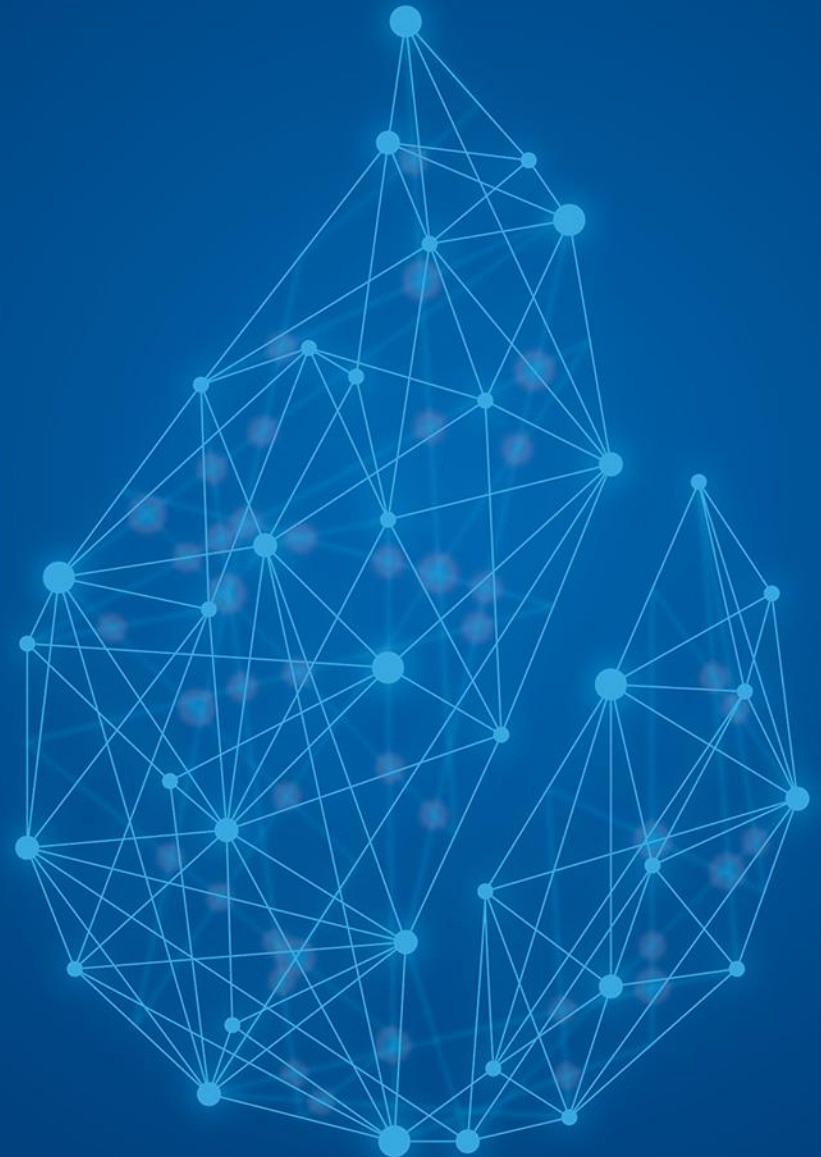




USING CAPE-OPEN TO MAKE A PYTHON PACKAGE ACCESSIBLE IN AVEVA PRO/II™ SIMULATION

22/09/22

Sebastian Liebschner / CAPE-OPEN 2022 Annual Meeting



AGENDA

1. Who is Sunfire?
2. Sunfire's CAPE-OPEN Use Case

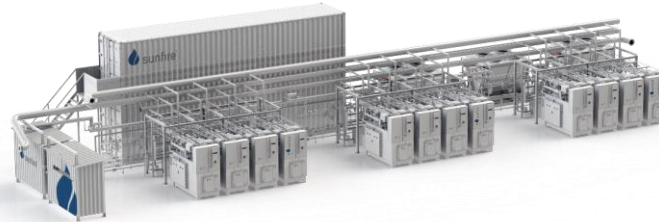
WHO IS SUNFIRE?

