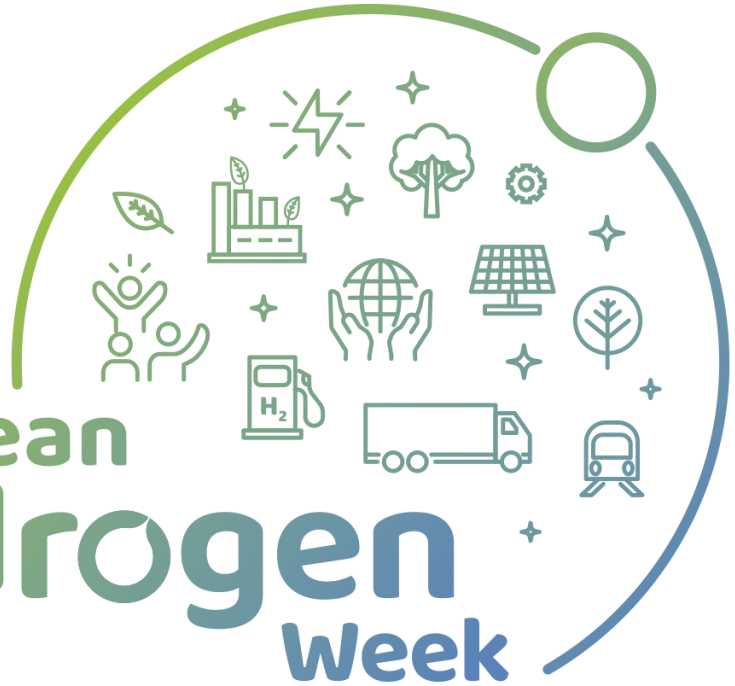
BioRobur^{plus}

Advanced direct biogas fuel processor for robust and cost-effective decentralised hydrogen production



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European Commission

Project Overview

Call year: 2016

Call topic:
FCH-02-2-2016
Development of compact reformers for distributed bio-hydrogen production

Project dates:
01/01/2017 - 30/06/2021

Total project budget:
3 813 536,24 €

BioRobur^{plus}

% stage of implementation
01/11/2019: 65 %

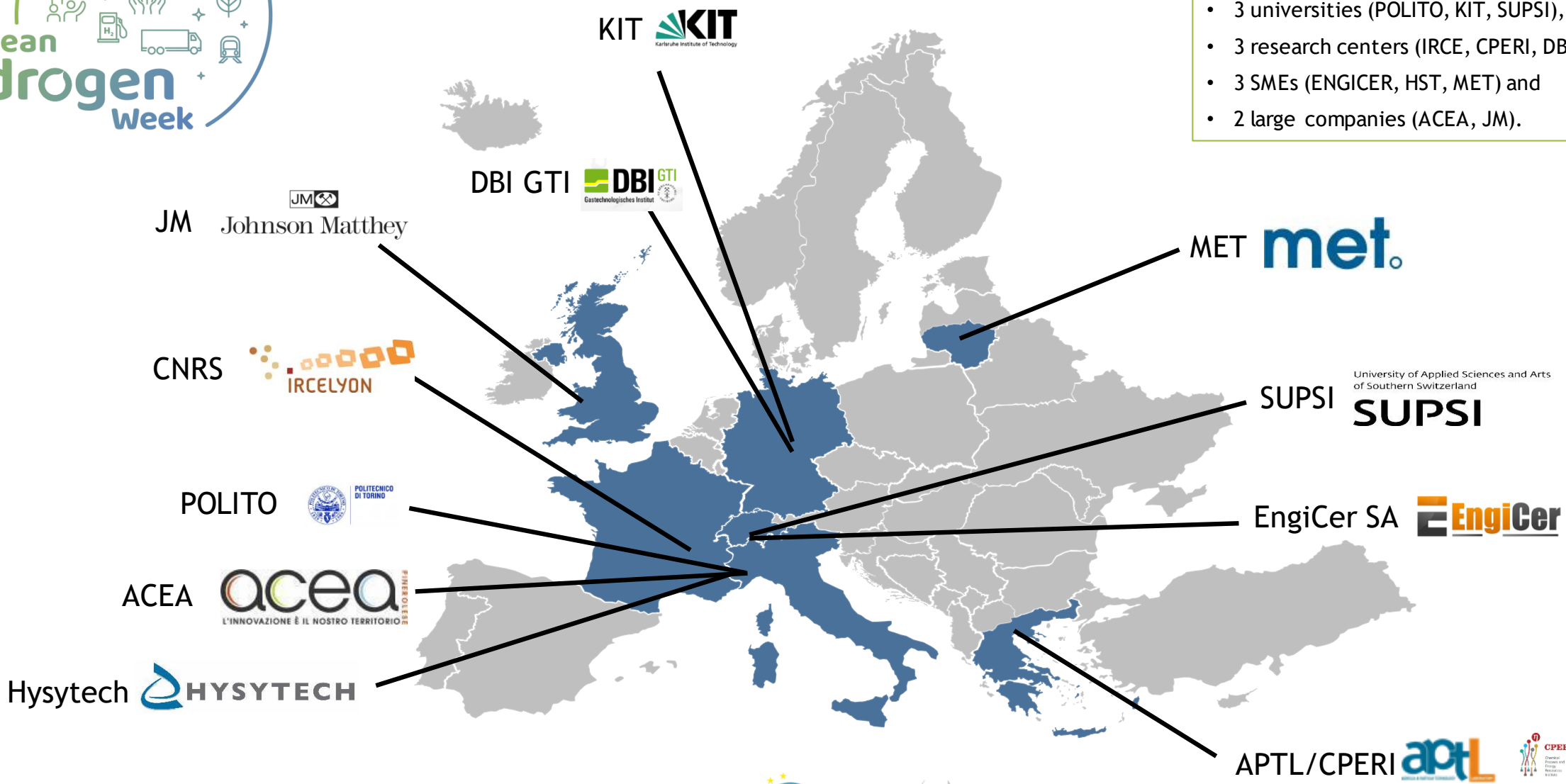
FCH JU max. contribution:
2 996 248,74 €

