central generation module that uses a next-generation compressor, engineered to optimize the condensation of atmospheric moisture with minimal energy input.

This core unit is complemented by an auxiliary renewable decarbonated power generator and a water treatment line ensuring the safety and non-toxicity of the extracted water. A recirculation loop is connected to an external storage tank, which includes a fungicidal chlorination system to preserve water quality, and an outlet booster pump to stock and/or distribute the water to nearby users or auxiliary systems.



The primary objectives of this pilot include:

- **Technological validation** of the water generation process under real-world Mediterranean coastal climatic conditions (temperature, humidity, salinity).
- **Quantification and analysis** of the system's production capacity and stability over time.
- **Evaluation of potential use cases** within the port environment (e.g., vessel supply, sanitation, landscaping, firefighting reserves) and in nearby communities.
- **Engagement with local public authorities** to assess needs, regulatory pathways, and potential integration into existing infrastructure.

In parallel, the demonstrator will serve as a testbed for public awareness and stakeholder dialogue, promoting decentralized, low-footprint solutions for industrial water access and climate adaptation.

This initial phase will lay the groundwork for a second stage: the design and deployment of a full-scale production unit.

This future plant may include heat recovery features to produce hot water as a by-product and integrate autonomous renewable energy sources to ensure off-grid autonomy and minimize environmental impact. This scaling-up strategy aims to provide a reliable, eco-responsible, and resilient water source suitable for port zones, isolated sites, or regions facing chronic water stress.

ATM-EAU SERVICES aspires to be at the forefront of atmospheric water technologies, offering a flexible and modular solution to help meet the growing global demand for sustainable water access.

Bawat
Ballast Water Management

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*A Danish company **Bawat** revolutionizes ballast water treatment with pasteurization-a heat-based, chemical-free, and filter-free solution that is cost-effective, sustainable, and reliable in all water conditions. As the first USCG/IMO-approved pasteurization system, **Bawat** offers flexible compliance solutions for ships, ports, and yards through onboard systems, mobile containerized units, and Ballast-as-a-Service (BaaS).*

BAWAT BAAS

Water management
Protection and restoration of biodiversity

Flexible, port-based **Bawat BaaS** (Ballast as a Service) is a mobile, containerized ballast water treatment service solution for compliance and contingency challenges in ports/terminals/dry-docks.

Challenge for ports: When a ship with a malfunctioning onboard BWMS (Ballast Water Management System) arrives carrying untreated, non-compliant ballast water, ports face the risk of discharging invasive species, threatening local ecosystems and violating regulations. **Bawat's BaaS** addresses this by receiving non-compliant water, treating it on-site, and delivering IMO D-2 compliant ballast water, ensuring environmental protection and regulatory adherence.

Challenge for dry-docks: when a ship arrives at a dry dock with untreated, non-compliant ballast water, the facility faces the challenge of managing invasive species and preventing harmful discharges while adhering to strict environmental regulations. Bawat's BaaS addresses this by receiving non-compliant water, treating it on-site, and delivering IMO D-2 compliant ballast water, enabling dry docks to maintain environmental standards and support sustainable ship maintenance operations.

The technology behind **Bawat BaaS** is pasteurization, a proven method effective at eradicating invasive species such as bacteria, algae, and plankton, housed within a containerized Mobile Ballast Water Management System. After treatment through the one-pass BWMS, the ballast water discharge complies with the IMO D2 standard.

Infrastructure Requirements:
Minimal setup required within the port, leveraging standard power connections.
Containerized design allows easy integration into existing port facilities.

Necessary Equipment:
Mobile, containerized Ballast Water Management System (BWMS) utilizing heat-based pasteurization technology.

Expertise and Know-How for Implementation:
Bawat's team provides full installation, operation, and maintenance support.
User-friendly design requires minimal training for port operators.

EODev

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***EODev** is a French industrial SME specialised in zero-emission energy solutions for both land and maritime applications. The company designs hydrogen-powered generators and advanced battery systems to decarbonize high-impact sectors such as industry, transportation, construction, and data centers. Its solutions, conceived and manufactured in France, are deployed in over 25 countries as concrete alternatives to diesel.*

BESSTIE 120

Energy management
Improvement of air quality

EODev's **Energy Storage System BESSTIE 120 the "New Decarbonization Best Friend"** is a groundbreaking battery energy storage system designed to address modern energy challenges with its compact and versatile design. This innovative solution offers a 124kWh capacity, leveraging Lithium Iron Phosphate (LiFePO4) technology to provide safe, efficient, and emission-free power. **BESSTIE® 120** is ideal for diverse applications, ranging from backup power to hybrid integration with generators and electric vehicle charging infrastructure. Its modularity and rapid deployment make it adaptable to a wide variety of technical configurations and environments.

One of the key advantages of **BESSTIE®** is its commitment to sustainability. The system is entirely emission-free, operating without CO2, NOx, particulate matter, or noise, making it a vital asset in reducing the carbon footprint and creating an eco-friendly working environment. Its low-noise operation is particularly advantageous in noise-sensitive applications, contributing to a quieter and more pleasant workplace.

The **BESSTIE® 120** offers three key modes: Hybrid, Grid Support, and Stand-alone. In Hybrid mode, it stores energy from generators to reduce fuel use and extend their lifespan. In Grid Support mode, it helps stabilize the grid, especially for EV charging stations during peak demand. As a stand-alone system, it works in remote or noise-sensitive locations, providing reliable, off-grid power, perfect for applications like telecom sites or film sets.

In terms of durability, the **BESSTIE®**'s design ensures it can withstand the rigors of various environments. Its compact and portable nature allows it to be deployed rapidly and efficiently, without compromising on power output or reliability. Whether it is used in hybrid configurations, to support EV infrastructure, or as a standalone system in remote locations, **BESSTIE®** delivers high performance, ease of use, and long-lasting results.

The **BESSTIE® 120** is more than just a battery system – it is a versatile energy solution designed to meet the ever-evolving demands of energy storage and management. With its modularity, emission-free performance, and ability to integrate seamlessly into various environments, it is an essential tool for businesses, industries, and communities looking to embrace the future of sustainable energy.

Whether it's for hybrid applications, grid support, or as a stand-alone energy solution, the **BESSTIE® 120** ensures a reliable, eco-friendly, and efficient power supply, all while supporting the global transition towards cleaner, greener energy sources.

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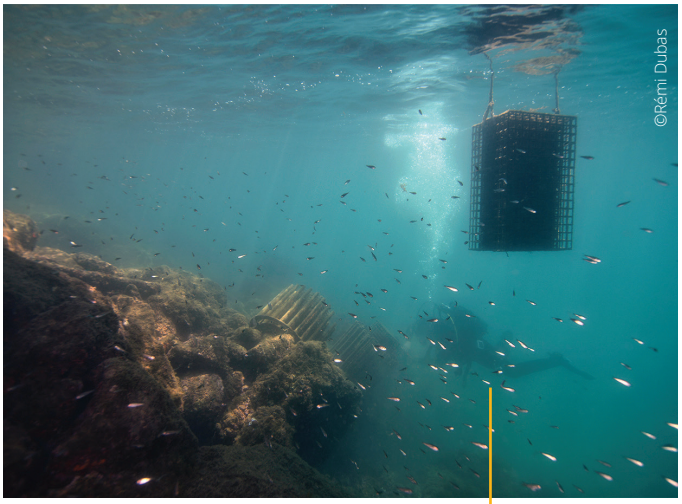
*Founded in 2003 in Montpellier, **Ecocean** is a French company specialised in ecological engineering for aquatic ecosystems. It develops innovative solutions, such as **Biohut®** habitats, to restore coastal fish nurseries and support marine fauna. Scientifically validated, its technologies contribute to biodiversity conservation and address environmental challenges.*

BIOHUT

Protection and restoration of biodiversity

Biohut® is an innovative solution for restoring aquatic nurseries by protecting post-larvae and young fish from predators. This enables them to reach «refuge size» and contribute to increasing adult fish populations. As well as restoring the vital functions of nurseries, the **Biohut®** provides a suitable habitat for a wide biodiversity, essential for a sustainable ecological balance. They are composed of a steel cage filled with oyster shells (or other natural substrate) acting as a complex support for the development of a diversified food source (trophic chain) and one or several empty cages offering protection against predators.

This solution is applicable to all marinas as well as commercial ports and all other forms of artificial infrastructures. Indeed, Ecocean has designed 7 types of **Biohut®** to be installed in different locations, depending on the life cycle of the juveniles and the existing artificial structures. **Biohut®** can transform docks, pontoons, Dolphin piles, breakwater and other coastal infrastructures into functional habitats for numerous marine species, facilitating the transition of juvenile fish from life in the natural environment adjacent to ports. The **Biohut®** are attached to the structure by different ways, suspended, screwed or attached with a Kevlar strap. Modules can be attached from the surface or by diving operators directly in the water, depending on sites or authorizations.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©Leslie Bissey

The location of the structures in ports and marinas is not random: it depends on a diagnosis of the site, made by our experts. Parameters like depth, presence of drain, careering or fuel station, industrial zone, etc. are taken into account to choose the best place. Each project is unique and the price depends on a lot of parameters as the number of units, monitoring, maintenance, etc.

At **Ecocean**, we are careful to minimize our environmental impact at every stage of our operations. This commitment is reflected in our exclusive use of 100% recyclable and recycled materials, in particular our **CRAPAL© steel** and our natural substrate from local sources. We have also set up a recycling channel for each material, ensuring responsible management of the end-of-life of our solutions.

Moreover, we have taken the firm decision to refuse all plastics, even bioplastics, because we believe it is unacceptable to add more plastic to the already saturated oceans. We valorize an approach based on the circular economy, favouring the use rather than the sale of products.

BIO-UV Group
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***BIO-UV Group**: For more than 35 years, **BIO-UV Group** has been designing, manufacturing and marketing water treatment systems using ultraviolet (UV-C), ozone, AOP and salt electrolysis for various applications: swimming pools, aquaculture, aquariums, industrial process water, wastewater and drinking water. In 2011, it added ship ballast water treatment to its range.*

***MicroWISE**: MicroWISE is a company developing equipment for accurately measuring and sampling living organisms in water-samples. MicroWISE was founded in 2017 by a dedicated team of scientists, engineers and software developers.*

BIO-SEA WISE

Water management
Protection and restoration of biodiversity

In order to tackle the issue of aquatic invasive species (AIS) introduction, since September 2024 the IMO Ballast Water Management (BWM) Convention requires all commercial vessels to be equipped with a treatment system (BWMS), which is designed to remove or kill live organisms in ballast water to avoid AIS discharge above numbers set in the D-2 standard by size class.

However, for a variety of reasons, ships may not be able to carry out ballast water treatment adequately to discharge compliant water when arriving in ports.

The **BIO-SEA WISE** project aims at developing a shore-based BWMS integrating an online monitoring of organisms, to ensure compliance with the D-2 standard in situations not managed by ships (contingencies, by-passes, BWMS out of order, etc...) to protect ecosystems at the location of discharge.

The technical solution is composed of 3 main parts:
1) A ballast water treatment system adapted to onshore treatment; **BIO-SEA** BWMS is already approved according to IMO regulations with 2 treatment steps: a filtration unit + a UV treatment at uptake, and UV treatment at discharge. The automated process needs to be modified to ensure full treatment is done in a single pass for port use. Available capacities range from 30 to 2100 m3/h.

2) A secondary treatment unit is needed to handle the backwash water generated by the filter automatic cleaning system, to separate organic matters as a waste (inland disposal). This is achieved through flocculation and separation; residual water being recirculated in the BWMS.

3) An inline monitoring system to count live organisms (zooplankton, algae) present in water samples. The **Ballast WISE** Inline system consists of valve-controlled water inlet, a filtering unit for collection of water samples, a measuring unit for quantification of organisms by the motility and fluorescence assay (MFA).

This allows treatment of water (marine, brackish or fresh) according to the D-2 standard, either for ballasting, deballasting or circulation.

The monitoring device enables risk assessment of incoming water and ensures compliance of treated water.

The complete equipment could be mounted in a containerized unit (mobile, to be connected to vessel when service is needed), or an onshore installation (as part of a reception facility, as proposed in the BWM Convention Guidelines G5).

BIO-UV Group is supplying the treatment system (approx. 130 k€ for 300 m^3/h capacity) and the 3rd treatment stage (7500 € plus consumables) ; and **Microwise** is supplying the monitoring device (approx. 26 k€ plus consumables), all of them being integrated into one installation with adequate pumps, compressor, pipes and other water management components (for draining, cleaning etc..) implying additional costs around 60 k€.

Required infrastructure includes electrical power (400-440V 3-ph, 185kW for 300 m3/h capacity), fresh water (cleaning) and a dedicated area of approx. 60m^2 (footprint of installed equipment being approx. 21m^2).

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*The Environmental Microbiology Unit of the Biology Department, **University of Pisa**, operates in the field of biotechnology for restoring resilience of environmental matrices.*

BIOTECS

Protection and restoration of biodiversity
Sediment management
Waste management

BioTechnoSoil (BioTecS) technology is the result of combining culturomics and metagenomics techniques, integrated into an established train of treatments for dredging sediments through turned biopiles, bioaugmentation, and co-composting with lignocellulosic matrices (TRL9). This technology is proposed within the context of a decade-long synergy between the **Department of Biology** and Teseco Bonifiche srl, which has led to the development of TRL8 technologies for both in-situ and ex-situ treatment of contaminated matrices.

Today, the anthropization of the environment and the need for urbanization in both developed and developing areas worldwide, necessitates the preservation of virgin soil and the development of technologies that produce technosoils, stemming from the concept of the circular economy. In the context of technosoil production methods, the approach based on waste recovery and reuse has been consolidated.

Dredging sediments, given the quantities produced annually, the widespread sources, and the availability of technologies for their recovery, represent a case of interest.

In Europe, between 100 and 200 million cubic meters of sediments are dredged annually. Since June 1, 2012, with the implementation of the **Waste Framework Directive 2008/98/EC**, the reuse of dredged sediments

has been subject to end-of-waste criteria. Consequently, the development of sustainable technologies for their decontamination and recovery has become necessary and urgent.

In this context, biotechnologies are of primary interest. The proposed technology involves a consolidated protocol for isolating indigenous fungi from the matrix under treatment and developing mycoremediation protocols. The assumption is based on prototype experimentation (TRL6-7), which has already shown the establishment of a metabolic network between fungal species and indigenous bacterial communities in the treated matrix.

This metabolic network relies on the fungal strain's ability, generally saprotrophic, to increase the bioavailability of the contamination by producing a wide range of extracellular enzymes to degrade any carbon source in the environment, even if recalcitrant to biodegradation and present at growth-limiting concentrations.

The results are supported by chemical and molecular analyses through a functional predictive metagenomic approach focused on the enzymatic activities responsible for contamination depletion and those associated with a soil matrix capable of restoring ecosystem services.

BioTecS can function as a standalone technology or be modular and integrated into decontamination trains that include the depletion of inorganic contaminants such as soil washing and electrokinetic treatments of marine sediments.

BioBright

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United Kingdom

***BioBright** is a UK-based company helping the maritime industry reduce CO2 emissions and water pollution by integrating algae cultivation and real-time monitoring into harbour infrastructure. The algae absorb carbon, heavy metals, and excess nutrients, while our monitoring system continuously tracks air and water quality and measures algae performance. This enables ports to verify environmental impact, meet regulations, and reduce carbon-related costs effectively.*

BLUEPORT

Water management
Protection and restoration of biodiversity
Improvement of air quality

BioBright combines cutting-edge monitoring technology with advanced algae cultivation to address CO2 emissions, water pollution, and biodiversity loss in ports. Ports face challenges in achieving net-zero targets by 2050 due to limited data and costly solutions that often overlook water quality and marine ecosystems. **BioBright's** solution deploys specialized algae containers near harbor walls or buoys to absorb CO2 emissions 15% faster than traditional strains while removing pollutants like zinc, copper, nitrates, phosphates, and ammonia. This reduces ocean acidification, prevents coral bleaching, and enhances marine biodiversity, all with minimal disruption to port operations.The system provides real-time data on CO2 levels and water quality, algae performance and harvesting schedules. With 400g of algae absorbing 800g of CO2 per hour and doubling in biomass every two months, ports can save up to £80M in carbon taxes and liability fines.

