SOCIETAL, ENVIRONMENTAL, AND ECONOMIC ANALYSIS OF NOVEL HYDROGEN PRODUCTION PROCESSES

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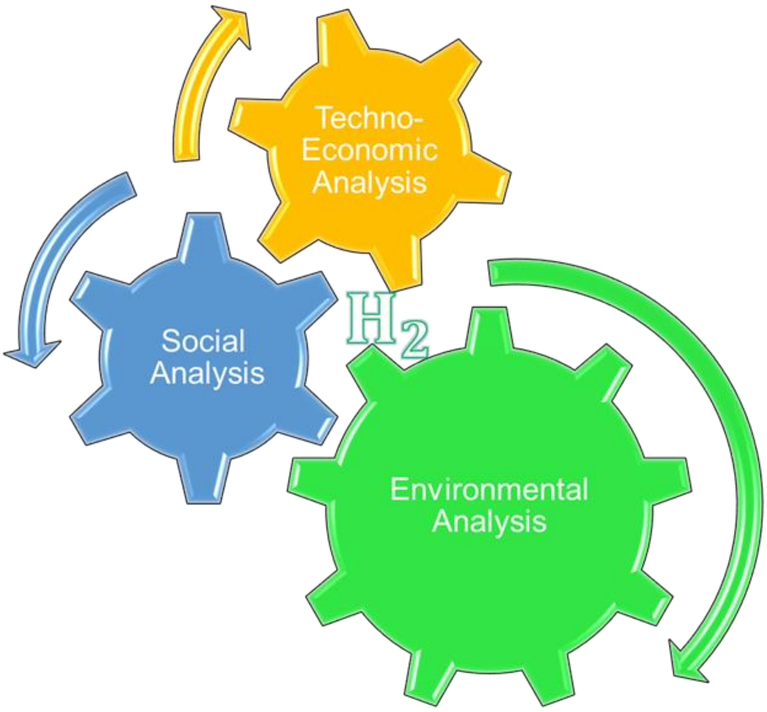
Water splitting for H2 production driven by solar energy is quite attractive while the current efficiency is very moderate due to both the extremely sluggish water oxidation half reaction and limited light harvesting (mostly UV-visible light). In addition, the separation of one product H2 from the other O2 during water splitting is very costly. In this project these challenges will be addressed by analyzing novel processes able to better utilize the full solar spectrum, couple water splitting with biomass-derivative oxidation to avoid water oxidation, combine photocatalysis and thermal catalysis, and use continuous reactors, thus targeting to produce green H2 from both water and biomass with a high yield. The process should not use fossil fuels nor produce CO2, thus being a zero carbon-emission technology. Finally, the system should be readily scaled up by numbering up the reactor modules.



The focus of the research will be the analysis of the societal, environmental, and economic potential of the novel production processes. The specific objectives of this work are:

• The life cycle assessment (LCA) and optimization of the novel hydrogen production processes;

• Techno-economic analysis (TEA) of the novel hydrogen production processes;

• The system integration of the produced green hydrogen into the future sustainable industry, resolving the integration with the bio-based industry, hydrogen economy and high-value chemicals;

• Working simulation tool, represented by an integrated Agent-Based (AB) model able to analyze the environmental, social, and economic impact of the developed technology and the related potentially generated value chains;

• Possible final impacts drafting advertisements and implementation baselines, basing on the results of suitable designed experiments, analyzed through the simulation model, of a set of plausible scenarios, focusing on the impacts at three complementary levels: environmental, social, and economic.

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