Sunfire is a leading industrial electrolysis company

Solutions & Markets



Pressurized Alkaline Electrolyzers



Solid Oxide (SOEC) Electrolyzers



Steel



Refineries



Utilities



Chemicals



Mobility

Company Sites



Neubrandenburg
Sunfire Fuel Cells

Dresden (HQ)

Solingen

Monthey

> 70

Electrolysis
projects¹⁾

> 250 MW

Installed
capacity¹⁾

100 MW

Largest electrolyzer
installation

500 MW/year

Production capacity
as of 2023

> 400

Talented
employees

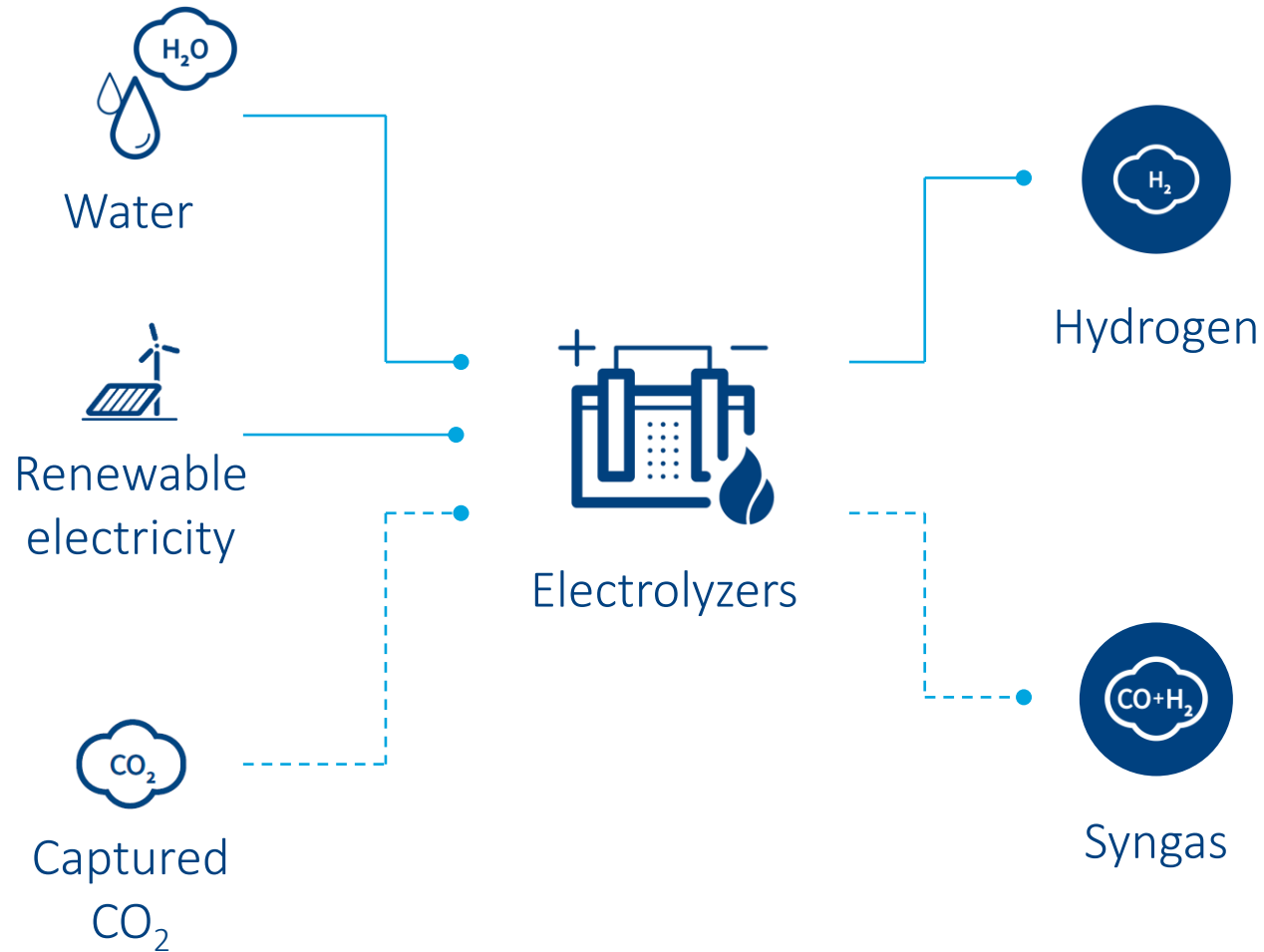
> EUR 500 m

Private and public
funding

1) Including projects from predecessor alkaline company "IHT SA" prior to the acquisition by Sunfire

WHO IS SUNFIRE?

