



Life cycle analysis and hydrogen sustainability

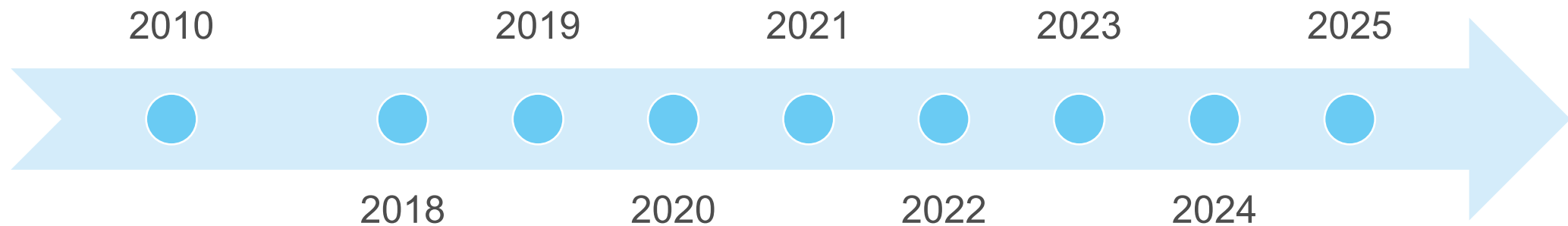
A JRC historical perspective

Webinar on Hydrogen Sustainability and Circularity - 8 May 2025

Pietro Moretto, European Commission - JRC C.1

A. Arrigoni, M. Serafini, F. Dolci, E. Weidner

Act 1 - How we got here

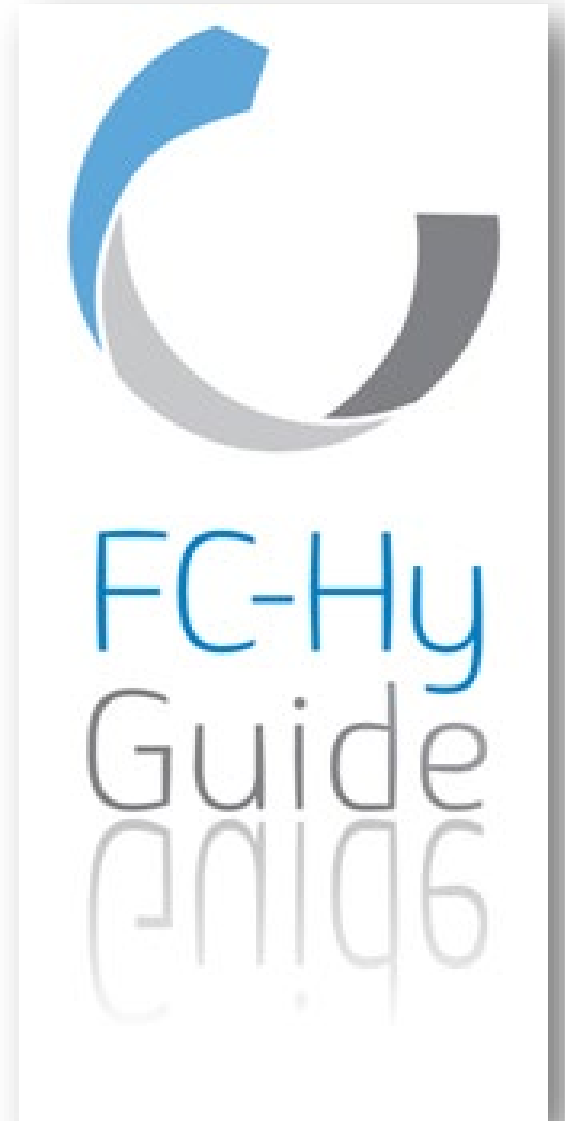


2010 - The LCA programme start

FCH JU first methodology effort:

Twin-projects **HYGUIDE** and **FC-Guide** (*JRC was part of the consortium*)