Other financial contribution:
817 287.50 € (Swiss government)

Partners

A consortium that involves the whole society/stakeholders with complimentary expertise:

- 3 universities (POLITO, KIT, SUPSI),
- 3 research centers (IRCE, CPERI, DBI),
- 3 SMEs (ENGICER, HST, MET) and
- 2 large companies (ACEA, JM).



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Project Summary

The BioRoburplus project will develop a pre-commercial oxidative steam reformer (OSR) for sustainable and **decentralized hydrogen production from biogas**. The TRL6 demo-plant will deliver at least 50 Nm^3/h (107 kg/day) of H_2 at 99.9% purity and 1.5 bar with an energy efficiency conversion of 81% on a HHV basis.

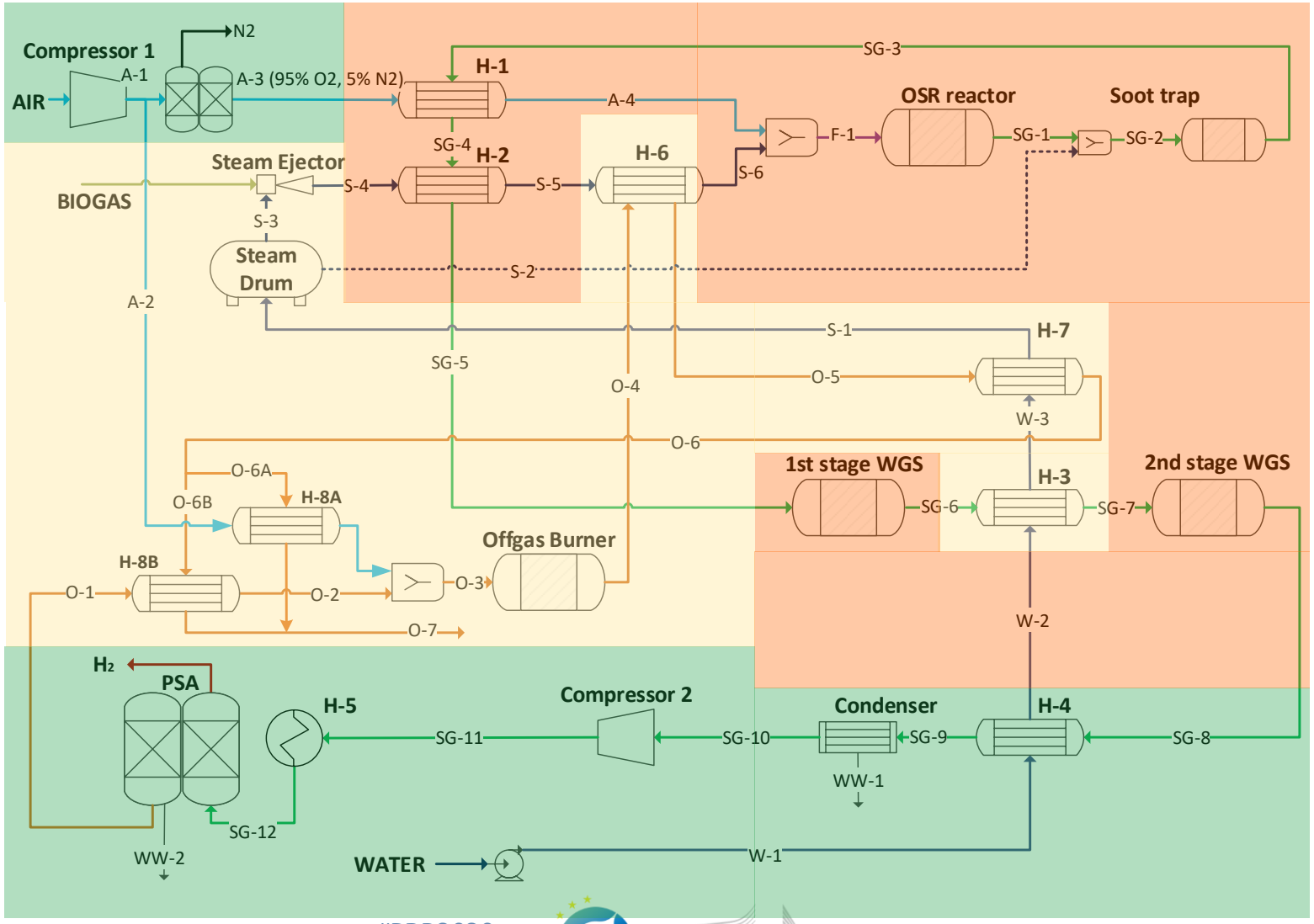
These targets will be achieved by pursuing the following new developments and concepts:

1. A high thermal integration.
2. A tailored innovative purification system to drive H_2 separation from syngas.
3. A recuperative burner based on cellular ceramics capable of exploiting the low enthalpy hydrogen purification off-gas for the reformer feed preheating.
4. A robust OSR structured catalyst.

A dedicated TRL6 demo campaign will be carried out integrating the processor with an anaerobic digestor plant in a real industrial site (ACEA).

