Workshop BioTheRoS

Collaborative actions to bring novel BIOfuels THErmochemical Routes intO industrial Scale

GREEN HYDROGEN PROJECT

The path towards a Hydrogen Hub in East Med

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www.moh.gr | 23 OCTOBER 2025

MOTOR OIL

Potential uses of Renewable H2

Industrial Processes

- **Hard-to-abate Industries**: Renewable H_2 can replace fossil fuels in various industrial processes, such as **steel and cement** production, where **high-temperature heat is required**
- **Refineries:** Renewable H_2 has the potential to **replace grey H_2** in refineries, especially as the global energy transition towards cleaner and more sustainable sources accelerates
- **Backup Power:** Hydrogen-powered fuel cells or combustion engines can provide **backup power in critical infrastructure**

Transportation

- **Heavy-Duty Vehicles**: Renewable H_2 can **power heavy-duty vehicles** like trucks, buses, and trains, offering long-range capabilities and reduced emissions
- **Aviation**: **e-SAF** & other synthetic fuels can be produced using **renewable H_2 & captured CO_2**, through a process called power-to-liquid (PtL) or power-to-X (PtX)
- **Maritime**: Renewable H_2 is a key feedstock in the production of chemicals, including **ammonia, methanol** which hold potential for decarbonizing Maritime Transport

Energy Storage & Grid Balancing

- **Grid Balancing Services**: Renewable H_2 **can serve as a valuable tool for grid balancing services**, helping to address the **intermittency and variability of renewable energy sources** such as solar and wind power. It can be produced during times of excess renewable energy generation, addressing the foreseen curtailments and be stored. It can then be converted back to electricity using fuel cells or combustion engines during peak demand or when renewable energy generation is low, helping to balance the electricity grid

Blending with Natural Gas

- **Injection to Natural Gas grid:** Renewable H_2 **injection into the natural gas grid** involves blending hydrogen, utilizing the existing natural gas infrastructure. This will enable the decarbonization of the gas sector and the increase of energy security. Examples of its usage can be found in the the **fossil fuels-based Power Generation** (i.e., CCGTs) and **in District Heating applications** (i.e., CHP Units)

Circular Economy

- **Upcycling through waste valorisation e.g. waste-to-fuels:** Using renewable hydrogen to convert waste into synthetic fuels **supports** the **circular economy**, **reduces waste disposal**, and provides a sustainable alternative to fossil fuel-based production methods.
- **Hydrogen as a Process Heat Source**: Renewable H_2 can be used as a heat source for **waste treatment processes**, such as pyrolysis and thermal gasification

International Trade & Exports

- **Green Hydrogen as an Export Commodity**: Countries with abundant renewable energy resources can produce green hydrogen and **export it to regions with limited renewable energy potential**. This supports **energy diversification**, reduces dependence on fossil fuel imports, and fosters international cooperation in achieving climate goals

Legend

H_2 derivatives

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Source: Hellenic Hydrogen 2024

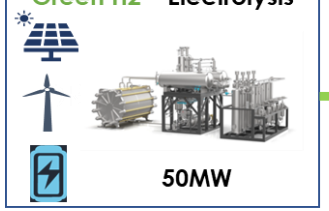
GREEN HYDROGEN PROJECT: The Path Towards a Hydrogen Hub in East Med

Development of flexible, scalable and cost advantaged infrastructure for the production and distribution of Renewable Hydrogen for use in industry and transport

PRODUCTION

Ephyra[1]

Green H2 – Electrolysis



50MW

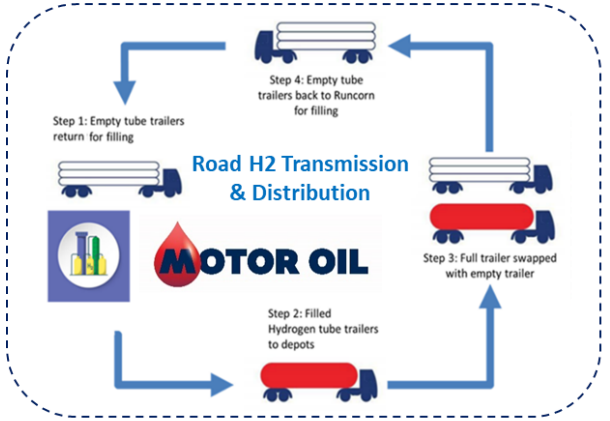
IRIS

Refinery CCS

CO2

CONVERSION & DISTRIBUTION

TRIĒRĒS[2]



