Chair of Renewable and Sustainable Energy Systems
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Exercise

Life cycle analysis: Hydrogen production and H_2 mobility

The learning objective of the exercise is to get to know the LCA approach further and to familiarize yourself with hydrogen production.

The exercise aims to estimate the potential environmental impact of using H_2 vehicles on climate change and the scarcity of mineral resources, considering a well-to-wheel analysis.

The study will provide answers to the following questions:

- How many grams of CO_2 are emitted per kilometer driven over the life cycle in each case?
- Which phase accounts for the largest share of CO_2 emissions?
- Which materials account for the largest share of CO_2 emissions?
- How many grams of copper equivalent are consumed per kilometer driven over the life cycle in each case?
- Which phase has the largest share of the resource scarcity of minerals?
- Which materials account for the largest share of the resource scarcity of minerals?
- Do both impact categories behave in the same way?
- If you were a decision-maker, would you consider recommending the use of H2 vehicles? Please explain why.

The Excel file contains all the data needed to perform the exercise.

- PEM water electrolysis: main description, hydrogen production, electricity consumption.
- Tank-to-Wheel: Hydrogen consumption.
- German electricity mix: Electricity generation
- PV system: Main description, electricity generation.

The data are described in different sheets.

- The first sheet describes the system boundaries and has additional information that explains the well-to-wheel term.
- The second sheet presents the "German electricity mix" scenario.

- The third sheet presents the "PV system" scenario and follows the same structure as the "German electricity mix" scenario.
- The life cycle assessment contains the life cycle assessment of materials and energy. These data show the emissions of production of 1 kg, 1kWh or 1 MJ per product, taking into account the entire cycle of life (raw material procurement, transport, processing, manufacturing). This information is provided by various LCA databases.

To perform the exercise, you can follow these steps:

1. Choose the function of the system.
2. Define the functional unit.
3. Create a diagram with the phases and processes to be considered and the system boundaries of the analysis.
4. Calculate the embedded emissions of each process (before using the vehicle) using the data from the LCA.
5. Calculate the emissions of driving 1 km with an H_2 vehicle, considering the functional unit.