European Hydrogen Week

Project Summary



Project Progress/Actions - Range/TRL

Unit under manufacturing. It has been designed to produce 50Nm^3/h H_2 99.9%

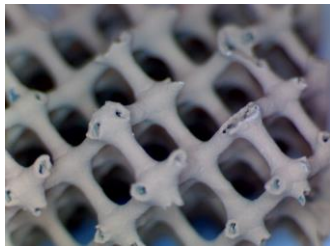
Achievement to-date

TRL3 → TRL6 50Nm^3/h 99.9%

25% 50% 75%

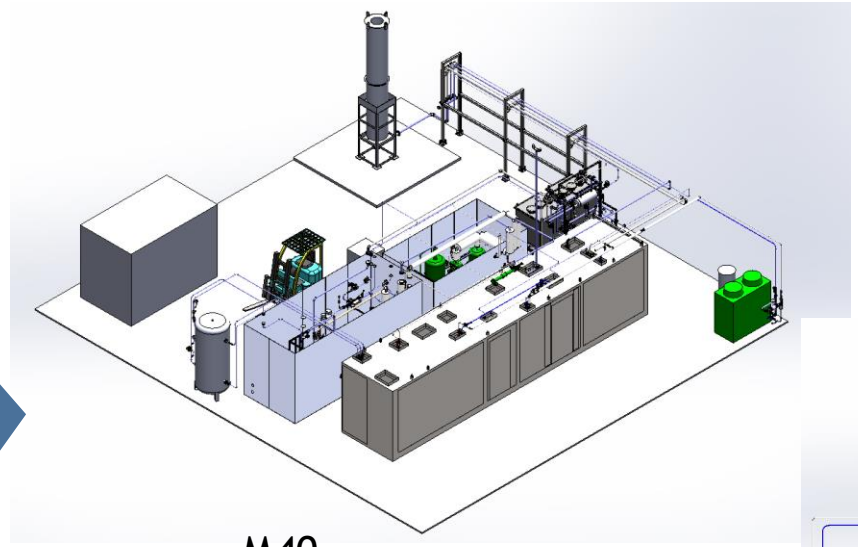
M18

OSR Catalyst

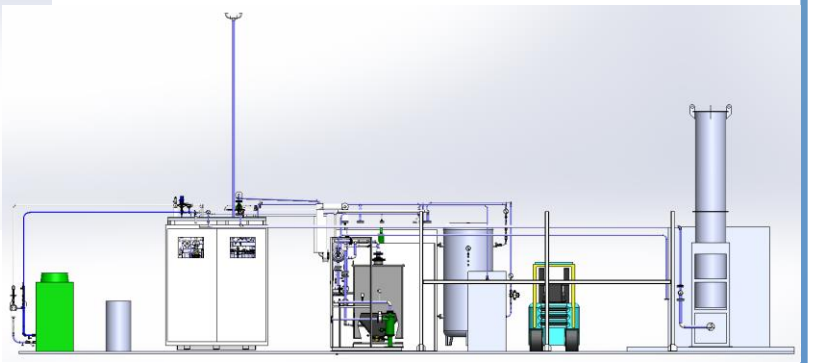


M24

M39



M40



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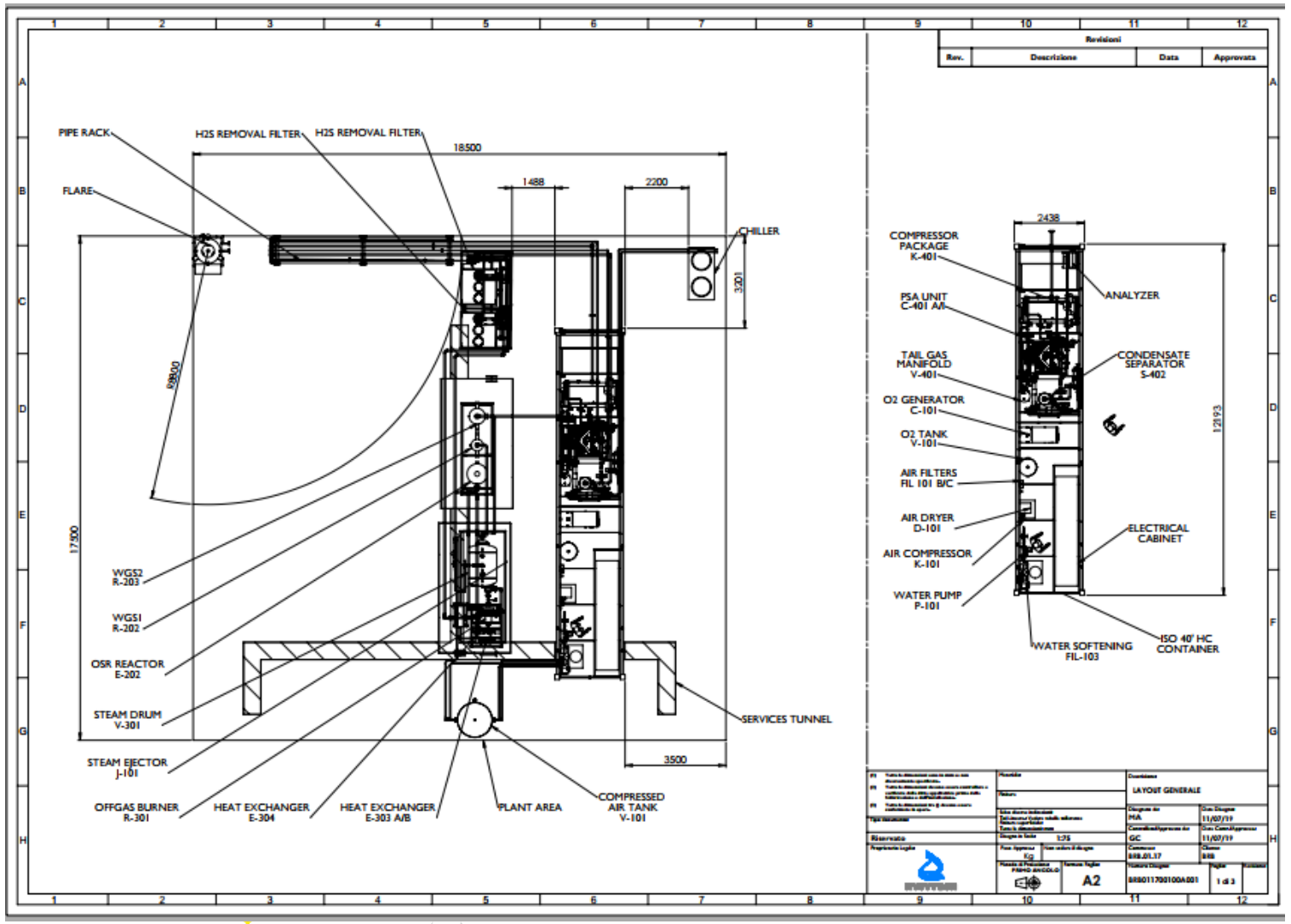
Project Progress/Actions - Range/TRL



