WP6
Task 6.2: Environmental LCA

Environmental footprint assessment

Gemma Raluy, Darío Cortés, Jesús Simón

FINAL CONFERENCE

25-26/05/2023

Acknowledgment

The Project is co-founded by European Union

1 LCA methodology

2 Results of E-LCA

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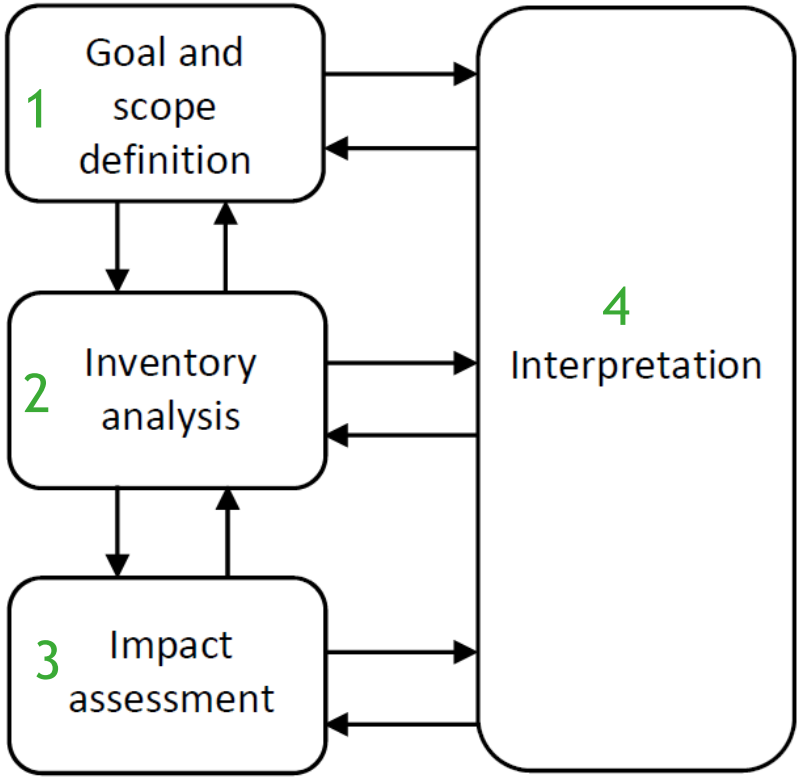
LCA methodology

Task 6.2 Environmental Impact – LCA methodology

Life Cycle Assessment(LCA): estimate potential environmental impacts throughout the life cycle



LCA structure (ISO 14040)