👉 A guidance document for JU projects



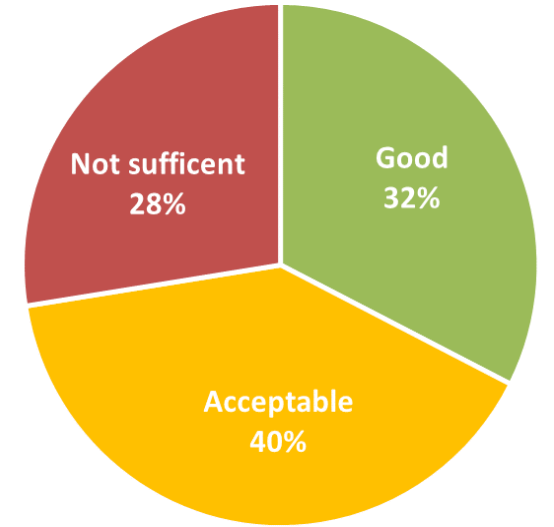
<https://fc-hyguide.eu/>

2018 - An LCA reality check

First JRC **assessment of LCA deliverables** submitted by **FCH 2 JU** projects

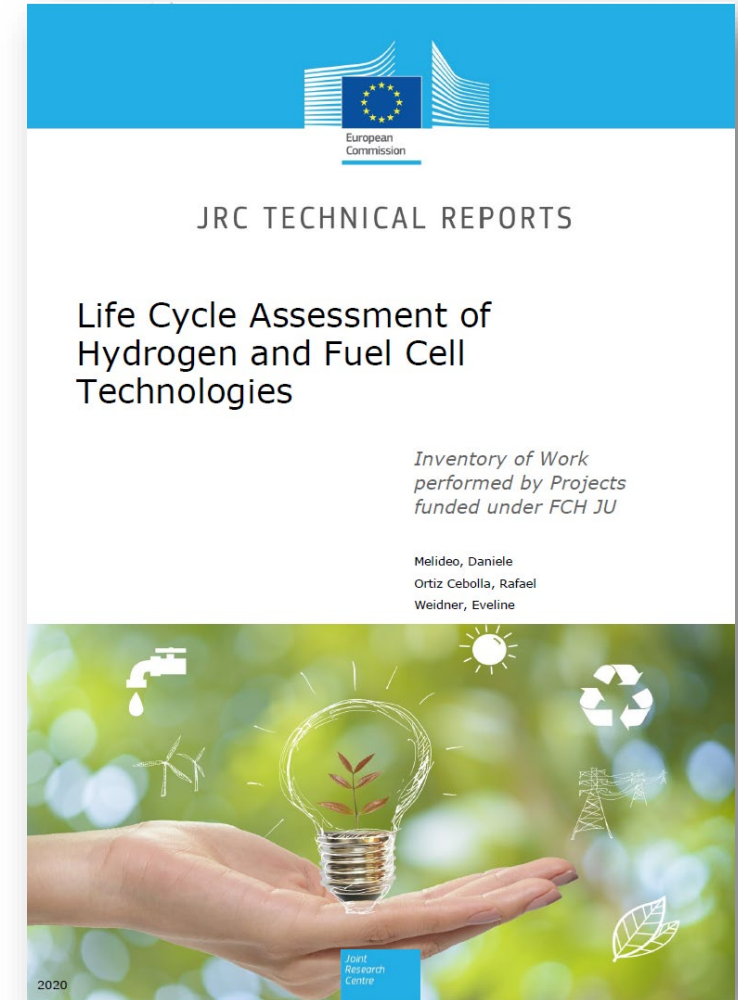
Finding:

- **Less than 50%** of the LCAs analyzed stated that they have followed **FC-HyGuide**
- **Lack of adherence** to Guidelines
- **Lack of comparability**
(different reference systems, data sources,)



