

Hydrogen production by means of solar heat and power in high temperature solid oxide electrolyzers

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Abstract

Solid Oxide Electrolysis (SOE) is a highly-efficient technology for the production of hydrogen by high temperature electrolysis. The coupling of SOE with solar heat and photovoltaic power is a promising solution for efficient, flexible and reliable green hydrogen production. However, the intermittency of solar energy challenges both SOE operations and cost-competitiveness of green hydrogen production via high temperature solar-thermal-photovoltaic electrolysis.

The project PROMETEO aims to optimize the coupling of SOE with non-programmable renewable electricity and high-temperature solar heat generated from Concentrating Solar (CS) systems by employing a Thermal Energy Storage (TES) system to supply solar heat also when solar energy is not directly available (e.g. during the night) and when power is less expensive.

In PROMETEO, a fully integrated and optimized prototype will be constructed and validated, where the SOE combined with the TES and ancillary components will efficiently convert intermittent heat and power sources into green hydrogen. The design of the prototype will consider multiple criteria: end-users' needs, sustainability aspects, regulatory and safety concerns, scale-up and engineering issues.

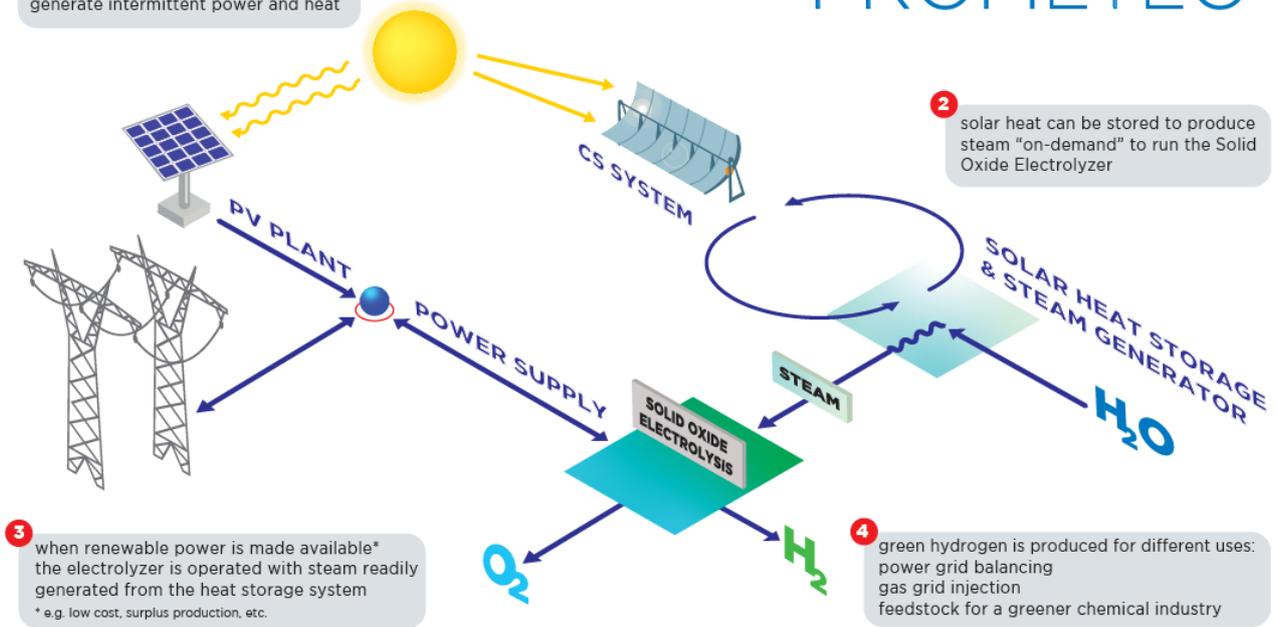
A fully-equipped modular prototype with at least 25 kWe SOE (about 15 kg/day hydrogen production) and TES (for 24 hours operation) will be designed, built, connected to representative external power/heat sources and validated in real operation environment. Particular attention is paid to partial load operation, transients and hot stand-by periods.

Industrial end-users will lead to techno-economic and sustainability studies to apply the technology in on-grid and off-grid scenarios and for different end-uses: utility for grid balancing, power-to-gas, and hydrogen as feedstock for the fertilizer and chemical industry.

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PROMETEO

1 non-programmable renewable sources generate intermittent power and heat



2 solar heat can be stored to produce steam "on-demand" to run the Solid Oxide Electrolyzer

3 when renewable power is made available* the electrolyzer is operated with steam readily generated from the heat storage system
* e.g. low cost, surplus production, etc.

4 green hydrogen is produced for different uses:
power grid balancing
gas grid injection
feedstock for a greener chemical industry