Task 6.2 Environmental Impact – LCA methodology

Inventory data: **Geostock**

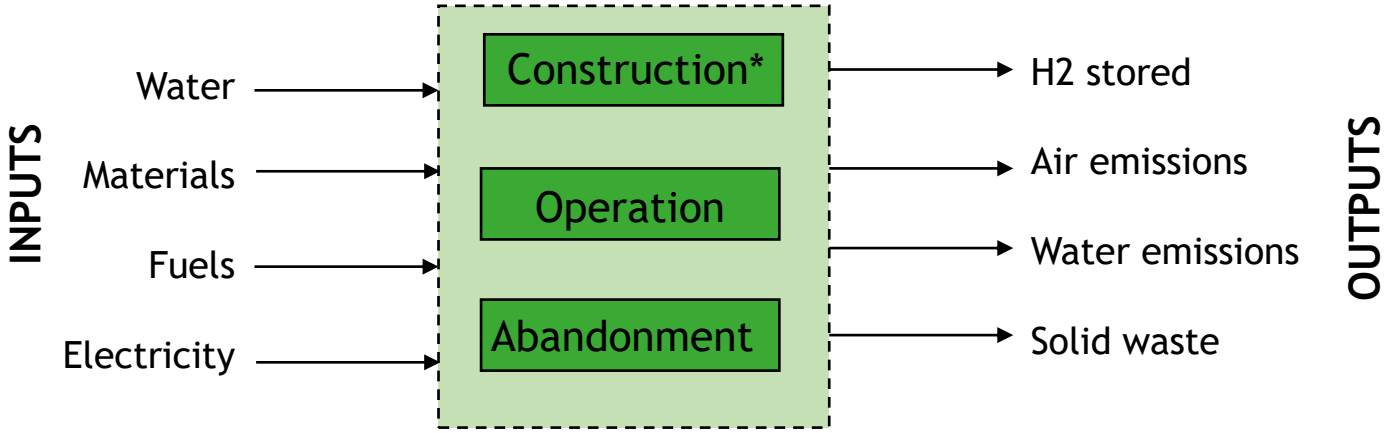
Software: **GaBi Professional**

Processes: **GaBi 2022 database**

Method (7 impact categories): **EF 3.0**

Functional unit (FU): **1 kg of H_2 stored for cycles of 329 days (1.1 cycles per year)**

System boundaries:



* Investigation phase, Drilling & Completion, Leaching (salt cavern), Surface facilities, Buildings

Task 6.2 Environmental Impact – LCA methodology

Main features of the UHS analysed (Geostock)

Feature	Salt cavern (SC)	Porous media (PM)
Number of salt cavern/porous reservoir per storage site	8	1
Free gas volume per cavern (m^3)	380,000	-
Storage site working gas (MSm^3)	250	550
Maximum site withdrawal flowrate (MSm^3/d)	2.17	4.78
Withdrawal-to-injection flowrate ratio	1	1
Number of wells	8	24 + 6
Cycles per year	1.1	1.1
Cavern height (m)	155	-
Quality of H_2 (%)	99.93	99.93
Pressure range (bar)	55-180	55-130
Temperature range (ºC)	40-60	40-60
Electricity consumption during operation (kWh/year)	29,183	109,354
Total H_2 stored (ton/year)	25,000	55,000