Project Progress/Actions - Overall plant efficiency.

Unit under manufacturing, 80.% achieved with simulations

Achievement to-date 65%

25% 50% 75%

≥ 80%

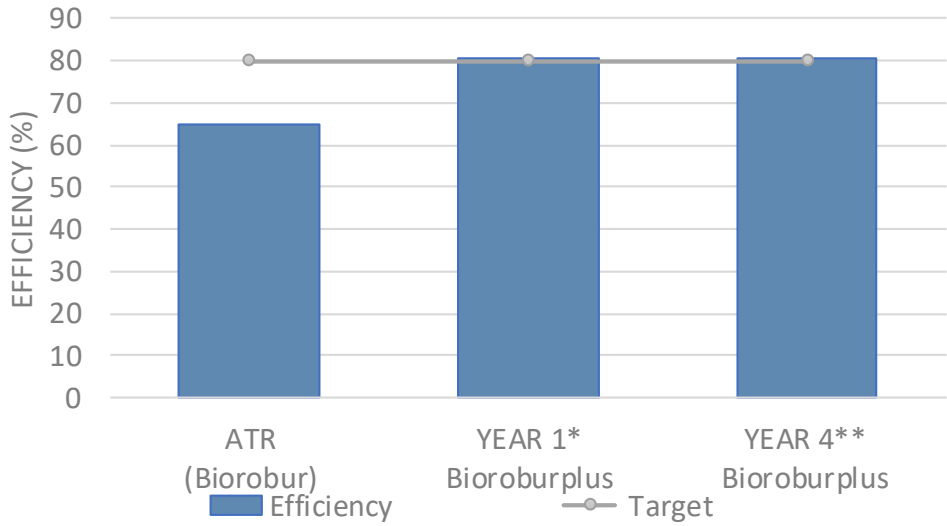
Off-gas burner enthalpy valorisation

M24

H_2 Purification

- Purification module efficiency: 85%,
- η_{plant} = 80.7%
- Hydrogen Purity: 99,9%

M18



* From simulations
** To be validated during Demo campaign

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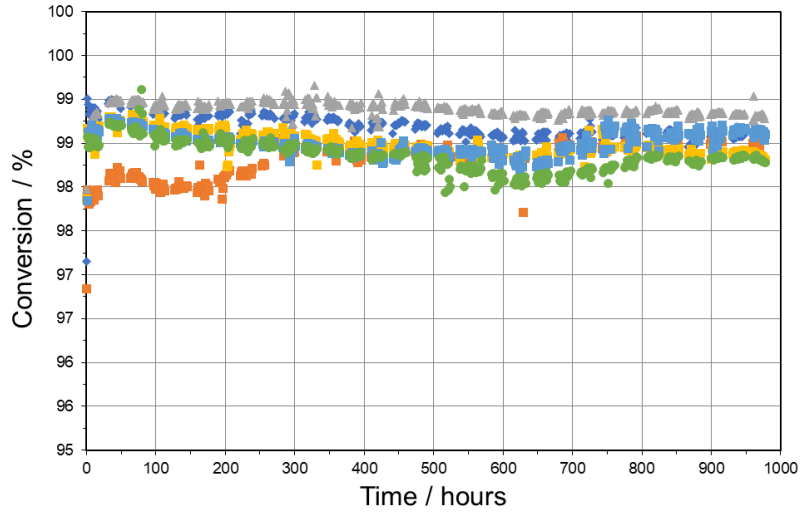
Project Progress/Actions - Durability

