FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

Energy Topics

in the 2020 call

N. Lymperopoulos
A. Aguilo-Rullan

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Energy Pillar Overview

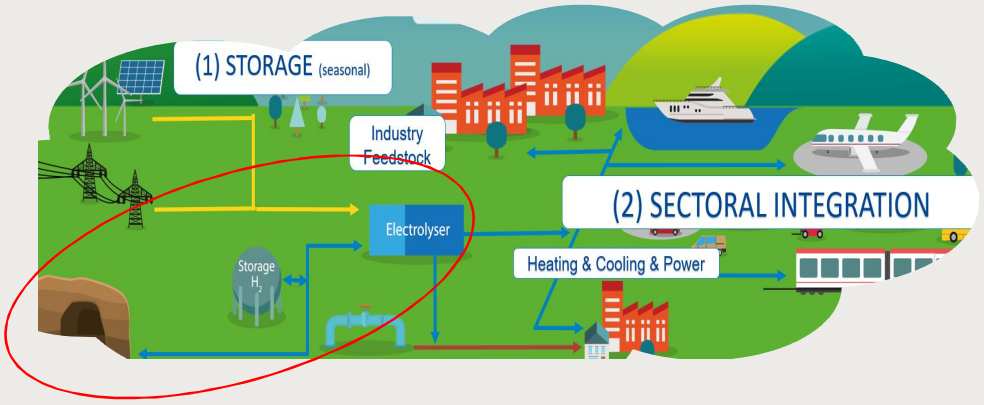
Hydrogen storage and distribution; Electrolysers for off-shore H_2 production

Main Focus

- Preparing for Bulk H_2 storage
- Preparing for off-shore H_2 production

What is new

- Underground storage of H_2 in salt caverns or depleted gas fields
- Electrolyser suitable for off-shore production



Energy Pillar

Hydrogen storage and distribution; Electrolysers for off-shore H_2 production

Topic	Type of Action	Ind. Budget (M€)
FCH-02-1-2020: Catalyst development for improved economic viability of LOHC technology	*RIA*	*2.5*
FCH-02-5-2020: Underground storage of renewable hydrogen in depleted gas fields and other geological stores	*RIA*	*2.5*,***
FCH-02-6-2020: Electrolyser module for offshore production of renewable hydrogen	*RIA*	*5*,***
FCH-02-7-2020: Cyclic testing of renewable hydrogen storage in a small salt cavern	*IA*	*5**

** Eligibility criterion: maximum funding ** Included under leftover budget flexibility*

Energy Pillar

Research and Innovation actions

FCH-02-1-2020: Catalyst development for improved economic viability of LOHC technology

Reduce LOHC system costs through improved catalysts or novel catalytic system architecture

- Decrease PGM loading, increase catalytic selectivity & space-time yield
- Open to all LOHC concepts provided carrier addresses efficiency, regulatory, safety issues
- Capacity of rig @ dehydrogenator >10 kW_{th} & < 6 kWh/kg H_2

Mission Innovation

FCH-02-5-2020: Underground storage of renewable hydrogen in depleted gas fields and other geological stores

Assess techno-economic feasibility of storing H_2 in depleted gas or oil fields

- Identification of stores – proximity to wind/solar plants & NG networks
- Geological, microbiological, engineering etc. tests and modelling
- Involve geologists

Energy Pillar

Research and Innovation actions, continued.

FCH-02-6-2020: Electrolyser module for offshore production of renewable hydrogen

Develop a >1MW electrolyser compatible with an offshore environment

- One module of multi-module design, certified for offshore operation
- Off-shore operation fully simulated – desalination, high salinity, direct connection to RES, transportation, maintenance
- Involve electrolyser OEM, off-shore energy sector, hydrogen safety competence centre

Energy Pillar

Innovation Action

FCH-02-7-2020: Cyclic testing of renewable hydrogen storage in a small salt cavern

Understand cycling of salt caverns storing H_2

- Suitable cavern identified coupled to MW-scale electrolyser and H_2 demand that lead to daily cycling
- Establish technical (geological, geochemical, microbiological) and economic capabilities and limitations of salt caverns for H_2 buffering
- Address purity/composition issues after injection/extraction cycles
- Evaluate scalability for sector coupling with industry / mobility / NG grid injection