The initial implementation cost for a 3-month pilot at the Port of Valletta, Malta, is estimated between £60,000 to £100,000.This is because we have been selected for the Blue Economy ClimAccelerator Malta and one of the plan that we have for this program is also to do a pilot project there. Following this, we would like to expand with pilot projects at the Port of Bar and the Port of Livorno, bringing the total cost to £300,000 for all three locations.
The ultimate goal is to test in 3 different port in the Mediterranean Sea and then implement our solution in all ports.

Access to power sources and basic connectivity is essential for real-time data transmission. Additionally, a biodiversity assessment is necessary to determine the optimal placement for the pilot project and to evaluate existing conditions, including biodiversity levels, CO2 emissions, and water quality before the implementation of our solution.

For this pilot project, the required equipment includes algae cultivation units customized to suit the specific environmental conditions of the port. The project will commence with 20 kg of algae and 10 specialized containers for cultivation. Additionally, a real-time monitoring system with sensors is essential to track CO2 emissions and absorption, pollutant levels in the water, as well as the health of marine biodiversity and create a biodiversity report at the end of the pilot project.

BioBright ensures a smooth implementation by training local staff on how to monitor algae performance and CO2 and water pollution data, while managing setup and providing ongoing technical support.

BioBright's solution is highly scalable, making it suitable for ports of various sizes. It can also be adapted for other sectors such as marinas. By choosing **BioBright**, ports gain access to an innovative, cost-effective technology that not only mitigates environmental challenges but also aligns with global sustainability initiatives, enhancing their reputation as leaders in the green transition.

CLEAN SEA SOLUTIONS

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Clean Sea Solutions *delivers cloud-connected, autonomous systems to remove marine debris from waterfront environments. Powered by AI-driven computer vision and cloud integration, our solutions provide real-time impact and data-driven insights for smarter, more efficient clean-up operations.*

CLEANPORT

Protection and restoration of biodiversity
Waste management

The **Clean Sea Solutions Aquapod** and **Aquadrone**, combined with the Clean Sea Impact computer vision model and cloud-connected data analytics service, form a cutting-edge, AI-powered ecosystem for marine waste management. These solutions revolutionize the traditionally labour-intensive process of cleaning waterways by making it more efficient, accurate, and impactful.

Key Features: Both systems utilize advanced artificial intelligence to monitor and manage waterway cleanliness, providing real-time insights and performance optimization. The cloud-connected Clean Sea Impact system offers actionable analytics for monitoring pollution trends and evaluating the effectiveness of waste collection efforts.
Designed to reduce pollution in real time, these solutions align with environmental sustainability goals and support organizations' ESG commitments.

The **Aquapod** is a stationary, cloud-connected system capturing debris ranging from large items to microplastics (down to 1mm). It operates quietly and integrates seamlessly into waterfront infrastructure attachable to any jetty or floating installation, it requires only 230V power access.
Purchase price: €23,000 + an annual subscription cost of €4,500, including service agreement and IOT services. Can also be equipped with absorbents for oil spills.

The **Aquadrone** is a multipurpose, autonomous unmanned surface vehicle (USV) designed with extendable arms for waste collection, tailored absorbents for oil spills, boom deployment, and seabed monitoring. Its AI capabilities streamline operations, offering actionable insights and optimizing efficiency.
Purchase price: €95,000 + annual software subscription and support cost of €3,500. Easily deployable with special infrastructure needed.

Installation, Training, and Support:
Clean Sea Solutions manages seamless deployment for both **Aquapod** and **Aquadrone**, ensuring minimal disruption to existing operations. In collaboration with Maritime Robotics, **Clean Sea Solutions** provides comprehensive training programs for **Aquadrone** operation and servicing, along with guidance for effective **Aquapod** usage. Support includes maintenance, troubleshooting, software upgrades, and ongoing user assistance.

By making the «dirty jobs» of waterway cleanup more effective, **Clean Sea Solutions**' technology empowers stakeholders to address pollution challenges while promoting ecological health and contributing to global sustainability objectives. These innovations not only enhance operational efficiency but also foster long-term environmental impact and corporate responsibility.

Seaboost
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***Seaboost** is a pioneering ecological engineering company, working to restore key ecological functions in man-made areas in France and abroad. We have developed a comprehensive approach to ecological engineering in port environments. Part of the company's activity is centred on artificial reefs and artificial habitats and the declination of these concepts in different forms and applications, including nature inclusion of coastal and offshore marine infrastructures.*

CONNECTIVITY REEF

Protection and restoration of biodiversity

The **Connectivity® reef** is an artificial habitat module designed mainly to support habitat transition for juvenile species. The goal of this module is to increase connectivity between different functional areas within ports as well as with surrounding natural habitats, participating in the overall objective to increase habitat functionality of urbanized coastlines.

It combines multiple types of microhabitats, including shell elements, bamboo, **Roseliere© seagrass**, and biomimetic **Giant urchins©**. By incorporating diverse habitats, this solution increases biodiversity and provides essential resources for young marine species to thrive (shelter, feeding).

Built to withstand local hydrodynamic conditions, these reefs are durable and require minimal maintenance, offering a long-lasting solution.

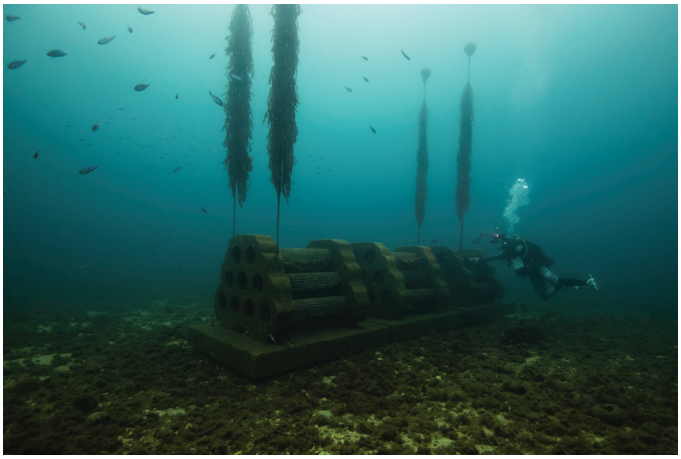

Figure 1: The Connectivity© modules restore connectivity between different functional areas within ports as well as with surrounding natural habitats (credit Seaboost)

Figure 2: By incorporating diverse habitats, the Connectivity© increases biodiversity in port areas and provides essential resources for young marine species to thrive (shelter, feeding) (credit Seaboost)

EODev

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***EODev** is a French industrial SME specialized in zero-emission energy solutions for both land and maritime applications. The company designs hydrogen-powered generators and advanced battery systems to decarbonize high-impact sectors such as industry, transportation, construction, and data centers. Its solutions, conceived and manufactured in France, are deployed in over 25 countries as concrete alternatives to diesel.*

Containererized Fuel Cells - H2 POWERED

Energy management
Improvement of air quality

EODev has been approached to provide a high-power hydrogen-powered generator. This generator is an innovative product for the company but is fully aligned with our product development strategy defined in 2023.

These high-power generators are the natural extension of the company's initial product developments and commercialization since 2019. With over a hundred units of our **GEH2®** and **REXH2®** in operation with clients, we are confident that this new product range will meet the growing demands of our customers for both stationary and maritime applications.

To address this need, we have developed a new product based on many proven and reliable components. The generator is modular, flexible, and capable of meeting the required power output for a wide range of applications.

This project involves the development of a quay-side hydrogen-powered generator designed to electrify large vessels while docked. As many docks are not electrified, vessels typically rely on their diesel generators to provide onboard power.

Our hydrogen-powered generators offer a clean and sustainable alternative, eliminating the need for diesel and significantly reducing its associated environmental impacts.

H2 Powered effectively meets the energy requirements of vessels in port, contributing to the reduction of emissions and supporting the transition to cleaner energy sources in the maritime industry.

cosma

COSMA
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__Cosma__ uses swarms of underwater micro-drones and AI to map and analyze benthic ecosystems and seabed with unmatched precision. By combining photogrammetry, sonar, and magnetometry, it delivers 3D models, semantic maps with geophysical and biological indicators. Its fast, cost-efficient and detailed surveys are provided in standard GIS format or through an interactive cloud platform.

COSMA4PORT

Protection and restoration of biodiversity
Sediment management

Leveraging new generation robotics and AI, **COSMA** (formerly Deess) developed an integrated solution for benthic ecosystems inventory and monitoring in partnership with **IFREMER**.

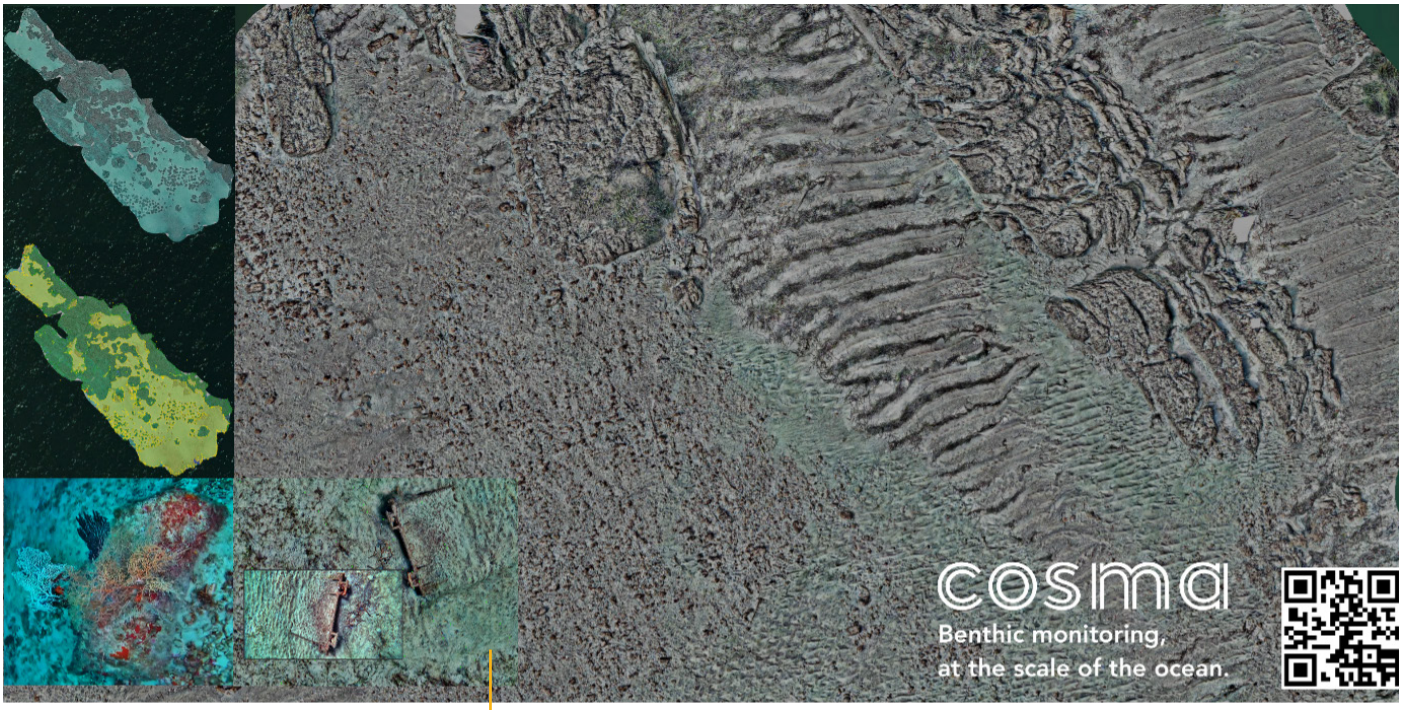
We deploy small underwater drones navigating just above seabed to take overlapping pictures of the benthos at close range. We reconstruct 3D photographic models of the sea bottom in a scalable way and provide biologists with the AI toolbox they need to identify habitats and species of interest from the millions of pictures collected.

Our underwater drones can carry side scan sonar and magnetometers in addition to cameras to identify obstructions or UXO, detect scouring and sediment accumulations while evaluating biodiversity health.

We deliver precisely positioned «underwater landscapes», semantic maps and relevant pictures. We can build and extract quantitative indicators (collaboration ongoing for biomass estimation for instance).

Timelapse analysis can be conducted through repeated surveys for security or biodiversity monitoring **COSMA** is primarily a service company mobilizing two staff with a van and a small drone inventory to carry out the survey.

Data is processed online, and we typically deliver unrivalled seabed survey results within a few days, in a user-friendly platform or in conventional GIS format with pdf reports.



WEST TRUCK
IVECO

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The company is engaged in the implementation of complete solutions in the sale, production and maintenance of communal equipment, special vehicles, vehicles for transport and distribution, special machines for construction and maintenance of traffic infrastructure.

DULEVO 120

Improvement of air quality
Waste management

Dulevo is a historical name in the world of professional sweepers and street washers, with over 40 years of history. Because of the technical and qualitative characteristics of our vehicles we can satisfy all the needs of our customers, our products are able to adapt to any type of application, environment and season to always offer a high standard of work quality. **Dulevo** is the largest Italian company in the field of street cleaning machinery production, with the widest range of products available on the market, able to satisfy all needs and provide a perfect solution for everyone.

Its capacity to capture both the finest dust and gravel makes **Dulevo 120** the perfect machine for working in any type of environment, even the dustiest. In fact, thanks to its direct-load, mechanical suction-filtering sweeping system, it guarantees excellent cleaning results even in particularly difficult working conditions.

The **Dulevo 120** ride-on sweeper has been designed for operation in all dusty environments. Its capacity to capture both the finest dust and gravel makes **Dulevo 120** the perfect machine for heavy-duty industry applications, but also for public areas and loading/unloading areas such as warehouses, loading bays, car parks, etc. The **Dulevo 120** industrial sweeper has all the features of top-of-the-range industrial machines such as a large container, high power, outstanding sweeping performance and a high-performance suction system. In addition to the high-quality filter that is fitted as standard, the **Dulevo 120** ride-on sweeper can be equipped with a different filter for even greater performance.

The **Gore®** technology of this series of sweepers achieves the best filtration results thanks to improved dust control (down to 1 micron), optimal suction and easy and cost-effective maintenance. Easy access to all sweeper components and fully hydraulic technology make this machine easy to use and economical to maintain. The 120 sweeper is available in the BK version with a petrol and LPG engine, DK diesel version, suitable for outdoor areas, and finally in the EH version with battery-powered motor, for indoor and outdoor areas. Each of the versions can be fitted with a wide range of accessories, depending on the customer's needs.

Strengths:

- Direct load sweeping system for exceptional cleaning results, even under particularly arduous work conditions.
- Water cooled engines to assure operation in very hot climate and over extended work shifts.
- Power steering for a more comfortable drive.
- Compacting system inside container which increases collection capacity.
- Little maintenance required as all functions are hydraulically operated.
- No electronics present.
- The hydraulic turbine does not require maintenance and guarantees powerful suction.
- No tools required to replace the central broom.
- The focus is on the machine, sweeper **Dulevo 120**EH, with battery-powered motor, fully electrical.

