UNIT FOR THE UTILISATION OF WAVE ENERGY FOR THE PRODUCTION OF ELECTRICITY, DESALINATED POTABLE WATER AND GREEN HYDROGEN

GENERATION OF RENEWABLE ENERGY, SEAWATER DESALINATION FACILITY, GREEN HYDROGEN GENERATION, COASTAL EROSION MITIGATION

VIRGÍLIO MARQUES PRETO

SUMMARY

INTRODUCTION

INNOVATIVE

The Wave Energy Conversion Unit is an innovative technological solution designed to efficiently and sustainably convert the potential, kinetic, and chemical energy of sea waves into electricity, freshwater, and green hydrogen.

MULTIPURPOSE

In addition to electricity generation, the unit can also produce green hydrogen and oxygen, using the renewable energy generated and the freshwater obtained in the process.

ADVANCING ENERGY MANAGEMENT

In conclusion, this new technology offers a sustainable and integrated solution, contributing to decarbonization and the optimization of maritime resources. It also aligns with the principles of the circular economy by enabling integration with other sustainable production processes. As such, it represents a significant step forward in the energy transition and in the efficient management of natural resources.

BACKGROUND

THE BEGINING

This innovative technical solution was developed by Virgílio Preto, a Civil Engineer by profession, who took his first steps in the field of renewable energy in 1998. That same year, he developed a revolutionary wave energy conversion system for electricity generation. Due to its originality and pioneering nature, this system was granted a national patent in September 1998 and, later, an international patent in September 2003, having received numerous innovation awards at both national and international levels.

EARLY SUCCESS

In 2002, driven by his pioneering vision and commitment to sustainable solutions, Virgílio Preto developed a new system to harness urban wind for electricity generation. This second invention was also recognized and awarded, receiving a national patent in 2003 and an international patent in October 2006, further cementing his reputation as one of the leading innovators in the field of renewable energy.

CONTINUED COMMITMENT

This ongoing journey of innovation reflects Virgílio Preto’s strong commitment to the environment, through the creation of sustainable technologies, advancing the field of renewable energies and offering efficient technical solutions that contribute to a greener, more ecological and technologically advanced future.

TECHNICAL DESCRIPTION

1

UNIT DESCRIPTION

The developed system consists of modular energy production units designed to convert wave energy into electricity. These units are intended to operate within existing or new maritime infrastructures, such as ports, breakwaters, and other coastal structures.

The key innovation of this system lies in the simultaneous optimization of the potential and kinetic energy of the waves, using a conversion technology based on Magnetohydrodynamic (MHD) principles. This method maximizes energy efficiency, distinguishing itself from conventional solutions through its high performance, operational robustness, and low environmental impact.

In addition to electricity generation, the system includes a highly efficient desalination unit, which directly harnesses the mechanical energy of the waves to convert seawater into freshwater. This process significantly reduces the energy costs associated with desalination by minimizing the reliance on external electricity sources.

Furthermore, the system is designed for the sustainable production of green hydrogen, through an electrolysis process using the freshwater obtained via desalination. The electricity generated by the system itself is used for this purpose, making hydrogen production more efficient and economically viable.

When applied to coastal infrastructures, the system can play a strategic role in protecting against coastal erosion. Its modular geometry and layout enable it to act as a wave energy dissipator, mitigating erosive impacts while simultaneously harnessing that energy to generate electricity and freshwater in a sustainable and economically efficient manner.

TYPES OF UNITS 1/2

1. IMPLEMENTATION IN EXISTING PORTS AND QUAYS

- **Use of Existing Infrastructure:** Maximiser the utilization of established maritime facilities, allowing for rapid and efficient adaptation with minimal environmental or structural impact.

- **Optimized Investment:** Reduces costs by leveraging existing infrastructures, with scalable investment levels according to specific adaptation requirements.
- Investment Attraction: High potential to attract private investors in sustainable technologies, private equity funds, public-private partnerships, and public funding sources.

