



# High-capacity hydrogen-based green-energy storage solutions for grid balancing



## The problem

The increasing energy demand and the rising penetration of decentralized fluctuating renewable energy sources (RESs) often situated in areas with **weaker power connection (at the end of Medium Voltage/Low Voltage lines)** are challenging power networks stability, security and congestion level, due to the electricity surplus available in periods of low demand. Moreover the actual decoupled operation of energy distribution networks (electricity, gas, heating) results in inefficient energy supply and calls for holistic interconnected energy networks management.

**Hydrogen energy storage** is a promising way to **enable a paradigm shift from "power" to "energy"** Smart Grids, where larger **flexibility** allows to integrate large shares of RESs, thanks to its high potential for integrated operation of **different energy infrastructures**.



McPhy hydrogen-based solid state storage

## The system

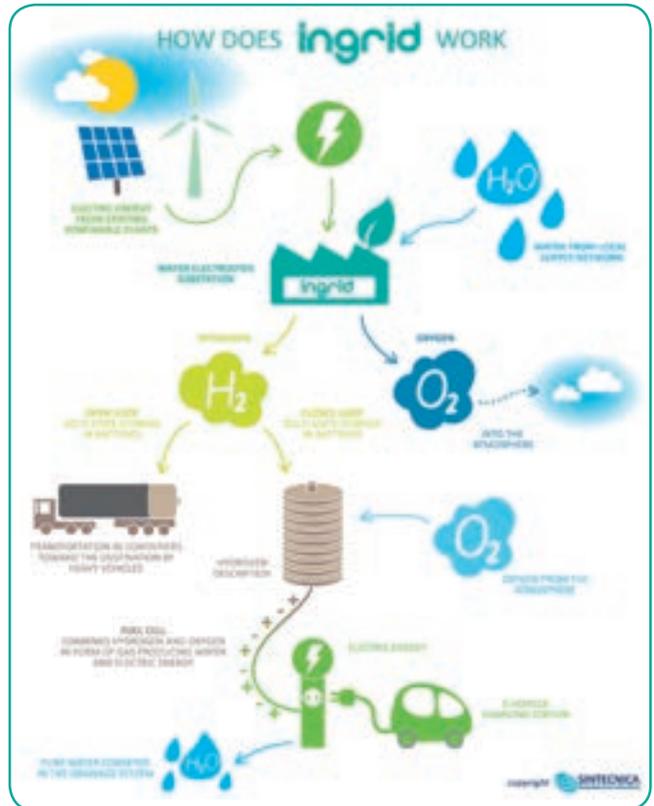
INGRID 23,9 MEUR R&D European project has been demonstrating technical and economic viability of **Solid-state Hydrogen Energy Storage System** aimed at operating a **Hybrid Multi-Network Energy Management System**, which integrates electricity and hydrogen networks operation.

The INGRID system includes a 1,2 MW water electrolyzer connected to the primary power substation, working as controllable load while producing hydrogen to alleviate power network congestion; a magnesium metal hydrides solid storage subsystem, which stores the hydrogen generated by the electrolyzer at higher volumetric density than compressed or liquid gas; and the energy delivery subsystem, consisting of a fuel cell serving electric cars chargers or providing Low Voltage regulation services to power distributors (**Closed Loop Operation**). Otherwise, the hydrogen surplus is made available to the hydrogen value chain either injected into nearby gas distribution networks (**Open Loop Operation**).

The **Energy Storage Management (EMS)** is in charge for the optimal allocation of hydrogen surplus through the Closed and/or Open Loop modalities, depending from technical/operational constraints or economic opportunity.

## The facility

The INGRID technology is about to be demonstrated through the deployment and operation of a 39 MWh hydrogen energy storage facility with more than 1 ton of stored hydrogen in the Italian Puglia region, where over 3.500 MW of solar, wind and biomass are already installed. The optimal



operation of the facility is expected to relieve the congestion of the MV branch of the power network.

## Consortium

Engineering Ingegneria Informatica (ITA, Coordinator); ARTI – Puglia Regional Agency for Technology and Innovation (ITA), Enel Distribuzione, RSE (ITA); McPhy (FRA); Hydrogenics (BEL); Tecnalia (SPA).



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