

System technology and grid integration of hydrogen plants

HyLeiT Workshop, 26. September 2025



Final Workshop

System technology and grid integration of hydrogen plants

Agenda	
09:00 - 09:10	Opening Remarks and Moderation (Philipp Strauss, Fraunhofer IEE)
09:10 - 09:15	The Role of HyLeiT in H2Giga (Isabel Kundler, DECHEMA)
09:15 – 11:10	The HyLeiT Project – presented by the Project Partners:
09:15 - 09:25	The HyLeiT Project: Objective and Results (Norbert Henze, Fraunhofer IEE)
09:25 - 09:30	Challenges in the Power Supply of Electrolysis Plants. A review of DERlab Workshops (Norbert Henze, Fraunhofer IEE)
09:30 - 09:45	Electro-Chemical Cell and Stack Models (Michael Schwalm, Fraunhofer IEE)
09:45 - 09:55	Test Setup for Aging Investigations on PEM Cells (Moritz Mondre, Hochschule Bonn-Rhein-Sieg)
09:55 - 10:10	Optimized Semiconductor Power Modules for Electrolyzer System Applications (Varun Raghunath, Infineon)
10:10 – 10:30	Innovative Inverter for Grid Servicing Electrolyzers (Simon Thomas, Fraunhofer IEE)
10:30 - 10:50	New Inverter Technologies for Large Electrolyzer Systems (Ralf Juchem, SMA and Stefan Wettengel, Technische Universität Dresden)
10:50 - 11:05	<i>Coffee Break</i>
11:05 - 11:25	Aspects of Reliability of Electrolyser Systems (Moritz Ullrich, and Michal Bruhns, Technische Universität Dresden)
11:25 - 11:45	Grid Integration of Electrolyzers (Nils Wiese, Fraunhofer IEE)
11:45 - 11:50	Impulse: Future Research Demand (Norbert Henze, Fraunhofer IEE)
11:55 - 12:20	Questions and Discussion
12:20 - 12:30	Conclusions and End of the Meeting

Cost-optimised system technology and grid integration of systems for the production of green hydrogen

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Cost-optimised system technology and grid integration of systems for the production of green hydrogen

Profile

- Funding: Federal Ministry of Research, Technology and Space (BMFTR)
- Part of the flagship project H2Giga: Serial Production of Electrolysers
- Duration: 01.04.2021 – 30.09.2025
- Project Partner
 - Fraunhofer IEE (Project lead)
 - SMA Technologies AG
 - Infineon AG
 - Technical University Dresden
 - University Bonn-Rhein-Sieg

Content and objectives

- Project content
 - Development of system-optimised rectifiers
 - Investigation of electrolysis stacks to build real-time simulation models for optimal power converter design
 - Grid integration of electrolysis plants (grid support, system services)
- Key objectives
 - New generation of power inverters for electrolysis plants
 - Cost reduction in system technology
 - Better DC power quality for the electrolyser
 - Grid compatibility and options for system services
 - Embedding in scenarios with renewable energy

Project partner in HyLeiT

Cost-optimised system technology and grid integration of systems for the production of green hydrogen



**Fraunhofer Institut für Energiewirtschaft und
Energiesystemtechnik**

Fraunhofer IEE deals with application-oriented research and development in the field of the use of renewable energy sources and decentralized energy supply technology



SMA Solar Technology AG

SMA is one of the world's leading power converter manufacturers for PV and battery systems with an annual production of 20 GW



**Hochschule
Bonn-Rhein-Sieg**
University of Applied Sciences

H-BRS conducts research in the entire field of power electronics for the grid integration of renewable energies and electric vehicles



Infineon Technologies AG

As the world's leading supplier of semiconductors, Infineon uses R&D to ensure the availability of state-of-the-art power semiconductors and their specific optimization for future electrolysis converters



Technische Universität Dresden

With the Chairs:

- Power Electronics
- Components of Intelligent Energy Networks
- Electrical Power Supply

