HTCOEL

Synthesis gas production by high-temperature co-electrolysis

08/06/2021 Oliver Posdziech

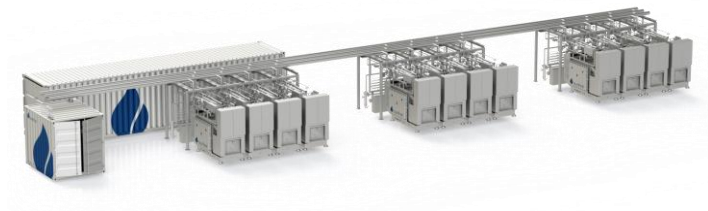
GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

EXECUTIVE SUMMARY

Sunfire is a leading industrial electrolysis company

Solutions & Markets

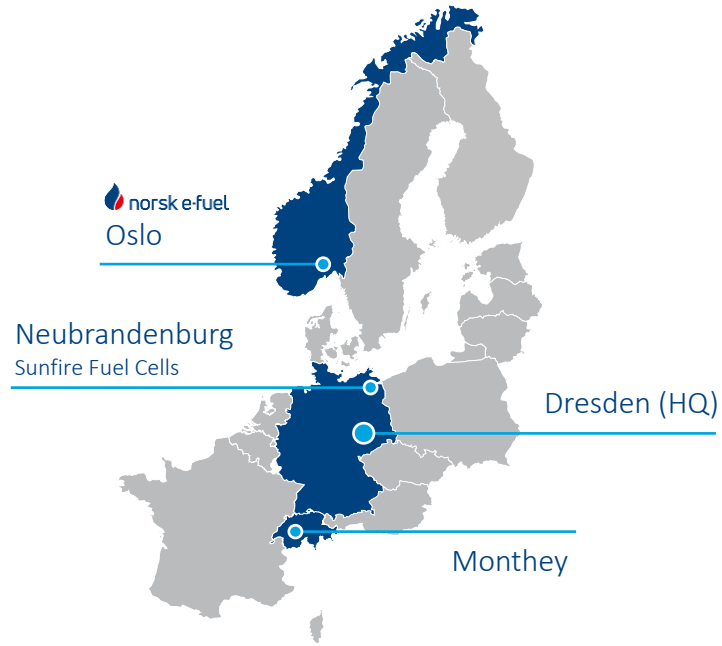
Alkaline Electrolyzer



Solid Oxide (SOEC) Electrolyzers

Steel · Refineries · Utilities · Chemicals · Mobility

Company Sites



> 70	> 250 MW	100 MW	47 MW/year	> 250	> EUR 100 m
Electrolysis projects[1)]	Installed capacity[1)]	Largest electrolyzer installation	Production capacity[2)]	Talented employees	Private and public funding

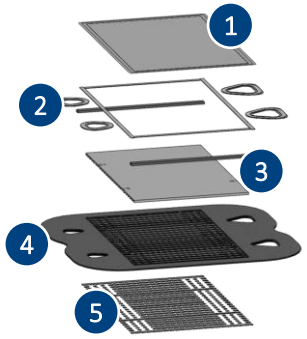
1) Including projects from predecessor alkaline company “IHT SA” prior to the acquisition by Sunfire 2) Production scaling in preparation