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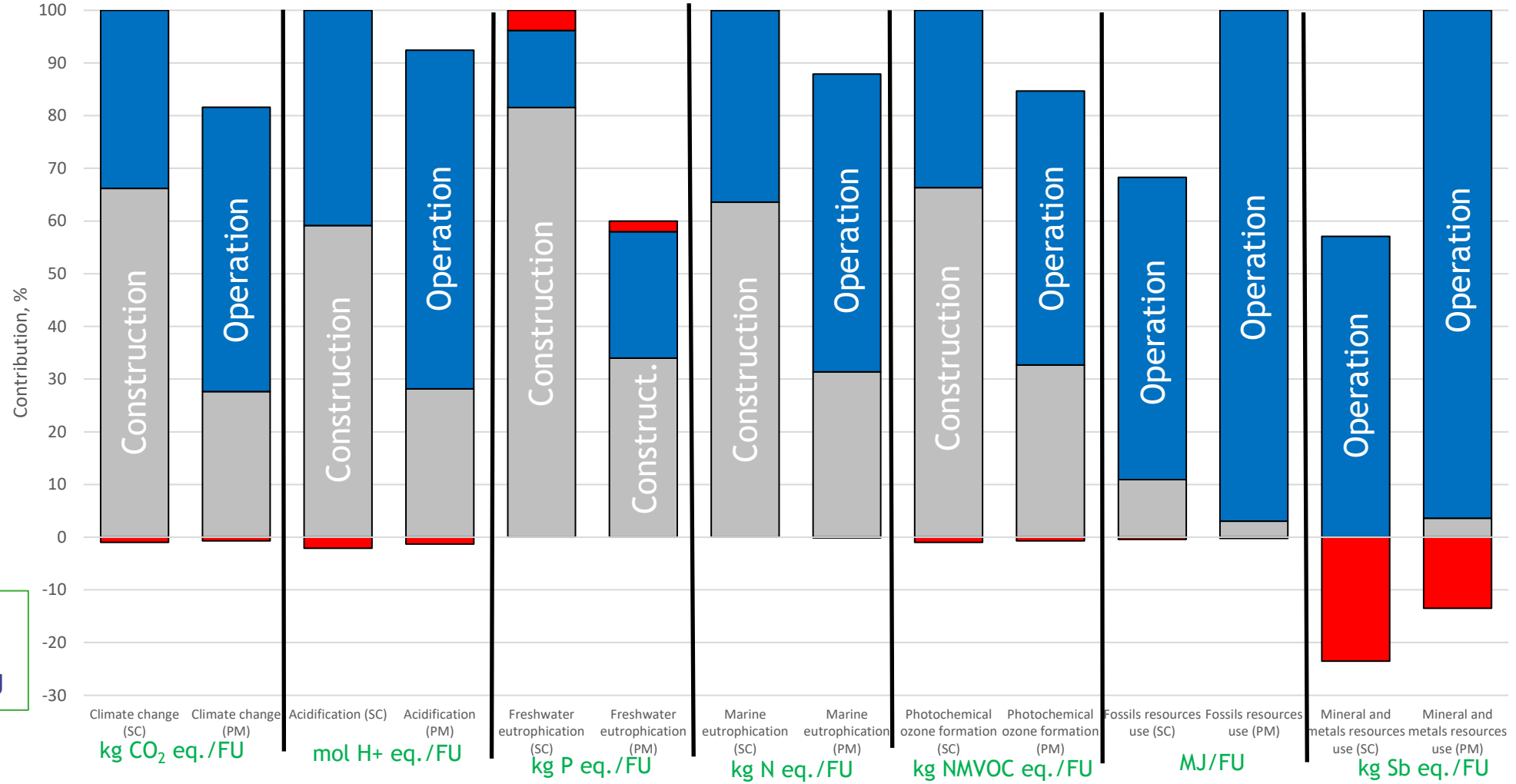
Results of E-LCA

Task 6.2 Environmental Impact – Results of E-LCA

Contributions of life cycles stages for salt cavern (SC) and porous media (PM) to the potential total environmental impact per FU by impact category

Stages:

- Construction
- Operation
- Abandonment



Climate change

SC: 0.281 kg CO_2 eq./FU

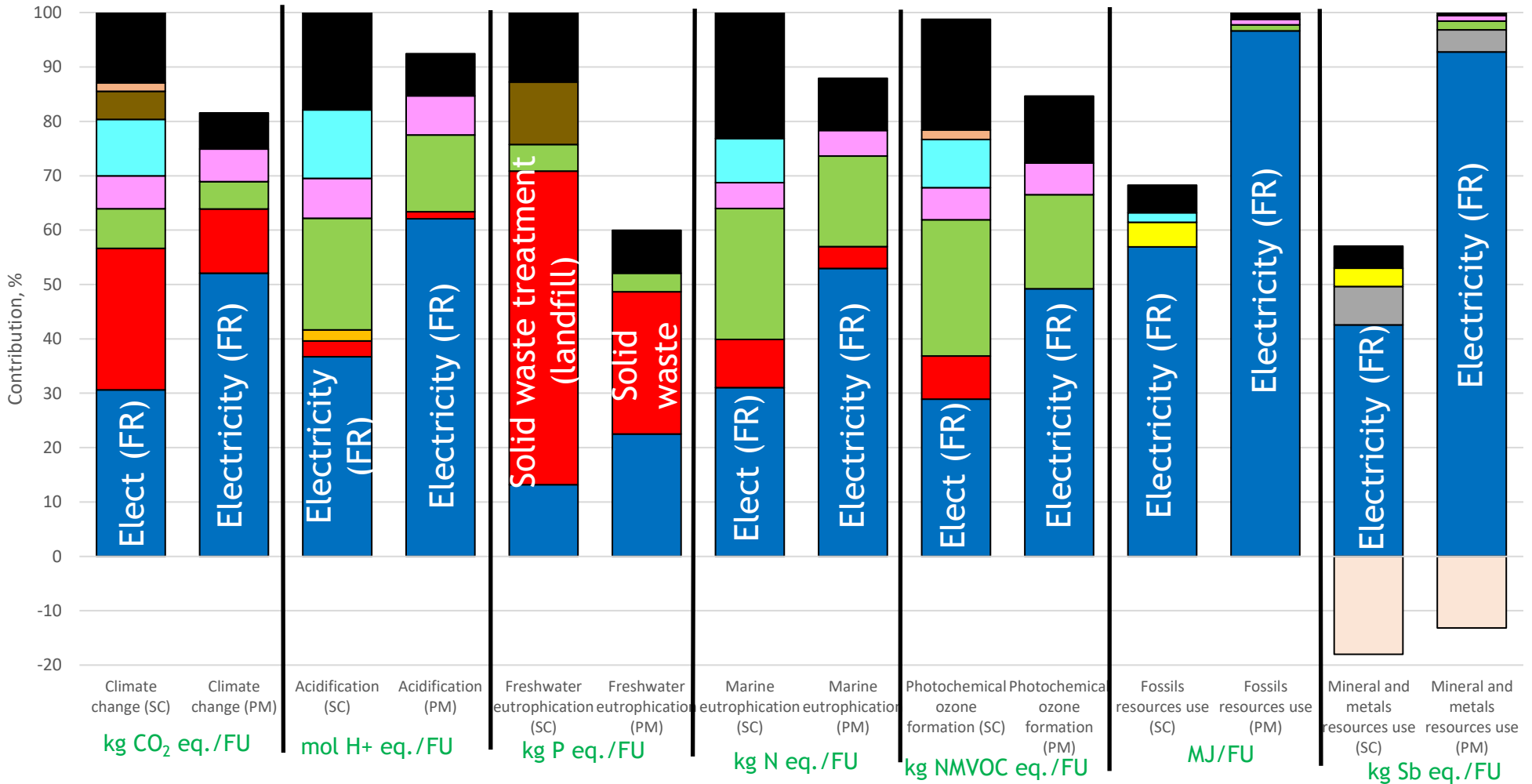
PM: 0.229 kg CO_2 eq./FU

Task 6.2 Environmental Impact – Results of E-LCA

Hotspot processes:

- Construction
  - Diesel (Drilling & completion)
  - Steel pipe (Drilling & completion)
  - Steel pipe (Leaching)
  - Electricity (Leaching)
  - Solid waste treatment (Leaching)
  - Cable (Surface facilities)
  - Steel pipe (Surface facilities)
  - Solid waste treatment (Surface facilities)
- Operation
  - Electricity (FR)
- Abandonment
  - Recycling steel
  - Remaining

Contributions of main processes for SC and PM to the potential total environmental impact per FU by impact category