TU Dresden conducts interdisciplinary research on applications of power semiconductors and converters as well as electrical contacts and connections

Highlights from HyLeiT (I)

Cost-optimised system technology and grid integration of systems for the production of green hydrogen

Transistor technologies replace thyristors in electrolysis converters

Thyristor:

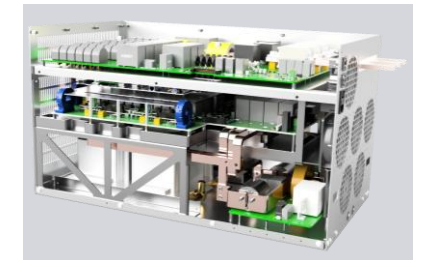
- So far, often individual designed solutions
- Strongly limited grid compatibility

Transistor:

- High power density
- Grid-compatible system integration with the option of ancillary services
- Good price and service life level (from multi-MW PV and battery converters) transferred to electrolysis converters

Optimized semiconductor module technology for electrolysis applications

- 3kV SiC MOSFETs offer significant advantages. High electric strength, self-regulating current distribution and temperature compensation for parallel semiconductor switches.

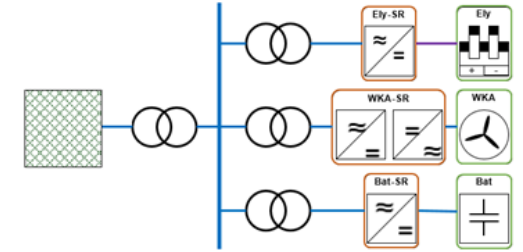


Highlights from HyLeiT (II)

Cost-optimised system technology and grid integration of systems for the production of green hydrogen

Tools for assessing the grid integration of electrolysis plants

- Models for dynamic analysis of electrolysis plants in the grid
- Studies to assess the system behaviour, e.g. in the event of grid faults (FRT)
- Grid-forming controlled electrolyzers also provide ancillary services
- Electrolysis plant simulations in the context of certifications

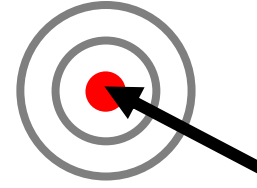


Electrochemical Cell and Stack Models

- Real-time capability / use in Power-HiL (individual emulator control)
- Prediction of the terminal behavior of arbitrary operating states
- Detailed insights into internal cell processes
- Simulation of dynamic short-term processes and aging effects
- Complete individual parameterization of cells