DESTEC
DIPARTIMENTO DI INGEGNERIA
DELL'ENERGIA, DEI SISTEMI, DEL TERRITORIO E DELLE COSTRUZIONI

DESTEC - University of Pisa
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*The laboratory of Sanitary and Environmental Engineering of the University of Pisa (LISAP) is a research group of the **Department of Energy, System, Territory and Construction Engineering (DESTEC)** focusing on three main topics, namely treatment of organic and solid waste, wastewater reclamation and remediation of soil and sediment, following a sustainable and circular economy perspective aimed at resource recovering.*

EKEEF

Protection and restoration of biodiversity
Sediment management
Waste management

The proposed solution concerns the treatment of contaminated marine sediments through electrochemical-based technologies, such as **electrokinetic (EK), electrochemical remediation (ER) and electro-Fenton (EF)** systems.

This technology involves the application of appropriate potentials between a couple of electrodes which induce an electric field (E) in the contaminated soil.

Specifically, under the gradient E, electroosmosis, electromigration, electrophoresis (motion of water, ions, and charged particles, respectively) and redox reactions are induced into the sediments by **EK** and **ER** processes. The **ER** configuration consists of a single plexiglass cell containing the polluted sediments, and the electrodes are inserted directly into the sediment to be treated. The **EK** configurations consists of three compartments: two of these are external compartments, where electrolytes and electrodes are placed, while the sediment is placed into the middle compartment.

On the other hand, **EF** is an advanced oxidation process (AOP) based on Fenton reaction, involving the reaction between iron salts and hydrogen peroxide to generate hydroxyl radical (OH•) which are employed to destruct the nonbiodegradable compounds into less-harmful entities high oxidizing power. Compared to conventional Fenton process, **EF** is an electrochemical advanced oxidation process based on in situ generation of hydroxyl radicals (•OH) in an electrocatalytical way, allowing a reduction in the use of chemical agents.

These technologies have been particularly successful thanks to their adaptability both in-situ and ex-situ, applicability on coarse-grained and fine-grained soils with low permeability, removal efficiencies of both organic (such as polycyclic aromatic hydrocarbons, PAHs) and inorganic (such as heavy metals) contaminants. Furthermore, they can be integrated in series with other remediation treatments (such as soil washing, landfarming) or combined with biological processes (bio-electrochemical remediation processes).

The implementation of an electrochemical-based technologies requires investment costs, including the compartment tanks, pumps, pipes, electrodes (iron, steel or graphite) and power generator, and operating costs that mainly include the use of chemicals, water electricity and transportation. The efficiency of the electrochemical treatments for the soil remediation depends on several factors, including intensity and type of the applied E, soil pH, treatment time (up to 6 months in some cases), materials of the electrodes, usage of enhancing agents, contaminated media characteristics. Anyway, total cost required amount to around 50,000 euros.

The **Department of Energy, Systems, Territory and Construction (DESTEC) Engineering** has already had experience with electrochemical-based technologies and collaborated with the Italian Institute for Environmental Protection and Research (ISPRA) in the framework of **GRRinPORT** project (Interreg Marittimo IT-FR 2014-2020).

NauticSpot
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Nauticspot develops smart solutions to help marinas and mooring areas digitalize their management while preserving environmental impact and improving boater safety thanks to our smart mooring buoys and our speed boat radar.

ENVIRONMENTAL SPEED SAFETY

Protection and restoration of biodiversity

ENVIRONMENTAL SPEED SAFETY aims to measure the noise impact on the environment caused by speeding in the port entrance area.

This solution combines both a port educational radar and an acoustic buoy equipped with a hydrophone.

The objective is to record each passage in the direction of entry and exit from the port, to measure the speed via an artificial intelligence algorithm and to associate it with the noise measurement.

• All passages are measured and stored on an interface for the marina.

• All speeding is recorded with a photo, a time stamp, the speed and the noise level produced.

For the marina, it is a solution that allows both to collect data on the activity of its port, increase safety by reducing port entry speeds, raise awareness among boaters to properly comply with navigation rules thanks to an outdoor LED panel placed at the entrance to the port while being part of an environmental approach aimed at reducing its footprint on the environment.

Technically, the complete solution is composed of:
• a wide-angle 4K camera optimized with a motorized lens.
• a server integrating an AI machine learning calculator.
• a 1920 x 640 mm outdoor LED panel.
• an instrumentation buoy with acoustic probe.
• speed detection analysis software.
• acoustic analysis software.
• a gateway between the two solutions.

Financially, **ENVIRONMENTAL SPEED SAFETY** requires an investment of €75K and a joint software development of 3 months for each structure equivalent to €50K.

To go further, **version 2** provides a double panel at the port entrance to raise awareness in both directions of entry and exit; and an advanced acoustic level allowing the detection of marine species (porpoises, cetaceans, etc.) to alert ships leaving the port too quickly in order to reduce their speed and no longer hit whales as was sadly the case recently in Polynesia.

The overall budget for **version 2** (including version 1) would be €200K.

Eco Wave Power
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Eco Wave Power (EWP) is a leading onshore wave energy company revolutionizing clean energy with its patented, smart, and cost-efficient technology that converts ocean and sea waves into sustainable electricity.

ECO WAVE POWER

Energy management

How It Works

Eco Wave Power's system utilizes floaters that attach to existing man-made structures such as breakwaters, jetties, and piers. The floaters draw energy from incoming waves by converting the rising and falling motion of the waves into a clean energy generation process. More precisely, the movement of the floaters compresses and decompresses hydraulic pistons which transmit bio-degradable hydraulic fluid into land-located accumulators. In the accumulators, pressure is built. This pressure rotates a hydraulic motor, which rotates the generator, and then the electricity is transferred directly into the grid, via an inverter.

Key Benefits

Eco Wave Power's technology is:
a. Cost-efficient – Most of the system is on land, enabling easy construction, operation, and maintenance.
b. Reliable – Most equipment is on land and not exposed to harsh marine conditions. The system includes a patented storm protection mechanism.
c. Insurable – Fully insurable by global insurance companies, a milestone for commercial-scale projects.
d. Environmentally Friendly – The system does not connect to the ocean floor or alter the seabed, using only existing man-made structures.
e. Proven Grid Connectivity – EWP has real-world experience in connecting two separate power stations to national grids, demonstrating cost-effective grid integration.

Proven Operational Experience

EWP stands out for real-conditions, grid-connected operational experience, proving its ability to handle technology development, regulation, and commercial deployment.

- **Gibraltar Power Station (2016)** – EWP's first grid-connected station, proving wave energy's feasibility as a continuous renewable source.
- **Jaffa Port, Israel (2023)** – Co-owned by EDF Renewables IL, this project is Israel's first grid-connected wave energy station. It's recognized as "pioneering technology" by Israel's Energy Ministry, a co-founder of the project.
- **Port of Los Angeles, USA** – EWP's first U.S. project, co-invested by Shell MRE. As of March 2025, all licenses are secured, with operations starting Q2 2025.
- **Taiwan Project** – A turnkey agreement with I-Ke International Ocean Energy marks EWP's first wave energy station in Asia, expanding regional wave energy.
- **India Project** – EWP signed an agreement with Bharat Petroleum (a government-owned Fortune 500 firm) for a feasibility study and pilot project.
- **Porto, Portugal** – EWP is developing its first MW-scale station in Portugal, starting with a 1 MW array in a country known for its wave resources and renewable energy policies.

Eco Wave Power's pioneering solution offers a scalable, eco-friendly, and cost-effective clean energy source. By harnessing untapped wave resources, EWP promotes coastal resilience, economic growth, and decarbonization worldwide.

T1 SOLUTIONS

T1 Solutions
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***T1 Solutions** is an innovative Italian company that has patented FoamFlex200, a revolutionary technology for oil and hydrocarbon spill response. We are transforming oil spill prevention and intervention from an expensive and underperforming activity into a profitable and highly efficient one through sustainable and reusable solutions.*

FOAMFLEX200

Protection and restoration of biodiversity
Sediment management
Waste management

FoamFlex200 represents a breakthrough in managing oil and hydrocarbon spills within port environments.

Its advanced material composition enables a highly efficient absorption ratio of 95% oil and 5% water, ensuring maximum recovery of contaminants while preserving water quality.

This makes it particularly suited for handling accidental leaks, routine maintenance spills, and contamination in sensitive marine ecosystems.

FoamFlex200 sponges are reusable up to 25 times, drastically reducing waste and operational costs compared to single-use polypropylene absorbents.

Each sponge can absorb and retain large quantities of oil, ensuring effective spill control even in high-demand settings. The sponges allow the oil to be classified as «waste oil» (less than 15% water content) instead of a «mixed oily substance,» simplifying regulatory compliance and reducing disposal costs. This supports environmentally responsible waste management practices and aligns with global sustainability goals.

By reusing **FoamFlex200**, ports achieve significant savings over time. The initial investment is offset by the reduction in disposable absorbent usage and the lower costs associated with handling and disposing of oily waste.

The solution includes the FF Wring system, available in manual and automatic versions, designed to wring out

sponges efficiently for reuse. Additional tools like **FoamFlex-Geo** (containment barriers) and **vertical FF-System barriers** help contain and manage spills, preventing contamination of surrounding areas.

FoamFlex200 requires minimal infrastructure. Basic storage for sponges and the FF Wring system is sufficient. Implementation is straightforward, with training sessions provided to ensure staff can utilize the system effectively. The training equips personnel with the skills to handle spills rapidly and efficiently, reducing downtime and environmental impact. **FoamFlex200** contributes to improved environmental outcomes for ports by reducing waste and ensuring clean water.
Its performance supports achieving sustainability certifications such as Blue Flag and RINA, enhancing the port's reputation and commitment to ecological preservation.

Using this system demonstrates proactive environmental stewardship, a key consideration for stakeholders and regulatory bodies. Ports can customize the **FoamFlex200** system based on their unique operational needs. By tailoring the solution to specific spill scenarios, ports maximize efficiency and ensure comprehensive coverage.

FoamFlex200 offers a sustainable, efficient, and cost-effective solution for oil spill management in ports. It reduces waste, lowers disposal costs, and enhances environmental sustainability, making it an ideal choice for modern port operations.

With minimal infrastructure requirements, ease of implementation, and training included, **FoamFlex200** sets the standard for spill response and environmental care in the maritime industry.

Helion
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***HELION Hydrogen Power**, a subsidiary of the Alstom group, is a key European player in the hydrogen sector. It designs, manufactures and markets high-power fuel cell systems (100kW to several MW) for heavy mobility (rail, maritime, construction and mining) and stationary (temporary power generation and back-up power) markets.*

GENHY

Improvement of air quality

Within the ports eco-systems, the electrical grid is not able to provide sufficient power for the always increasing number of reefers or docked ships. Most of these consumers are currently using diesel gensets. Our company has developed a zero-emission hydrogen power generator to replace these gensets.

Founded in 2001, **HELION Hydrogen Power** (subsidiary of ALSTOM) designs, manufactures, and commercializes PEM fuel cells for the hydrogen trains of ALSTOM, but also for maritime applications and stationary applications.

Headquartered in Aix-en-Provence with over 1,200 sqm of industrial site, **HELION** employs about 100 people.

Based on its latest rail developments and its 20 years' experience, **HELION** has designed a new stationary product, a fully integrated hydrogen power generator. This new genset will be a zero-emission solution able to replace polluting diesel gensets.

HELION is using graphite bipolar plates in the stacks (succession of bipolar plates and membrane electrode assembly, MEA). Thanks to this technical choice and to advanced modelization tools, **HELION** can deliver highly robust systems, able to operate in harsh maritime environments with an extended lifetime of 25 000 hours before a maintenance operation on the stacks (expected life of the system is over 20 years).

Available in two versions, delivering 200 kW or 400 kW of nominal net power, the complete system is a 20-foot standard container. It includes the fuel cell modules, batteries for peak shaving, the cooling system and power conversion.

Transportable, compact, plug & play, **HELION**'s Hydrogen Genset requires the same operating procedures as a standard diesel genset. User can add H2 gensets, providing a modular solution with a total power over several MW.

It can be deployed to provide a back-up solution for ports infrastructures, increase the number of reefers or provide additional power for ships, allowing them to shut-down their diesel generators.

Transportable, the system can easily be moved from one site to another application. Connected to hydrogen storage, it will produce only fresh water, and a fresh breeze for the European ports.

AXON ENVIRO-GROUP Ltd.
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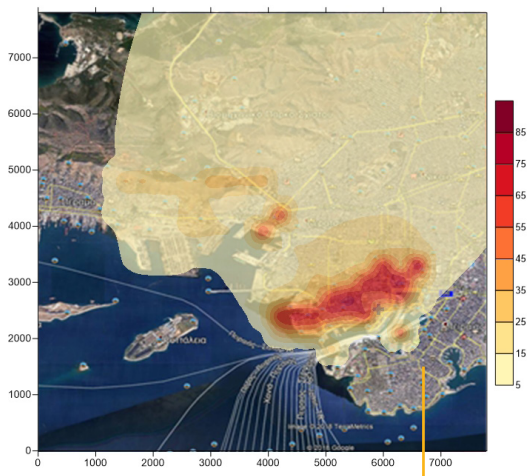
__AXON__, an independent consulting firm, has been at the forefront of air pollution and climate change issues since 1997. Utilizing advanced modelling and monitoring techniques, __AXON__ provides high-level support to policymakers, helping identify air pollutant sources, assess pollution levels, and develop effective mitigation strategies.

IMPAQ

Improvement of air quality

Passenger and commercial ports are known for their unique emission patterns, with both spatial and temporal variability and a diverse array of emission sources and pollutants that differ from those commonly found in urban areas. Beyond conventional pollutants, port air quality is affected by specific emissions that require non-regulated indicators for tracking, such as black carbon (BC), ultrafine particles (UFPs), volatile organic compounds (VOCs), and chemical components within PM2.5 and PM10 aerosol fractions. Monitoring these non-standard pollution metrics requires advanced instruments, such as aethalometers and particle counters.
In this context, the strategy combines high-precision and cost-effective monitoring tools, applied using different temporal approaches, to generate high-quality data with fine spatial and temporal resolution for hotspot identification and emission source tracking. This advanced monitoring approach will be complemented by detailed emission calculations and localized dispersion modelling tools, all integrated into a comprehensive air quality management framework.

The proposed holistic strategy for air quality mapping and management in port areas is structured in three stages. This integrated approach, initially tested in a fully operational industrial port in Spain, incorporates enhancements through real-time emission calculations and localized dispersion modelling. The three stages are outlined below:



Stage 1: Identifying Hotspots with:
• Low-cost Sensors to map ambient PM2.5 concentrations in busy port areas, supplementing existing monitoring stations.
• Passive Dosimeters will capture NO_2.
• TSI NanoScan will monitor fine and ultrafine particles number and size distributions (10–420 nm).
• Grimm Mini-LAS Laser Aerosol Spectrometer will monitor mass concentrations of particles from 0.25 to 32 μm.
• High-Volume Samplers Two high-volume samplers will operate for 24-hour periods at locations impacted by heavy traffic. PM mass concentrations will be determined gravimetrically, and aerosol composition will be identified.

Stage 2: High-Resolution Emission Inventories:
• Effective air quality management in hotspots requires developing detailed spatial and temporal emission inventories that reflect specific port activities. This will be achieved through a real-time emission inventory tool.
• Source apportionment analyses, informed by emission inventories and monitoring data, will help identify dominant emission sources.

Stage 3: Air Quality Improvement Measures:
• Based on measurement and source apportionment results, targeted measures for pollution reduction will be proposed.
• Measures' impacts will be assessed through local-scale air quality models to predict resultant air quality levels.
• Future pollutant emissions will be projected under anticipated policies, alongside corresponding air quality predictions.
• A comprehensive air quality plan for the port area will be developed, for both current and projected conditions.