Achievement to-date

250 h
2 %

1000h
2 %



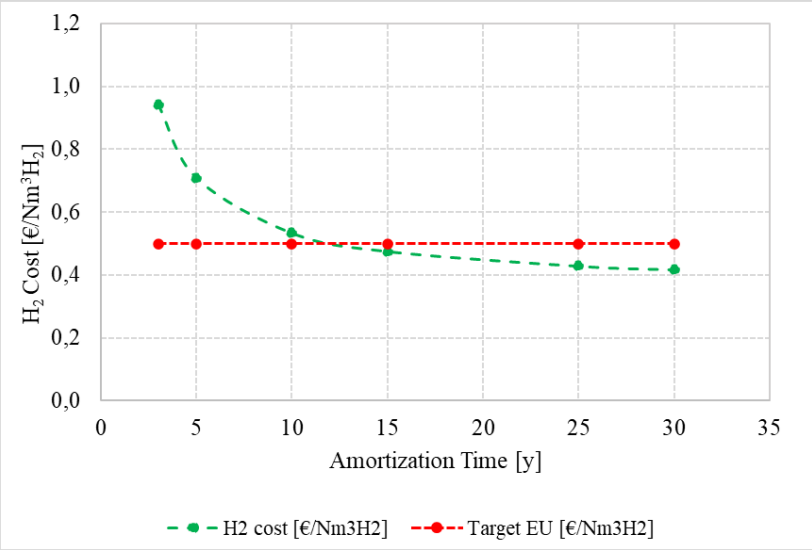
Durability – 6 Powder catalyst samples

- Catalyst activity stable over 1000 hours
- No catalyst regeneration was required
- MS2.1 reached: target is <2% deactivation over 1000 hours ✓

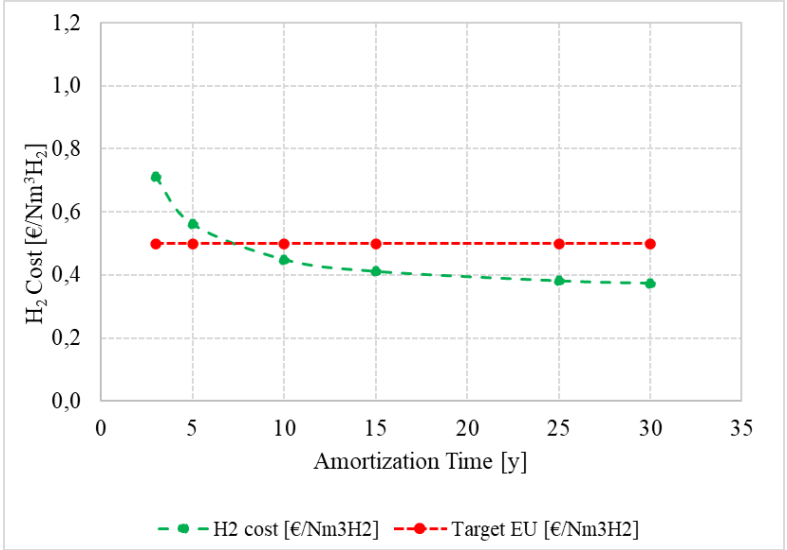
Project Progress/Actions - H_2 cost

TARGET: Total cost of H_2 (including CAPEX, OPEX) between 0.3-0.5 €/Nm^3

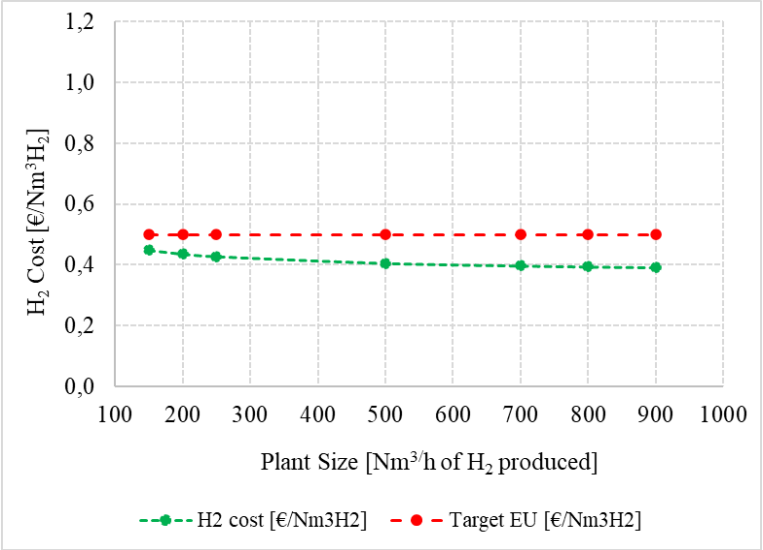
Total actual cost of H_2 produced with the BioRobur^{plus} demo (including CAPEX, OPEX)