2018 – JRC Recommendations

- 👉 **Better guidance** needed (and better adherence to guidelines)
- 👉 **Minimum requirements** to be defined
- 👉 **Lack of primary data** should be addressed
- 👉 **Expert workshop** to agree on a way forward

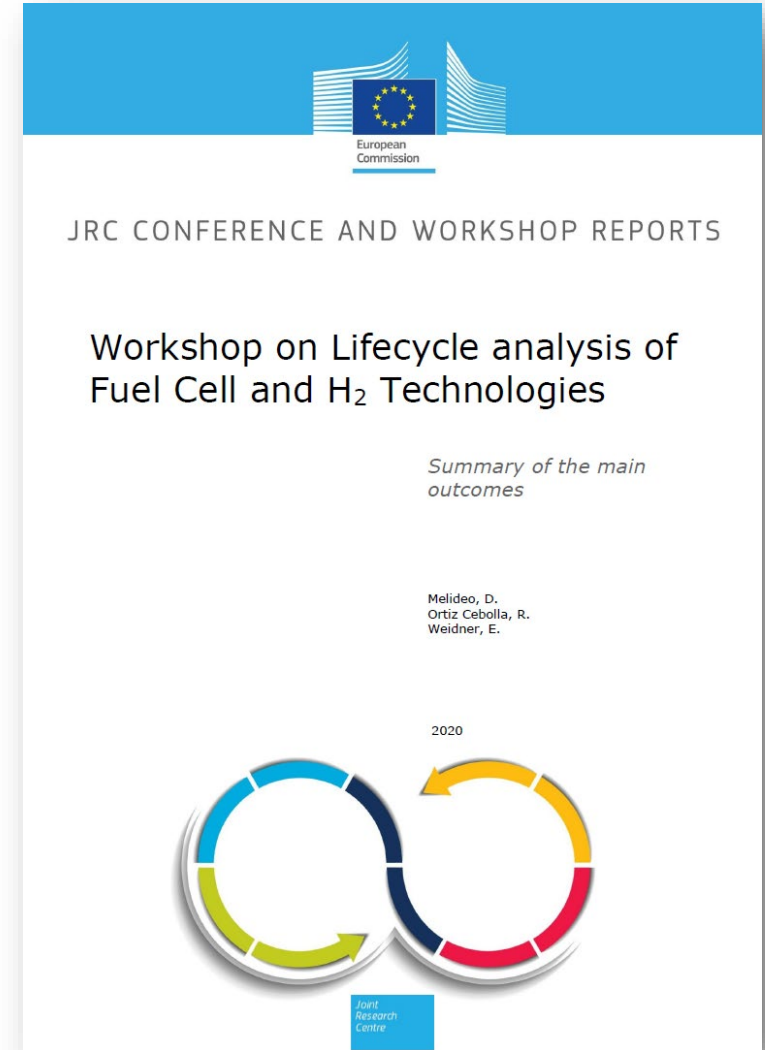


Melideo, D. *et al.*, doi:10.2760/434747

2019 - Expert workshop

Conclusions:

- **Update of FC-HYGUIDE** (lead to SH2E project funded by JU and Horizon 2020)
- **Harmonised approach**, identification of reference cases
- Creation of **LCA databases for fuel cell and hydrogen technologies**



Melideo, D. *et al.*, doi:10.2760/459675

2020: 3 projects related to a LCA dimension

eGHOST : Development of eco-design guidelines for FCH products.

BEST4HY: Development and validation of existing and novel recycling technologies for key FCH products.

SH2E: Guidelines for Life Cycle Sustainability Assessment (LCSA) of fuel cell and hydrogen systems.

JRC operative support

JRC contributed to the preparation of these 3 JU projects

The JRC **assessment of LCA deliverables** of JU projects becomes an annual activity.

