SWITCH

SMART WAYS FOR IN-SITU TOTALLY INTEGRATED AND CONTINUOUS MULTISOURCE GENERATION OF HYDROGEN

Project ID	875148
PRR 2024	Pillar 4 – H_2 end uses: stationary application
Call topic	FCH-02-3-2019: Continuous supply of green or low carbon H_2 and CHP via solid oxide cell based polygeneration
Project total cost	EUR 3 746 753.75
Clean H_2 JU max. contribution	EUR 2 992 521.00
Project period	1.1.2020–31.3.2024
Coordinator	Fondazione Bruno Kessler, Italy
Beneficiaries	Deutsches Zentrum für Luft- und Raumfahrt EV, École polytechnique fédérale de Lausanne, HyGear BV, Shell Global Solutions International BV, SolydEra SA, Sweco Polska Sp z.o.o.

https://switch-fch.eu/

PROJECT AND GENERAL OBJECTIVES

The Switch project aims to design, build and test a 25 kW (solid oxide fuel cell (SOFC)) /75 kW (solid oxide electrolyser cell (SOEC)) system prototype for hydrogen production, operating in an industrial environment for 5 000 hours. The Switch system will be a stationary, modular and continuous multisource H_2 production technology designed for H_2 refuelling stations. The core of the system will be a reversible solid oxide cell operating in electrolysis mode (SOEC) and fuel cell mode (SOFC).

NON-QUANTITATIVE OBJECTIVES

- Switch aims to ensure the reliability and stability of power and hydrogen supply. A system with cogeneration potential with substantial dynamic behaviour can deliver reliable and stable production of hydrogen and power to match demand-side management, securing the form of energy needed and connecting the generation profile to the end user.
- The project aims to ensure modularity through the development and validation of two modules, each producing 50 kg of H_2 per day. This will be achieved by integrating modules composed of high-reliability stack modules provided by SolydEra.
- Switch aims to ensure that the hydrogen purity level complies with ISO 14687. Hydrogen will be purified to within the range of 99.70 % to 99.99 %, and will have a water content of less than 5 ppm.
- In-field testing in a relevant environment will be assured, installing the final Switch system prototype in a bench infrastructure and in a real operational environment. The system will be operated for 5 000 hours in the relevant environment.
- A life-cycle analysis and life-cycle cost analysis will help to evaluate the benefits of the Switch technology in comparison with state-of-the-art steam methane reforming and other H_2 production technologies (electrolysis).

PROGRESS AND MAIN ACHIEVEMENTS

École polytechnique fédérale de Lausanne (EPFL) has performed the life-cycle assessment and life-cycle costing on the Switch system (SOEC). The Switch system was compared with competing technologies, including proton exchange membrane, alkaline water electrolyser and anion exchange membrane electrolysis.

The following were considered in the analysis:

- all electrolyser manufacture processes and environmental impact of 1 kW electrolyser unit;
- different types of renewable electricity (wind, solar and hydroelectric power);
- electricity mix of different countries;
- degradation impact (for final outcomes).

Three different hydrogen storage methods have been tested and compared through life-cycle analyses. EPFL conducted life-cycle costing and a sensitivity analysis on the pilot plant's operation and performed various case studies to meet the EUR 5/kgH_2 target.

EPFL reported that the segmented short stack test with daily SOFC/SOEC switching showed no degradation but instead a slight improvement during operation. This was confirmed by local impedance measurement data. The local mapping of current density, voltage and temperature also confirmed that the thermoneutral operating point of 1.3 V provides the most homogeneous regime and is therefore the best target for operation in SOEC mode. Regimes of feed starvation (SOFC or SOEC) were also diagnosed and quantified during this test.

The control system was finalised and the PLC/SPLC was delivered and installed.

New communication materials (factsheets) were designed. This activity was led by Fondazione Bruno Kessler, which also launched a 'factsheet campaign' on social media. The campaign resulted in a large increase in followers on LinkedIn.

In 2023, Switch received the Energy Globe Award (application submitted by Fondazione Bruno Kessler). In addition, Elena Crespi (who conducted research as part of the Switch project) won the Young Scientist Award 2023.

FUTURE STEPS AND PLANS

The prototype will be tested and a final event will be held.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?	SOA result achieved (by others)	Year in which SOA result was reported
Project's own objectives	Low switching time	minutes	30	15	✓	N/A	N/A
	Fuel cell conversion efficiency	%	75	0.66		80	2021
	Cost of H_2	€/kg	5	N/A		11.2	2020
	Electrolyser conversion efficiency	%	75	78		80	2021
	Stack lifetime	hours	10 000	N/A		3 000	2021

Clean Hydrogen Partnership
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