PROJECT CONTEXT

Increased production of renewable energies is necessary for **sustainable development and for a cleaner environment**. While renewable electricity is already being produced from solar and wind energy sources, several key components in these novel technologies contain significant amounts of Critical Raw Materials, such as Platinum-Group-Metals and rare-earth elements.

For large-scale and sustainable deployment, the **Critical Raw Materials content must be significantly reduced** in e.g. solar cells, lightweight magnets, rechargeable batteries, electrolysers and fuel cells.

Electrolysers and fuel cells can be used in tandem to reversibly store renewable electricity in the form of hydrogen or liquid fuels, with broad applications for smart electricity grids, portable electronics and clean electric vehicles with long driving range.

PROJECT OBJECTIVES

CREATE aims to lay the foundation for the **next generation of high-performance electrolysers and fuel cells for the renewable generation of H_2** and its conversion to electric power with much lower cost than today.

This will be achieved by shifting from acidic polymer-electrolyte membranes to hydroxyl conducting membranes, allowing the replacement of catalysts based on precious metals or Critical Raw Materials by **novel catalysts based on Earth-abundant elements.**

PROJECT CONSORTIUM

The CREATE partnership involves partners from both academia and industry who jointly:

- advance novel catalysts and membranes,
- test the most promising materials in hydrogen fuel cells and electrolysers in industrial conditions,
- perform cost and life-cycle analysis of the most promising device configurations.

PROJECT COORDINATOR

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CREATE

Critical Raw Materials Elimination by a top-down Approach To hydrogen and Electricity generation

The CREATE project aims at developing new concepts of hydrogen fuel cells and water electrolysers based on polymer electrolytes with lower acidity than those currently on the market. This approach will enable the use of novel anode and cathode catalysts that are free of Critical Raw Materials (and especially of platinum group metals), thereby reducing the high cost of today's electrolysers and fuel cells

http://www.create-energy-h2020.eu

Horizon 2020
European Union funding
for Research & Innovation

H2020 grant N°: 721065

FIRST YEAR ACHIEVEMENTS

Protocols for harmonised characterisation of the functional properties of catalysts, ionomers and membrane-electrode assemblies have been established for fuel cells and electrolysers.

Two different classes of catalysts free of critical raw materials with high performance have been designed and successfully tested for oxygen evolution and oxygen reduction reactions. **Promising catalysts with ultralow platinum content have been designed** for hydrogen oxidation and evolution reactions, while high-throughput methods are being applied to identify promising catalysts totally free of Critical Raw Materials for these reactions.

Several **novel anion-exchange ionomers have been synthesized**, with conductivity closely approaching those necessary for transfer into fuel cells and electrolysers.

Regarding stability of anion-exchange ionomers, the **importance of hydration in operating conditions** has been revealed, an important input to design and operate electrochemical cells with improved lifetime. **Bipolar membranes** have been **improved** via thinning while approaches for novel designs of bipolar membrane structures are being investigated.

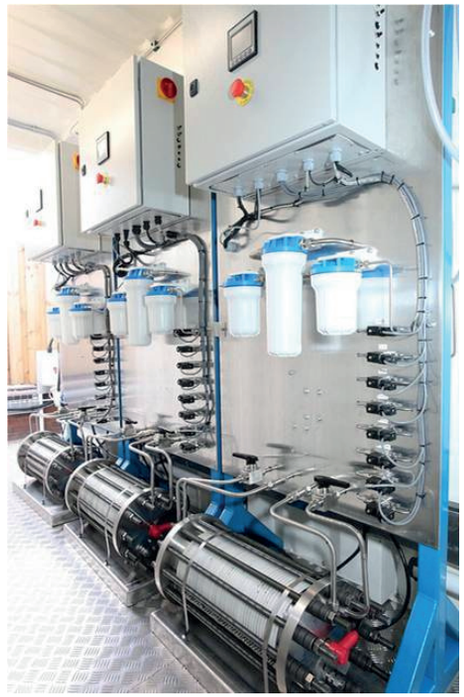
An **international workshop - EFCD2019, focusing on Critical Raw Materials free devices for electrochemical energy conversion has been planned - 22nd-25th September 2019**, La Grande Motte, France.

EFCD2019 is jointly organised with the European project , CRESCENDO - *www.efcd2019.eu*

SCOPE OF PROJECT ACTIVITIES

NOVEL IONOMERS AND MEMBRANES

Backbone polymers functionalised with cationic groups for imparting OH-conductivity are designed and processed to form ionomers and membranes, including bipolar membranes. The membrane design is adapted for use either in a fuel cell or electrolyser, tuning the thickness, water management and mechanical properties necessary for each application. Regarding ionomers, their stability and ionic conductivity are investigated and the compatibility between the novel ionomer and novel catalyst for forming a catalyst-ionomer interface suitable for high-performance electrodes.



ITM Power: Electrolyser Stacks

NOVEL CATALYSTS

Novel Critical Raw Materials (CRM) free and/or ultra-low CRM catalysts for the four key electrochemical reactions in fuel cells and electrolysers (namely: hydrogen oxidation and evolution, oxygen reduction and evolution) are synthesized and characterised. Novel catalysts passing the internal stage gates on activity and stability are transferred for cell assembly and cell testing. In particular, robust binary and ternary metal oxides are screened and optimised for oxygen evolution, atomically-dispersed metal-ions in nitrogen-doped carbon matrices optimised for OH-conducting polymer electrolyte environment and novel bifunctional catalysts for efficient hydrogen oxidation in the same environment explored with high-throughput methods.

TECHNICAL SPECIFICATIONS, COST AND LIFE-CYCLE ASSESSMENT

Protocols for material characterisation outside and inside cells as well as accelerated stress tests are defined for the screening of the broad set of novel materials developed in the project. Industrial requirements are identified and life-cycle assessments are carried out to demonstrate the environnemental and economic performance of novel fuel cells and electrolysers with no or much less precious metals compared to the existing technologies with high precious metal contents.

PROJECT DETAILS

Start date: January 2017

Duration: 3,5 years

Type of action: **Research and Innovation Action**

Innovative and sustainable materials solutions for the substitution of critical raw materials in the electric power system