- **Main Applications:** Renewable energy generation, seawater desalination for freshwater production, and green hydrogen generation via electrolysis.

- **Strategic Benefits:** Reduced environmental impact, effective integration with existing distribution networks, improved process efficiency through the adoption of innovative technologies and system integration. These advantages result in lower costs and waste, faster implementation timelines, and enhanced operational sustainability..

TYPES OF UNITS 2/2

2. NEW UNITS FOR PORTS, MARINAS OR AUTONOMOUS INFRASTRUCTURES FOR COASTAL PROTECTION

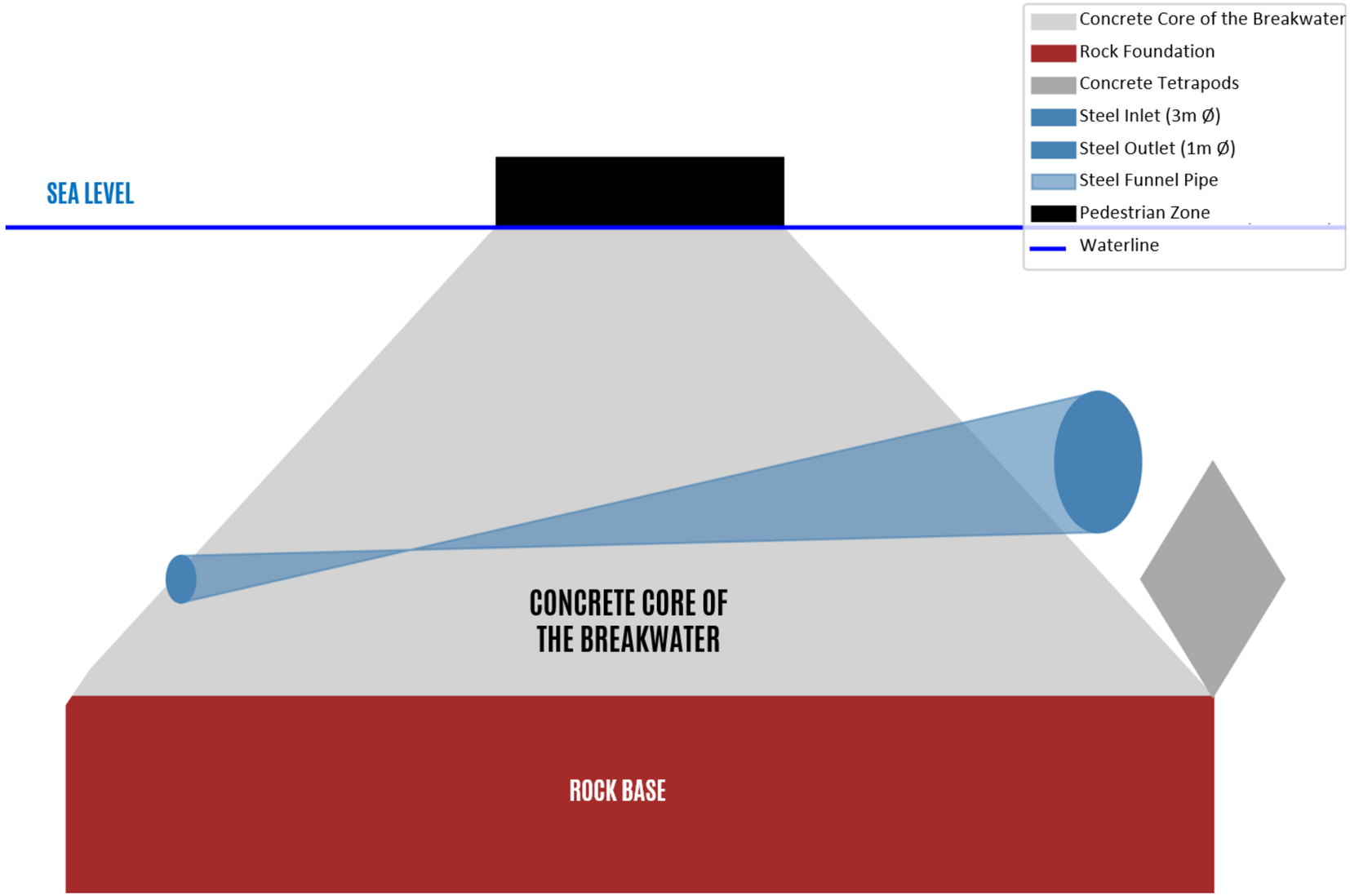
- **Multiple Functions:** Contribute to coastal erosion protection and the production of renewable energy, freshwater, and green hydrogen. These units may be integrated into the expansion of existing maritime infrastructure or deployed as autonomous installations.