Energy Pillar Overview

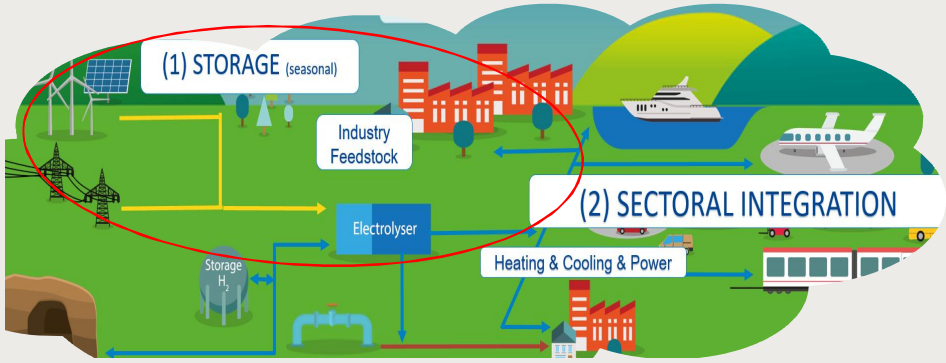
H2 production: Pushing the State of the Art on Solid Oxide Electrolysis to maintain European leadership

Main Focus

- Expanding the scope of SOE applications

What is new

- Improving SOE lifetime through diagnostics and control
- Coupling SOE to Renewable Energy Sources
- Co-electrolysis for industrial scale syngas production



Energy Pillar

H2 production: Pushing the State of the Art on Solid Oxide Electrolysis to maintain European leadership

Topic	Type of Action	Ind. Budget (M€)
FCH-02-2-2020: Highly efficient hydrogen production using solid oxide electrolysis integrated with renewable heat and power	*RIA*	*2.5*
FCH-02-3-2020: Diagnostics and Control of SOE	*RIA*	*2.5*
FCH-02-8-2020: Demonstration of large-scale co-electrolysis for the Industrial Power-to-X market	*IA*	*5**

** Eligibility criterion: maximum funding*

Energy Pillar

Research and Innovation actions

FCH-02-2-2020: Highly efficient hydrogen production using solid oxide electrolysis integrated with renewable heat and power

Optimising the coupling of the SOE with two intermittent sources, renewable electricity and high temperature heat

- Demonstrate an SOE system of 20kWel and operate> 1,000h with availability >98%
- Investigate the effect of heat and electricity variation on the SOE system under diurnal cycling
- Perform a concept design study for scaling up the SOE system to 100MWel with renewable electricity and heat supply

FCH-02-3-2020: Diagnostics and Control of SOE

Develop and validate a physical product that can provide monitoring, diagnostic and control services for SOE, r-SOC, and co-SOE operation

- Enhance understanding of degradation mechanisms in SOE, rSOC and co-SOE in relevant operating conditions and switching
- Develop algorithms to perform diagnostics and control strategies to improve durability and availability of systems
- Validate the diagnostic and control strategy in a relevant environment
- Evaluate the TCO for this diagnostic and control product and focus on exploitation pathways

Energy Pillar

Innovation Actions

FCH-02-8-2020: Demonstration of large-scale co-electrolysis for the Industrial Power-to-X market

The specific challenge is to scale up to the MW range and advance it to a TRL that is relevant for industrial syngas consumers while getting the cost of green syngas close to the steam reformer level.

- System of 700kWel that is capable of producing at least 80kg of syngas/h
- Fully equipped system incl. CO2, steam and electricity supply as well as compression of the syngas as required by consumer
- Demonstration of the system for 2 years producing 500-900 tons of syngas at >95% availability
- A techno-economic analysis indicating the TCO and an LCA indicating GHG mitigation potential should be delivered

Energy Pillar Overview

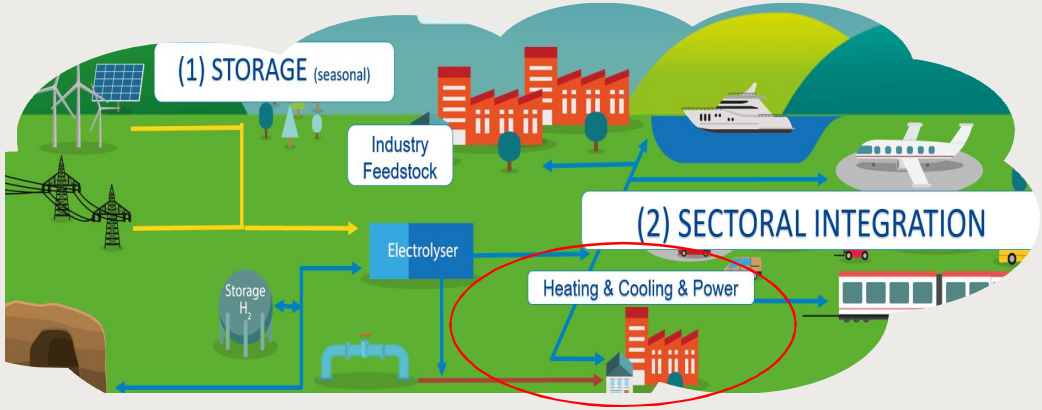
Fuel cells for Energy

Main Focus

- **Consolidating European leadership** on SOFC
- Opening-up **new markets**
- Preparing **next generation SOFC systems**