K-REN
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K-Ren is a Mediterranean-based family business committed to protecting both boats and the marine environment.
Its mission? Provide an innovative, eco-friendly, user-friendly, and sustainable alternative to traditional antifouling solutions.

Protection and restoration of biodiversity

K-Ren is centred on a protective cover made from an opaque technical fabric, designed for installation on a vessel's hull while it remains moored. Unlike traditional methods that might involve removing the ship from the water or deploying complex apparatus, this cover can be quickly installed without additional infrastructure or major port modifications. By limiting light penetration and reducing direct contact with marine environments, it significantly curbs the adhesion and growth of algae, barnacles, and other fouling agents.

This approach helps minimize the reliance on antifouling paints, which often contain metals and biocides harmful to aquatic ecosystems. Globally, antifouling paints release tens of thousands of tons of heavy metals and biocides into port sediments each year. These pollutants accumulate over time, weakening marine ecosystems and lowering water quality.

Besides the ecological damage, such contamination forces port authorities to invest in sediment treatment and other remediation measures to maintain regulatory and environmental standards. Offering a practical alternative, our cover decreases the need for intensive hull maintenance with toxic coatings, thus reducing the environmental footprint of maritime activity. In doing so, ports can more closely align with evolving regulations and growing societal demands for sustainable development, cleaner waters,

and healthier marine habitats. Economically, our solution does not aim to eliminate traditional hull cleaning operations (like periodic hull care) but to complement them. Instead of cutting off revenue from these services, it extends the intervals between maintenance sessions, diversifying the range of offerings a port can provide. Integrating seamlessly into existing logistics, it does not require costly new equipment or complex training. Installation typically takes under 30 minutes, performed by the vessel's crew after a brief orientation. This user-friendliness enhances the port's appeal to ship operators who increasingly value efficiency, simplicity, and minimized disruptions.

By adopting the **K-Ren** cover, ports position themselves as proactive, forward-looking stakeholders committed to environmental stewardship. Rather than appearing passive in the face of mounting ecological concerns, they can demonstrate tangible efforts toward cleaner waters, reduced pollution, and conservation of marine biodiversity. This approach resonates with various stakeholders—from environmental agencies to customers—who seek a more responsible maritime sector.

In essence, the **K-Ren** cover is a strategic addition that requires no drastic operational shifts. It provides a flexible, eco-conscious enhancement to existing practices, helping ports navigate evolving regulations and market expectations while maintaining their role as dynamic economic hubs committed to marine protection and sustainability.

MARINE ROBOTICS S.L.
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MARINEROB is a company devoted to the development of innovative solutions in engineering and research applied to the marine industry. Its main activities are focused on the proposal of advanced products of autonomous boats, renewable energy, and underwater vehicles for multiple applications.

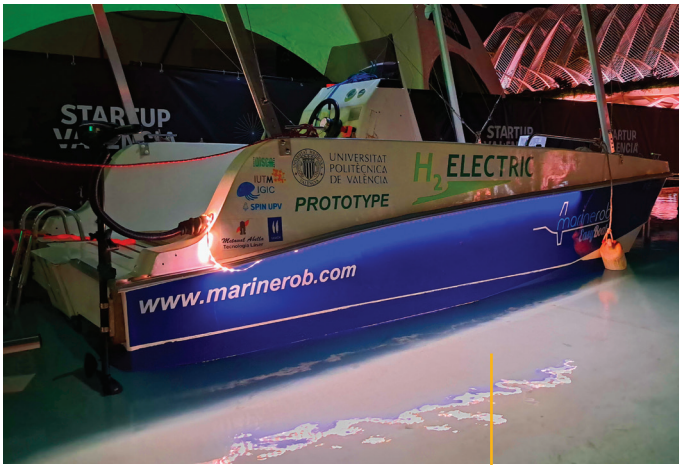
MARINEROB

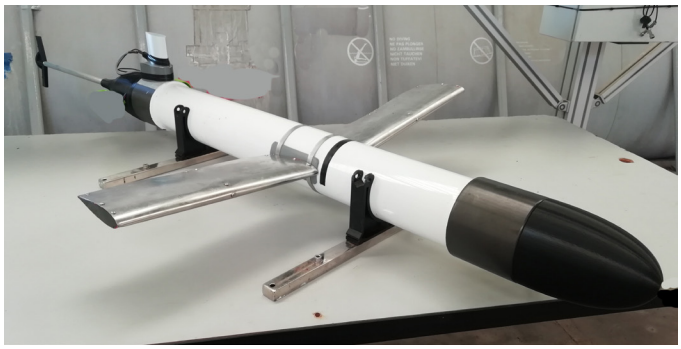
Water management

Monitoring water quality parameters throughout the water column in port facilities presents significant challenges. These challenges stem from the difficulty of implementing a permanent, flexible, dynamic, multipoint, and on-demand water quality monitoring system with real-time control. Regulations such as the MARPOL convention and EU Commission directives require port authorities to continuously monitor and assess various environmental factors, especially water quality. This includes detecting spills and other events that demand immediate attention and rapid response.

Surface oil spills can be detected during daylight, but their detection becomes much more difficult at night. In either case, spills are only identified after they have already occurred, preventing any possibility of issuing an early warning. For other pollutants, such as those in intermediate water layers, sedimentation, and effluents, continuous monitoring systems are practically non-existent. Many pollutants remain suspended in the intermediate water column for a period before rising to the surface and becoming visually detectable.

To address these issues, **MARINEROB** has been developing a solution that provides immediate, real-time monitoring of the port environment. This solution offers continuous analysis of water quality in the port's internal waters, external anchorage areas, and nearby coastal zones.





The proposal involves the utilization of a Surface Autonomous Vehicle (SAV) positioned near the AUVs to act as a relay between the Command Centre (CC) onshore. Furthermore, in port facilities and coastal areas, leveraging the extensive coverage of 5G mobile networks can enhance both communication performance and available bandwidth.

Because the particular and intensive operations of ship traffic In port facilities, the SAV faces the challenge of navigating effectively under a wide range difficult condition. Not only related with the ship traffic regulations applied to big ships and auxiliary boats manoeuvring at a low-speed but in addition, variable weather conditions (wind, rain, loss of visibility and sometime waves). To address these challenges, **MARINEROB** has been working on a dual system with IA based deep learning, and solution based on a tandem navigation strategy between the SAV and AUV. This system ensures continuous and reliable AUV operation while allowing the SAV to navigate safely by avoiding areas of heavy ship manoeuvring.

The proposal in this call for interest thus consists of combining a submarine unit in coordinated navigation with a surface unit, both operating linked but in autonomous mode.

MARINEROB has two units available in phase TRL5/6 with the capacity to, based on financial support from interested entities, or facilitating agents, carry out a pilot test that demonstrates the capabilities and raise the TRL level to 7/8. This will make it easier for facilitating agencies and entities to incorporate this technology in as early adopters.

Dipartimento di Ingegneria
Civile Edile e Ambientale

Sapienza
Università di Roma

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The Department of Civil, Building and Environmental Engineering of the University of Rome "La Sapienza" hosts the research group and the laboratory of Sanitary and Environmental Engineering, which has been active seen more than 3 decades in the field of environmental protection and remediation.

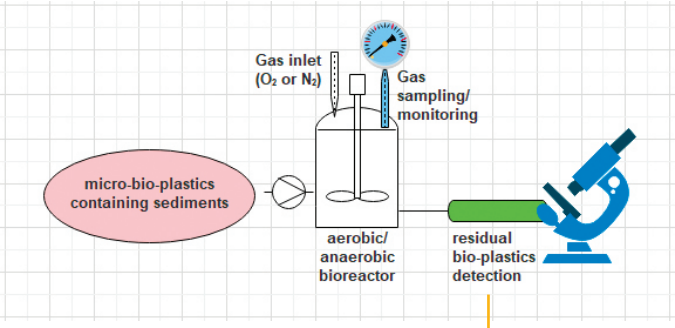
MINDER

Sediment management

Microplastics (MP), defined as plastic particles <5 mm, have emerged as a critical environmental concern due to their persistence, mobility and potential toxicity. These contaminants are increasingly detected in marine environments, including sediments from harbour areas. MP in dredged sediments originate from various sources. Urban runoff, wastewater discharges, industrial activities, and plastic waste degradation contribute to their accumulation. Sediments act as sinks for MP due to coagulation, flocculation and settling phenomena.

The dredging and disposal of sediment containing MP pose significant ecological risks especially when reuse of dredged sediments after treatment is envisaged as a sustainable alternative to landfill disposal.

Therefore, addressing sediment treatment in view of reuse increasingly requires taking into account the presence of MP in addition to "conventional" organic and inorganic pollutants. An innovative approach for sediment treatment should be based on a multifaceted strategy involving a combination of chemical and physical processes to provide the required degree of remediation.



Stemming from this, the project phases will include:
1. Development of protocols for appropriate dredging and characterization of MP: Implementing protocols for 1) sediment dredging avoiding any resuspension and loss of MP and 2) identification/quantification of MP to assess contamination levels and distribution patterns.
2. Testing of Sediment Treatment Technologies: Exploring advanced remediation technologies based on sediment washing that will be enhanced through the integration with density separation and chemical treatment.
3. Assessing the reuse potential: Through the developed protocols, the sediment properties will be evaluated to explore the potential reuse options, including land reclamation, civil engineering applications, or habitat restoration projects (e.g., beach nourishing).

The department of Civil, Building and Environmental Engineering of Sapienza has the required expertise for the proposed research and the availability of an advanced infrastructure for sediment and MP characterization, including newly acquired HPLC, TOC, GC-MS, microFT-IR. The latter is a frontier equipment specially designed for MP analysis in solid matrices and equipped with a dedicated software for automatic recognition of the individual microparticles and their chemical composition.

Moreover, the **department** is equipped with standard analytical apparatus for material handling, preparation and physico-chemical characterization, incubators and lab-scale reactors of different types for use in chemical electrochemical, physical and biological processes.

To carry out the proposed project, an estimated amount of € 40000 is required, including the consumables for the experimental campaign and a research contract for an early-stage researcher.

Molluscan-eye
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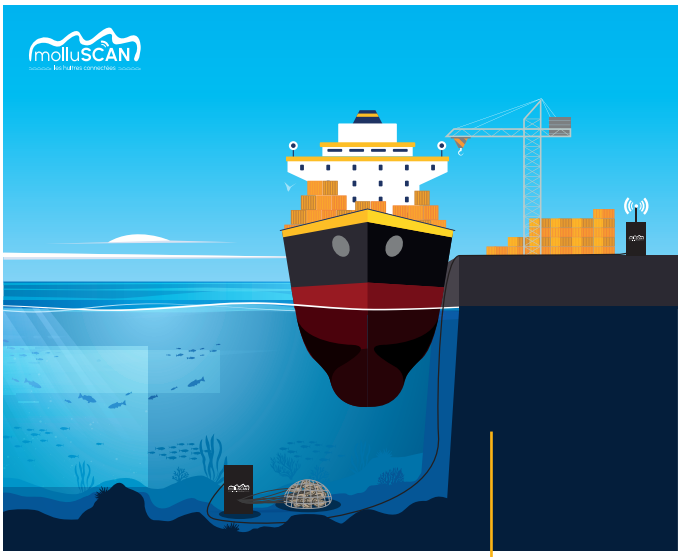
Molluscan-eye *offers a groundbreaking technology that turns mollusks into living bio-sensors, capable of detecting invisible water pollution in real time — helping to safeguard our environment.*

MOLLUSCAN

Protection and restoration of biodiversity

The **molluSCAN-eye®** solution is a cutting-edge tool designed to protect and restore biodiversity in ports by providing continuous, real-time water quality monitoring. This system leverages the natural behaviour of bivalve molluscs (e.g., oysters, mussels) as bioindicators to detect environmental disturbances with high sensitivity. By monitoring their valve movements using High-Frequency Non-Invasive Valvometry (HFNI), **molluSCAN-eye** delivers early warnings of pollution events, enabling rapid intervention before significant ecological damage occurs. It also follows several health parameters (like the growth, the circadian rhythm or the spawn) to understand the evolution of the biodiversity during long periods of time (months and years).

Unlike traditional water testing methods, which are periodic and reactive, **molluSCAN-eye** operates 24/7, ensuring no pollution event goes unnoticed. It tracks up to ten physiological and behavioral parameters daily, offering comprehensive insights into water quality and ecosystem health. Data is transmitted in real time via IoT technology to centralized servers. Results are displayed through intuitive visualizations, allowing port authorities to act quickly and effectively. This proactive approach supports biodiversity protection while fostering sustainable port operations.



The system is cost-effective compared to traditional methods. Each device costs €25,000, with a monthly subscription fee of €900 for service, maintenance, and data analysis. The hardware is robust, operating continuously for over 3 years in marine environments with minimal maintenance. Its non-invasive design ensures that monitoring does not harm local species, making it an environmentally sustainable solution.

Deploying **molluSCAN-eye** requires basic infrastructure: internet connectivity for data transmission and a spot under water. Once installed, the system requires no human intervention on-site, reducing operational costs.

In port ecosystems where biodiversity faces constant threats from pollution and human activity, **molluSCAN-eye** offers an efficient and reliable way to monitor environmental health. Its ability to detect pollution early ensures compliance with environmental regulations while supporting restoration efforts. By combining continuous monitoring, high sensitivity, and cost efficiency, **molluSCAN-eye** is a transformative tool for protecting biodiversity in some of the most vulnerable marine environments.

novobiom

NOVOBIOM
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Novobiom offers advanced, fungi-based bioremediation solutions, digitally optimized for superior contaminant degradation and efficient site remediation. Our bioremediation digital twin solution leverages the bioremediation potential of site microbiota combined with our site-specific bioaugmentation and biostimulation mix to offer unparalleled performance in challenging environmental projects.

MYCOBOOST

Sediment management
Waste management

Novobiom's Mycoremediation Solution for TREASURE: A Sustainable Approach to Sediment Management in Mediterranean Ports.

1. Addressing TREASURE's Sediment Management Challenge

Novobiom's expertise lies in using fungal biodegradative abilities to tackle recalcitrant organic contaminants, directly addressing the sediment management challenge outlined in the TREASURE project call. Our focus aligns with the project's goals of improving environmental quality and promoting sustainable practices in Mediterranean ports.

2. Innovative Mycoremediation Approach

We leverage the power of fungal biodegradation, combined with advanced digital twin modeling, to provide a targeted and efficient solution for sediment remediation.

This approach involves:

• In silico microbiome modeling: Tailored simulations predict optimal bioremediation strategies based on sediment characteristics, indigenous microbial communities, and contaminant profiles. This allows us to project the most adapted bioremediation strategy for each contamination matrix.

• In vitro validation and optimization: Column testing confirms the efficacy of selected fungal strains and identifies suitable structuring agents to enhance biodegradation kinetics.

• Targeted inoculant production: Drawing from a repository of over 400 fungal isolates, we produce customized inoculants optimized for specific contaminant profiles and environmental conditions.

3. Demonstrated Success and Cost-Effectiveness

We have successfully demonstrated our capacity to treat several families of contaminants at different scales.

At lab-scale, we achieved over 90% degradation rates for TPH, PAH, BETEX, and PCE/TCE contaminants and realized several large-scale demonstrators on heavy TPH contaminants. Our approach drastically reduces the cost of remediation treatments, offering on-site treatment of recalcitrant contaminants at costs like traditional bioremediation solutions and targeting a cost of 40€ to 50€ per ton of sediment. The implementation for the sediments would be like traditional bioremediation practices in static our dynamic biopiles.