- **Integrated Design:** Infrastructure planning from the design phase significantly reduces costs and optimizes the operational efficiency of the solution.

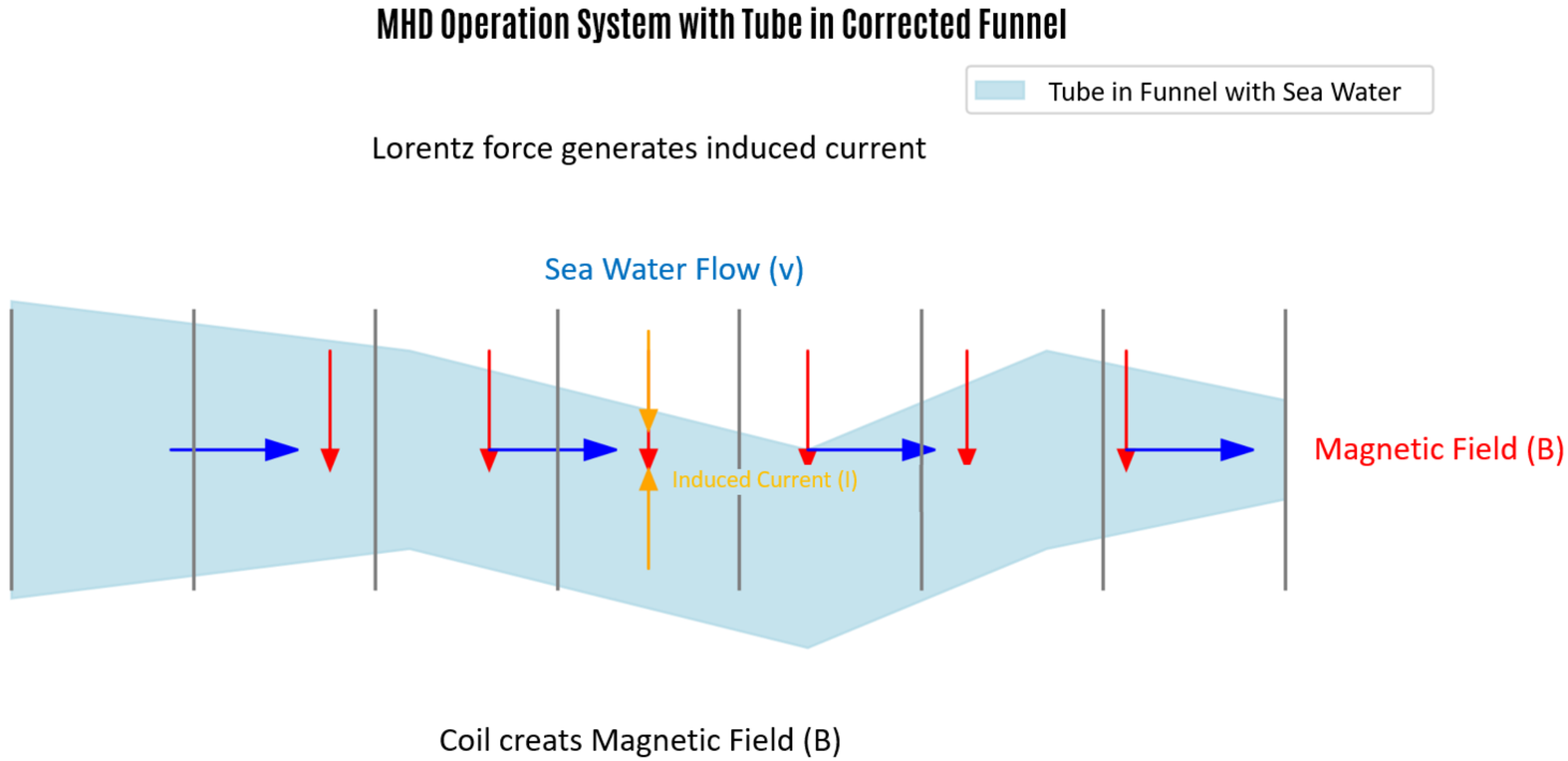
- **Investor Diversity:** Private and institutional investors focused on renewable energy, desalination technologies, and green hydrogen. Governmental or local authorities, as well as public–private partnerships, are also potential stakeholders.