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

One system consists of twelve modules with 60 stacks each

Cell
0.125 kW

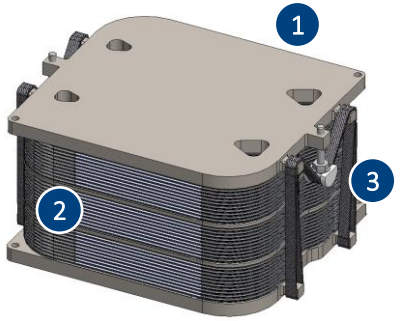
x 30



1. Membrane electrode assembly
2. Glass sealing
3. Nickel foam
4. Sheet metal cassette
5. Cathode contact

Stack
3.7 kW

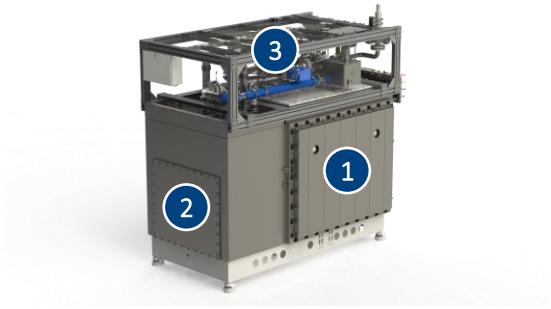
x 60



1. End plates
2. Cells
3. Stack tensioning

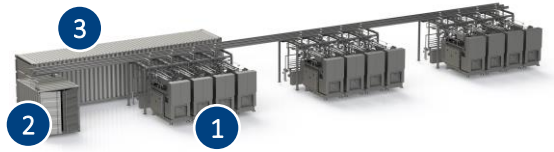
Module
225 kW

x 12



1. Stack unit
2. Gas processing unit (GPU)
3. Supply and discharge unit (SDU)

System
2.7 MW

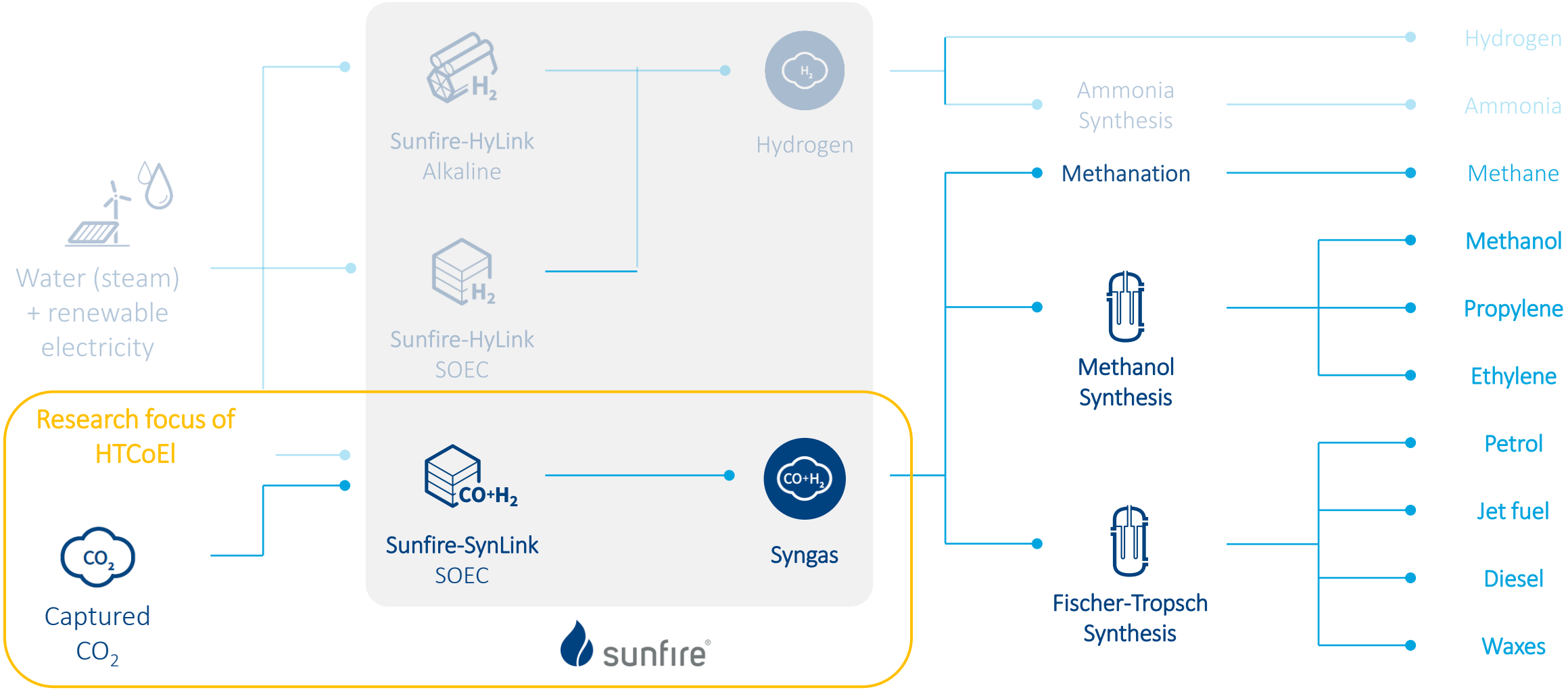


1. Block (= 4 modules)
