

Development of a Life Cycle Analysis of Green Hydrogen Plants

Motivation and Main Objective

The energy transition is now a reality on a global scale and a commitment of nations to issues related to climate change. In this way, renewable energies will have an increasing share in the energy matrix. This transition has chronology and form still uncertain and, in this context, it is essential to strengthen mechanisms and opportunities for data collection, which can assist in the definition or development of metrics that can facilitate the analysis of the environmental performance of companies in the energy sector and that respond to the specificities since the challenge of making these activities more sustainable.

It is generally believed that green hydrogen is one of the best bets in the energy transition to a carbon-neutral world if it is obtained through renewable-source electrolysis and can replace fossil fuel inputs in carbon-intensive industries. Green hydrogen is a strategic decarbonization energy source as it enables improved integration across renewables, in addition to helping reduce emissions in industries whose targets are hard to hit.

In Brazil, a green hydrogen hub is beginning to take shape on the coast of the State of Ceará. The area, located in the Pecém Industrial and Port Complex and directly connected to the Port of Rotterdam, will concentrate several companies connected to the production of the clean energy source. In accordance to the master plan of the State of Ceará Government, the 2 km² Hub area will be able to produce around one million tons of H₂ per year. Part of the production is expected to meet the demand of large companies installed in Pecém, such as cement and steel mills, in their energy transition as well as to become a strategic gateway to the European market.

The Ceará State has a unique and very strong position with very favourable weather conditions, both for solar and wind energy and is a major producer of wind power, as well as solar energy. Solar- and wind-produced energy are crucial to supply the electrolyzers, making the State competitive.

In this sense, this proposal intends to meet the "NoPa 2.0 Cooperation in the area of Green Hydrogen/PtX, Direct Electrification and Energy Storage DAAD" Call in order to collaborate with the reduction of environmental impacts arising from the use of renewable energy sources.

The proposal intends to develop tools to assist Brazilian environmental agencies in making decisions on the environmental licensing process of the new green hydrogen power generation units.

The proposal aims to apply the concepts of Life Cycle Management (LCM) to ensure an efficient environmental management of these activities.

We need a good foundation of data to calculate the environmental impact of economic activity, and this foundation still needs to be built in regard to green hydrogen, PtX and clean energy storage in Brazil. Data from Europe or North America is not fully applicable to Brazilian circumstances. To gather such foreign data is helpful, but it needs to be adapted to Brazilian circumstances (where some activities are done with different technologies and with greater preference for manual labour).

The project shall thus gather the necessary data by primary and secondary research and make it publicly accessible to the scientific community free of charge.

This activity will offer opportunities for young scientists and for creating lasting links between the German and Brazilian scientific communities.

Methodology and Planned Activities

The product to be developed by this proposal will be a data base that allows the generation of green hydrogen power through safe operations, environmentally appropriate and in accordance with current Brazilian legislation, so that environmental risks and their potential impacts are eliminated and / or mitigated. Life Cycle Management (LCM) is a tool with the objective of minimizing environmental and socioeconomic burdens associated with a product or process during its life cycle. In this context, the application of the concept of the life

cycle is presented as a tool to address new paradigms for innovation, integrated management, dissemination of knowledge and for the promotion of technologies and methods for the management of environmental risks, with the objective of promoting the sustainable use of natural resources and facilitating regulators in their decision-making processes.

Intended Outcome

The life cycle analysis will inform about the climate impact of green hydrogen production. This in turn enables the calculation of the difference between processes using green hydrogen and processes using its substitutes. This is a great economic relevance, as it enables to calculate the different financial impact of carbon pricing schemes such as in the European Union.

The inputs have a different carbon footprint depending on the region, so the project's output will inform the decisionmaking for green hydrogen production projects in Brazil and (with a lesser accuracy) in countries with great similarities to Brazil.

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Project Partners	Anhalt University of Applied Sciences & PUC Rio
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German-Brazilian Cooperation

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