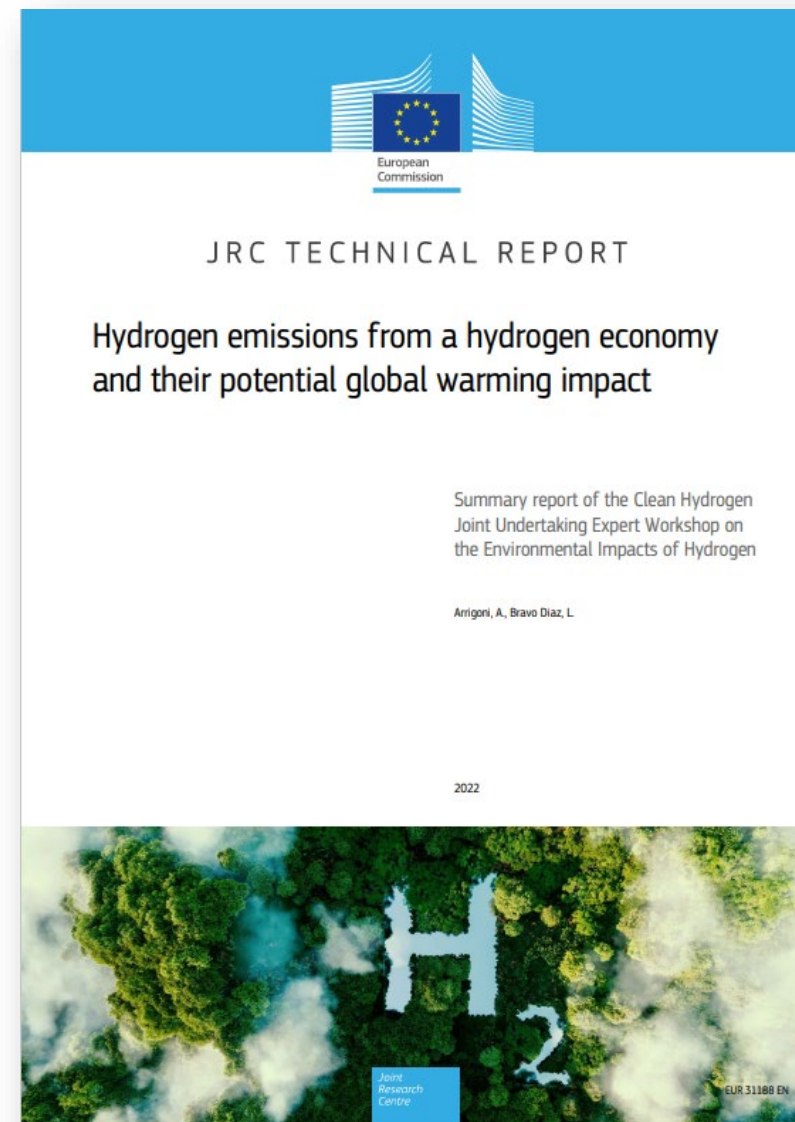
2021-22 – A new challenge: H₂ emissions

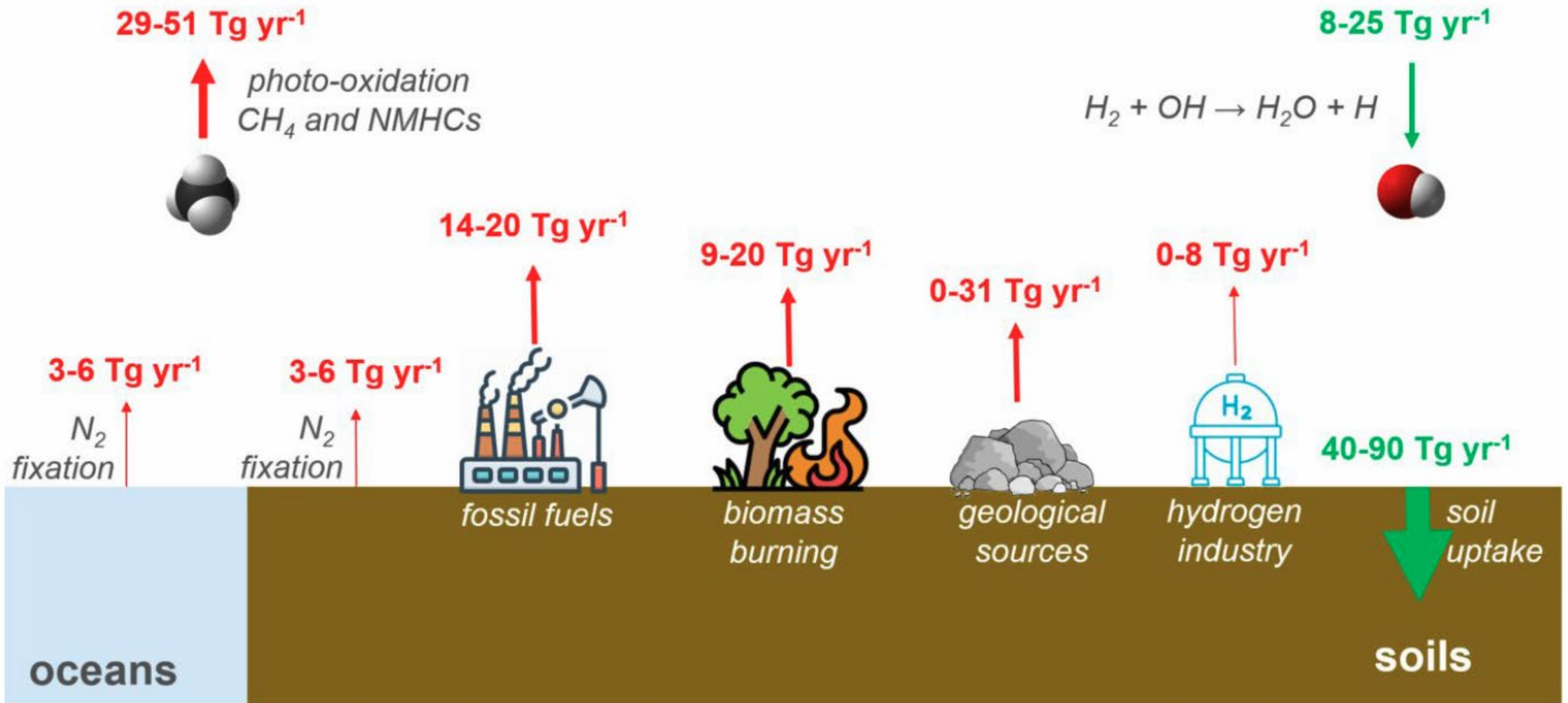
Report on hydrogen emissions from a hydrogen economy and their potential global warming potential.

LCI data collection process

Integration of the developed inventories in an “Hydrogen node” of the Life Cycle data Network

JRC operative support





Source: JRC (2022) adapted from the figures presented by Sand, Paulot, and Stevenson