2. Fluid interface unit (FIU)
3. Power electronics

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

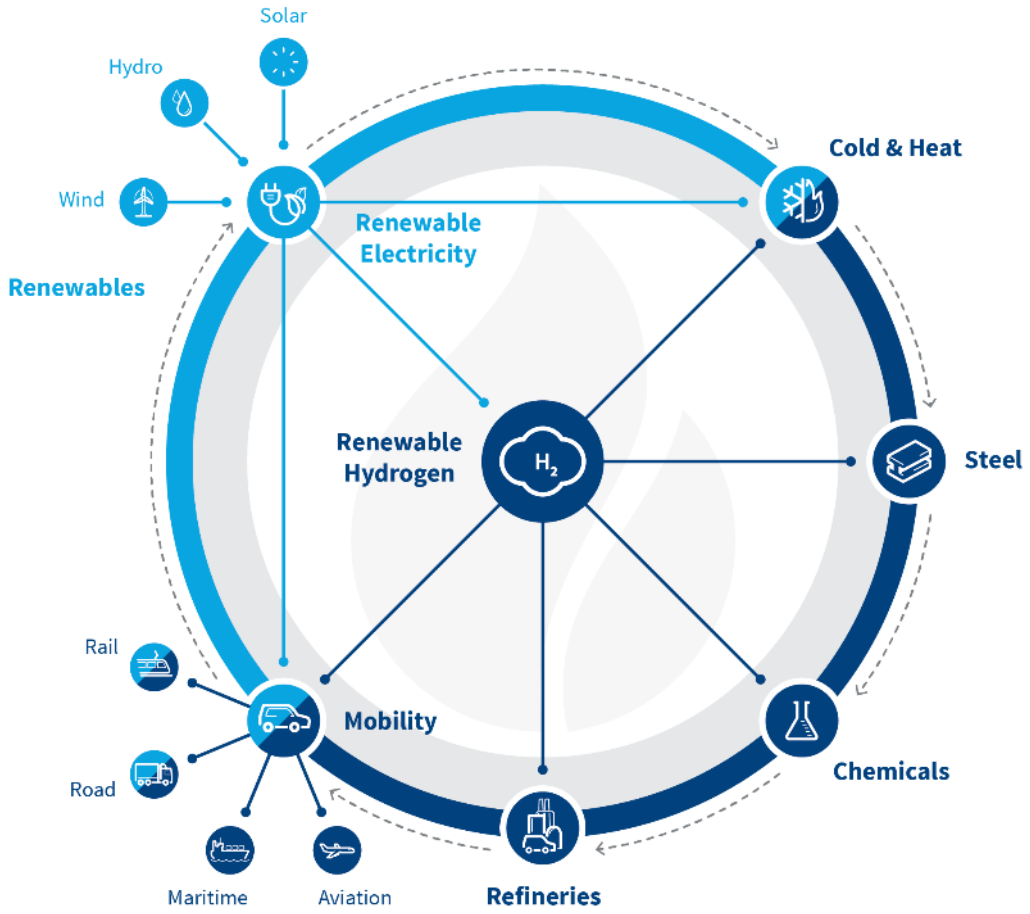
PRODUCTION PATHWAYS

Sunfire‘s electrolyzers produce renewable hydrogen or syngas



GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

A world without fossil fuels will run on renewables



Renewable Electricity

has the potential to decarbonize different sectors through direct electrification – but it cannot get everywhere.

Renewable Hydrogen

is required to achieve a decarbonization of critical sectors that continue to depend on gaseous and liquid energy carriers.