What is new

- **Next generation of SOFC** running on a 0-100% H2 mixture in gas grid
- Cost-competitive solutions for **data centres**



Energy Pillar

Fuel Cells for Energy

Topic	Type of Action	Ind. Budget (M€)
FCH-02-4-2020: Flexi-fuel stationary SOFC	*RIA*	*2.5*
FCH-02-9-2020: Fuel cell for prime power in data-centres	*IA*	*2.5**

*** Eligibility criteria: maximum funding**

Energy Pillar

Research and Innovation Action

FCH-02-4-2020: Flexi-fuel stationary SOFC

Develop and demonstrate in a **relevant environment** a stationary SOFC system capable to operate over a **wide range of gas compositions** including **H2 mixture** in natural gas from zero to 100% and additions of **biogas** in the gas grid

- Focuses on **adaptation of existing SOFC systems**
- At least **2 SOFC system manufacturers** based in EU or H2020 Associated Country
- Bring the fuel cell system developed **as close** as possible **to certification**
- Demonstrate in the operation window from **0 to 100% H2**
  - 6000 h at **stack level** with degradation rate below 1%/1000h
  - >9 months at **system level**, electrical efficiency >48% LHV, availability >90%
- System **performance** and **CAPEX** as in **MAWP 2024 targets**
- Should **lead** to **SOFC systems** that are fully **hydrogen ready**

Energy Pillar

Innovation Action

FCH-02-9-2020: Fuel cell for prime power in data-centres

Provision of highly reliable **power supply to data-centres** within **urban areas** and with **air quality** restrictions

Demonstration of **building integrated** solution using **fuel cells** adapted to **data centre** in urban areas

- **>50 Kwe** FC power supply**, modular** architecture**,** easily **scalable and** strong load **modulation**
- Provide a **99.999% availability**
- Demonstration in a **real data centre** for at least **8,000 hours**
- Address **service and maintenance** requirements
- Consider the **suitability of using the heat** generated from the fuel cell and data-centre
- Cost-effective and **high performance** solutions (specific KPIs in AWP)
- Foster **replication** and strengthen the **competitiveness** of EU industry
  - consortium composition: system **supplier based in the EU/H2020 AC** and **data-centre provider**
  - identify and/or develop **business models**

Overarching topics

Topic	Type of Action	Ind. Budget (M€)
FCH-03-1-2020: HT proton conducting ceramic materials for highly efficient and flexible operation	*RIA*	*3***
FCH-03-2-2020: Decarbonising islands using renewable energies and hydrogen - H2 Islands.	*IA*	*10**

* Eligibility criteria: maximum funding *** Included under leftover budget flexibility*

Overarching topics

Research and Innovation Action

FCH-03-1-2020: HT proton conducting ceramic materials for highly efficient and flexible operation

Unlock the potential of **proton conducting ceramic materials** as an alternative way to **compress and purify H2**

Mission Innovation

- **Integrated approach** of material science, reactor design and multiscale modelling
- Targets **laboratory scale validation** and a PCC technology system operated in different conditions.
- Proposed materials and cells should be implemented in **short stacks and/or mini-reactors**
- **LCA** compared to conventional purification and compression technologies **needed**

Overarching topics

Innovation Action

FCH-03-2-2020: Decarbonising islands using renewable energies and hydrogen - H2 Islands

Showcasing the ability of **hydrogen** and its associated technologies to **decarbonize islands in EU**

Demonstrating how **H2** enables **sector coupling and** allows **large integration of renewable energy** on the selected island

- All **H2** produced from **RES** installed **on the island** **("CertifHy Green H2"** should be used)
- At least **2 FCH applications** from energy and transport sectors
- At least **300 tons H2/year** should be produced and consumed on the island
- The **replicability and scalability** of the project is fundamental.
- Identify and **secure additional funding** -> include **financing scheme**
- Long-term vision (roadmap) on the **local/regional H2 economy plans** on the island towards 2050

Mission Innovation