SolydEra Company Presentation

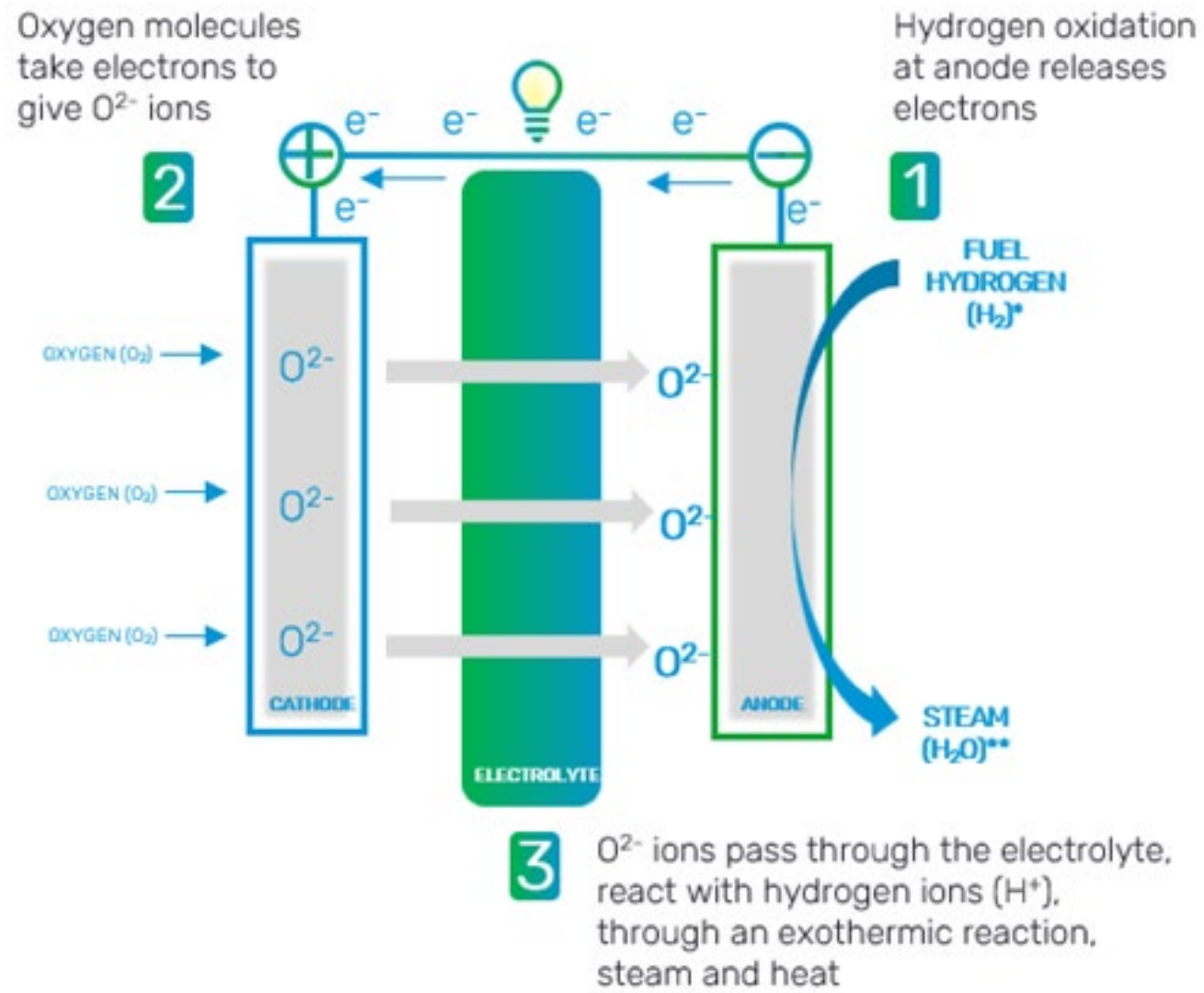
Le monde de l'Hydrogène et les innovations dans le secteur des eaux usées