4. Addressing Specific TREASURE Challenges

Our bioremediation digital twin combines soil metagenomics and advanced modeling techniques, integrating up to 15 microorganisms selected for their demonstrated bioremediation capabilities. This technology addresses the TREASURE call for innovative solutions and novel techniques for environmental remediation in port areas.

Mycoboost offers TREASURE a scientifically sound, cost-effective, and environmentally sustainable approach to sediment management. By integrating our technology, the project can achieve its goals of improving environmental quality and promoting sustainable practices in Mediterranean ports, contributing to a cleaner and healthier marine ecosystem.

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Italy

MAST Srl is a company that, with its international technical staff, expert in the chemical, geochemical and metagenomic characterization of microbial communities, deals with the development of innovative bioremediation products and services with high technological value, high economic sustainability and low environmental impact.

NEBASVE

Sediment management
Waste management

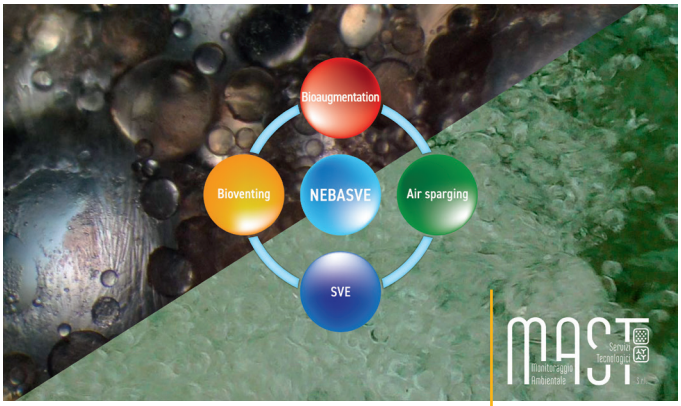
MAST has designed and developed a completely innovative technique for the remediation of contaminated soil and water, called **NebASve**, which consists in the simultaneous introduction of biological and biodegradable mixtures of air, water, microorganisms and nutrients into the contaminated system (subsoil, above-soil and mixed systems). At the same time, gas removal and oxygen recirculation occur through automated suction systems.

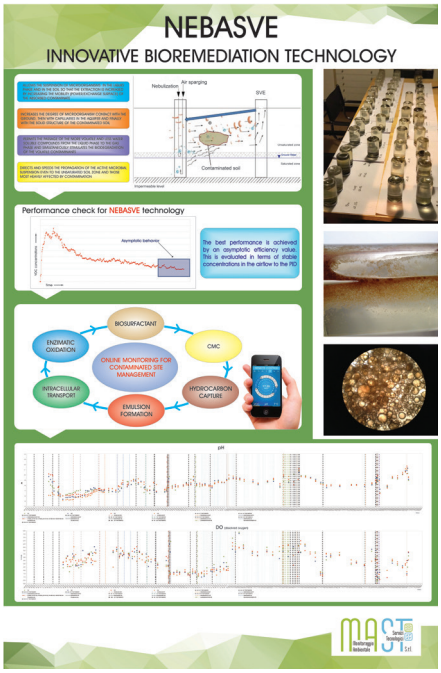
The biotreatment evolution is constantly controlled through continuous monitoring of the chemical/physical and biogeochemical parameters, to guarantee the optimal conditions of the different and continuous configurations generated in the treated environments.

Remote Control System is therefore essential to carry out timely corrective interventions of the guide indices - resulting out of optimal range - and to reduce remediation times and costs.

The **NebASve** prerogative is to avoid interruptions of production activities and interference with structures with different destinations, present in the treatment areas.

The results demonstrate that it is possible to apply the technology designed in any condition, degree/type of contamination, combining the monitoring results with the best biogeochemical regulation.





NebASve is born from a new criterion of management and control of biosystems (biosite-specific properties) allowing the use of high-efficiency microbial formulations, through specially designed and built machinery (**BiWell** and **Biomodulo**), to ensure the simultaneous use of the equipment and multi-parametric instruments necessary for monitoring the process.

The BiWells constitute a set of underground works with variable geometry that allow for the optimization of the flow between the different annulus, the oxygenation of the microbial mass and the production of biosurfactants, optimally increasing the biodegradative process.

The Biomodule is a self-supporting reticular structure that facilitates the distribution of fluids and gaseous mixtures introduced and present in the subsoil, increases the exchange between the biogeochemical reagent system and the contaminated matrices, improving the distribution of soil improvers and biosurfactants.

SEABOOST

Seaboost
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***Seaboost** is a pioneering ecological engineering company, working to restore key ecological functions in man-made areas in France and abroad. We have developed a comprehensive approach to ecological engineering in port environments. Part of the company's activity is centred on artificial reefs and artificial habitats and the declination of these concepts in different forms and applications, including nature inclusion of coastal and offshore marine infrastructures.*

NURSERY GIANT URSIN

Protection and restoration of biodiversity

The **Giant Urchin©** is an artificial habitat inspired by the symbiotic relationship between long-spined sea urchins and fish, which seek refuge among their spines.

This innovative solution was developed to enhance the micro-habitat complexity of breakwaters made from large boulders between which cavity diameter remains too large to generate optimal refuge for juvenile stages of various macrofaunal species.

By introducing features that locally reduce the slope and cavity diameter of these infrastructures, this solution enhances their nursery functionality.

The **Giant Urchin©**can also be deployed on other types of infrastructures (ex. suspended under pontoons) for the same purpose.

Figure 1: the Giant Urchin© is compatible with various type of infrastructures in operation (credit Seaboost)

Figure 2: the Giant Urchin© has been successfully deployed and monitored in multiple ports across the Mediterranean (credit Seaboost)

Requiring minimal maintenance, the **Giant Urchin©** enhances its ecological functionality over time through natural benthic colonization.

It supports photophilic communities with canopy-forming shapes and promotes the settlement of sessile species, supporting biodiversity and creating a more balanced marine ecosystem.

SEABOOST

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NURSERY ROSELIERE

Protection and restoration of biodiversity

The **Roseliere©** solution is an artificial seagrass habitat designed to enhance the nursery functionality within port ecosystems.

Its biomimetic structure provides countless shelters for juvenile fish along quay walls, piles, pontoons and other linear infrastructures.

Figure 1 : Roselieres© on a vertical quaywall in La Ciotat Shipyard (credit Seaboost)

Figure 2: Roselieres© along existing infrastructure (credit Seaboost)

The deployment of **Roseliere©** along port infrastructures increases biodiversity and participates in the restoration of critical shallow water habitat functionalities lost to port infrastructure development.

Roseliere© mainly focuses on supporting fish populations.

OCEAMM
Optimization of Combustion & Emissions to Air of Marine Motors

ECOSOFTEC
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France

***EcoSoftec** is a small independent company that designs and offers innovative technologies to improve the environmental, energy and operating performance of very large marine engines.*

OCEAMM

Improvement of air quality

OCEAMM is a pioneering technology and source of progress invented by EcoSoftec, dedicated to the «Optimization of Combustion and Emissions to the Air of Marine Motors».

The outstanding benefit of **OCEAMM** is that it significantly reduces unregulated pollution from noxious carbon particles produced by engine exhaust.

It has been well tested and proven on large 4-stroke engines on-board of Ferries, cruising in the Mediterranean Sea.

OCEAMM is an exclusive process. It consists in injecting a dosed catalytic precursor through the combustion air. Once in the engine, the catalyst increases the oxidation of the present unburnt carbon and primarily targets particulates.

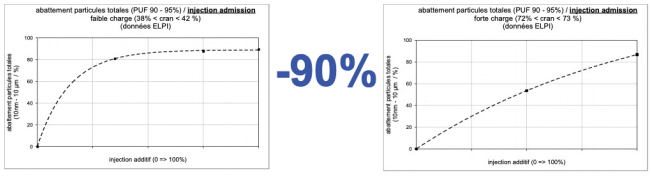
OCEAMM is a process dedicated to the existing fleets using any hydrocarbon (HFO, LSFO, MDO...), with or without scrubber. Compact and autonomous, it is designed to be very easily installed on any type of engine with a power rating ranging from a few MW to several tens of MW.

OCEAMM is the best and simplest available solution for limiting particulate emissions during manoeuvring phases with propulsion engines in urban port areas.

OCEAMM **VISIBLE PERFORMANCE**

OCEAMM **MEASURED PERFORMANCE**

Measured reduction in particulates
manœuvring mode
(arrival/departure from port, low load) (at sea, normal load)



Consequently, **OCEAMM** is a smart complement to the shore power connection to address Ships' fumes.

It does not need to redesign anything on the engines and is implemented without modifying them.

Thanks to the supervision of an independent metrology lab expert in particulates (CERTAM), **OCEAMM** performs to destroy up to 95% of the UFP (Ultra-Fine Particles) generated by the fuel oil burnt into a motor without other flue gas treatment.

ShipOwners can easily enjoy **OCEAMM** installed by our Company, particularly when maneuvering in ports inside or close to urban areas (Low Emissions Zones, according to European regulation). No CAPEX is necessarily requested, and OPEX counts for a very small fraction of the fuel cost alone.

OCEAMM represents a major technological advance in meeting these local and global health and environmental challenges, whether regulated or not, for the benefit of people exhausted by air contamination.

Ocean Ecostructures

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Spain

Ocean Ecostructures is a bluetech company developing large-scale solutions to regenerate marine life by turning infrastructures into blue oases. With a strong R&D and scientific foundation, we create scalable technologies that deliver real, tangible value to our partners.

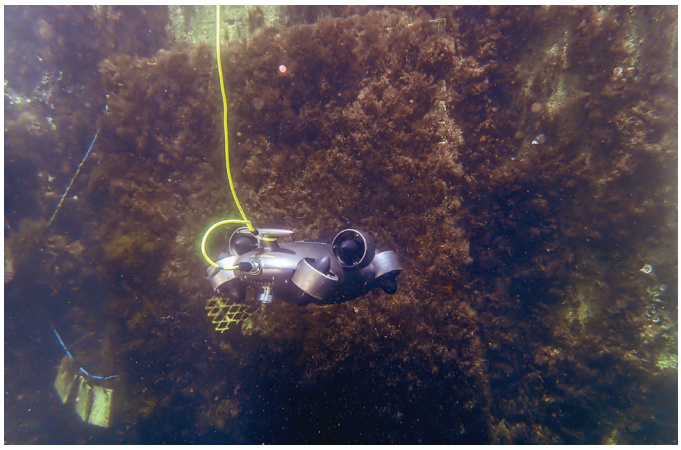
OE

Protection and restoration of biodiversity

Ocean Ecostructures provides multitechnological solutions for marine life regeneration, offsetting the impact of human activities on oceans and renaturalizing infrastructures such as ports, harbours, offshore platforms, and subsea cables, transforming grey spaces into blue oases.

Its biomimetic artificial microreef, the Life Boosting Unit (LBU), replicates the functionality of natural reefs, fostering resilient ecosystems. LBUs feature a natural CaCO3 substrate akin to coral skeletons, providing spaces for fish nurseries and marine species shelters, and contains a proprietary LifeBoostingMix designed to attract microfauna and larvae, enhancing biodiversity recovery.

Using advanced technologies such as ROVs, multiparametric probes, monitoring sensors, high-definition cameras, **OE** collects critical data on biodiversity, biomass, water quality, carbon dioxide removal (CDR), and oxygen generation. This information is securely stored on the iOceans cloud-based platform, offering clients access to a complete dashboard that visualizes historical trends, predictive models, and impact assessments.



All this information is then accessible to the customers, so that they can fulfil their ESG/Compliance, offsetting and social engagement needs.

OE's innovative solutions align with global standards like the CSRD and TNFD, integrating ecosystem services and natural capital evaluations into sustainability strategies. By leveraging cutting-edge technology, **Ocean Ecostructures** not only supports environmental restoration and CDR efforts but also empowers clients to generate and measure (showing evidence) positive impact

OE's solution is versatile and adaptable to any marine infrastructure. **OE** has developed onshore and offshore versions, and its monitoring procedure and technology is also adapted to different environments. Anchoring systems are tailored to customers' needs as well.

This versatility allows for installation and production in diverse locations, with monitoring handled by our experts. Costs vary depending on the project scope and the number of units required.

SolarinBlue

SOLARINBLUE
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France

SolarinBlue *is a pioneering French company specializing in floating offshore solar power. Founded in December 2019, it aims to mitigate land-use competition by transitioning solar photovoltaics offshore, in co-location with offshore wind or as port & islands projects. The company inaugurated in 2023 the very first offshore solar farm in France and the Mediterranean Sea*

OFFSHORE SOLAR

Energy management

SolarinBlue is the French leader in floating offshore solar, with a mission to free solar PV from land-use competition by moving offshore and enabling hybrid wind and solar farms. Founded in December 2019, **SolarinBlue** has developed a cutting-edge floating PV technology specifically designed for harsh offshore conditions—withstanding waves over 10 meters high and winds reaching 200 km/h—while maintaining the lowest possible ecological impact over a 30-year lifespan.

After three years of dedicated R&D, **SolarinBlue** filed two patents and inaugurated **Sun'Sète**, the first floating offshore solar farm in the Mediterranean, located in open-sea conditions (with waves exceeding 8 meters) within the district of the Port of Sète. Since early 2024, **SolarinBlue** has been working to expand **Sun'Sète** into **Mega Sète**, targeting 1 MW installed by 2025, and is simultaneously developing a new 3 MW project in Europe.

SolarinBlue's innovative floating offshore solar solutions are designed to help ports meet their decarbonization goals by utilizing marine spaces for renewable energy production and self-consumption. As ports increasingly look to achieve grid independence and meet growing electricity demands, offshore solar offers a scalable, cost-effective alternative to onshore solar installations, such as rooftop systems, which often come with higher LCOEs due to smaller project sizes.

This offshore solution is particularly advantageous for ports that have maximized their onshore solar capacity and are seeking additional renewable energy sources. In Sète, for example, **SolarinBlue**'s floating solar units (FSUs) are modular and equipped with bifacial panels that take advantage of the cooling effects of water, resulting in up to 6% more energy output compared to nearby rooftop installations.

The company's floating structures are designed with a minimal ecological footprint, limiting direct water contact to just 4% of the installation area, which significantly reduces wear and enhances durability. Helical anchors are used for mooring, disturbing only 4 square meters of seabed per 1.3 hectares, making it an environmentally responsible choice.

SolarinBlue's expertise spans marine engineering and renewable energy integration, ensuring the successful deployment of their technology. The company's partnerships with institutions like CNRS, TechnipEnergies and TotalEnergies ensure that its solutions remain at the forefront of innovation, offering ports sustainable, scalable, and cost-effective energy production options.

In summary, **SolarinBlue**'s offshore floating solar technology enables ports to harness marine space for renewable energy, providing competitive energy costs through large-scale projects while minimizing environmental impact and enhancing the sustainability of port operations.

IFP Energies Nouvelles
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IFP Energies nouvelles (IFPEN) is a French public research and training organization specializing in energy, transport, and the environment. It focuses on developing innovative solutions for the energy transition, including renewable energy, sustainable mobility, and eco-friendly processes. IFPEN also provides expertise and training to support industry and public policies

PLANET'AIR

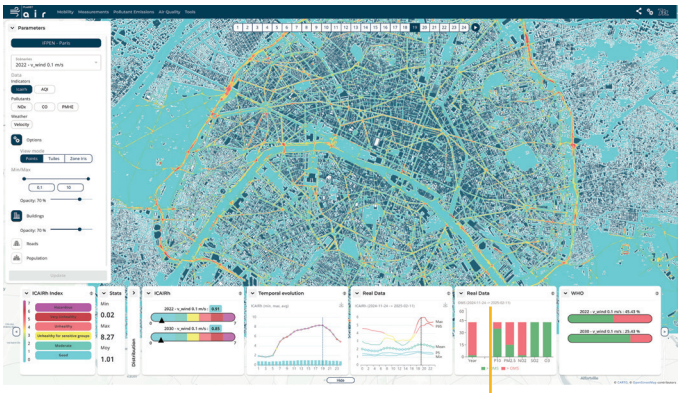
Improvement of air quality

PLANET'AIR is an innovative, cloud-based platform designed to address the environmental challenges of cities, port, and airport areas by enabling the monitoring, analysis, and modelling of pollutant emissions and air quality.