H2 Network

Injection to Gas Turbine

Alternative & Renewable Fuels

UTILIZATION

Industry

LPC Green Lubricants

Transport Sector

Heavy Duty Vehicles

Short-sea Shipping

MOTOR OIL

[1] *For the 30 MW system*

[2] *For 3 trailers*

Green Hydrogen Project – A Unique European Project

€ 111.8 mln Subsidy approved EC (SA.E. 1048999)

Scope of Supply	
1. Electrolysis Unit **50 MW** (incl. utilities, demin water supply, cooling tower, H2 & O2 purification, connections to refinery, PLC, MCC, MV substation)	
2. New HV Electrical Substation S-0	
3. H2 Tube Trailer Terminal (incl. compressors, loading panels, trailers)	
4. H2 Compression & Injection (GT6 injection capability)	
TOTAL BUDGET (mln EUR)	**146**

Project Key Features

- 50 MW Electrolyzer construction to be completed in 2026
- **>5000** tons per annum Green Hydrogen Production
- Electrolyzer to be supplied by a 212 MW green industrial PPA
- Among largest electrolyzers currently operating in Europe & largest under construction in Balkans
- Industrial Symbiosis (i.e. O2 utilization, Energy & digital management, waste heat valorization)
- Compressed Hydrogen Loading Terminal to be operational in 2026
- Compressed gas hydrogen transport by 4 tube trailers readily available with ability to reach up to 500 km radius
- Hydrogen Pipeline network at the refinery
- Supplying Industry – Hydrogen Refueling Stations & ability for injection to grid, CHP plant or new units (green fuels)

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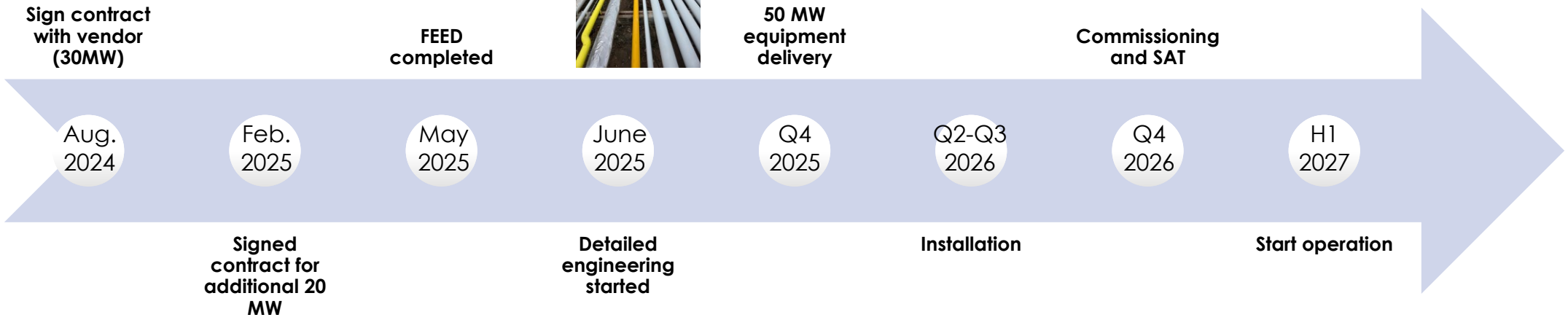
Project's Timeline

- In April 2025 MOH reached FID for an upscale of the Electrolysis system to **50 MW**. The additional 20 MW system will be installed and operate at the same time with the 30 MW system.
- For the 50 MW system funding is secured through the projects EPHYRA under the call HORIZON-JTI-CLEANH2-2022-2 and Green Hydrogen Project under Greek RRF State Aid. It is also co-financed by EIB.