GRESE – Journée Technique n°2, 9 Octobre 2025

SolydEra

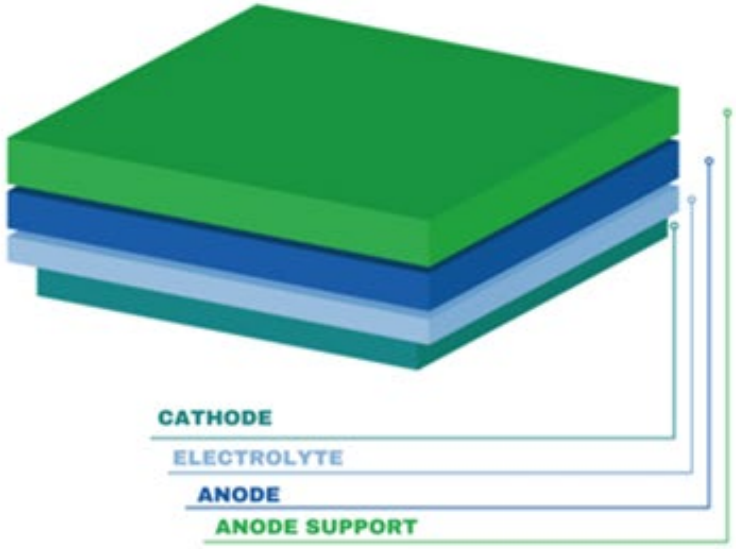
We stack it.

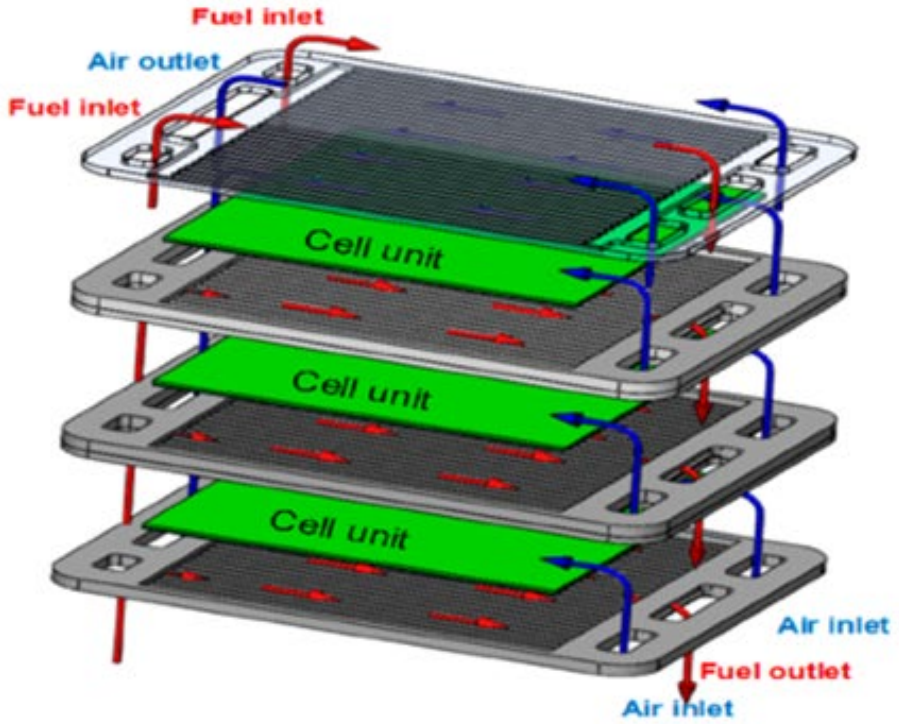
Principe d'une pile à combustible Solid Oxide