2023: Hydrogen Delivery and Checklist

JRC assessment on the **environmental impact of delivering hydrogen**

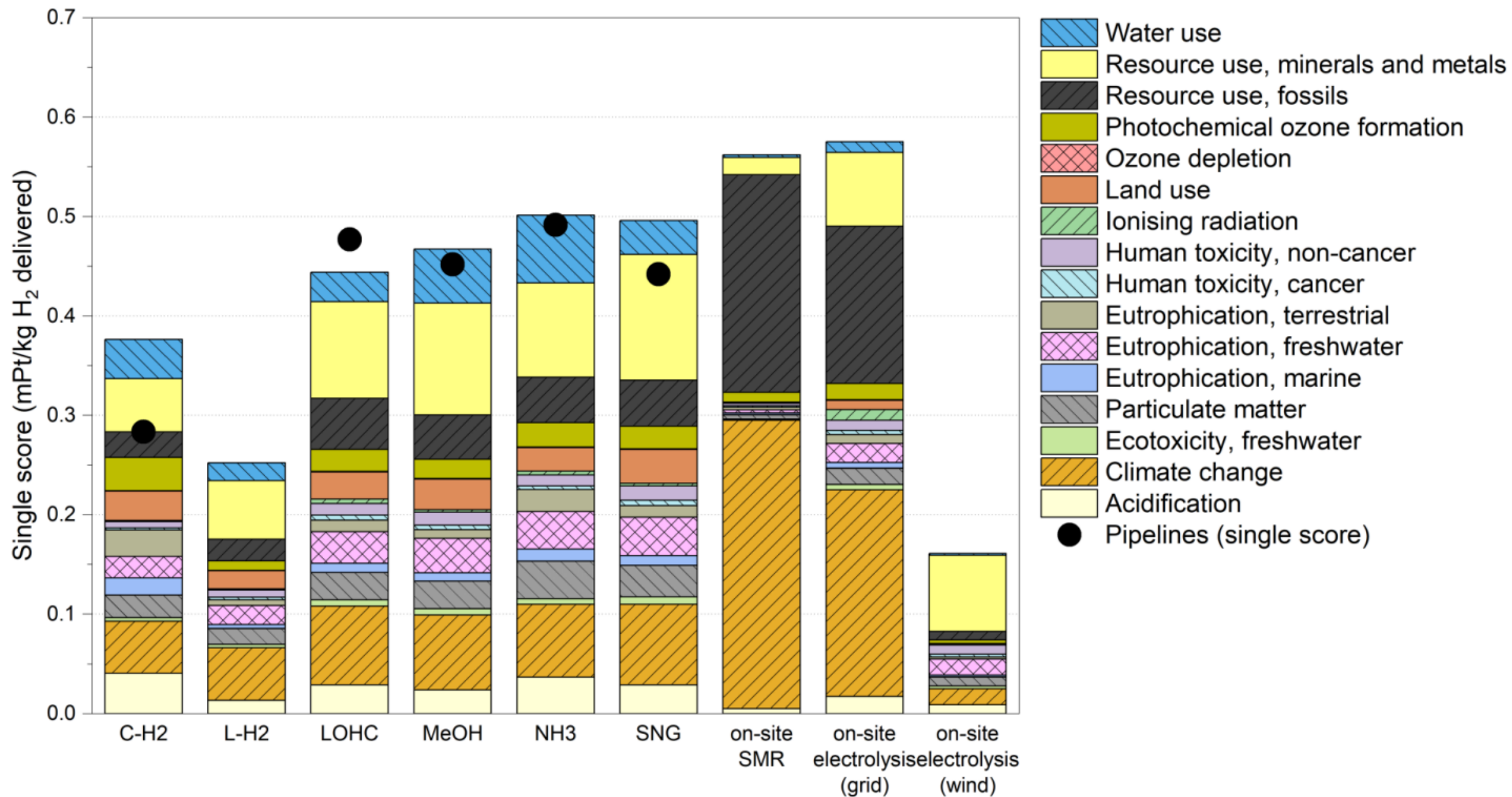
Development of **social impact assessment** methodologies for hydrogen technologies

● ————— JRC operative support ————— ●

Creation of a **checklist that projects should follow** for their LCA (with SH2E)