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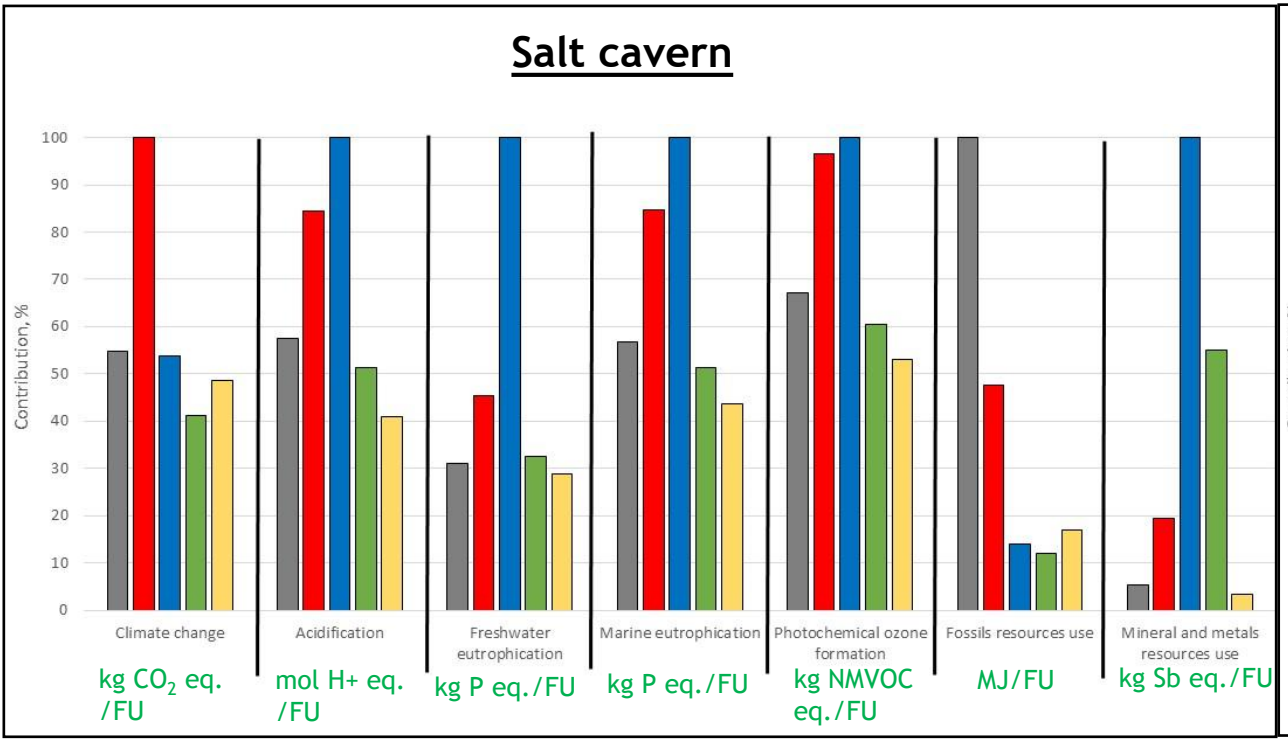
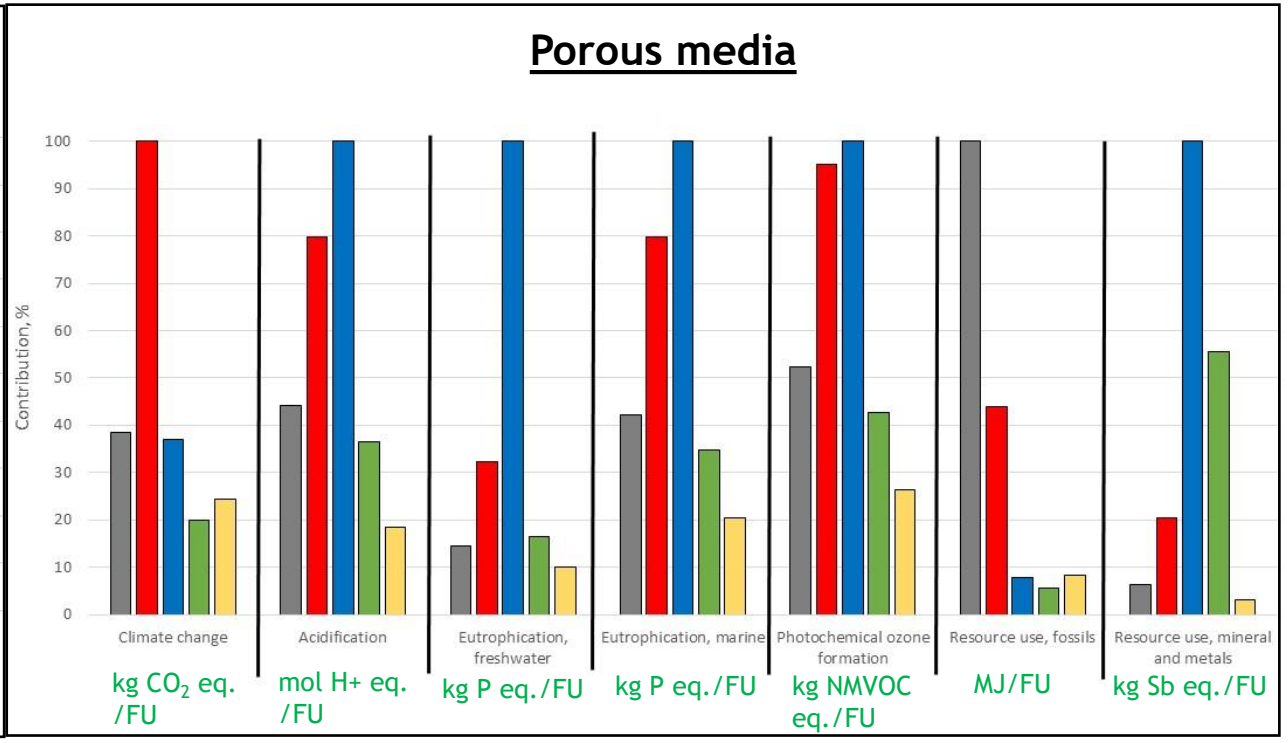
Contributions of total impacts according to the electricity production mix of 2018 by impact category