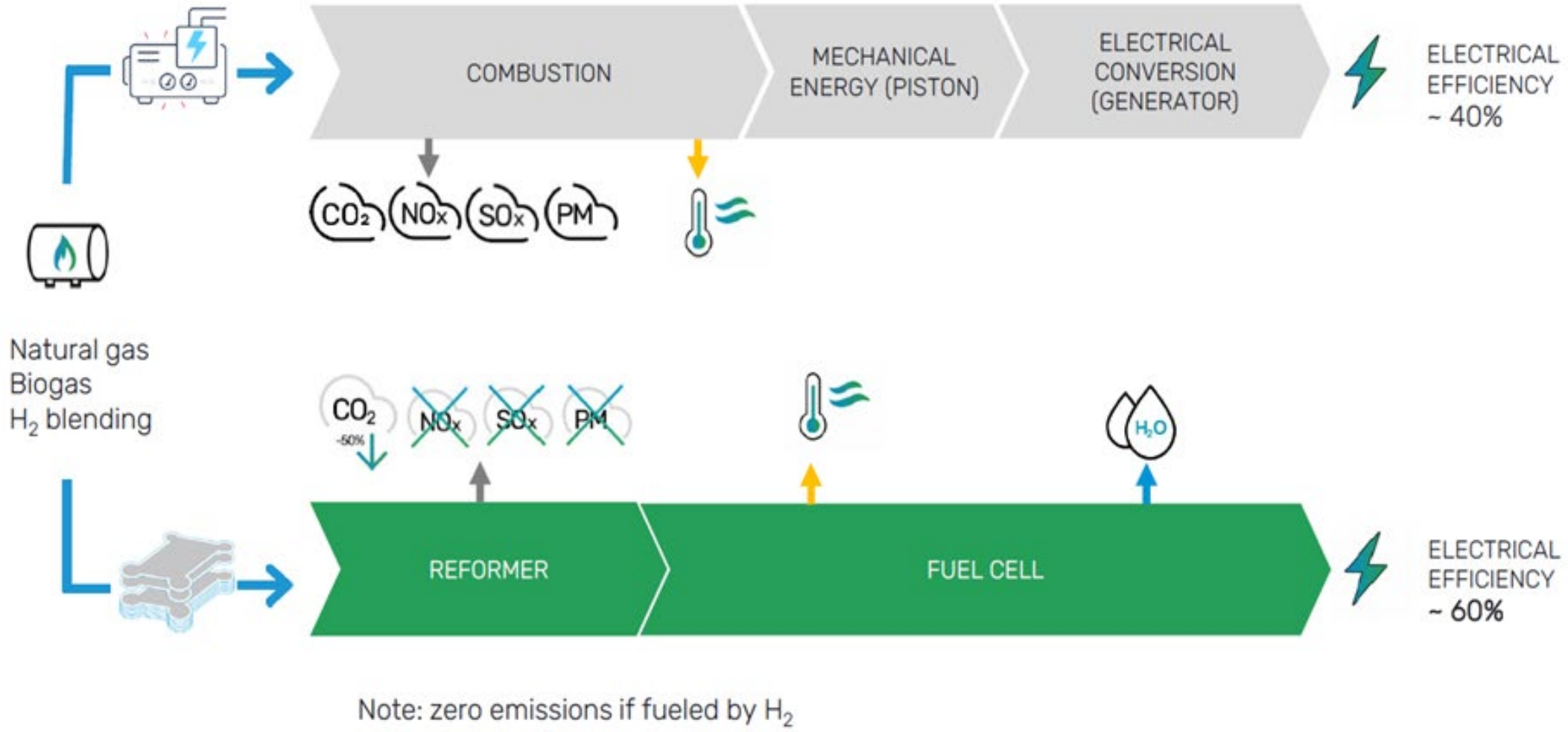
*At system level, wide range of fuels can be used (NG, biomethane, H2NG blends, Ammonia, H2, biogas);
**Also CO_2 in case of hydrocarbon fuels, or N2 in case of Ammonia

De la cellule au stack





Les principaux avantages d'une pile à combustible à oxide solide par rapport aux moteurs à gaz



Note: zero emissions if fueled by H_2

Solydera's mission

SolydEra is a **leading Solid Oxide (SO) stack supplier** for both, **power generation** and **hydrogen production** and contributing as core **technology provider to major decarbonizing solutions**. The company's Unique Selling Proposition consists of stack efficiency, high quality, fully industrialized technology, cost leadership and core system knowhow in the wide power range required by the energy market.

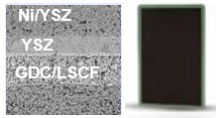
SolydEra - 30 years of Solid Oxide technology development and manufacturing

EPFL

Solid Oxide Fuel Cell development since **1995**

2000

HTceramix SA
Process for thin-film electrolyte cells



2006

Acquisition of HTceramix SA
First 500W SOFC stack demonstrated

2008

Start stack pilot production in Mezzolombardo (IT) up to 1MW SOFC capacity

2015

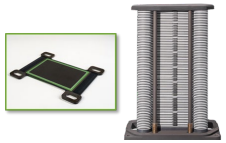
Acquisition of micro-CHP system production from Ceramic Fuel Cells (D)

2016

Market launch BLUEGEN with SOFC stack & HotBop from Australia

2017

Development of the 1.7kW G8 SOFC stack



2018

Development of the window frame G8X stack up to 6kW in SOFC.
First Solid Oxide Electrolyser tests

2019

Market Launch BLUEGEN BG-15
More than 1'000 units deployed

2020

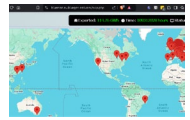
Industrial plant in Pergine (IT) with 25/75 MW capacity
First results of large stack module in electrolysis mode

2022

New name and company strategy for the hydrogen economy.
G8X stacks reaches 25KW in SOE mode

2023

More than 100GWh of electricity produced over > 90 million hours and proven degradation below 0.2%/1'000h



2024

First reversible electrolyser module reaching <40kWh/kg H_2 winning the IEA 2024 price.

