TOWARDS A ROBUST LIFE CYCLE ASSESSMENT OF END-OF-LIFE STRATEGIES FOR FUEL CELLS AND HYDROGEN TECHNOLOGIES

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INTRODUCTION

The current energy transition context requires the replacement of fossil-based technologies with alternative ones such as **fuel cells and hydrogen** (FCH) technologies. In this sense, **hydrogen** arises as a promising alternative with the potential to provide low-carbon energy for all sectors of the economy (*e.g.*, transport, building and industry sectors). However, in addition to infrastructure and social barriers, a wide deployment of commercial FCH technologies is also conditioned by the current lack of well-defined **end-of-life** (EoL) strategies. In the field of Life Cycle Assessment (LCA), the underdevelopment of EoL strategies for FCH technologies results in the weak consideration of the EoL stage in current LCA studies of hydrogen energy systems, as pointed out by Valente *et al.* [1].

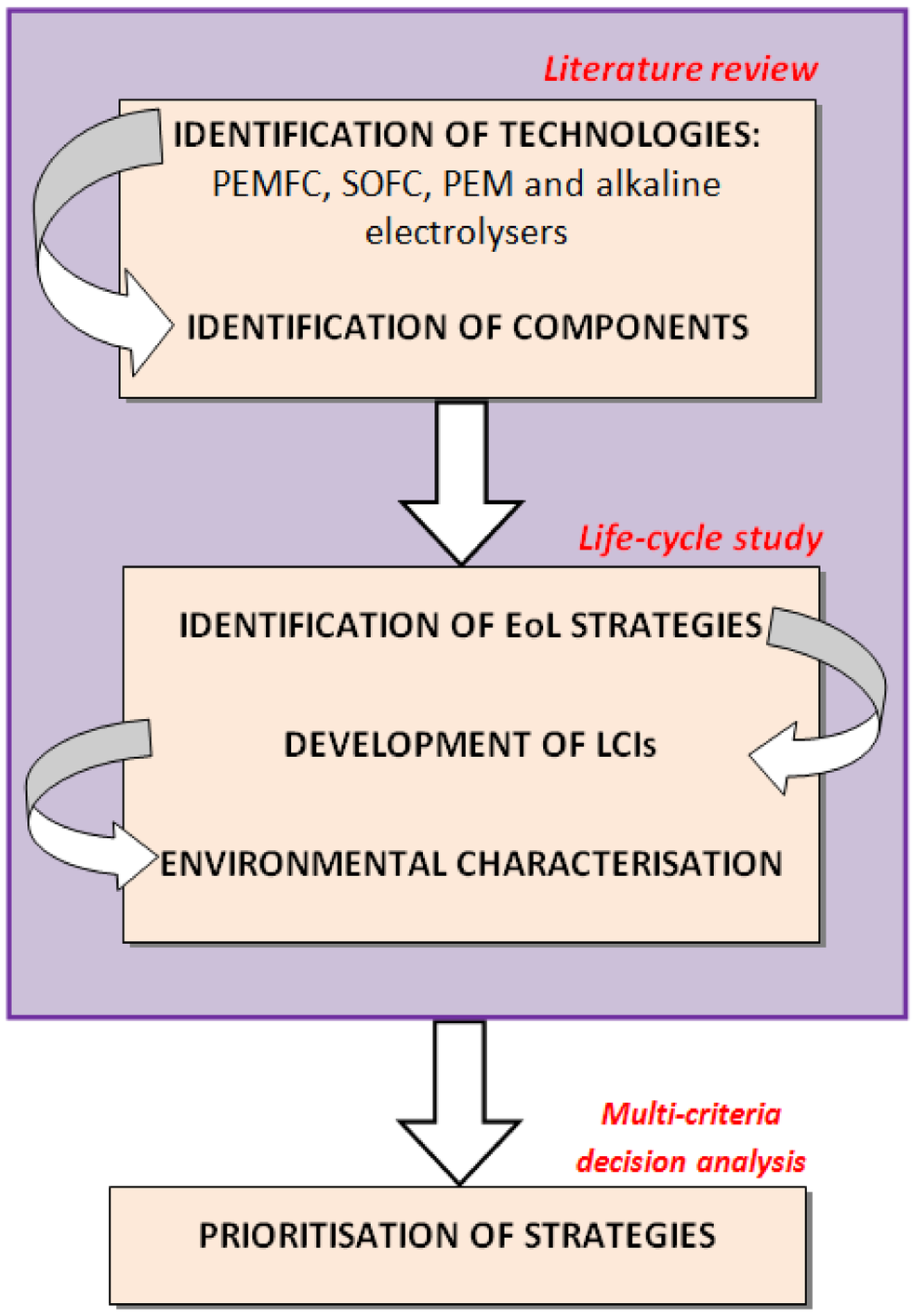
METHODOLOGY

✓ The **HYTECHCYCLING project** –funded by the Fuel Cells and Hydrogen Joint Undertaking (Grant Agreement No. 700190)– attempts to deliver reference documentation and studies on both conventional and novel EoL technologies and strategies applied to FCH technologies, paving the way for future demonstration actions and advances in roadmaps and regulations. In particular, one of the key steps considered to achieve this goal is the performance of robust LCA studies of EoL technologies and strategies for FCH systems.

✓ Based on a literature review, commercial FCH technologies and the corresponding components involved will be identified, along with conventional and novel EoL technologies. **Proton Exchange Membrane** (PEM) and **alkaline electrolysers** as well as **Proton Exchange Membrane Fuel Cells** (PEMFC) and **Solid Oxide Fuel Cells** (SOFC) are set *a priori* as key FCH technologies to be included in the study.

✓ According to the findings from the literature review, EoL strategies for FCH technologies will be identified and defined for the subsequent development of **life cycle inventories** (LCIs) and their subsequent **environmental characterisation**.

✓ A **Multi-Criteria Decision Analysis** (MCDA) –potentially using Data Envelopment Analysis– will support the prioritisation of EoL strategies according to sustainability criteria.



Methodological steps for the definition and selection of appropriate EoL strategies

EXPECTED RESULTS

✓ Quantitative information on the **life-cycle evaluation** of the EoL stage of FCH energy systems:

- Life-cycle inventories
- Life-cycle profiles

✓ **Enrichment of previous FCH-related initiatives on LCA** such as the FC-HyGuide project [2].

✓ **Recommendations** on the most appropriate EoL strategies.

CONCLUSIONS

✓ The advances proposed in this study are expected to allow **robust LCA and MCDA studies of EoL strategies for FCH technologies** while paving the way for **complete LCA studies of hydrogen energy systems**.

✓ Well-supported recommendations will facilitate **decision- and policy-making processes** for those FCH actors and stakeholders willing to add a comprehensive sustainability perspective to their decisions.

REFERENCES

[1] Valente A, Iribarren D, Dufour J. Life cycle assessment of hydrogen energy systems: a review of methodological choices, International Journal of Life Cycle Assessment (2016) DOI:10.1007/s11367-016-1156-z.

[2] Lozanovski A, Schuller O, Faltenbacher M. Guidance document for performing LCA on hydrogen production systems, FCH JU: Brussels (2011).

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