# SWITCH

## SMARTWAYSFORIN-SITUTOTALLYINTEGRATED ANDCONTINUOUSMULTISOURCEGENERATIONOF HYDROGEN


| | |
|---|---|
| **Project ID:** | 875148 |
| **PRD 2023:** | Panel 1 – H2 production |
| **Call topic:** | FCH-02-3-2019: Continuous supply of green or low carbon H2 and CHP via solid oxide cell based polygeneration |
| **Project total costs:** | 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 (EPFL), HyGear BV, Shell Global Solutions International BV, SolydEra SA, Sweco Polska sp. z.o.o. |

**https://switch-fch.eu/**

### PROJECT AND OBJECTIVES

SWITCH aims to design, build and test a 25 kW (solid oxide fuel cell) / 75 kW (solid oxide electrolyser cell) 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 (SOE) and fuel cell mode (SOFC).

### NON-QUANTITATIVE OBJECTIVES

- SWITCH aims to ensure the reliability and stability of power and hydrogen supply. A system with co-generation 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 a 50 kg of $H_2$/day technology, realised by integrating modules composed of high-reliability stack modules provided by SOLIDpower.
- SWITCH aims to ensure that the hydrogen purity level complies with ISO standard 14687. Hydrogen will be purified to within the range of 99.7–99.99 % and will have a water content of less than 5 parts per million.
- In-field testing in a relevant environment will be assured, with the final SWITCH system prototype being installed in a bench infrastructure and in a real operational environment. The system operation time will be 5 000 hours in the relevant environment.
- 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 (SoA) steam methane reforming and other $H_2$-production technologies (e.g. electrolysis).

### PROGRESS AND MAIN ACHIEVEMENTS

- EPFL conducted the analysis on the SWITCH SOEC mode three damage impacts in OPENLCA and carried out a comparison of $H_2$-production technologies including SOE, AEL, CH2P OM3 and steam methane reforming (SMR).
- HyGEAR and SolydEra performed a hazard and operability analysis of the latest piping and instrumentation diagram.
- The cold balance of plant (BoP) and purification section have been designed and constructed.
- The hot BoP gamma has been finalised and successfully tested, and integrated in the SOE operating mode.
- The control system has been developed, and power electronics have been selected and acquired.
- The analysis of the experiments with the 25 kW LSM was finalised in work package 5. This included steady-state performance in electrolysis, polygeneration and fuel cell mode, and the analysis of the transient behaviour while switching between the modes. In addition, a transient model was developed and validated.
- A 1 000-hour durability test with daily switches between SOFC and SOE mode was performed by EPFL in work programme 5.
- Four articles have been published, with input from partners. The results have been presented in several conferences and workshops.

### FUTURE STEPS AND PLANS

- The assembly of the full SWITCH system is in progress. Arrangements are being made to accommodate the testing of the full system at HyGear's premises. Initial work on operating condition optimisation has been carried out during the qualification test of the hot BoP and the LSM at SolydEra facilities.
- An exploitation workshop will be organised to enable work to start on the business model and business plan. The project consortium will apply for module B of the Horizon Results Booster to continue the activity related to the future exploitation of the SWITCH prototype. The focus will be on the business model and potential go-to-market strategy.

### QUANTITATIVE TARGETS AND STATUS

| Target source | Parameter | Unit | Target | Achieved to date by the project | Target achieved? | SoA result achieved to date (by others) | Year of SoA target |
|---|---|---|---|---|---|---|---|
| Project's own objectives | Electrolyser conversion efficiency | % | 85 | 80 | | 80 | 2021 |
| | Fuel cell conversion efficiency | % | 75 | N/A | | 80 | |
| | Hydrogen cost | €/kg | 5 | | | 11.2 | |
| | Stack lifetime | hours | 10 000 | | | 3 000 | |
| | Low switching time | minutes | 30 | 15 | ✓ | N/A | N/A |



Clean Hydrogen Partnership
Co-funded by the European Union