# HYDROSOL-BEYOND

## THERMOCHEMICAL HYDROGEN PRODUCTION IN A SOLAR STRUCTURED REACTOR: FACING THE CHALLENGES AND BEYOND

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| **Project ID** | 826379 |
| **PRR 2024** | Pillar 1 – Renewable hydrogen production |
| **Call topic** | FCH-02-4-2018: Thermochemical hydrogen production from concentrated sunlight |
| **Project total costs** | EUR 2 999 940.00 |
| **Clean $H_2$ JU max. contribution** | EUR 2 999 940.00 |
| **Project period** | 1.1.2019–31.03.2024" |
| **Coordinator** | Ethniko Kentro Erevnas Kai Technologikis Anaptyxis, Greece |
| **Beneficiaries** | Abengoa Innovacion Sociedad Anónima, Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, Commissariat à l'énergie atomique et aux énergies alternatives, Deutsches Zentrum für Luft- und Raumfahrt EV, EngiCer SA, HyGear BV, HyGear Fuel Cell Systems BV, HyGear Hydrogen Plant BV, HyGear Operations BV, HyGear Technology and Services BV, Scuola universitaria professionale della Svizzera italiana |

http://www.hydrosol-beyond.certh.gr/

### PROJECT AND GENERAL OBJECTIVES

The Hydrosol-beyond project is a continuation of the Hydrosol-technology series of projects, which focus on using concentrated solar power to produce hydrogen from the dissociation of water through redox-pair-based thermochemical cycles. Hydrosol-beyond is an ambitious scientific endeavour aiming to address the major challenges and bottlenecks identified during previous projects and to further boost the performance of solar hydrogen production technology through innovative solutions that will increase the potential of the technology's future commercialisation.

### NON-QUANTITATIVE OBJECTIVES

- Heat recovery.
- Minimisation of the parasitic losses mostly related to the high consumption of inert gas.
- Improvement of reactor design.

### PROGRESS AND MAIN ACHIEVEMENTS

- Stable $NiFe_2O_4$ lattice structures have been produced.
- The durability of the $NiFe_2O_4$ lattice structures has reached 430 cycles, but not end of life. The material is still operating at a stable performance.
- A small-scale hybrid ceramic/metallic heat exchanger has been constructed and tested. The results were taken into account in the development of the full-scale heat exchanger.
- The production of $NiFe_2O_4$ lattice structures for application on the tubular solar reactor at the solar platform has been scaled up.
- A scaled-up hybrid ceramic/metallic heat exchanger has been constructed and integrated into the solar platform.
- The indirectly irradiated tubular solar reactor was operated under suboptimal conditions. The hydrogen production was at the same level as in the directly irradiated solar cavity reactor.

### FUTURE STEPS AND PLANS

Operation of the Hydrosol solar platform with integrated heat recovery system will take place.

### PROJECT TARGETS

| Target source | Parameter | Unit | Target | Achieved to date by the project | Target achieved? | SOA result achieved to date (by others) | Year for reported SOA result |
|---|---|---|---|---|---|---|---|
| AWP 2018 | Demonstrate the process at a realistic scale and under realistic working conditions, using existing solar demonstration facility (> 200 kW range) | kW/reactor | 250 | 150 | ✓ | 250 | 2018 |
| | Durability | cycles | 1 000 | 430 | | 602 | 2018 |
| | Achieve heat recovery rates of high-temperature heat in excess of 60 % | % | 60 | 46 | | N/A | 2018 |
| | Water-splitting redox material durability | cycles | 1 000 | 400 | | 600 | N/A |
| | Solar-to-fuel efficiency | % | > 5 % in field tests | 6.60 | | 5 | 2017 |



Clean Hydrogen Partnership
Co-funded by the European Union