BioRobur^{plus} plant: 50 Nm^3/h



Considering a plant size of 150 Nm^3/h



Effect of the size of the plant on the H_2 cost.

Taking as size reference 150 Nm^3/h and considering 10 years of amortization time

Risks, Challenges and Lessons Learned

- Challenges:
  - High degree of process integration.
  - Catalysts and support development, coating optimization, sub-units construction and interconnecting
  - Final testing campaign

- Lessons learned:
  - Thanks to the combination of different partners know-how, experiences and ideas, potential solutions for the currently H_2 production challenges can be developed.
  - This kind of R&D projects are a great opportunity to strengthening the innovation capacity of the SME.
  - Lessons learned for replication of detailed engineering, construction, installation and commissioning.
  - It is important to avoid delays in the early stages of the project and to spend more time for testing and for data collection to optimize and drive future scaleup of the technologies. In addition, a large testing campaign is of great importance when several units are interconnected in order optimize the overall plant.

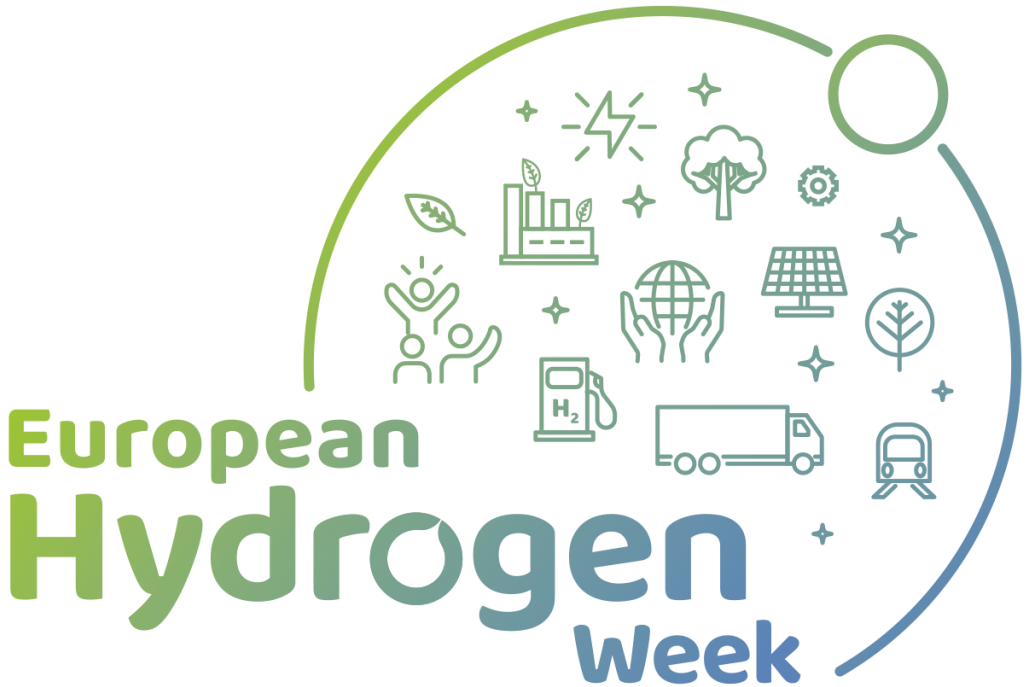
Exploitation Plan/Expected Impact

Exploitation

1. Ceramic media with continuous porosity gradient
2. Reforming catalyst stable under biogas reforming conditions
3. Cost-effective and efficient technology for hydrogen purification.

Impact

1. It could be implemented in gas-fired IR burners and catalyst supports. Sales of the ceramic materials could be generated in the medium/long-term.
2. IP protection under biogas reforming conditions being considered. Catalyst development samples will be made available to customers.
3. This innovation can be implemented in the transportation and industry feedstock sectors for Hydrogen purification applications.



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