As traffic emissions are a major contributor to air pollution in and around ports, **PLANET'AIR** offers real-time and prospective, context-specific data on pollutants such as NOx, CO2, particulate matter (exhaust and non-exhaust), hydrocarbons, and noise. This actionable information empowers stakeholders to make informed decisions for improving port environmental quality in compliance with increasingly stringent regulations.
The platform demands minimal infrastructure thanks to a SAAS implementation that allows to use it through a web browser.

PLANET'AIR is designed to be accessible, through a user-friendly interactive dashboard that allows stakeholders to navigate data, models, and scenarios effortlessly. Minimal training is needed to use the platform effectively.

Complex calculations, such as AI-driven emission modelling and prospective scenario analyses, are handled on the backend. Stakeholders do not require technical expertise in environmental modelling or software engineering, making **PLANET'AIR** suitable for a broad audience, including policymakers, urban planners, and port authorities.



PLANET'AIR can work with data from existing IoT devices and environmental sensors. While additional data, like advanced sensors, can be incorporated to enhance data precision, these are optional and not essential for initial deployment.

PLANET'AIR operates as a subscription-based SaaS platform, minimizing upfront investment and eliminating the need for specialized hardware such as micro-sensors or software installation. Costs are adaptable to the scale of deployment and the features required, making it suitable for ports of various sizes and budgets.

PLANET'AIR synthesizes diverse data sources, including traffic information, vehicle fleets, and geographic information systems (GIS), into a single platform. By integrating real-world driving behaviours, road slope variations, and traffic conditions, it delivers unparalleled resolution in emissions and air quality assessment.

This precision supports a wide range of initiatives, including:

- Emission Hotspot Identification to target specific areas for intervention.
- Scenario Testing to evaluate the effectiveness of policies or infrastructure changes.
- Regulatory Compliance to ensure adherence to current and emerging environmental standards.

PLANET'AIR represents a transformative tool for ports striving to improve their environmental footprint. Its ex-post capabilities allow for dynamic response measures, while predictive scenario modelling helps ports implement forward-looking policies.

By empowering stakeholders with actionable insights, **PLANET'AIR** supports sustainable urban planning, enhances air quality, and aligns port operations with global sustainability goals.

ECONAUTIK

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France

__EcoNautik__ develops conversion kits that enable existing marine engines to run on natural gas or hydrogen—immediately cutting emissions and costs without replacing propulsion systems. More affordable than alternatives, our kits are easily installed and maintained by marine mechanics everywhere.

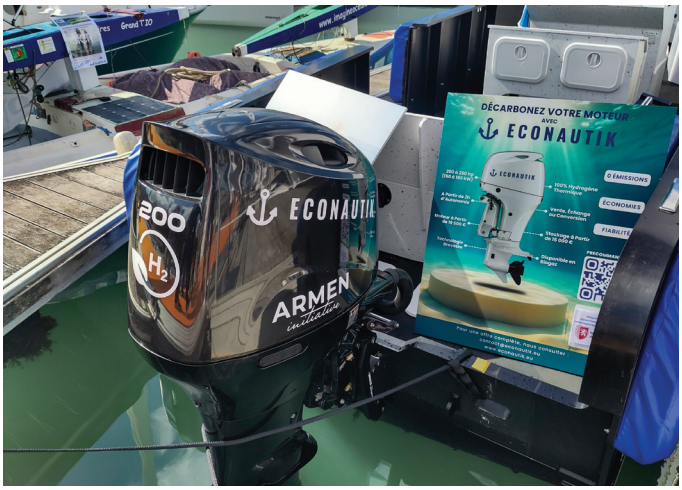
PUSHY

Improvement of air quality

EcoNautik is an Industrial Deeptech Startup of sustainable maritime, port and river mobility offering an innovative solution for converting existing marine thermal engines to decarbonized hydrogen or biogas combustion.

By means of a patented kit of our design for decarbonizing thermal engines, our technology enables a rapid, impactful, affordable and smooth transition of local ecosystems towards a blue and circular economy. With a strong focus on sustainability, **EcoNautik** aims to significantly reduce carbon emissions and improve energy efficiency in the maritime, port and river industry as well as in other sectors of activity using thermal engines as power generator largely used for cold ironing, also known as shore-to-ship power, whom have significant negative impact on the port environment.

This patented internal combustion engine technology will contribute to a wide range of environmental quality impact into Mediterranean port areas by reducing sediment, and water & air pollution:
• The elimination of greenhouse gas emissions will mitigate climate change impacts and therefore will limit submersion of coastal areas (oceans rising), drought (increase in average temperatures and limitation of water resources) and periods of flooding (degradation of infrastructure, sediment deposit).



• The elimination of pollutant emissions as fins particles, unburned, NOx and SOx, which will allow the restoration of air quality. This is a real public healthcare issue for the well-being of people, fauna and flora ecosystems.

• The removing of water pollution issues (acidification, unburned, etc.) allowing the sustainable restoration of marine fauna and flora.

It should be noted that the economic model of **EcoNautik** is based on an extremely competitive value proposition. Indeed, on an industrial scale, **EcoNautik** motorizations will be at the current average price range of users unlike decarbonized electric solutions much more expensive.

On the other hand, in terms of operation, maintenance will remain limited and the fuel (hydrogen) very competitive with cost control over long period because of it is local production or availability and therefore very little sensitive to fluctuations in the global market.

Our engines are also very reliable and efficient as based on two strokes engines technology with limited spare parts allowing little maintenance and simple mechanical operation.

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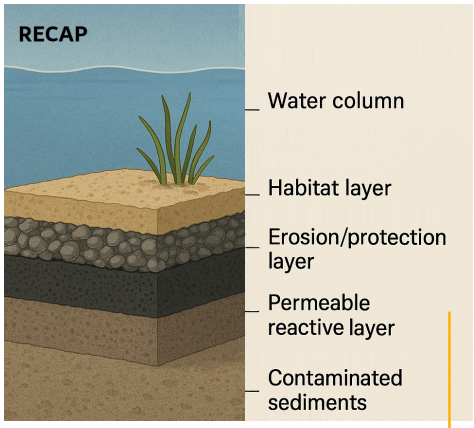
DND Biotech develops sustainable environmental technologies for water and sediment treatment. Combining expertise in bioremediation, zeolite-based solutions and ecological restoration, we deliver innovative, nature-based approaches for port environments. We offer integrated systems designed to enhance environmental quality and promote circular economy principles.

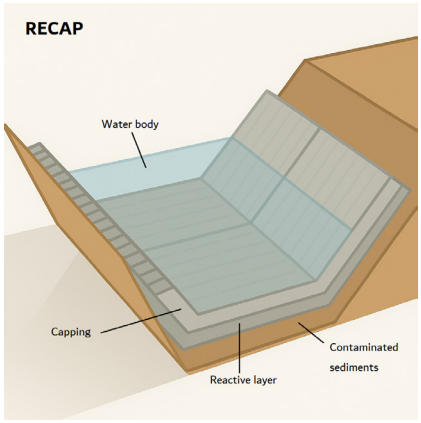
RECAP

Protection and restoration of biodiversity
Sediment management

Reactive Ecological Capping for Advanced Ports is an *in-situ* technology that ensures isolation and decontamination of sediments while allowing vertical water flow, inhibition of methanogenic activity resulting from organic matter degradation and durability of the capping and its suitability to become an active ecological substrate.

The capping structure is composed of a permeable reactive mattress, a loose inert layer for stability and a habitat layer. The permeable reactive mattress allows to establish a biologically active zone of high thickness in which different microbial processes are active to degrade recalcitrant organic contaminants (PCBs, PAHs, TPHs) and detoxify the matrix. The reactive filter layer is engineered based on the chemical-physical and biological characterization of the sediment from the site to be treated. It can contain selected bacteria or fungi immobilized on zeolite for organic contaminants degradation and adsorbent media (carbon or zeolites) for the removal of inorganic compounds (heavy metals). The use of chemically active mattresses reduces the thickness of the capping and evenly distributes the weight, reducing the risk of differential failure. Materials with a high percentage of biodegradability are used for the mattresses instead of geosynthetics. The filtration layer is protected from sea currents, navigation-induced hydrodynamics and anchor dragging by the installation of a loose inert layer of adequate size and stability, resistant to mechanical actions.





Finally, the "habitat" layer on top is engineered for the development of the marine ecosystem, consisting of sand with silt and soil conditioners to promote microbial activity (natural zeolites, plant conditioners). The transplant of endemic plant species aims at stimulating maximum biodiversity. The use of bio-active mat is functional for high-precision and controlled laying, which does not cause turbidity and ensures the regularity of the filter thickness.

Structural containment of the loose material layers of the capping is achieved by laying a geo-tube on the inner perimeter of the mat. Placing of the material is performed inside a "box" made of reinforced PVC silt curtains, anchored on the perimeter of the capping. The microbial species inoculated in the reactive layer are selected by means of metagenomic analysis to select highly competent species for effective degradation of the contaminants.

The costs are estimated at €200–€400/m^2, depending on site-specific conditions (sediment contamination level, customization of reactive materials, depth of deployment).

Minimal infrastructure is required, as **RECAP** is designed for *in situ* application: deployment vessels and equipment, silt curtains for containment, geo-tubes for structural stability. Expertise in sediment characterization, metagenomic analysis for microbial selection, marine ecology, engineering for tailoring of components to local conditions are also required.

GCEI
SOLUTIONS INNOVANTES

GCEI France
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France

GCEI France designs intelligent solutions for optimized water and energy management, integrating connected technologies for precise and sustainable control. Our systems adapt to existing infrastructures without heavy work, allowing significant savings and better preservation of resources. We support municipalities, ports, campsites, farmers and winegrowers, as well as industrialists in their digital and ecological transition towards more efficient and responsible management.

REFITS ET BORNES CONNECTEES

Water management
Energy management

GCEI solutions for managing charging stations in marinas stand out for their ability to integrate into existing installations. Instead of having to completely replace or renovate infrastructure, **GCEI** offers innovative refit options that allow the modernization of charging stations without heavy construction work or network updates.

Refit Solutions: Modernizing Existing Charging Stations
Thanks to LoRa technology, **GCEI** enables the integration of connected management systems into the stations already present on-site. Depending on the available space, **it is possible to:**
Integrate **GCEI** components (MID meters, controllers, LoRa communication systems) directly into the existing stations.
If space is limited, **GCEI** offers a refit cap that attaches to the top of the existing station, transforming it into a connected charging station.
This refit solution allows the stations to become communicative without the need to redo roads or electrical networks. Avoiding these works represents a significant advantage in terms of time and cost.

New Charging Stations: Flexibility and Customization
For installations that require new stations, **GCEI** offers fully customizable stations. They are locally manufactured with high-quality materials. These stations are equipped with MID meters and pulse solenoid valves for precise management of electricity and water consumption.

Consumption Management and Access Control:
Connected stations, whether from a refit or new, allow for: Measuring and tracking energy and water consumption in real-time via the HYDRACOM platform. It is also possible to allocate predefined volumes per user or calculate total consumption.

Integration of an RFID access control system:
Multi-purpose RFID badges allow users to access all **GCEI**-equipped facilities, whether charging stations, sanitary blocks, or docks.

Security and Detachment Detection:
GCEI stations are equipped with a plug detachment detection feature. If a user unplugs their connector and leaves the site, the session is immediately cut off, preventing another user from consuming without authorization.

Modernization without heavy construction work:
The refit solution transforms existing stations into connected stations without the need to redo roads or electrical networks.

Rotary Wave
energía renovable marina y eólica

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Rotary wave *is a startup which develop sustainable solutions in renewable energy field, focused in wave and wind energy and is developing wave energy devices to produce electricity from the movement of waves.*

RENMARINAS

Energy management

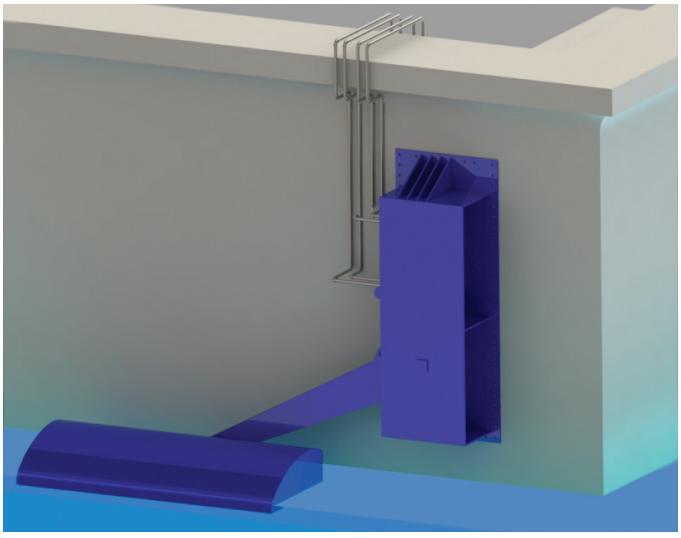
RENMARINAS is a wave energy converter anchored to the port breakwater. It consists of a float connected to an arm, which is connected to a piston.

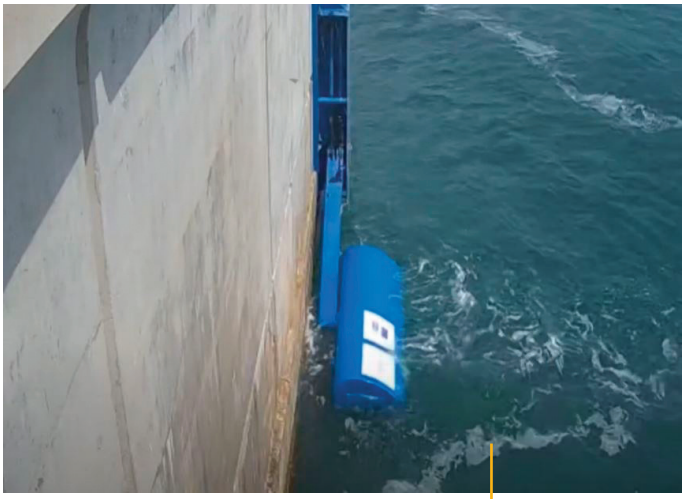
The device works by using a float and hydraulic pistons to harness the motion of ocean waves to generate electricity. The wave motion moves the float, which is connected to a hydraulic piston that pressurizes a fluid that goes to a generator or turbine and generates electricity.

The prototype is designed to be installed on vertical docks in any port around the world, generating sustainable electricity and contributing to their decarbonization, without environmental impact.

The **RENMARINAS**'s main advantages are that it uses recyclable materials, is oil-free, is environmentally friendly, adjusts to sea level, adapts to wave direction, and has a safeguard mechanism, low CAPEX and low OPEX.

RENMARINAS has a TRL 7 development level and has been tested on a test bench and in a real environment in the Port of Valencia, as part of several previous projects.