- **Environmental Benefits and Financial Return:** Sustainability combined with economic viability makes the project highly attractive due to its profitability potential and positive environmental impact.

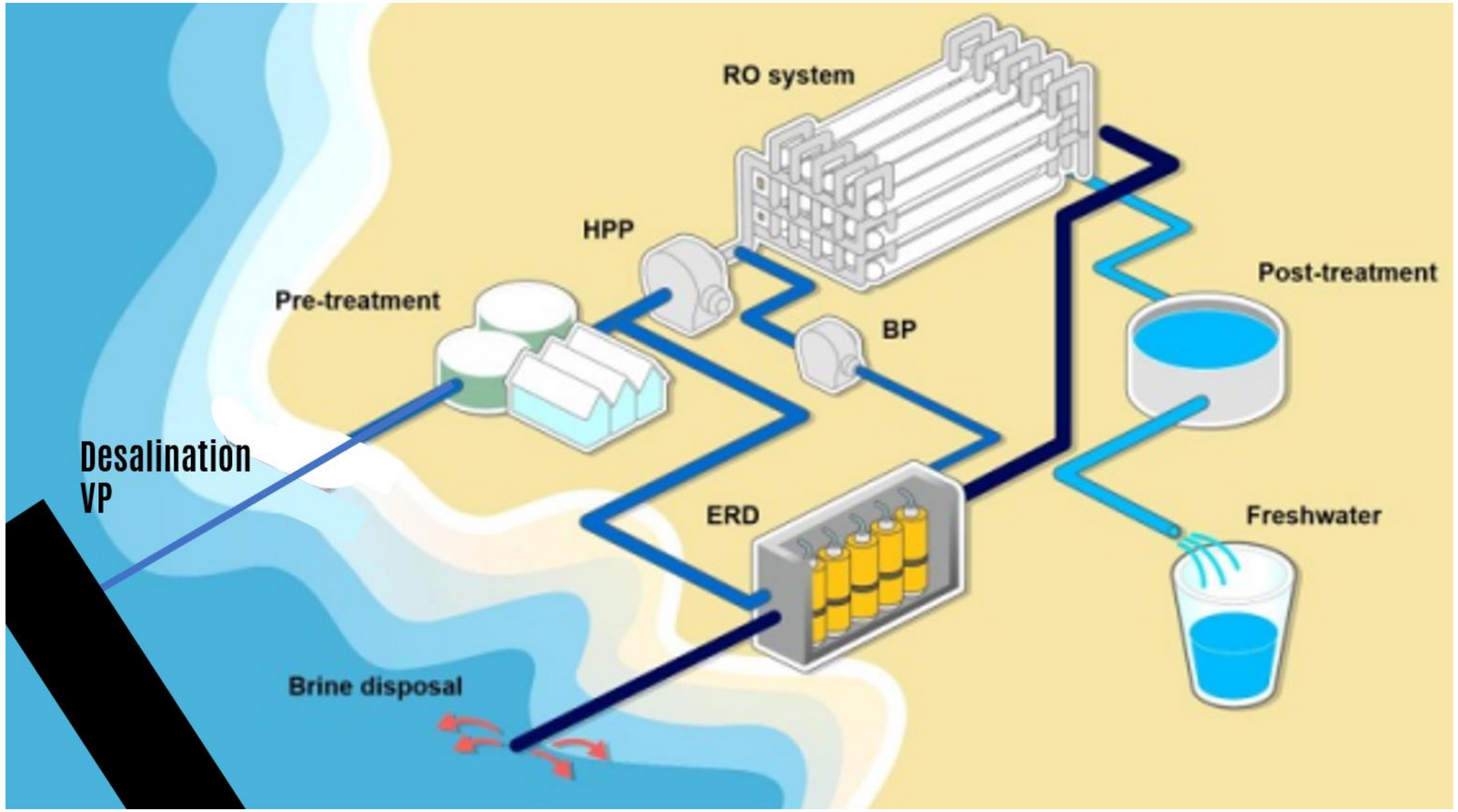
UNIT DIAGRAM
ILLUSTRATIVE CROSS-SECTION



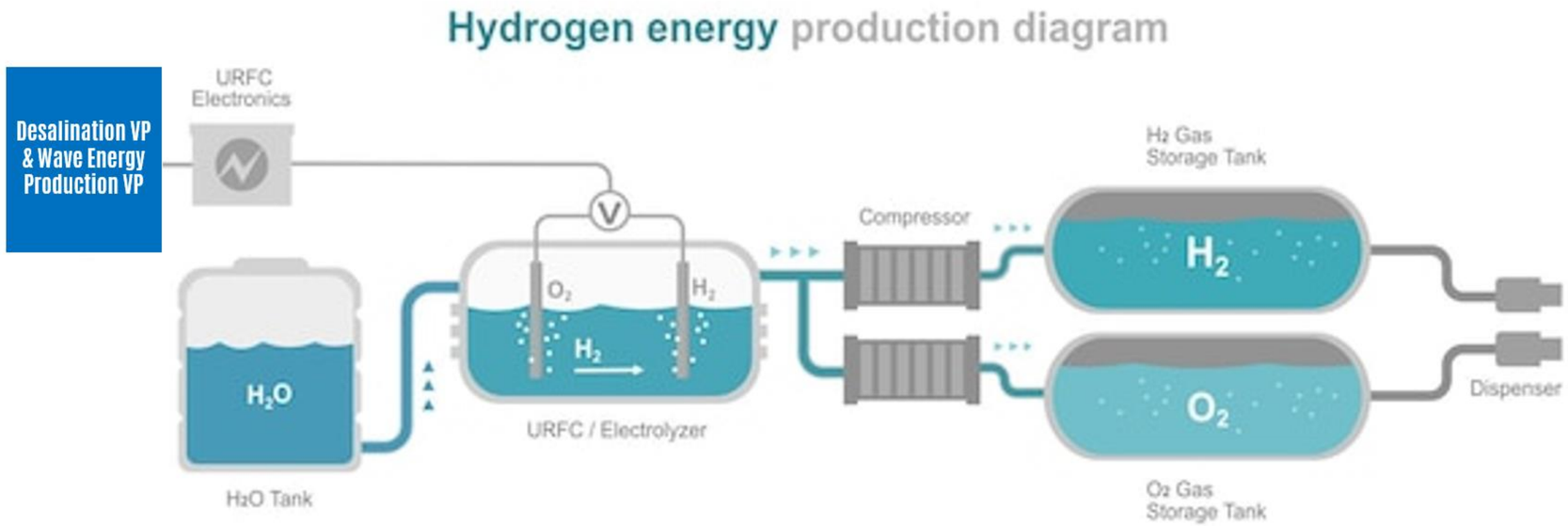
UNIT DIAGRAM
OPERATION OF THE MHD SYSTEM



