Fraunhofer ISE

Fraunhofer Institute for Solar Energy Systems ISE

Hydrogen Infrastructures and Supply Chains

Development and Evaluation of Hydrogen Systems

www.ise.fraunhofer.de/hydrogen-infrastructure

Development and Evaluation of Hydrogen Systems

The efficient and economically viable utilization of green hydrogen in various sectors requires a comprehensive understanding of all individual elements in the hydrogen supply chain. In our techno-economic analyses, we develop and evaluate tailor-made solutions for the production of clean hydrogen from renewable energy, its efficient storage and demand-oriented distribution.

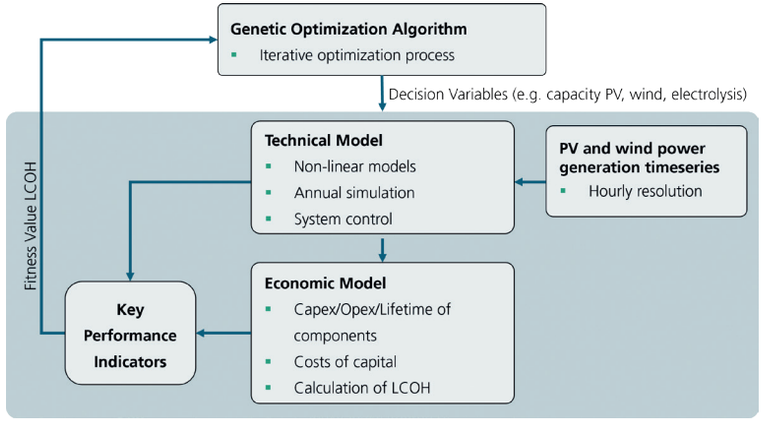
Our Offer

With our extensive R&D services we aim to develop efficient, cost-reduced and reliable hydrogen infrastructures for our international customers:

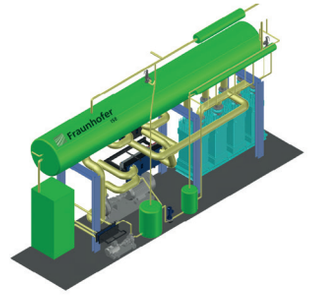
- dynamic system simulation of electrolysis plants and hydrogen infrastructure with our modeling tool H_2ProSim
- plant concepts, monitoring and component testing for hydrogen production, mobility and gas networks
- assessment and optimization of operational management and deployment strategies
- hydrogen yield forecasts and evaluation of business models
- geographic Information Systems (GIS)-based techno-economic studies on the integration of hydrogen in the energy system
- life cycle assessment of hydrogen production plants and supply chains
- technological and market studies

Dynamic System Modeling with our Toolbox H_2ProSim

The toolbox H_2ProSim developed at Fraunhofer ISE is an extensive tool for the simulation-based, techno-economic evaluation of hydrogen plants and supply chains using the simulation environment "Matlab/Simulink/Stateflow". The toolbox has a modular structure and is constantly being updated. Extensive data validation from our R&D projects and proprietary research platforms ensures high accuracy and allows us to derive various KPIs like hydrogen production costs.



Schematic layout of the model structure in H_2ProSim for the least-cost optimization of the system. Fraunhofer ISE models, simulates and optimizes hydrogen systems.



Technical design of a 10MW PEM electrolysis system: Fraunhofer ISE designs plants according to customer specifications.

Techno-Economic Analysis of Electrolysis Plants and Hydrogen Infrastructure

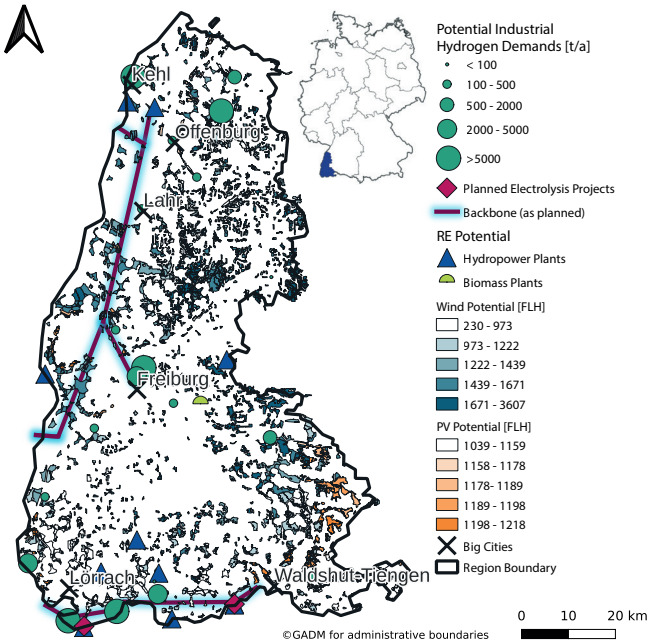
We support our customers along the entire hydrogen value chain:

- **risk mittigation and cost estimation through feasibility analyses:** Using standard models and parameters, we estimate hydrogen production and supply costs and assess the benefit of different plant configurations. The model easily analyzes different scenarios and variations of business models.
- **optimized system performance:** With in-depth modeling, a plant design can be developed up to the rough concept level with techno-economic plant optimization. The impact of different electrolyzer types and locations on the operation and performance of the plant can be evaluated. Typical tasks are minimization of operational expenditures (OPEX), possibilities of heat extraction and oxygen utilization. Selected parameters can be optimized for specific techno-economic targets.
- **reliable financing:** Hydrogen yield forecasts for submission to lenders can be made for existing plant concepts and locations.
- **strategic insights:** We carry out infrastructure analysis and localize suitable sites for large-scale hydrogen and PtX hubs and calculate the production and transportation cost analyses of regional and global hydrogen supply chains.

Spatial Resolved Analysis of Hydrogen Model Regions

We use Geographic Information Systems (GIS) software independently or in combination with our H_2ProSim toolbox to identify suitable locations for hydrogen installations and plants and to determine where hydrogen can be produced most economically.

Thus, we enable a spatial representation of both demand and production potential. By linking this data, we can use our process expertise to develop a cost-efficient and locally optimized placement of a hydrogen landscape, such as the best location for electrolyzers or hydrogen refueling stations under given constraints, such as transportation costs. Special focus lies on the transformation of the existing infrastructure (electricity, heat and gas grids) and the integration of the analyzed regions into the higher-level energy system, with roadmaps to build up hydrogen regions.



Case study Southern Upper Rhine: Renewable electricity (RE) potentials and industrial H_2 demands that can be connected by the optimised hydrogen supply chain.

Further Information

H_2ProSim – Toolbox for the Process Simulation of Hydrogen Systems

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