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Strong partnerships form the consortium

Participation

sunfire

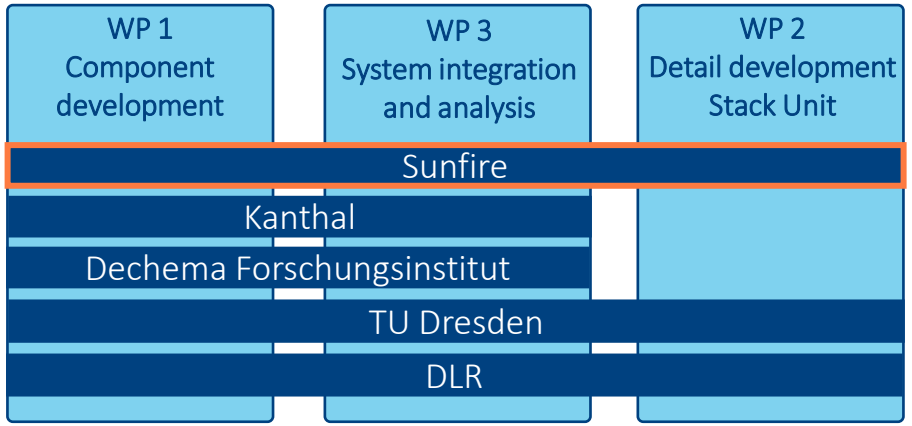
TECHNISCHE UNIVERSITÄT DRESDEN

DECHEMA FORSCHUNGSINSTITUT

DLR

KANTHAL® Part of Sandvik Group

„Efficiency in three steps“



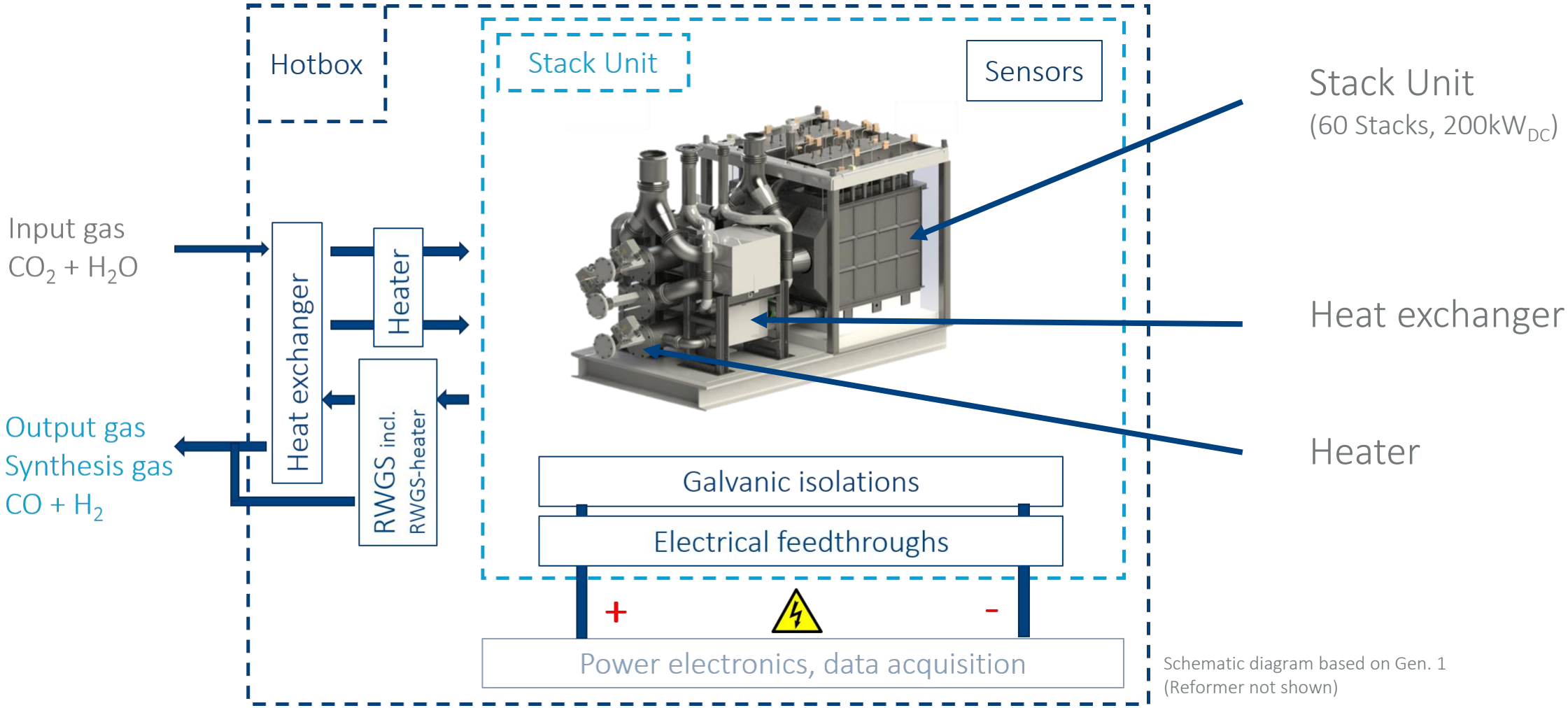
Short discription

- Development of balance-of-plant (BOP) components for high-temperature co-electrolysis (HTCoEl) regarding future industrialization.

- Grant: 3.090.040 €
- Project duration: 01.03.2020 - 28.02.2023
- Project goals
  - Efficient production of synthetic fuels and chemicals based on renewable electricity, CO_2 and water
  - Greenhouse gas reduction for hard-to-electrify sectors
  - Component development for SOEC Electrolysis
  - Detail development electrolyser stack integration