Value chain - From enhanced renewable H2 production to a small-scale valley operations

GREEN H2 PROJECT

Ephyra

MOTOR OIL

Electrolyser
Green H2 production

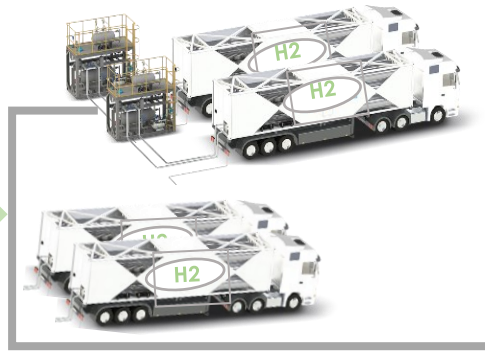
H2
O2

Direct H2 and O2
use in MOH refinery

Refinery decarbonization & synthesis of advanced fuels

MOTOR OIL

Track loading Compression Terminal



Pipe System
Compression Terminal

TRIĒRĒS *

- LPC — Lubricants Refinery
- AVIN — HRS Network
- OLYMPIA ODOS, ΟΣΥ — Mobility applications
- ECOFERRY — Maritime applications
- ΟΛΠ — Energy production
- DIORIGAGAS — Injection to Natural Gas Grid
- FULGOR, MOTOR OIL — Industrial applications

H2 Production

- ✓ Short-term forecast of available H2 quantity (according to PPA execution)
- ✓ Real-time availability of H2 quantity
- ✓ Cost of production
- ✓ H2 quality parameters

H2 Trading & Distribution

- Quantity H2 requested
- Quantity of trucks
- Timing of request
- Quality of supply
- Retail cost to the customer

* The Greek Hydrogen Valley is developed in the framework of the EU project TRIERES co-funded by the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research under Grant Agreement No. 101112056.

EPHYRA - Project Summary

SCOPE

- To establish the 1st of its kind **renewable** hydrogen production facility at industrial scale in South-eastern Europe – **30 MW Electrolysis plant (upscaled to 50 MW)** within MOH's Corinth refinery. The EZ will enter a **commercial operation** for at least 2 years to supply H2 to **refinery's processes** and **external end-users**

High-level objectives

Develop a **detailed technology** and **integration concept** for an innovative **AEL electrolyser**

Optimize the **synergies** among: H2 production - use - complementary supply & valorisation streams

Develop a **digital twin**, controls and automation of the **H2 plant and its (symbiotic) environment**

Set up and operate the integrated H2 production plant and complementary supply and valorisation streams (local circular H2 economy), including **standardization** and **safety** aspects

Duration June 2023 – May 2028 (**5 Years**)

Clean Hydrogen Partnership
Co-funded by the European Union

Consortium and main roles in the project

10 Beneficiaries

1 Associated Partner

6 Countries

MOTOR OIL

Coordinator / Electrolyser Operator

Beneficiary / ORC technology assessment

CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

Beneficiary / Technology assessment, lab scale plasma technology experiments for WWT processing, Modeling, optimization, digital twin

orcan The Efficiency Company

Beneficiary / ORC technology

ITAINNOVA INSTITUTO TECNOLÓGICO DE ARAGÓN

Beneficiary / Digital twin of electrical network

RINA

Beneficiary / Life Cycle & Cost Benefit Analysis

DLR

Beneficiary / Modeling, optimization, digital twin

SoluForce®

Beneficiary / Transport piping (RTP)