EODev

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France

***EODev** is a French industrial SME specialized in zero-emission energy solutions for both land and maritime applications. The company designs hydrogen-powered generators and advanced battery systems to decarbonize high-impact sectors such as industry, transportation, construction, and data centers. Its solutions, conceived and manufactured in France, are deployed in over 25 countries as concrete alternatives to diesel.*

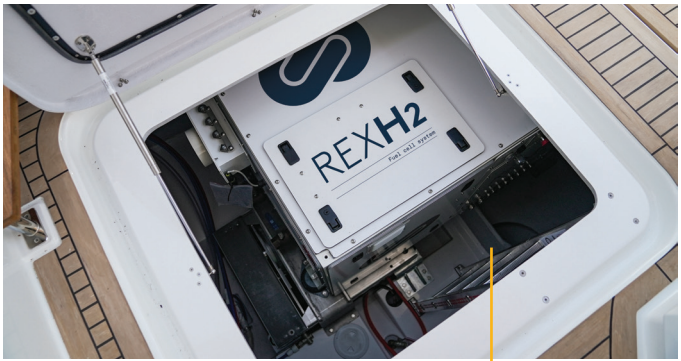
REXH2

Energy management
Improvement of air quality

The **REXH2®**, EODev's onboard Hydrogen Range Extender, is the result of feedback gained from its use aboard Energy Observer during 63,000 nautical miles of navigation in extreme conditions.

This system offers:
• Emission-free maritime and riverine mobility, eliminating CO2 emissions, fine particles, and noise.
• Compact design: With a size of less than two cubic meters and weighing 570 kg, the **REXH2®** is equipped with Toyota's latest-generation fuel cell (FC) technology.
• Delivers 70 kW per unit and over 1 MVA when connected in series.
• Provides clean, modular energy for powering onboard systems and electric propulsion.
• Wide application range: Ideal for various vessels, such as:
  - Maritime passenger or tourist shuttles.
  - Inland barges for river transport.
  - Fishing boats and workboats.
  - Pleasure yachts and luxury vessels.

The **REXH2®**'s innovative use of a marine-grade fuel cell generates decarbonized electricity from hydrogen, powering both propulsion and onboard systems. After initial testing aboard Energy Observer, the **REXH2** has been integrated into several vessels, including:
• Two America's Cup Chase Boats.
• The hydrogen-powered training boat at the Lycée Professionnel, Maritime & Aquacole of Bastia.
• The Ocean Buoy for the french ownership Phare et Balise.



Key Advantages:
• Sustainable and accessible: The **REXH2®** represents a reliable alternative for reducing marine pollution today. Its modular design can be tailored to different maritime needs, from transportation to recreation.
• Resilient and durable: Designed to withstand demanding maritime conditions, the **REXH2®** ensures reliability and longevity, even in challenging environments. This makes it perfect for vessels operating in sensitive ecosystems or regulated emission zones.
• Aligns with regulations: Hydrogen-powered fuel cells significantly reduce the environmental impact of marine transport, aligning with international maritime regulations, such as those set by the International Maritime Organization (IMO).

Looking Ahead:
• Hydrogen as a clean energy source: The **REXH2®** is a prime example of how hydrogen technology can support diverse maritime applications.
• Addressing global challenges: As the world pushes for reduced greenhouse gas emissions, hydrogen-based solutions like the **REXH2®** are key to creating a carbon-neutral maritime future.

Through the successful deployment of the **REXH2®**, **EODev** is helping shape the future of maritime innovation, proving that vessels can be operated in a way that reduces emissions, protects the environment, and promotes long-term sustainability.

Ecocean
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*Founded in 2003 in Montpellier, **Ecocean** is a French company specialised in ecological engineering for aquatic ecosystems. It develops innovative solutions, such as **Biohut®** habitats, to restore coastal fish nurseries and support marine fauna. Scientifically validated, its technologies contribute to biodiversity conservation and address environmental challenges.*

SCOUR PROTECTION & BALLAST

Protection and restoration of biodiversity
Waste management

Ecocean's **scour protections**, made from a by-product of the iron and steel industry - Basic Oxygen Furnace Slag (BOF-Slag), represent a major advancement in the protection of marine infrastructures against erosion.

These dense materials, heavier than concrete, are not only extremely resistant but also chemically inert, guaranteeing their durability in marine environments. Derived from an industrial process, LAC ("Laitiers d'Aciérie de Converstisseurs") are classified as waste, making them a key resource in a circular economy approach aimed at reducing environmental impacts while reusing industrial by-products. These solutions can also be used as ballast, such as for deadweights or cable protection.

The special feature of this solution lies on the containment of LAC within high-strength stainless steel nets designed by **GEOBRUGG**. These nets provide a robust and durable structure, enabling safe installation even in hostile marine environments. Thanks to their density, these assemblies effectively stabilize marine soils, preventing scour around the bases of infrastructures. They also make it an interesting material for ballast.

In addition to their functional role, these solutions offer significant ecological benefits. The chemical composition of LAC, which includes free lime, and their textured surface with its many asperities, create a habitat that supports local biodiversity. This ecological dimension enhances their relevance, particularly in projects that combine environmental considerations with the protection of marine infrastructures.

In terms of implementation, **Ecocean's** solutions stand out for their simplicity and efficiency. The nets containing LAC can be transported and deployed using standard equipment such as cranes or boats equipped with lifting systems. However, preliminary expertise in marine engineering is required to assess site-specific needs, ensure optimal placement, and maximize their effectiveness. Additionally, administrative procedures are necessary to obtain the required permissions for submerging a material classified as waste in marine environments (e.g., authorization requests). Costs remain competitive thanks to the valorization of LAC as industrial waste, while their durability minimizes maintenance requirements and ensures long-term viability.

With their dual functional and ecological benefits, these solutions offered by **Ecocean** address the challenges of modern marine infrastructures while embracing an innovative and environmentally respectful approach.

seabots

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*Founded in 2019, **Seabots** aims to facilitate the digitization of marine assets through next-generation robotic solutions. Our specialization in coastal environments has allowed us to establish ourselves as a strategic partner for projects that require precision and control in complex conditions, where conventional methods are not efficient.*

SEABOTS

Water management
Protection and restoration of biodiversity
Sediment management

The solution offered by **Seabots** refers to the measurement of water quality using autonomous robots.

The sensors integrated in the robot offer real-time monitoring of all the values of the psycho-chemical parameters of the water. (Ph, temperature, conductivity, turbidity, chlorophyll, oils, hydrocarbons, E-Coli detection, etc.)

This monitoring is carried out by autonomous robots, so it offers quick and easy deployment into the water, it eliminates human risk and reduces operational cost by up to 80%.

Results show a heat map of each parameter. These maps show the spatial distribution of the parameter over the entire surveyed area. Therefore, we could create digital twins to identify changes or prevent possible alterations in the water that are critical for human health (beaches) or for marine biodiversity (Sea).

In addition, **Seabots** is specialised in digital twins of seabed to check the sediment accumulation and port infrastructure.

Obtaining a digital twin of a biotope or platform for the generation of marine life, will help us to perform an exhaustive monitoring of the process, (from the first populating species to total regeneration). We strongly believe that this innovated technology is a fundamental tool for calculating biomass generated or blue carbon capture.

Finally, **Seabots** has designed a platform for cleaning solids, oils and hydrocarbons on the Surface (**SB 100 CLEANER**). An innovative low-cost device which allows to keep the water always clean.

This robot incorporates all sensors to reach all corners of the port and work with maximum safety.

Neo-Eco Developpement
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Neo-Eco is a circular economy consultancy specialised in waste reuse and recovery. Since 2008, the company has developed more than 500 eco-materials from secondary resources (sediment, soil, demolition rubble, etc.) to create sustainable, local and economically competitive solutions.

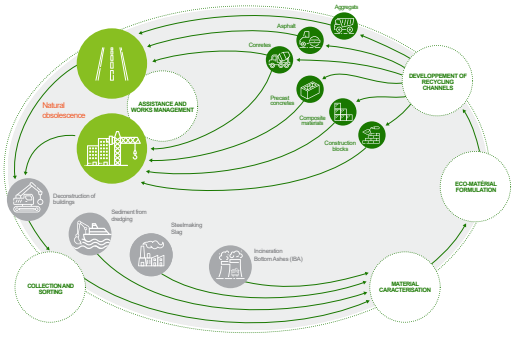
SEDIMERS

Protection and restoration of biodiversity
Sediment management
Waste management

The **SEDIMERS** project is an innovative initiative that leverages **Neo-Eco** and **Sédimatériaux**'s expertise in sediment valorization to address the challenges of sediment management within a circular economy framework. By transforming sediments—traditionally considered as waste—into valuable resources, **SEDIMERS** demonstrates how ports can enhance sustainability, reduce environmental impact, and create eco-products for construction and landscaping applications.

The methodology of **SEDIMERS** is designed to optimize sediment management through five distinct phases:
The first phase involves comprehensive sediment sampling and characterization. This step ensures a detailed understanding of sediment composition, contamination levels, and potential applications. Advanced analytical techniques are employed to assess geochemical and physical properties, enabling precise identification of suitable pathways for sediment reuse. This scientific rigor provides a foundation for informed decision-making and regulatory compliance.

The second phase introduces multi-criteria decision tools to evaluate sediment management scenarios. These tools balance environmental, technical, and economic factors, guiding stakeholders toward the most viable reuse strategies. By integrating data from characterization studies, decision frameworks prioritize solutions that maximize value creation while minimizing ecological impact. This approach ensures that sediment management aligns with port sustainability objectives and circular economy principles.



The third phase focuses on the formulation and development of sediment-based products. Tailored to meet specific market and project needs, these formulations include materials such as eco-concrete, aggregates for road construction and substrates for landscaping. Leveraging innovative techniques, **SEDIMERS** transforms sediments into high-performance products that meet stringent mechanical and environmental standards. This step highlights the potential of sediments as a sustainable resource for the construction sector.

The fourth phase involves mechanical and environmental monitoring of the sediment-derived products. Extensive testing ensures that materials meet durability, safety, and performance requirements under real-world conditions. Environmental assessments are conducted to verify compliance with regulations, particularly concerning leaching and contamination risks. This phase guarantees that products are not only effective but also environmentally responsible.

The final phase is pilot implementation, where the methodology and products are tested in real-world settings. Demonstration projects are established within ports or urban environments, showcasing the viability and scalability of the solutions developed. These pilots provide critical feedback, refine processes, and engage stakeholders, promoting broader adoption of sediment reuse practices.

marinehound
sulphur limit remote sensing

Marine Hound Limite
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Malta

__Marine Hound__ helps port authorities and shipping companies meet complex environmental regulations by making emissions monitoring simple, accurate, and automated.
What makes us different is our end-to-end approach — we build the full solution in-house, combining deep maritime knowledge with engineering, AI and environmental science. Our diverse and skilled team has a proven ability to turn complex regulatory challenges into practical, scalable tools that protect people, reduce pollution and create real value.

SNIFF

Improvement of air quality

SNIFF is a cutting-edge situational awareness system designed for advanced gas detection and analysis. At its core is a highly sensitive and configurable multi-gas analyzer capable of detecting and measuring trace gas concentrations at parts-per-billion (ppb) levels. This is complemented by an integrated suite of sensors, including weather monitoring and ship location tracking. Together, these components provide real-time and historical situational awareness, enabling the identification and marking of extraordinary events such as elevated emissions or the presence of toxic gases with precision and reliability.

A current Use Case of the solution is the remote and non-invasive detection of high Sulphur fuel for IMO2020 and SOx-ECA regulation purposes. Other gases such as Methane, Methanol, Ammonia, NOx, CO_2 and specific Volatile Organic Compounds (VOCs) can be also detected.

The cost structure comprises both of initial CAPEX costs (equipment and setup costs) and OPEX costs (subscription including annual maintenance/calibration). The detection and measurement setup can be versatile: grounds station, buoys, Remotely Operated Vehicles (ROVs) and drones.

Required infrastructure: System can be installed on a ground station (cabinet) or buoy. We are collaborating with drone and ROV companies to install the sniffing technology on these mobile platforms. Connectivity is mostly achieved through 3G/4G mobile communication and in other cases satellite communication such as Starlink. Power can be obtained from mains power supply or off-grid system.

Expertise required from user: We take away all the system complexities from the user and only present a cloud-based software Human Machine Interface, where the user can access real-time and historic situational awareness concerned with a specific region of interest.

TecnoConverting Engineering
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TecnoConverting Engineering *is a company with 20 years of experience in the water sector, specialised in lamella settling and water treatment solutions. In 2020, we developp the* ***TecnoGrabber® systems****, designed to retain solid waste.*

TecnoGrabber® Deflector System

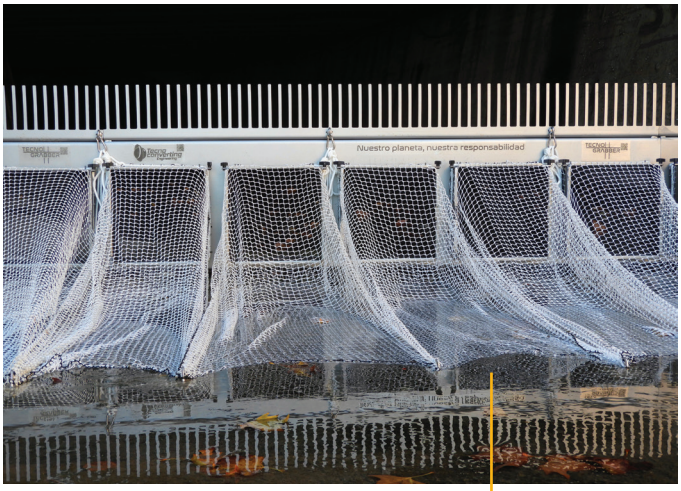
Water management
Protection and restoration of biodiversity
Waste management

The **TecnoGrabber® Deflector System** for Galleries is a highly efficient solution designed to capture and retain solid and floating waste during overflow events in sewer systems. It consists of robust deflectors installed along gallery walls, paired with retention baskets to maximize waste collection capacity.

The deflector system includes metal sheets fixed to gallery walls, directing waste towards strategically placed retention baskets, which are customizable in size and mesh type to suit gallery dimensions. These are simple, high-performance systems that are easy to install and cost-effective.

The system is capable of retaining large volumes of waste, including bulky solids and small floating debris, during intense rain episodes; for example, a basket with a diameter of 300mm can retain about 300kg of waste.

Constructed with inox AISI-316L stainless steel, it is resistant to corrosion and wear, ensuring a long operational lifespan even in harsh conditions.



The **TecnoGrabber® system** complies with current Spanish legislation, specifically Royal Decree 665/2023, which modifies the regulations governing public hydraulic domains. The decree mandates the generalized installation of systems for retaining solid and floating waste in sanitation systems to reduce visual and surface degradation in public hydraulic domains. This ensures that the **TecnoGrabber® system** aligns with regulatory requirements and supports environmental preservation efforts.

It is suitable for galleries with wall or floor surfaces that allow secure anchoring, though minor civil works may be needed to prepare the site for installation. Its implementation requires engineering knowledge for proper design, manufacture, anchoring, and alignment, and maintenance staff must be trained to replace baskets periodically using crane trucks or other extraction tools if necessary.

This deflector system is ideal for enhancing the quality of water discharged from galleries into rivers and seas, contributing significantly to the environmental preservation of ecosystems.

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TecnoConverting Engineering *is a company with 20 years of experience in the water sector, specialised in lamella settling and water treatment solutions. In 2020, we developp the* ***TecnoGrabber® systems****, designed to retain solid waste.*

TecnoGrabber® Retention Clamps

Water management
Protection and restoration of biodiversity
Waste management

The **TecnoGrabber® Retention Clamps** is a compact and efficient solution for capturing and retaining solid and floating waste in sewer systems during overflow events. These clamps consist of durable, reusable metal grates designed to be fixed directly to floors, guiding waste into retention areas and preventing its discharge into aquatic environments. Minimal infrastructure modifications are required for their installation, as they are suitable for flat and stable gallery floors where the clamps can be securely anchored without significant civil works. Constructed from inox AISI-316L stainless steel, the clamps are highly durable and resistant to corrosion, ensuring a long lifespan even in harsh conditions.