  - Design and validation of a HTCoEl module including newly developed components

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Development steps of HTCoEl



Schematic diagram based on Gen. 1
(Reformer not shown)

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

PROJECT STATUS

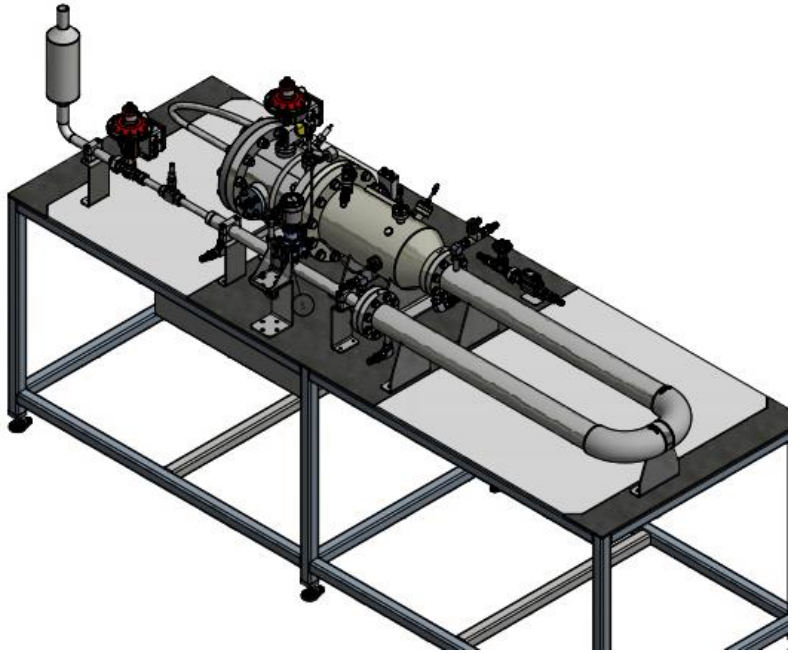
Kanthal: Development of a low-cost, long-term stable electrical heater

Role within the project:

(1) Production automation and (2) pressure test bench

Results: (1) Implementation of manufacturing automation in production

(2) Finalization of the design of the pressure test bench



GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

TU Dresden: Power connection and galvanic insulation

Role within the project:

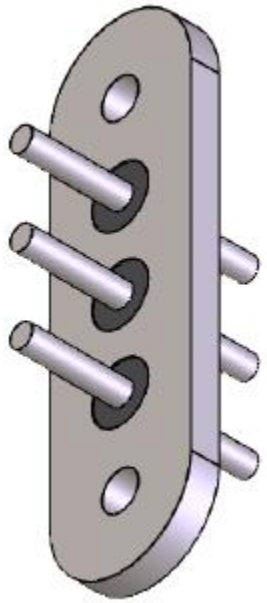
(1) Development of long-term stable and cost-effective electrical power feedthroughs