Our electrolyzers produce renewable hydrogen or syngas

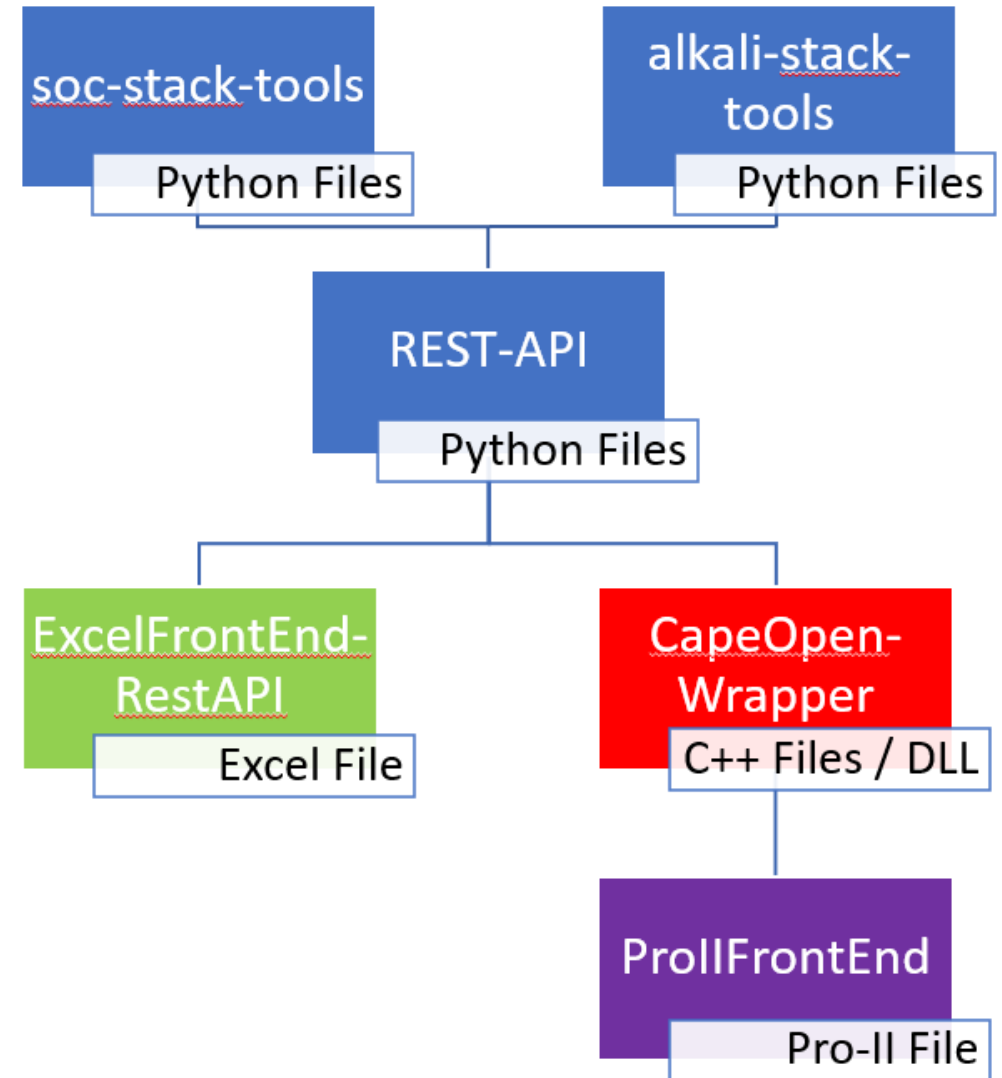


Alkaline and Solid Oxide (SOEC) Electrolyzers

SUNFIRE'S CAPE-OPEN USE CASE

Structure of the Frame Work

- We use – in-house developed – Python packages to calculate/simulate our products.
- Access to other softwares is realized with a REST-API.
- To enable usage in AVEVA PRO/II™ Simulation, a CAPE-OPEN compliant DLL is used.