Their implementation requires basic engineering knowledge to design and align the clamps for optimal waste retention. Maintenance staff must be trained to periodically clean and inspect the clamps to ensure consistent performance and longevity. The **TecnoGrabber® Retention Clamps** are simple, high-performance, and easy-to-install systems that provide an economical solution for reducing solid waste discharge in ports and spillways.

Their compact design ensures adaptability to a wide range of sewer systems, significantly contributing to environmental preservation. Moreover, the clamps comply with regulations such as the Spanish Royal Decree 665/2023, which mandates the use of solid waste retention systems in sanitation infrastructure to reduce visual and surface degradation in public hydraulic and maritime-terrestrial domains.

This makes the **TecnoGrabber® Retention Clamps** an ideal solution for enhancing the quality of water discharged from ports into surrounding ecosystems.

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*The company **AEL/LEA** is a laboratory for environmental analyses of terrestrial, marine and atmospheric environments, which relies on proven and internationally recognized expertise.*
*Thanks to high-tech methods developed as part of R&D actions, **AEL/LEA** has equipped itself with a range of tools among the most efficient to detect early disturbances in the marine environment, however minimal they may be.*

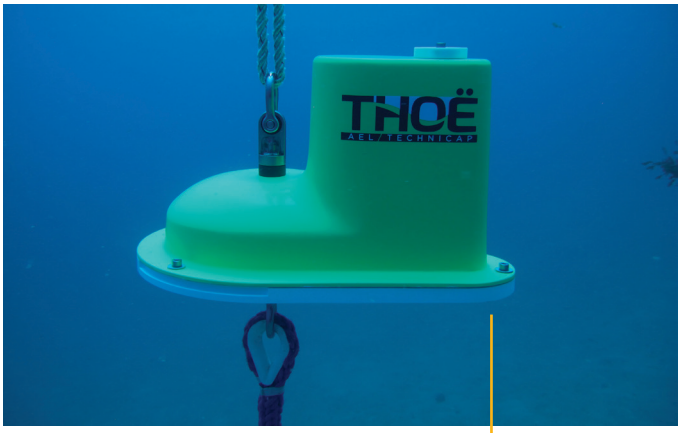
THOË

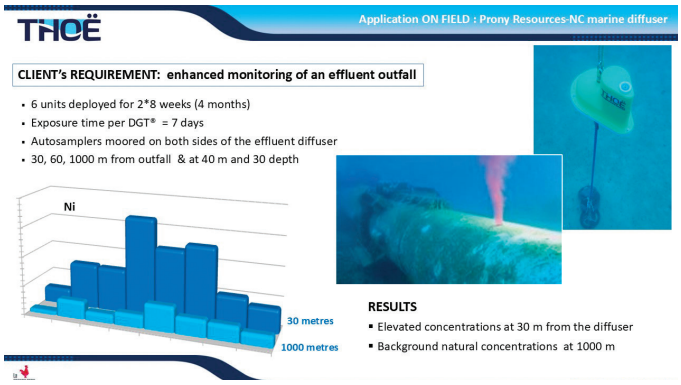
Water management

Any industrial activity located within the port's area of influence has the potential to disrupt marine water quality and, consequently, affect ecosystems. For this reason, monitoring before, during, and after industrial operations is essential to assess impacts and, if necessary, implement corrective measures. The innovative **THOË®** system, developed by **AEL** to support monitoring efforts associated with nickel ore extraction and processing in New Caledonia, has proven to be the ideal tool for such missions over the past seven years. Thanks to its versatility, **THOË®** is perfectly suited for marine impact surveillance related to ship construction/dismantling activities, naval maintenance, infrastructure development (e.g., dock extensions, dredging), and outfall discharges.

In the same way, to improve environmental quality in and around Mediterranean port areas, effluent treatment should become standard practice prior to discharge. However, assessing the effectiveness of such treatments requires high-frequency monitoring of pollutant concentrations in the water column to ensure proper dispersion and compliance with discharge standards.

Traditionally, this type of monitoring involves three steps:
• Establishing a baseline reference for the area, which includes documenting existing industrial and/or natural disturbances;
• Monitoring impacts during the start of operations;
• Long-term environmental monitoring of potential impacts.





These steps, particularly the last one, often necessitate frequent site visits for sampling. Such a strategy can quickly lead to significant operational costs for environmental monitoring, primarily due to the extensive logistics required, making it economically prohibitive.

The **THOË®** system offers a solution. Automated, autonomous, and programmable, it can collect data over several months in continuous sequences using passive sampling technology (**DGT®**). This technique provides time-averaged concentration data, enabling clear tracking of industrial, urban, agricultural, and meteorological disturbances (linked or unrelated to climate change) and their impacts on respective areas.

By automating and streamlining data collection, **THOË®** significantly reduces the costs associated with environmental monitoring. For instance, over three months of weekly measurements to produce 12 time-averaged analyses, only two field campaigns are needed (deployment and retrieval of **THOË®**), compared to 13 campaigns required by traditional manual methods.

Finally, the passive sampling (**DGT®**) approach dramatically enhances the precision of the results, lowering detection limits by up to 50 times.

SEABOOST

Seaboost
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***Seaboost** is a pioneering ecological engineering company, working to restore key ecological functions in man-made areas in France and abroad. We have developed a comprehensive approach to ecological engineering in port environments. Part of the company's activity is centred on artificial reefs and artificial habitats and the declination of these concepts in different forms and applications, including nature inclusion of coastal and offshore marine infrastructures.*

Tidal Pool

Protection and restoration of biodiversity

Coastal infrastructures like riprap structures or vertical quays retain very little water at low tide due to their slope and macroporosity. It limits the variety of sessile species that can thrive.

Inspired by natural rock pools found in intertidal zones, **Tidal pool** modules recreate water retention areas in urbanized environments, such as port infrastructures, at the upper edge of the infralittoral zone. These modules support complex ecosystems and enhance the development of diverse species typical of these rocky intertidal habitats.

Custom-designed, our approach focuses on enhancing material characteristics such as roughness, microporosity, and specific pH levels to promote richer biodiversity.

Tidal pools can be integrated into maritime infrastructure using concrete-based pool structures. These modules can be attached to vertical walls, placed at the base of breakwater or quay walls.

Built to withstand local hydrodynamic conditions, these reefs are durable and require minimal maintenance, offering a long-lasting solution.

Figure 1: Tidal pools can be attached to vertical walls, placed at the base of breakwater or quay walls

Figure 2: Inspired by natural rock pools found in intertidal zones, Tidal pool modules recreate water retention areas in urbanized environments

BRUGG
Geobrugg

Safety is our nature

GEOBRUGG
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France

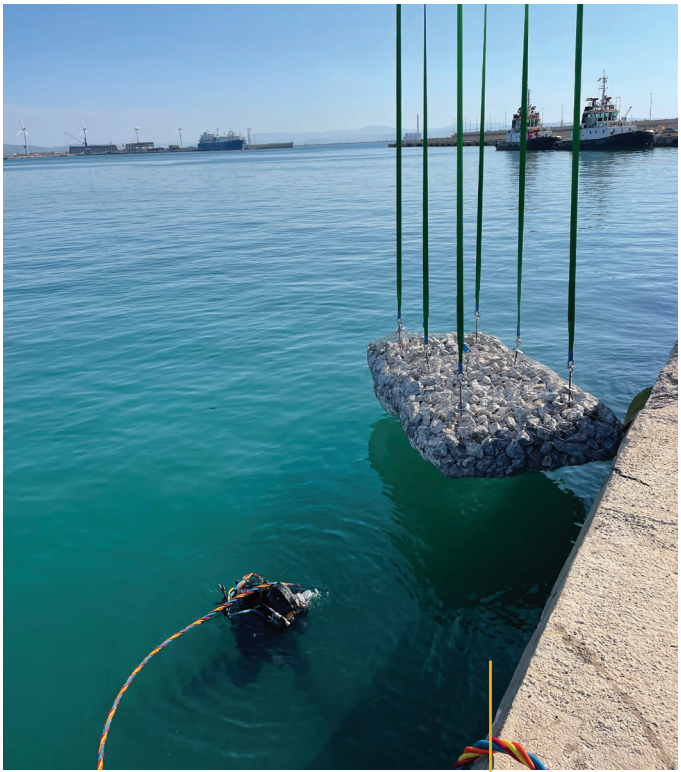
*Since 1951, **Geobrugg** is specialised in absorbing energies caused by natural or industrial hazards. The company designs, tests, and distributes protection systems made from high-tensile steel wire nets, including seawater proof stainless steel. These are major assets in facing the challenges posed by coastal erosion*

TRAPUNTA

Protection and restoration of biodiversity
Energy management
Sediment management

TECCO® Trapunta is a modular monolithic structure specially designed for underwater applications, with a compact cell assembly capable of withstanding the most rigorous conditions.

It provides robust protection for aquatic infrastructure such as quay walls and piers, effectively preventing scouring and protecting subsea installations such as pipelines and cables. Thanks to its great flexibility, **TECCO® Trapunta** adapts perfectly to the natural topography of the seabed, making it an ideal solution for sediment erosion control. Its high-strength stainless steel mesh guarantees exceptional durability in the most demanding marine environments, and its harmlessness helps to preserve the natural environment in which it is installed.



As part of an innovative environmental approach, **Geobrugg** is working together **Ecocean** to replace the local natural stone filling with BOF slag, offering even better performance in terms of ballast.

This solution makes it possible to recycle inert waste, optimise the use of materials and reduce transport, maintaining the infill physical requirements, thereby helping to reduce the system's carbon footprint. It also encourages the creation of habitats for marine fauna and flora, in line with studies conducted by **Ecocean**, with a fully recyclable system.

ELWAVE

ELWAVE
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Elwave pioneers advanced electro-magnetic technologies inspired by nature to revolutionize underwater operations. We design and manufacture innovative and compact underwater electromagnetic sensors which can detect metallic or plastic targets in the most complex environment such as high turbidity, buried targets and noisy environment.

Underwater Electromagnetic Sensors

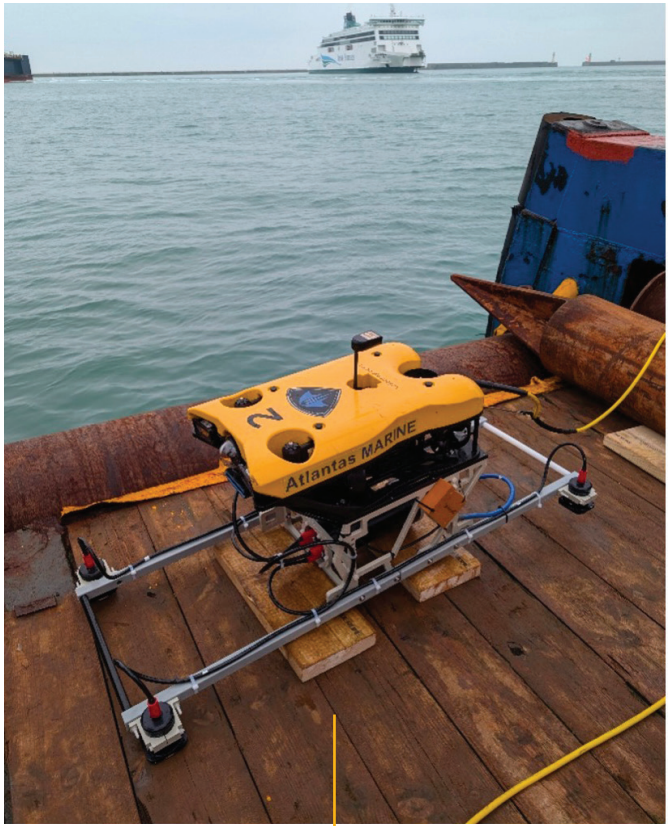
Waste management

Elwave designs and manufactures compact subsea electromagnetic sensors for the detection and the discrimination of plastic and metallic underwater targets located on the seabed or covered with sediments. These sensors are based on a patented subsea sensing technology called **CEDAR** (Controlled Electric Detection And Ranging).

CEDAR is a bio-inspired form a natural perception named «electric sense», used by some tropical fishes living in turbid and congested waters. Academic research about the electric sense was conducted by the French University IMT Atlantique between 2005 and 2018. **Elwave** is a spin-off of this university founded in 2018 to valorise these academic works.

For this project, **Elwave** will deploy its sensors Tetrapulse mounted on man portable mini ROV type Defender to perform seabed survey in port. Electrical resistivity map will be generated to localize marine litters on the seabed or buried in the sediments and discriminate between plastic and metallic debris.

CEDAR technology is efficient even in very high turbidity environment so is adapted to operate in harbours and will allow to schedule efficient marine litter removal to improve the port environmental conditions.



UTEK
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Utek is a leader in innovation for unmanned surface vehicles, offering highly reliable, advanced performance ad-hoc solutions tailored to client requirements. The core of the systems is a proprietary set of technologies that provide unmanned capabilities to any kind of ground or surface vehicle for different missions. Its activities cover all phases of the product life cycle: concept, development, integration, testing, training, and operation.

UPRBOAT

Protection and restoration of biodiversity

More and more often, it is possible to see news that involves the use of drones in many applications. It means that the use of Remotely Controlled Systems has been increased in the last years in many tasks and those developed in the sea will not be an exception.

Daily operations in ports and coastline are nowadays performed with manned boats with more than one person. Those crews sometimes work in shifts, in particular for long time operations and some precious time is lost changing people. On the other hand, human being becomes more affected by polluted environments or bad weather. Unmanned systems solve most of these limitations thanks to their advantages: reduction of operational resources and costs, no risk for crews, people constrained to operate a manned system due to physic limitations or one operator can oversee several unmanned boats operating in autonomous way.

UTEK proposal intends to comply with the Protection and restoration of biodiversity topic by using autonomous/Remote Controlled USV (Unmanned Surface Vehicle) systems.

To cover the tasks for this topic, **UTEK** has two systems:

One is the **KALUGA ER** which is an intensely proven USV based on a commercial Rigid Hull Inflatable Boat 6,7 meters powered by an outboard engine. It has a high maturity level and has been already used in several NATO exercises and in a demonstration of crisis management in the port of Valencia in 2019.

The other one is the **KRILL**, a 2 meters catamaran powered by electric engines with rechargeable batteries and specially designed for applications related to hydrography, environmental control, oceanic research, etc.

UTEK USV systems allow different kinds of payloads such as, camera for persistent surveillance and environmental monitoring to detect oil spills as well as plastic and floating trash, sensor for water quality measurement, meteorological sensors, bathymetries system to check the seabed or even a robotic arm for pollution recovery installed in the **KALUGA ER**.

KALUGA and **KRILL** systems can be continuously operating up to 24 hours at a speed of 5 knots both in autonomous or in remote controlled mode. They provide data processing and an intuitive user interface for visualization of payloads telemetry: the Ground Control Station (GCS) will display all telemetries related to the USV as well as information gathered by on-board sensors.

Regarding the infrastructure and costs, it must be considered the main items that compose the system: the boat/catamaran that can be easily deployed and recovered using common port resources, the GCS that could be located at the Operations Control Center of the port already prepared and the communication network that depends on the communication system available within the port since a 4G- 5G private or commercial network can be used. In case it is not available, only a RF antenna installation shall be considered. Therefore, huge costs for the implementation of the system are not expected.

THANK YOU

To all the solution providers featured in this catalogue.
Your ideas and efforts contribute to a more sustainable environment
for our Mediterranean ports.

TREASURE

Interreg Euro-MED

Co-funded by the European Union