UNIT DIAGRAM
DESALINATION



UNIT DIAGRAM
GREEN HYDROGEN PRODUCTION



INNOVATION ADVANTAGES

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ADVANTAGES OVER TRADITIONAL EXISTING TECHNOLOGIES

This integrated, multi-product approach creates an unparalleled value proposition. Unlike existing alternatives, which face technical limitations, high costs, and low efficiency, our technology sets a new standard for wave energy utilization.

By offering reliable renewable energy, sustainable desalination, and green hydrogen production within a single, modular, and scalable system, we present the only truly viable and competitive solution on the market, with no direct competition in the current technological landscape.

OPTIMIZED HARNESSING OF KINETIC AND POTENTIAL WAVE ENERGY

Unlike existing solutions, which suffer from low efficiency and high installation and operational costs, our system minimizes both upfront and ongoing expenses while maximizing wave energy capture and conversion into electricity.

DIVERSE GREEN PRODUCT PORTFOLIO – ENERGY, WATER, AND GREEN HYDROGEN

While conventional systems focus solely on electricity generation, our system uniquely enables the simultaneous production of electricity, potable water, and green hydrogen.

ADVANTAGES OVER OTHER RENEWABLE SYSTEMS

Continuous and Predictable Energy

Our system harnesses the kinetic, potential, and chemical energy of waves to ensure stable and predictable electricity generation. This significantly reduces the daily fluctuations common in solar and wind power systems.

Multifunctional Infrastructure Integration

Our system can be integrated into existing maritime infrastructure (ports, breakwaters) or incorporated into new installations, substantially reducing implementation costs. In contrast, wind and solar power often require dedicated spaces, frequently located on agricultural land or in open sea, resulting in significant environmental impact and high installation costs.

Lower Cost per kWh

Our system boasts higher energy capture efficiency and lower maintenance requirements, resulting in a highly competitive cost per kWh, comparable to onshore wind and photovoltaic farms. Offshore wind and photovoltaic installations, on the other hand, face high maintenance costs due to marine corrosion, energy losses from long-distance transmission to the grid, and the need for large installation areas. The variability in their daily energy production further compromises the competitiveness of the generated kWh.

Reduced Environmental Impact

Our system's integration with existing infrastructure minimizes ecological impact, helps protect against coastal erosion, and enables sustainable desalination. Conversely, offshore wind and photovoltaic installations can impact marine life and migratory birds, interfere with navigation and fishing activities, and require large areas, potentially leading to deforestation and ecosystem disruption.

Circular Economy and Sustainability

Our system goes beyond energy generation. It facilitates the integrated production of green hydrogen and oxygen. Leveraging technological advancements, these byproducts can be converted into synthetic fuels like e-fuels and LOHCs (Liquid Organic Hydrogen Carriers), offering an efficient and sustainable alternative to fossil fuels in the automotive, land transport, shipping, and aviation sectors. By utilizing existing infrastructure, these fuels represent a significant step towards reducing reliance on fossil fuels. Solar and wind power, in contrast, are limited to electricity production, which can be used in conventional desalination and hydrogen generation processes, but lack this integrated and versatile approach.

ADVANTAGES OVER OTHER RENEWABLE SYSTEMS

Our system stands out as an efficient, economical, and sustainable solution for the energy transition. Its ability to integrate with existing infrastructure, coupled with continuous energy generation and synergy with desalination and green hydrogen production, positions it as an innovative alternative without direct competition in the current landscape.

With a projected return on investment between 3 and 5 years across its various product streams, our system offers a viable and disruptive solution for a sustainable energy future.

