MULTIPLHY

MULTIMEGAWATT HIGH-TEMPERATURE ELECTROLYSER TO GENERATE GREEN HYDROGEN FOR PRODUCTION OF HIGH-QUALITY BIOFUELS

Project ID	875123
PRR 2025	Pillar 1 - H_2 Production
Call Topic	FCH-02-2-2019
Project Total Costs	9 751 722.51
Clean H_2 JU Max. Contribution	6 993 725.39
Project Period	01-01-2020 - 31-12-2025
Coordinator Beneficiary	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FR
Beneficiaries	NESTE ENGINEERING SOLUTIONS BV, NESTE NETHERLANDS BV, ENGIE ENERGIE SERVICES, NESTE ENGINEERING SOLUTIONS OY, PAUL WURTH SA, SUNFIRE GMBH, NESTE OYJ, ENGIE

http://www.multiplhy-project.eu

PROJECT AND GENERAL OBJECTIVES

MultiPLHY will demonstrate the technological and industrial leadership of the EU in solid oxide electrolyser cell (SOEC) technology with its rated electrical connection of ~3.5 MW, electrical rated nominal power of ~2.6 MWel and a hydrogen production rate of more than 670 Nm3/h. MULTIPLHY's electrical efficiency, 85 % with regard to lower heating value, will be at least 20 % higher than efficiencies of low temperature electrolysers, enabling the reduction of operational costs and the reduction of the connected load at the refinery and hence the impact on the local power grid.

MultiPLHY aims to install and integrate the world's first high-temperature electrolyser (HTE) system on a multi-MW scale at a renewable product refinery located in Rotterdam, in the Netherlands. The project's central element is the manufacturing and demonstration of a multi-MW high-temperature electrolyser and its operation in a renewable product refinery. As a result, MultiPLHY promotes the SOEC based HTE from technological readiness level 7 to 8.

NON-QUANTITATIVE OBJECTIVES

- Scale up technology to the multi-MW level by optimising efficiencies, increasing availability, improving operations and improving stack durability.
- Reduce capital cost and operation and maintenance expenditure by developing a design-to-cost strategy and refining the cost analysis.

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

- The high-temperature electrolyser (HTE) and hydrogen process unit (HPU) manufacturing, commissioning and factory acceptance test (FAT) have been successfully achieved. The site was prepared (civil works, piping, mechanical, electrical, automation, instrumentation and IT). Mechanical completion of the system installation has been achieved. Commissioning of the installed equipment has taken place. The HTE is fully operational, the HPU has been operated individually and successful coupling between the HPU and HTE has been achieved.
- The design of the HTE and HPU focused on achieving high efficiency. The H_2 output was confirmed during testing of the Gen 2.1.0 module. During FAT, a quality criterion was set for an electrical consumption below 42 kWh/kgH_2. The twelve modules passed this criterion, which is an important milestone towards the final objective of 84 % LHV efficiency. The final assessment of both the efficiency and LCOH will be performed during the demonstration period.
- A service and maintenance concept has been defined. The tests performed on the Gen 2.1.0 module and HPU already contribute to a better knowledge of their reliability. The real availability will be monitored during the operation phase. Ahead of this phase, NESTE operators have been trained to operate the unit and to intervene in case of maintenance/incident. In addition, in order to minimise the downtime, spare components have been ordered and stored close to the unit for replacement as soon as possible, if needed.
- Sunfire stacks and CEA stacks have been successfully tested first in the 2-to-5 kWDC range, then, following upscaling efforts, in the 10-to-20 kWDC range. A total of more than 42 000 hours of operation was accumulated, placing MULTIPLHY at the forefront of projects in terms of durability testing, and at the scale of large stacks. ASR degradations below 15 mOhm cm²/kh, and even as low as 11 mOhm cm²/kh for some test sequences, have been measured on the latest Sunfire generation of stack.
- The operation strategy applied to both stacks, consisting of degradation compensating by an increase of the temperature resulted in stack operation without production loss.
- Reduction of capital cost and of operation and maintenance expenditures.

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- A design-to-cost strategy has been developed and the cost analysis will be refined taking into account operational data that can only be completed when the integration with the refinery is done.
- Techno-economic evaluations have been performed, providing methodology and reference values for several scenarios. Selected use cases of the steam electrolysis technology related to the production of hydrogen in biofuels refinery have been proposed and the techno-economic specifications of the SOEC system designed for industrial application have been determined. The results obtained so far show that the bigger the plant: (i) the higher the impact of electricity prices and efficiency and CAPEX total integration cost, and (ii) the lower the impact of CAPEX Stack. Lastly, in all scenarios high full load hours and lower discount rates are beneficial. Based on the aforementioned results, recommendations for future projects can be formulated.
- Attempts have been undertaken to have MultiPLHY's hydrogen certified that has proven to be a complicated and expensive process. For that reason, the certification of the hydrogen's origin was deemed neither relevant nor feasible.
- Three options for sourcing of renewable power have been described. Guarantee of origin (GO) purchase and contractualisation was found to be the only feasible option. However, the regulatory context and the RE supply options evaluated are not favourable. Due to the fact that in the end the origin of hydrogen produced in MultiPLHY will not be certified, it is not relevant to purchase renewable electricity.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?	SoA result achieved to date (by others)	Year for reported SoA result
Project's own objectives	Demonstration duration	hours	as long as possible over year 2025	⚙	longest operation reported at system level is also by Sunfire > 15 000 h (Grinhy sequence of projects)	2023
	Downtime	%	2		98%	N/A
	H_2 production loss	% / 1 000 h	1.2	✓	1.9	2017

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