(2) Optimization of material usage for galvanic isolation of stacks

Results:

- ✓ Solution concept developed with three different materials
- ✓ Construction of a test rig for proving the long-term thermochemical resistance of the electrical feedthrough
- ✓ Construction of a test rig for the proof of the pressure resistance

Currently: Production of the first samples



Test samples for collecting power connections

- ✓ Selection of alternative materials carried out
- ✓ Test of these materials regarding tightness and insulation capacity ongoing

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

DECHEMA DFI: Material investigations

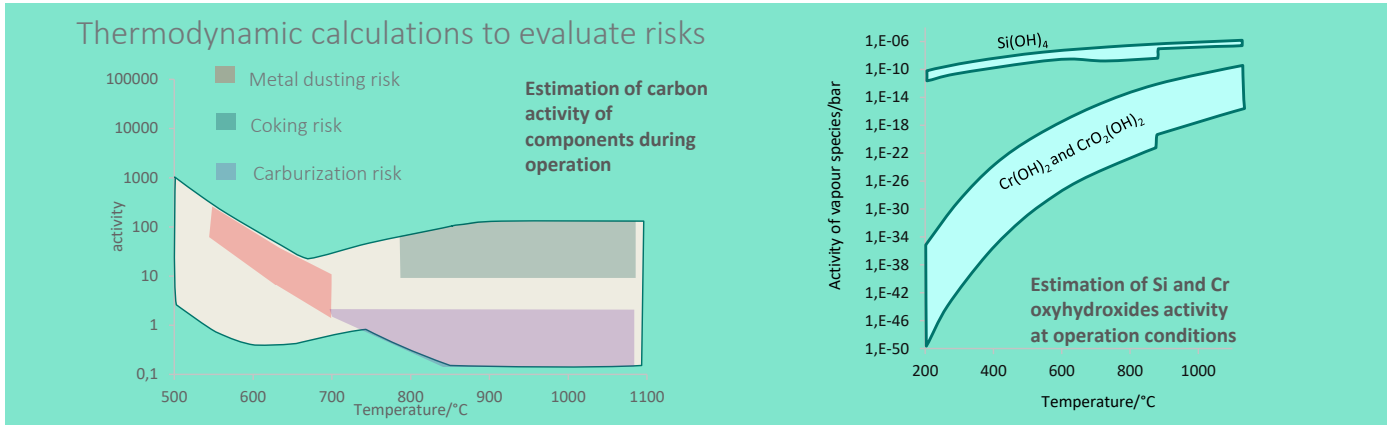
Role within the project:

(1) Quantification of contaminants evaporated from “hot” components

(2) Quantification of the metal dusting resistance of components

(3) Evaluation of thermal cycling influence on high temperature corrosion resistance

Results:



GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

DLR: Transient module simulation and validation

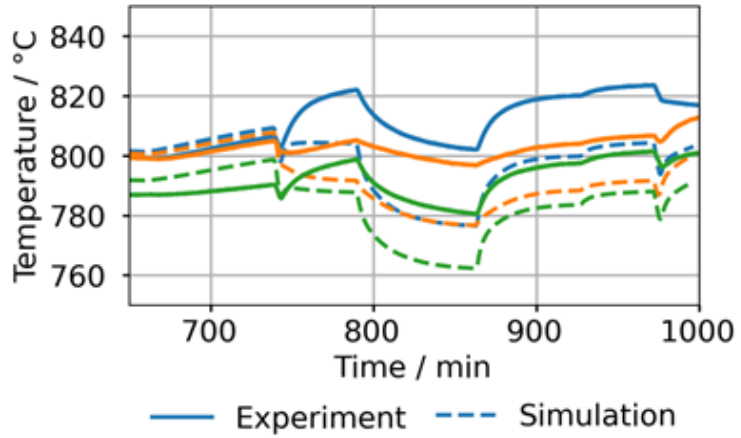
Role within the project:

(1) Linking reactor and system simulation with experimental reactor investigations
(2) Development of operating and control strategies for co-electrolysis

Results:

- Modification of the test facility to meet the project objectives completed
- Adaption of the simulation framework for flexible scaling of co-electrolysis reactors
- Investigation of sensors placement and concept

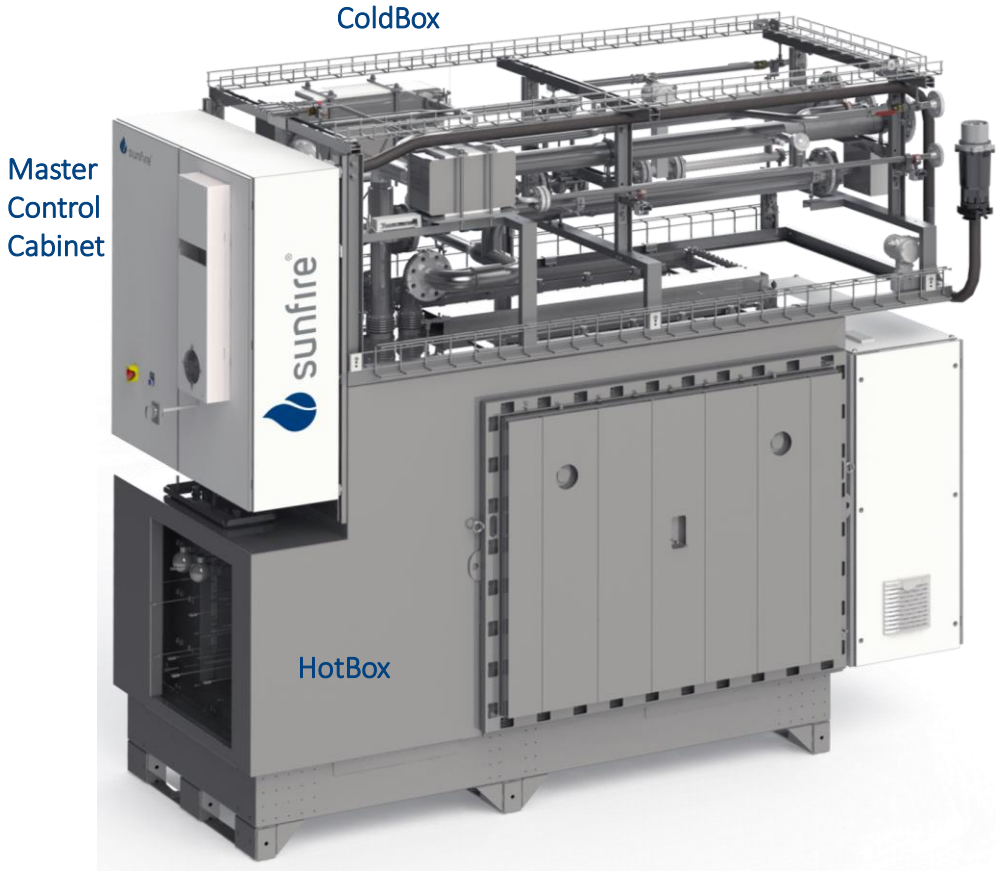
DLR test facility for the investigation of stack units with an EC power of up to 100 kW_{el}



Comparison of simulation and experiment during transient operation

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Sunfire: Development of a cost and production optimized Gen2.1 module



Results

- Compact heater/reformer combination developed
- Detail engineering finalized
- Module is currently in manufacturing
- Tests will start in 07/2021

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

OUTLOOK

SOEC has reached multi-megawatt scale

> 5 MW
SOEC electrolysis capacity

> 10 industrial projects
with global companies

World's longest
SOEC operating experience

NL

MultiPLHY
3 MW
HyLink SOEC
Refineries
Project start in 2020
NESTE

DE

e-CO_2Met
1 MW
HyLink SOEC
Chemicals
Project start in 2019
TOTAL

DE

GrInHy2.0
1 MW
HyLink SOEC
Steel industry
since 2019
SALZGITTER FLACHSTAHL

Further development and demonstration projects in planning

THANK YOU

Oliver Posdziech
Large Systems Development
oliver.posdziech@sunfire.de

Sunfire GmbH · Gasanstaltstraße 2
01237 Dresden · Germany
www.sunfire.de