ECONOMIC VIABILITY STUDIES

3

TECHNICAL AND ECONOMIC FEASIBILITY STUDY OF A SINGLE MODULE

ESTIMATED UNIT COST

MHD Unit	380 000€
Desalination Unit	65 000€
Electrochemical Unit	30 000€
Green Hydrogen Unit	70 000€
Study and project development	100 000€
Contingency and prediction errors (15%)	96 750€
TOTAL (PER UNIT)	**741 750€**

TECHNICAL AND ECONOMIC FEASIBILITY ASSESSMENT OF A DESALINATION MODULE

	Energy	Freshwater	Hydrogen
Estimated Annual Production	2 190 000 kWh	53 000 m3	3 000 m3
Projected Annual Revenue	350 000€ / year	53 000€ / year	30 000€ / year
Maintenance and Operation	48 565€ / year	8 224€ / year	8 724€ / year
Annual Return	301 920€	44 775€	21 275€
RETURN OF CAPITAL*	**2 years**	**2 years**	**4,5 years**

*Estimated module cost – amortization period during commercialization.

ACTIVITY PLANNING CALENDAR

4

ACTIVITIES DESCRIPTION

1 FINANCIAL STRUCTURING AND INTELLECTUAL PROPERTY STRATEGY

Developing a robust fundraising plan targeting private investors, venture capital, and public funding. Securing intellectual property protection through patents is prioritized to establish technological exclusivity and strengthen the company's intangible assets.

2 TECHNICAL AND ECONOMIC FEASIBILITY STUDY

A detailed assessment of the technical, financial, and commercial potential will ensure the project's viability and sustainability across its three core areas: green energy production, desalination, and green hydrogen.

3 RESEARCH PROJECT AND UNIT DESIGN

This phase focuses on developing innovative solutions and defining the technical architecture of the unit, emphasizing efficiency, scalability, and sustainable integration.

4 CONSTRUCTION OF THE PILOT UNIT (EXPERIMENTAL MODULE)

A pilot unit will be implemented for practical validation, ensuring that technical and operational requirements are met. This hands-on testing is crucial for demonstrating the technology's effectiveness.

5 CONSTRUCTION OF PARALLEL MODULES

The project will scale up by creating multiple operational modules to increase production capacity. This phase includes integrating new green products (green energy, fresh water, green hydrogen, and oxygen) and optimizing the profitability of the base unit. The focus extends to developing and implementing green technology within a circular economy framework, promoting sustainable mobility in land, sea, and air transport using easily adaptable green fuels.

6 MAINTENANCE AND OPERATION

This ongoing phase focuses on managing operations and maintenance, ensuring efficiency, optimal performance, and long-term sustainability. It emphasizes the continuous improvement and evolution of green technologies, reinforcing the circular economy and sustainable mobility.

PLANNING FOR 3 YEARS

The detailed planning emphasizes a robust approach focused on risk mitigation, operational efficiency, and project scalability. This makes it an attractive and secure opportunity for new investors and partners, facilitating expansion to new units and the development of strategies for new products. The summary reinforces the project's value proposition by highlighting its well-structured plan and potential for growth.

TECHNICAL AND ECONOMIC FEASIBILITY STUDY

3 MONTHS

This phase emphasizes detailed analysis to inform strategic decisions and mitigate risks. Key activities include:

1) Evaluating the technical and economic potential of individual projects and their integration; 2) Filing for intellectual property protection (patents). This reinforces the importance of securing IP rights early in the process; 3) Conducting market research to assess commercial viability and competitiveness;. **Objective: To establish a solid foundation for subsequent phases.**

RESEARCH PROJECT AND UNIT DESIGN

1 YEAR

This phase centers on technological development, including:

1) Studies and adaptation tests for selected locations, using numerical models and small-scale prototypes. This demonstrates a practical, iterative approach to design; 2) Optimization of technologies for efficiency and sustainability; 3) Detailed design of the Pilot Unit (Experimental Module) in the areas of energy production, desalination, and green hydrogen, ensuring technical compliance.

Objective: To validate solutions and adapt the unit to real-world conditions.