ENVIROMETRICS Climate | Environment | Energy

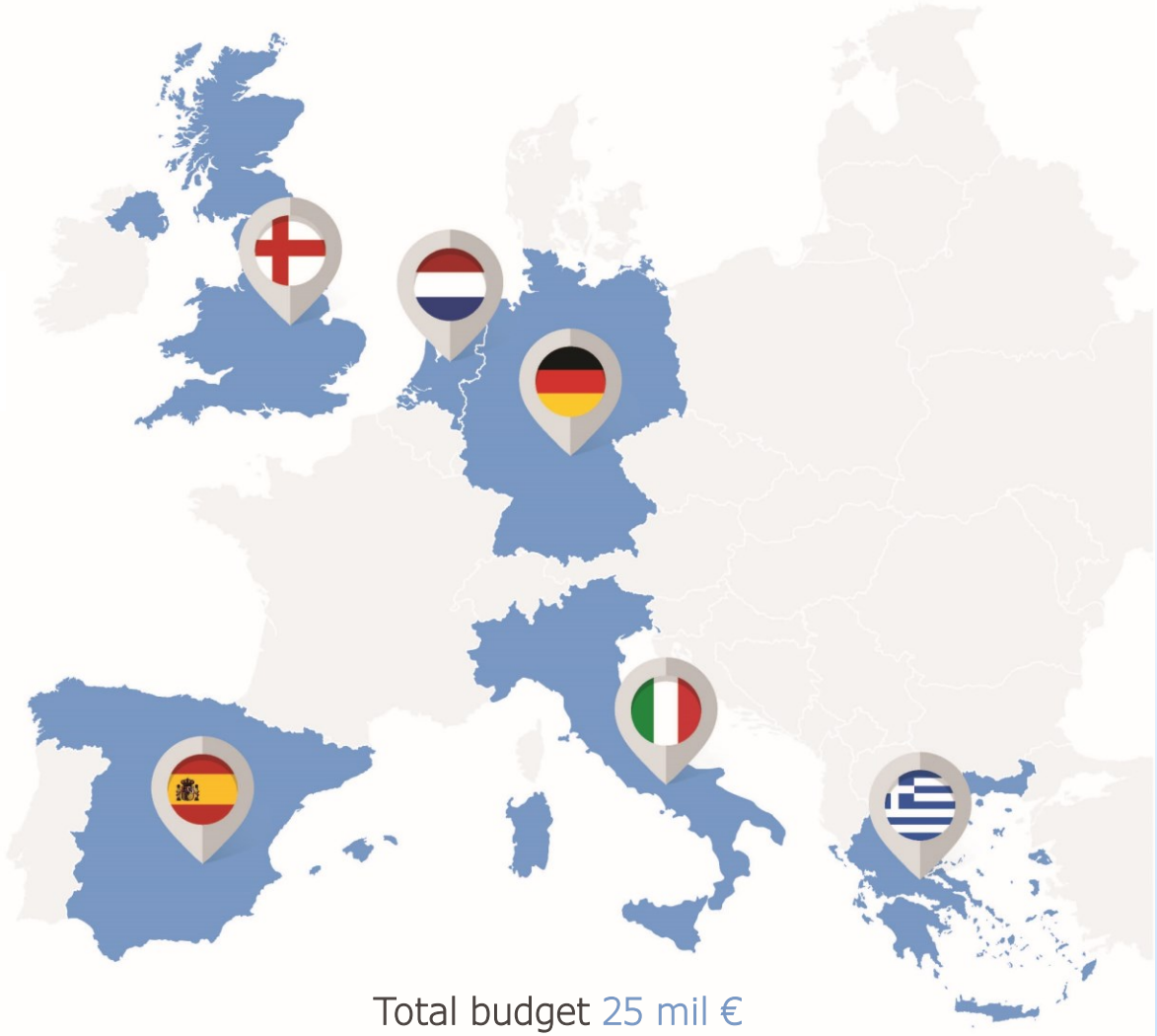
Beneficiary / Emission monitoring & GHG footprint

SIEMENS

Associated Partner / Process modelling, digital twin, Real-time digital operation support

etaflorence renewable energies

Beneficiary / Communication, dissemination



Total budget 25 mil €
EU Grant 18 mil €

Ephyra

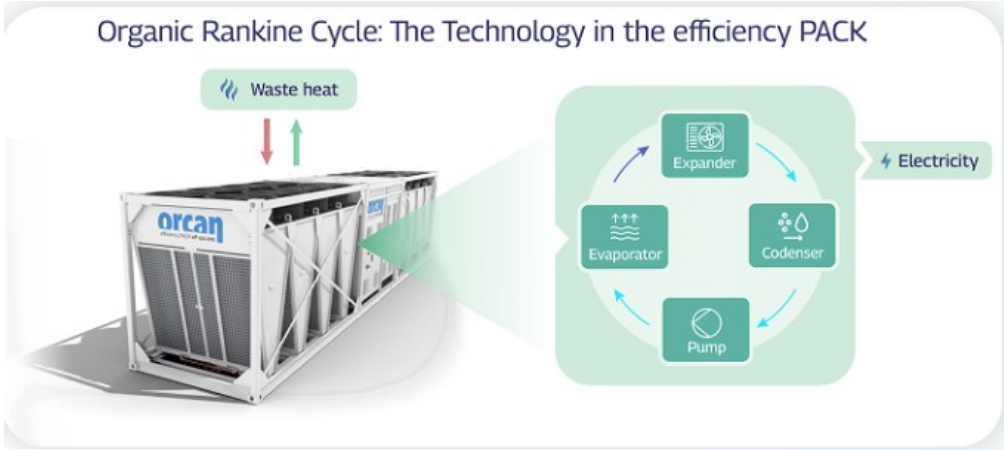
The project is supported by the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research under Grant Agreement No. 101112056

