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Technical and Economic Optimization of the PtX Value Chain

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Abstract:
At the moment, there are more than 500 announced electrolysis based H2-projects in the world but an abundance of techno-economic parameters makes FIDs of the projects risky. Risks include striking the right balance between installed capacities of wind-solar-battery and the electrolysis capacity as well as the product storage capacity. Add hereto the availability risk of biogenic CO_2 in projects aimed at producing green methanol or Sustainable Aviation Fuel (SAF).

The problem consists of a set of multivariable equations with more unknowns than the number of equations. In essence, it is an optimization problem with a set of constraints and an objective function, which needs to be minimized for levelized cost of hydrogen or green fuel.

This work is about a model for early stage technoeconomic assessment of this optimization problem, used to minimize the projects' financial risks.

The model optimizes the dimensioning of more than 20 value chain components from renewable energy capacities over energy storage to final product synthesis and distillation to determine the ideal system configuration for green fuel production with minimal levelized cost of fuel. The results enable decision makers to de-risk the project investment and develop the most technically and financially viable projects.

Inputs to the model consist of renewable power profiles and CO2-sourcing. The objective function or cost function is the levelized cost of green fuels like methanol, ammonia, hydrogen and SAF, which needs to be minimized.

Feasible solutions must adhere to all external and internal constraints imposed on the model, such as regulatory constraints to achieve certifiable fuels (external) and technical constraints on operational limits (internal).

Once the model is optimized it provides valuable information on how to optimally design the value chain of a PtX-system for a given location, decreasing some of the significant risks in these H2-projects.