PILOT UNIT CONSTRUCTION Experimental Module

1 YEAR

This phase involves operational testing for practical validation:

1) Assessing technical performance, efficiency, and viability before scaling up production; 2) Identifying and correcting flaws for continuous improvement. This highlights the importance of learning from the pilot phase before full-scale implementation.

TRIALS & NETWORK INTEGRATION

9 MONTHS

Definitive validation and integration of the unit into the operational ecosystem. Key activities include:

1) Detailed operational tests and continuous optimization of the unit. This emphasizes the importance of fine-tuning performance before full-scale deployment; 2) Compliance testing with industry standards and regulations. This ensures the project meets all legal and safety requirements; 3) Integration with local networks, guaranteeing scalability and full functionality of the unit for market entry, adapting solutions to the real operating environment. This crucial step ensures the unit can seamlessly integrate into existing infrastructure.

COMMERCIALIZATION

CONCLUSIONS & POTENCIAL

5

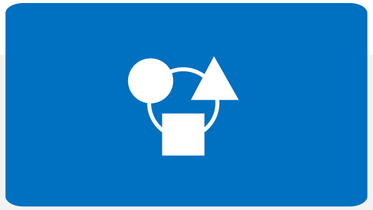
THE PROPOSED SYSTEM IS AN INTEGRATED SOLUTION FOR RENEWABLE ENERGY GENERATION, DESALINATION, AND GREEN HYDROGEN PRODUCTION, WITH FLEXIBLE INSTALLATION ON EXISTING STRUCTURES (PORTS AND OFFSHORE PLATFORMS) AND NEW INFRASTRUCTURES.

High Versatility and Environmental Sustainability

Quick installation, with low visual, noise, and environmental impact. Protects coastal ecosystems while producing energy and fresh water.

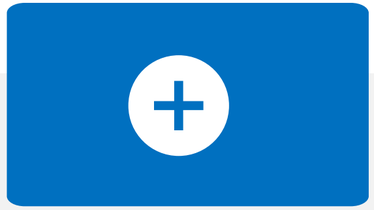
Energy Efficiency and Innovation

Use of innovative and advanced technologies in the production of electricity and fresh water, reduces transmission losses and connection network costs, offering high operational performance.



Multiple Functions and Added Value

Combines renewable energy, desalination, hydrogen, and coastal protection, with minimal impact on navigation and fishing.



Contribution to the Energy Transition

Innovative system that also produces green hydrogen and oxygen, allowing its combination with CO_2 from waste incineration - a byproduct that must be captured and eliminated. This integration enables the production of e-fuels (e-Fuels, LOHCs) at competitive market prices. Furthermore, these fuels can use existing gasoline, diesel, and natural gas transport and distribution infrastructures, with minimal adaptations, accelerating the decarbonization of various sectors, such as road, maritime, air, and fishing transport.

PARTNERSHIPS

PROMOTER/COORDINATOR: Virgílio Preto is leading the project's promotion and overall coordination. He is the point person and driving force.

FUNDING INSTITUTIONS: The project is seeking funding from venture capital firms and other entities interested in backing innovative projects. The possibility of participating in R&D (Research and Development) incentive programs is also being explored. This highlights the project's focus on securing financial backing and leveraging available support.

RESEARCH INSTITUTION: The project is actively looking for a research partner with strong expertise in applied research and technological development. This indicates a need for scientific and technical expertise to bring the project to fruition.

UNIVERSITIES: Similar to the research institution, the project aims to collaborate with recognized higher education institutions. This partnership would strengthen the academic and technological aspects of the project, likely involving student research, faculty expertise, and access to university resources.

DRIVING ENTITY: The project seeks an organization capable of promoting and expanding the project within the business ecosystem. This suggests a need for a partner with strong business development and networking capabilities to help commercialize the project's outcomes.

AUTHOR: This document was authored by Virgilio Marques Preto, reinforcing his role as the project's originator and promoter.