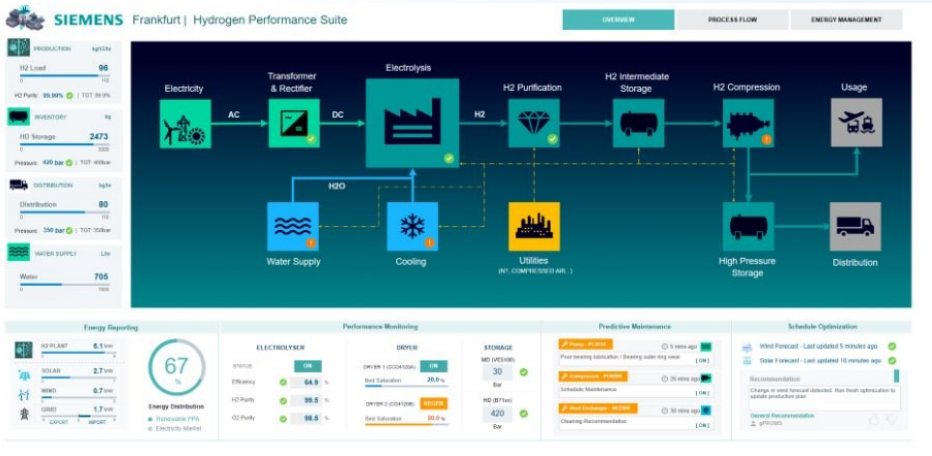
Clean Hydrogen Partnership

Funded by the European Union

Innovations

1. **Large-scale** (5-10 MW stacks), **pressurized** (20 barg) **systems with next generation electrode technology** to optimize performance, cost, footprint and dynamic response
2. **Usage of Co-product Oxygen** at the refinery (e.g. Claus units)
3. **Usage of waste heat** for energy generation **via an Organic Rankine Cycle** machine
4. **Usage of non-fresh Water** (desalination) and assessment of a novel method of reject water re-use via lab-scale plasma wastewater treatment
5. Optimal design of **large-scale industrial electrical grids & energy management** concept
6. **Digital** process **twin** development
7. **Transport piping** concept via use of Reinforced Thermoplastic Pipes (RTP)





Clean Hydrogen Partnership

Co-funded by the European Union

Value chain - From enhanced renewable H2 production to a small-scale valley operations

GREEN H2 PROJECT

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Electrolyser
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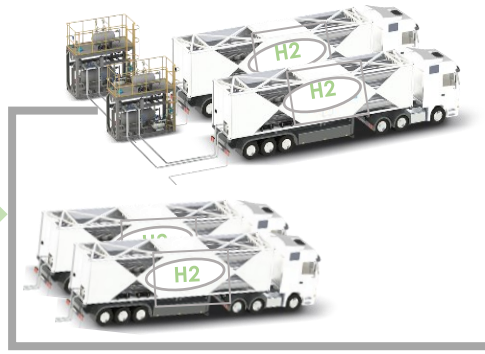
Refinery decarbonization &
synthesis of advanced fuels

MOTOR OIL

Track loading Compression
Terminal



Pipe System
Compression Terminal

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* The Greek Hydrogen Valley is developed in the framework of the EU project TRIERES co-funded by the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research under Grant Agreement No. 101112056.