Arrigoni, A. et al., doi:10.2760/5459



2024 – pioneering on social LCA

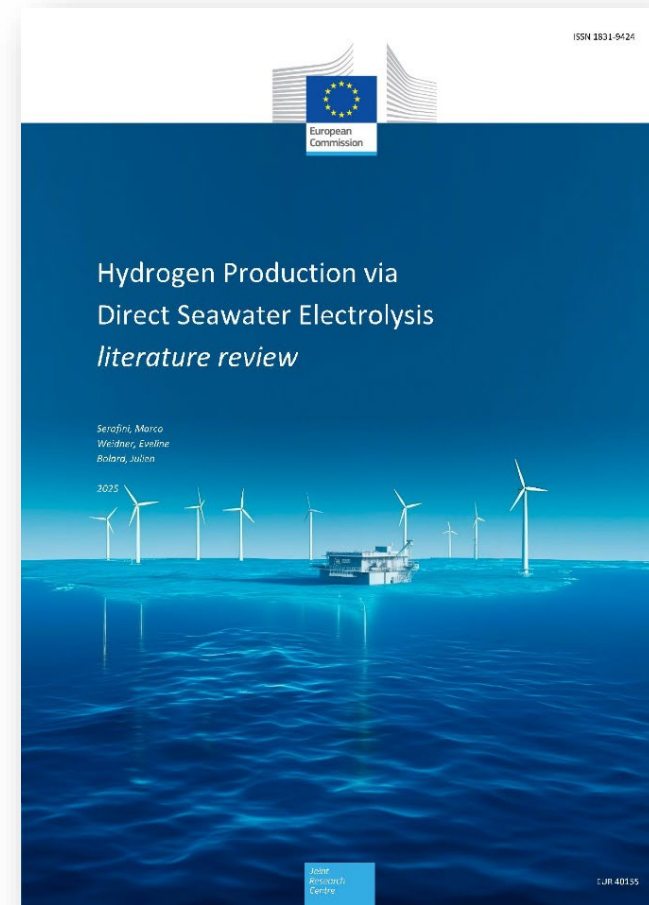
State of the art of Direct Seawater Electrolysis (looking for alternative source of water)

Development of a **social LCA framework** related to hydrogen value chain

— JRC operative support —

Kick-off and collaboration with the EHS&CP

Support to sustainability-related projects such as **HyPEF, NHyRA**



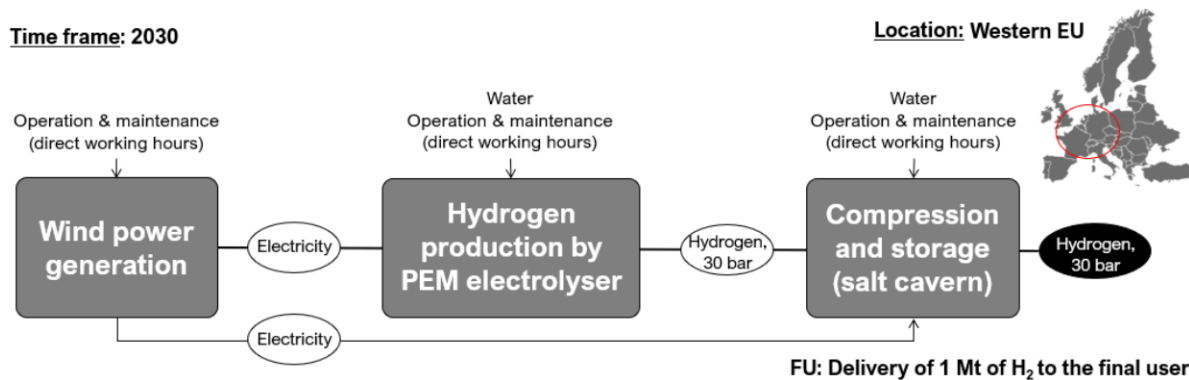
Serafini, M. et al., doi:10.2760/7173530

Social LCA

- Identification **hotspots** in the hydrogen value chain
- **Conceptual framework** assessing and monitoring **social risks** and impacts related to hydrogen technologies

