# **ENLENS:** Energy Transition Through the Lens of SDGs

*Research Priority Area application*

**1. Title:** Optimizing Energy Efficiency and Policy for Green Hydrogen Production and Market Adoption

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**3. Societal case**

In recent years, Europe has been at the forefront of the global energy transition, striving to reduce greenhouse gas emissions and promote sustainable development. A vital component of this transition is the establishment of an energy-efficient system for producing green hydrogen [1]. Green hydrogen, generated through electrolysis using renewable energy sources, has emerged as a promising solution to decarbonize various sectors, such as industry, transportation, and heating [1]. European countries have actively invested in developing green hydrogen infrastructure and fostering international collaborations to accelerate its adoption [1]. Traditionally, the electrolysis process for green hydrogen production entails a high-energy consuming anodic oxygen evolution reaction (OER), making the system economically less viable [2,3]. Against this backdrop, this proposal addresses the enhancement of energy efficiency in green hydrogen production through paired electrolysis [3, 4]. The objective is to optimize the electrolysis process, minimizing energy consumption while maximizing the output of green hydrogen. In addition, to ensure market take-off for green hydrogen, innovation must be accompanied by supportive policies to create an enabling environment for the energy transition [5]. This ambition aligns with SDG goals to ensure access to clean and affordable energy (SDG 7), to advance green innovation and economic growth (SDGs 8 and 9) and to combat climate change and its impact (SDG 13). By improving energy efficiency and identifying effective policies for market-take-off, the proposal aims to contribute to a more environmentally friendly approach and widespread adoption of green hydrogen production. It reveals the potential synergies of developing electrochemical processes to enhance technological maturity and energy efficiency, offering valuable insights for policymakers and practitioners.

**4. Scientific case**

Our scientific inquiry focuses on investigating the enhancement of energy efficiency in green hydrogen production through paired electrolysis. By working in partnership with an EB expert, we will develop a broad discussion that goes beyond the energy efficiency of this system to include its commercialization and market take-off potential. Lab experiments will be performed to provide us insight into important parameters that must be considered, and we will draw on analysis of literature. From the experimental perspective, it is proposed to investigate the replacement of the OER with the oxidation of glycerol, a waste from biodiesel production. It is known that organic molecules, such as glycerol, have lower oxidation potentials compared to water, lowering the input energy in an electrolizer, and they can be converted into value-added products [3]. In this regard, the paired electrolysis system will not only offer an energy-efficient approach to producing green hydrogen but also will serve as a valuable opportunity to utilize glycerol. By providing a robust framework, this academic output will facilitate in-depth exploration and understanding of the electrochemical processes involved, enabling researchers to navigate the complexities and intricacies of this field with clarity and efficacy. Ultimately, this work aims to empower the scientific community in advancing sustainable energy-efficient and policy solutions that foster sustainable innovation and accelerate the energy transition.

## 5. Contribution to the aims and success indicators of ENLENS

***A.*** *How will your project evolve after the proposed research/activity. What is the long-term goal? (ENLENS aims at initialization of new activities that may carry on thereafter (seed-money)*

After the proposed research/activity, our project will evolve by leveraging the developed comprehensive, science-based workflow to drive further advancements. Considering the intended results, we also have prospects of applying for greater subsidies. The long-term goal is to establish a framework for the development of electrochemical methods in producing green hydrogen, including policy and market conditions for widespread adoption. This framework will enable efficient analysis and understanding of energy efficiency, leading to optimized processes and increased scalability. By achieving this goal, we aim to facilitate a significant and lasting impact on the ongoing energy transition, supporting a greener and more sustainable future.

***B.*** *Why and how does your project contribute to the UvA-community of interdisciplinary research, and ENLENS more specifically?*

Our project significantly contributes to the UvA's interdisciplinary research community and the Energy Transition. By focusing on green hydrogen production, our study aims to establish a foundational framework that aligns with the SDGs. This framework not only supports industries involved in developing technologies for green hydrogen but also addresses the key challenge of market take-off. Interdisciplinary collaboration will combine the technical knowledge of HIMS members [3,6,7] with expertise on market formation and policies for sustainable industries of the EB partner [8-11]. Our research will thus provide insights that would not be possible by these groups working in isolation, contributing to ENLENS' interdisciplinary and sustainability agenda.

***C.*** *ENLENS aims at broadening the community beyond the group of project PIs. Describe how your project will contribute to this goal.*

We will integrate this research: into our respective teaching activities in (i) the Electrochemistry Master Course and (ii) the Business Strategy & Sustainability Master course; and (iii) within interdisciplinary Master theses. Furthermore, we will seek to share results within ENLENS but also with related groups (e.g. the A Sustainable Future initiative at EB; the UvA USP platform) in addition to guest lectures and a workshop. The experiences and findings will be disseminated via a joint academic publication and a policy report, and reported in popular news such as Folia.

## 6. Budget

The budget will be spent as described below:

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| **HIMS - Van't Hoff Institute for Molecular Sciences** | |
| 1 Postdoc position for 3 months (part-time: 20 h/week) | € 15000 |
| **EB - Faculty of Economics and Business** | |
| Research Assistance<br>Workshop and knowledge dissemination | € 9000<br>€ 6000 |
| Acquisition of data/market reports [1] | € 10000 |
| ***Total budget:*** | ***€ 40000*** |

[1] Examples: "GMI Insights": https://www.gminsights.com/industry-analysis/green-hydrogen-market , "MarketsAndMArkets": https://www.marketsandmarkets.com/Market-Reports/green-hydrogen-market-92444177.html?gclid=EAIaIQobChMIqsTUgp2LgAMVDeDICh2KrwhoEAAYBCAAEgL_O_D_BwE

The innovative and exploratory nature of this interdisciplinary cross-faculty research, within the context of the challenging energy transition, makes it difficult to find funding from normal budgets.

**References**

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