The project
in a nutshell

5
Countries

26
Partners

2,410
Tons of renewable H_2 supplied per year

9,880
Tons/year CO_2 removed from industry & mobility via fuel substitution with renewable H_2

58 Months
5 years
July 2023 – April 2028

8 mil €
Total EU grant

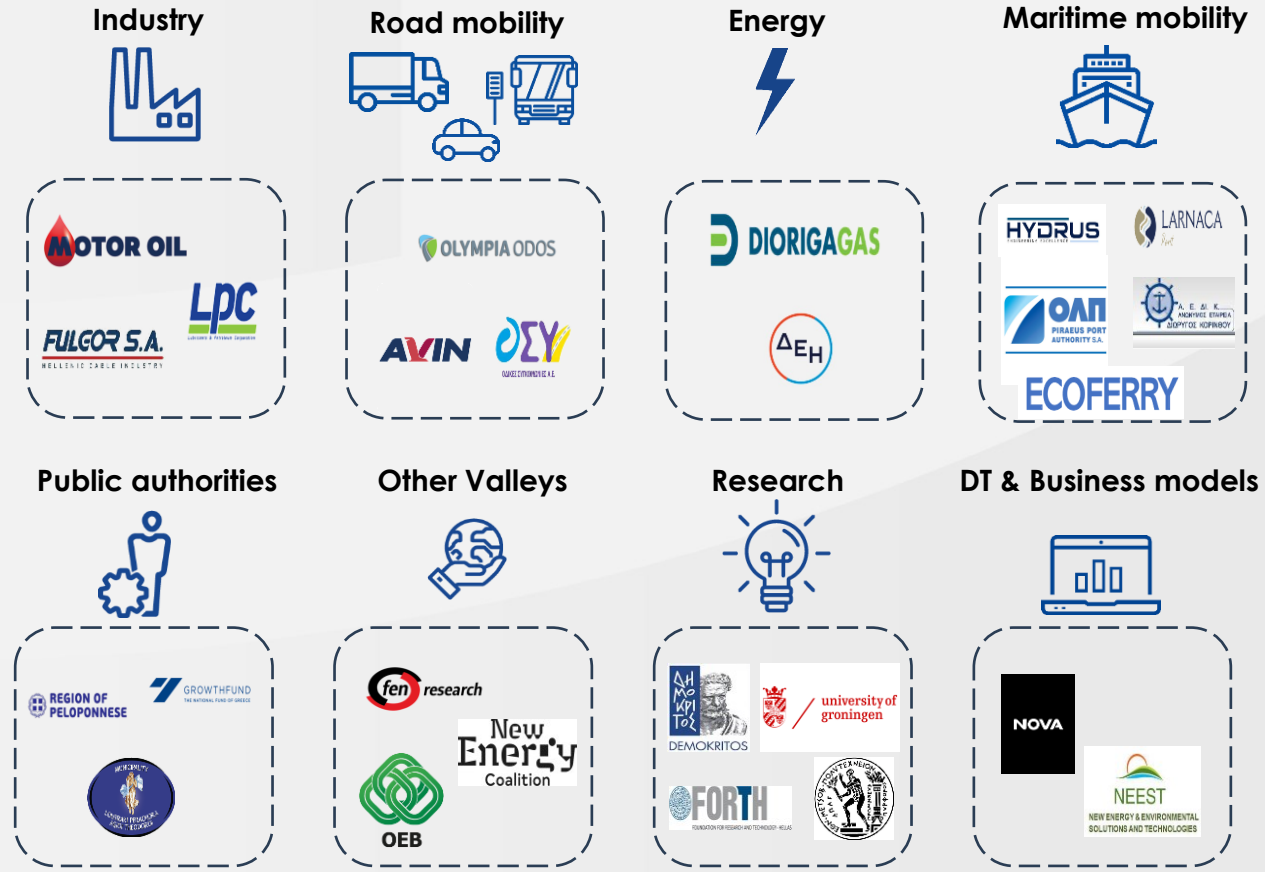
TRIĒRĒS

The project is supported by the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research under Grant Agreement No. 101112056

Clean Hydrogen Partnership

Funded by the European Union

Versatility in end-use applications



Industry:

- Consumption of renewable hydrogen by **Motor Oil Hellas refinery** in Ag. Theodoroi and the **lubricant refinery of LPC** in Aspropyrgos during TRIĒRĒS project, aiming to reduce carbon dioxide emissions from their production processes.

Road Mobility:

- Up to three (3) **urban buses** operated within the metropolitan area of Athens.
- One (1) **light hydrogen-powered vehicle** used for day-to-day operations along the TEN-T network.
- One (1) **passenger car** operated by the Municipality of Loutraki– Perachora – Ag. Theodoroi.

Maritime Mobility:

- One (1) **short sea ferry vessel** retrofitted with a 200kW FC system.