Salt cavern



Porous media



France, base case	Denmark	Green Germany	Green Global	Norway
71% nuclear 13% hydropower 5% NG	46% wind 22% hard coal 14.5% solid biomass	52% wind 22% FV 13.5% biogas	55.6% wind 26% FV 16% hydropower	95% hydropower 2.5% wind 2% NG

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Carbon intensity of UHS

SC: 0.281 kg CO_2 eq./kg H_2 stored
PM: 0.229 kg CO_2 eq./kg H_2 stored

Emission factors and benchmarks for CO_2 emissions related to H_2 according to the stages considered

Origin of H_2	Production (kg CO_2/kg H_2 produced) [a]	Production + storage in SC (kg CO_2 eq./kg H_2 produced and stored)	Production + storage in PM (kg CO_2 eq./kg H_2 produced and stored)
Electrolysis: Iceland mix electricity	0.0	0.281	0.229
Electrolysis: France mix electricity	2.8	3.081	3.029
EU Taxonomy [b]	3.0	3.281	3.229
RED II (threshold from RFNBO) [c]	3.384	3.665	3.613
SMR with CCS capture rate of 60%	4.4	4.681	4.629
SMR without CCS	9.0	9.281	9.229
Electrolysis: EU-27 mix electricity	11.5	11.781	11.729
Electrolysis: Poland mix electricity	35.5	35.781	35.729

RFNBO: Renewable transport Fuels of Non-Biological Origin; SMR: Steam Methane Reforming; CCS: Carbon Capture Storage

[a] Values from Hydrogen Europe (2022), based on EEA data for 2020.

[b] EU Taxonomy threshold for sustainable H_2 manufacturing.

[c] RED II: Renewable Energy Directive from July 2021.

Hystories project consortium

Geostock

ludwig bölkow systemtechnik

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GeoNet

MicroPro GmbH
Microbiological Laboratories

FUNDACIÓN PARA EL DESARROLLO DE LAS NUEVAS TECNOLOGÍAS DEL HIDRÓGENO EN ARAGÓN

Mineral and Energy Economy Research Institute
Polish Academy of Sciences

Acknowledgment

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 101007176. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation program, Hydrogen Europe and Hydrogen Europe Research.

The Project is co-founded by European Union

Clean Hydrogen Partnership

Thank you !

jsimon@hidrogenoaragon.org
dcortes@hidrogenoaragon.org
graluy@hidrogenoaragon.org

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