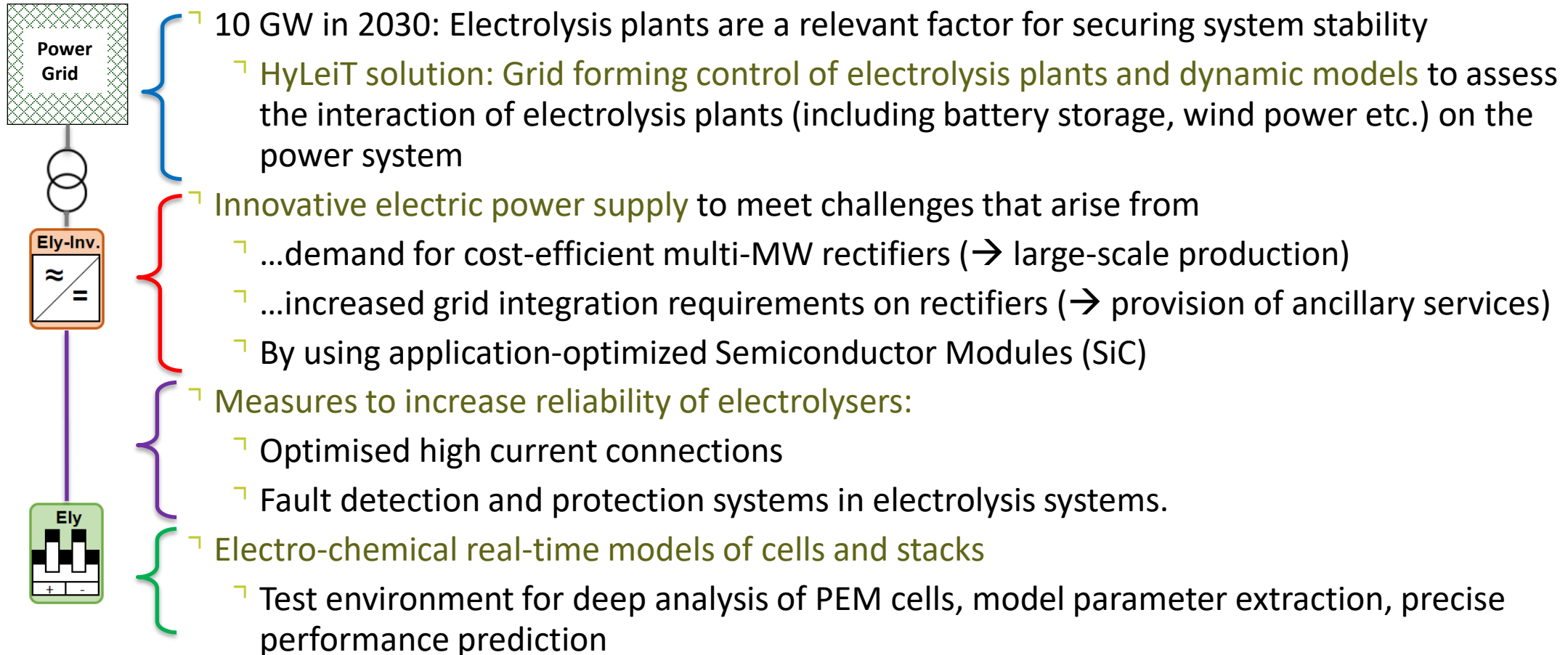


The results from HyLeiT enable...



- ▮ **modular power supply solutions with transistor technologies for electrolysis plants**
 - ▮ smaller, lighter compared to the state of the art
- ▮ **innovative converter topologies...**
 - ▮ for tackling and driving through network faults.
 - ▮ to provide ancillary services.
- ▮ **high reliability due to...**
 - ▮ application-optimized semiconductor modules with SiC technology.
 - ▮ optimized material and design parameters for high-current connections.
 - ▮ detection, localization and control of system faults
- ▮ **precise, real-time simulation of electro-chemical processes...**
 - ▮ for predicting any operating conditions and assessing ageing effects.

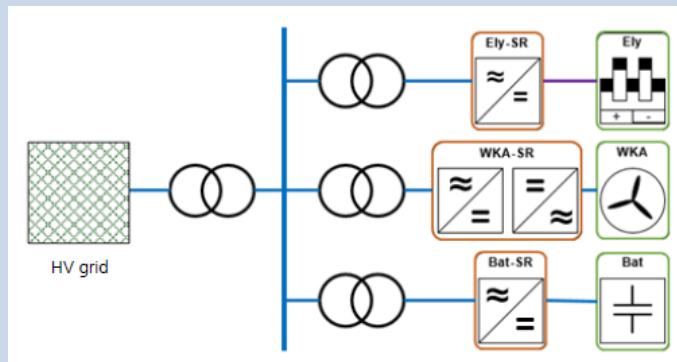
HyLeiT results - Solutions for electrolysis plants



Solutions for electrolysis plants by Fraunhofer IEE

Grid integration of electrolysis plants

- ▮ Assessment of grid stability
- ▮ Dynamic system modelling



Electrolyzer Park with Battery Storage and Wind Power Plant

Modular power supply for electrolyzers

- ▮ $P_N = 200 \text{ kVA}$ per Module
- ▮ Voltage Range DC: 0 - 500 V



PEM cell models

- ▮ Based on electro-chemical processes
- ▮ Customized real-time model