Energy:

- One (1) **small-scale clean energy production unit** (100 kWe FC-APU) to produce electricity via green hydrogen at the Port of Piraeus.

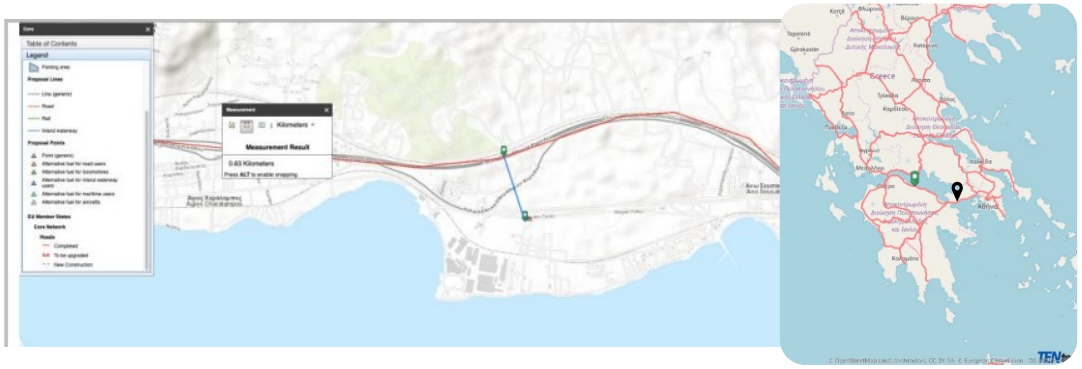
The project is supported by the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research under Grant Agreement No. 101112056

Co-funded by the European Union

REA / REAH3 – Hydrogen Refueling Stations

- REA - Construction of a HRS for passenger, light-duty and especially long-haul heavy-duty vehicles in Agioi Theodoroi (Corinth, Peloponnese, Greece)
- REAH3 - Construction of a HRS for public transport buses in a bus depot (Attika, Greece)

- The **1st Hydrogen Refueling Station (HRS) – REA** will be installed inside a new service station of AVIN OIL (AVIN) located near the central TEN-T road network in the area of Ag. Theodoroi, Corinth, Greece
- It serves as a **gateway and local hub** to the south part of **Orient/East Med corridor**



- **REA 1st HRS Ag. Theodoroi - Operational in Q1 2025**

Source: EPHYRA Electrolyzer by MOH in Ag. Theodoroi Refinery

Mass flow (compressor): 65 kg/hour minimum

Service Capacity: Trucks, Buses, Cars

Pressure Levels: 350 bar and 700 bar

* REA project is funded from the Connecting Europe Facility programme under Grant Agreement No. 101079451.

* REAH3 project is funded from the Connecting Europe Facility programme under Grant Agreement No. 101165972.

Synergies of EU co-funded projects

Disclaimers for EC funding:

- EPHYRA project is supported the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research under Grant Agreement No. 101112220
- TRIERES project is supported the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research under Grant Agreement No. 101112056
- IRIS project receives funding from the European Innovation Fund programme under Grant Agreement No. 101133015
- REA project has received funding from the Connecting Europe Facilit – Transport programme under Grant Agreement No. 101079451
- REAH3 project has received funding from the Connecting Europe Facility – Transport programme under Granta Agreement No 101165972

AKRATA

Safe reliable transport to end users by Coral Gas

MOTOR OIL

MOH Refinery

Ephyra

Green Hydrogen Production Unit

TRIĒRĒS

Small Scale Hydrogen Valley

IRIS

Sustainable hydrogen and e-methanol production through deep refinery decarbonization

LPC

Supply H_2 to Lubricants' Refinery

AVIN

REAH3

1 Hydrogen Refueling Station (HRS) for public transport means – buses in Attika

1 FC EV passenger car

Municipality of Loutraki

CORINTHOS

Olympia Odos

1 FC EV passenger car

Safe reliable transport to end users by Coral Gas

3 FC EV Buses

ATHENS

PORT OF PIRAEUS

AG. THEODOROI

SALAMINA

1 short-sea ferry vessel, 200kW FC

1 FC APU 100kWe to produce clean electricity via green hydrogen

AVIN

REA

1 Hydrogen Refueling Station (HRS) for passenger cars, light-duty and heavy-duty vehicles

Circular Economy & industrial symbiosis

Ephyra

Renewable H_2 Production

+ Green Hydrogen Project (expansion to 50 MW)