Development of the DLL

- The DLL is based on the „CPP Mixer Splitter Unit Operation Example“ (C)CO-LaN 2010 implemented by AmsterCHEM and was kindly provided by Michel Pons.
- In- and output parameters have been modified accordingly.
- A static CURL library is used to send requests to the REST-API.
- The REST-API returns output parameters in XML format, which are then parsed by the DLL and exported to AVEVA PRO/II™ Simulation.

SUNFIRE'S CAPE-OPEN USE CASE

Usage of the DLL

The screenshot displays the AVEVA PRO/II Simulation 2020.2 (64 bit) - test-1D-Solver - [Flowsheet] interface. The main window shows a flowsheet with a CAPE-OPEN unit. A configuration dialog for the CAPE-OPEN unit is open, showing the following tables:

CAPE-OPEN Unit Parameters:

Name	Mode	Value	UOM
stack type	in	default	
input quantities	in	default	
gas evolution model	in	default	
flow configuration	in	default	
version soc-stack-tools	out	1.5.0	
version REST-API-tools	out	0.3.0	
version DLL	out	0.0.0	
l in A (input)	in	-22	

CAPE-OPEN Unit Ports:

Name	Direction	Stream	Thermodynamic System
Feed 1	inlet	AIR-IN	
Feed 2	inlet	GAS-IN	
Product 1	outlet	AIR-OUT	Default (SRK01)
Product 2	outlet	GAS-OUT	Default (SRK01)

The Messages window on the left shows the following simulation output:

```
calculation of CAPE-OPEN unit.
Error in Python: default is not a known 'module_type'.
Supported are ['StackUnit A101', 'SU Gen.2 (alpha)',
Stack', 'Einzel-STB-B411', 'Einzel-STB in EBZ3 (4.4)',
'Einzel-STB in FC4 (4.1)', 'ICH (240E) (GrInHy)', 'use
defined', 'SU Gen.3', 'CFX/CONSOLE']

UNIT 22 NOT SOLVED
*** PROBLEM SOLUTION NOT REACHED
***
*** GLOBAL DEVIATION 0.00 MOLE PERCENT
***
** WARNING ** Unit 'C01' DID NOT SOLVE
*** Run completed - Case not solved

*** RUN STATISTICS
STARTED 20:27:05 09/09/22 1 ERROR
FINISHED 20:27:05 09/09/22 1 WARNING
RUN TIMES NO MESSAGES
INTERACTIVE 0 MIN, 0.00 SEC
CALCULATIONS 0 MIN, 0.23 SEC
TOTAL 0 MIN, 0.23 SEC
** WARNING ** PROBLEM SOLUTION NOT REACHED. ** Note- Default Toleran
unit specifications, recycle loops and columns are tig
starting with PRO/II 9.4. If the file is happened to c
in previous version, probable reason for non-convergen
be tightened tolerance in current version.

*** CHECKING
UNIT DATA
EXECUTION SEQUENCE
FEED FLASH CONDITIONS
TH TH
AVEVA PRO/II SIMULATION Version 2020.2 - Calculation module

*** READING AVEVA PRO/II SIMULATION DATABASE
PROJECT USER
PROBLEM DATE

*** PROBLEM SOLUTION BEGINS
FEED FLASH BEGINS
FEED FLASH COMPLETE
UNIT 22 BEGINS - 'C01'
UNIT 22 SOLVED
*** PROBLEM SOLUTION REACHED
***
*** GLOBAL DEVIATION 0.00 MOLE PERCENT
*** MAXIMUM DEVIATION ON COMPONENT 02 OF -63.11 MOLE PERCENT
***
*** Run completed - Case solved

*** RUN STATISTICS
STARTED 20:27:21 09/09/22 NO ERRORS
FINISHED 20:27:22 09/09/22 NO WARNINGS
RUN TIMES NO MESSAGES
INTERACTIVE 0 MIN, 0.00 SEC
```

THANK YOU!

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Development

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