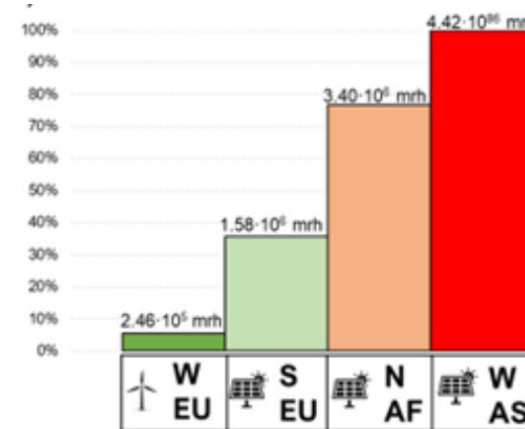
Time frame: 2030

Location: Western EU

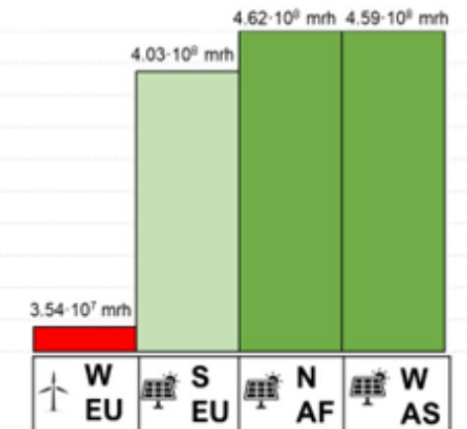


Publication currently under review at the International Journal of LCA

child labor



economic development



2025 – ongoing work

Further developing a framework on **social risk and impacts** related to hydrogen value chain

Liaising CH-JU and non-CH-JU projects to better understand the potential impact of H2 emissions

• *JRC operative support* •
Developing guidelines to harmonise LCA for Hydrogen Valleys



Act 2 - Other JRC LCA actions



JRC LCA actions for the European Commission

Support to policy DGs for the development of environmental impact methodologies for hydrogen (CBAM, Taxonomy, NZIA, PCF)

Development of Life cycle inventories for different electrolysers and technologies

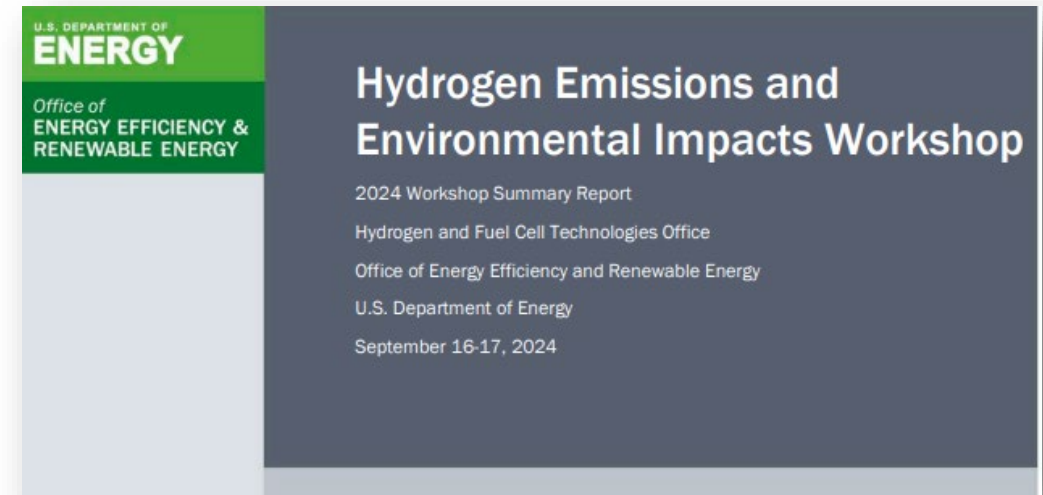
H2 Water nexus - Assessment of the water consumption of hydrogen production pathways and impact on EU water resources

Simplification and **harmonisation** of the different H2 LCA methodologies appearing in specific European policies .

JRC intervention in the international fora

IPHE - participation to Hydrogen Environmental Impact Analysis (HEIA) and Hydrogen Certification Mechanisms (H2CM) task forces

ISO 19870 - Methodology for determining the GHG emissions through production, conditioning and transport of hydrogen to consumption gate



<https://www.energy.gov/eere/fuelcells/hydrogen-emissions-and-environmental-impacts-workshop>

**2027 IPCC Methodology Report
on Inventories for Short-lived
Climate Forcers**

Thank you



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