TRIĒRĒS

Renewable H_2 Logistics

Renewable electricity · Waste heat usage via ORC · Non-fresh water use · Digital Twin & dedicated energy management system

- 30 MW AEL Electrolyser
- Direct H_2 & O_2 use within MOH Refinery
- Track loading compression terminal
- Pipe system compression terminal
- 3 Tube trailers
- DIORIGA GAS Injection to Natural Gas Grid
- FULGOR Physical pipeline MOH-FULGOR

Key take-aways

- **Green Hydrogen project** develops a 50 MW industrial hydrogen production facility using renewable energy along with supporting infrastructure for its distribution.
- **EPHYRA**, co-funds the electrolysis system and promotes circular economy principles, like valorizing waste heat.
- **TRIĒRĒS**, creating a small-scale hydrogen valley, linking renewable hydrogen production with diverse end-users and centered on Motor Oil's Agioi Theodoroi refinery, fostering pilot projects, and collaborating with pioneer EU valleys in Netherlands and Austria and emerging hydrogen economies of Cyprus and Egypt.
- **Renewable Hydrogen (RH2)** will be used directly as **fuel** and as **feedstock** to produce hydrogen derivatives contributing to the decarbonization of **hard-to-abate industries** and **transport sector.**

- **5,160 tpa** of renewable hydrogen produced within the Green Hydrogen project
- **Scope-1 and scope-3 emission avoidance** of the Green Hydrogen Project of Motor Oil:

  - **48,710 tpa** of CO2 (scope-1), if it was assumed that RH2 would substitute hydrogen produced from the SMR process[1].
  - **3,771 tpa** of CO2 avoidance (scope-1) from natural gas replacement in the gas turbine at the Refinery.
  - **39,894 tpa** of CO2 scope 3 emission savings via fuel substitution (with hydrogen and hydrogen derivatives), amounting to **~797,880** tons of CO2 emission savings over the Project's lifetime.

[1] *Based on emission factor of 9.44 t CO2 / t H2 produced from the SMR.*

European Commission

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Available languages: English

DAILY NEWS | Feb 13, 2025 | Brussels | 10 min read

Daily News 13 / 02 / 2025

Commission approves €111.7 million Greek State aid measure under the Recovery and Resilience Facility to support Motor Oil Hellas to produce renewable hydrogen

The European Commission has approved, under EU State aid rules, a €111.7 million Greek measure to support **Motor Oil Hellas**, a Greek refinery company, to produce renewable hydrogen. The measure will contribute to the decarbonization of the mobility and industrial sectors and will help kick-start the hydrogen market in Greece. The measure will be fully funded through the Recovery and Resilience Facility ('RRF'), following the Commission's positive assessment of Greece's Recovery and Resilience Plan, and its adoption by the Council.

The measure will support Motor Oil Hellas in the implementation of its "Green Hydrogen" project. The project concerns the **installation of an electrolyser** with a target capacity of 50 MW, which will operate with **energy from renewable sources**. The renewable hydrogen will be used for different purposes, such as for mobility and other industrial applications (e.g. the production of sustainable fuels). The aid will take the form of a **direct grant**.

The Commission assessed the measure under EU State aid rules, in particular Article 107(3)(c) of the Treaty on the Functioning of the EU, which enables Member States to support the development of certain economic activities under certain conditions, and the 2022 Guidelines on State aid for climate, environmental protection and energy ('CEEAG'). The Commission found that the measure is **necessary and appropriate** to contribute to the reduction of greenhouse gas emissions through the production and supply of renewable hydrogen, in line with the objectives of the REPowerEU Plan. The Commission also found that the measure is **proportionate**, as: (i) the aid is limited to the minimum necessary, (ii) a claw-back mechanism will be triggered in case the project renders higher profits than foreseen, and (iii) it has a limited impact on competition and trade between Member States. On this basis, the Commission approved the Greek measure under EU State aid rules.

The non-confidential version of the decision will be made available under the number SA.104899 in the State aid register on the Commission's competition website once any confidentiality issues have been resolved.

(For more information : Lea Zuber – Tel.: +32 2 295 62 98; Sara Simonini - Tel.: +32 2 298 33 67)

Thank you!

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