Delivery of 2 x 45kW SOFC systems to datacentre reaching 58% electric efficiency.

Winners of Hydrogen TCP Awards of Excellence 2024

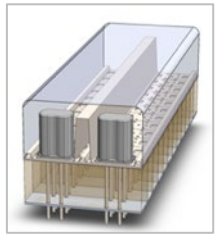
Solydera maintains leading-edge SO technology ready for scale in power generation and green hydrogen production

Factories ready to manufacture


- Fully functional **production line up to 1MW** for customized cells & stacks in Mezzolombardo (IT)
- Best in class **production line for cells (25MW/75MW) and G8 stacks (6MW/18MW)**

R&D labs and teams built leading solid oxide expertise/ IP




- Fully **functional R&D testing laboratories** in Italy, Switzerland and Australia
- **500+ man-years of accumulated expertise in Solid Oxide technology**: cells, stacks, integration, Hot Balance of Plant, power electronics, controls, safety & monitoring software and Multi-MW concept for large H2 production

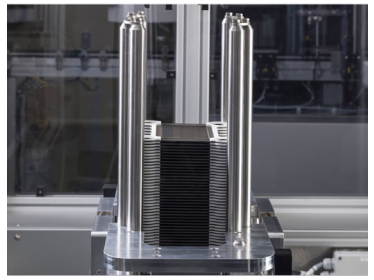
Products ready to sell

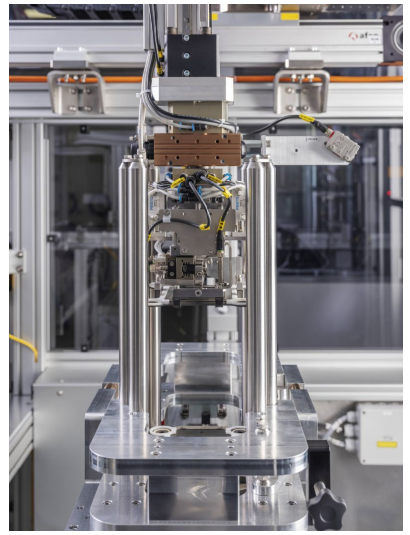
- Best in class **solid oxide cells** for SOFC & SOE
- Best in class **1.7kW/5kW stack** for SOFC & SOE
- Best in class **10kW/30kW stack** for SOFC & SOE

System engineering

- 1.5kW microCHP system, more than 3’000 units put in operation
- 9kW SOFC system for outdoor operation
- 45kW SOFC system for data centers
- 75kW SOE & 25kW SOFC reversible system

Largest solid oxide cells and stack production plant in Europe





Production Capacity in SOFC/SOE mode

25/75 MW
Yearly cell capacity

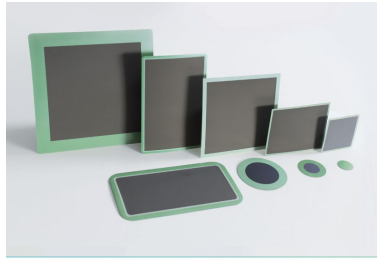
6/18 MW
G8 stack capacity, automatic assembly

1/3 MW
G8X stack capacity, manual assembly

Solydera's product portfolio

Products

Solid oxide cells for SOFC & SOE



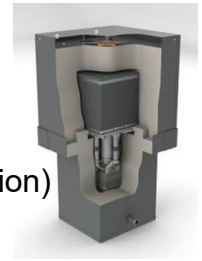
1.7kW/5kW stack for SOFC & SOE

10kW/30kW stack for SOFC & SOE

License

1.7kW HotBop for SOFC stack

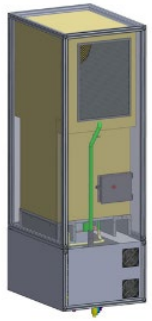
1.7kW Fuel Cell Module (stack + HotBop + insulation)



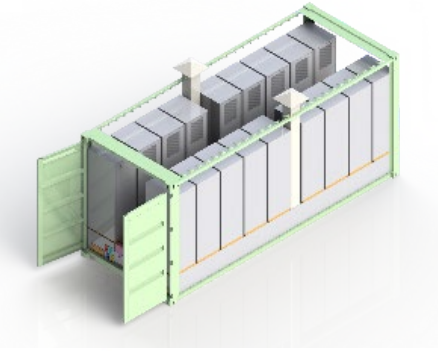
BlueGen15

Products in development

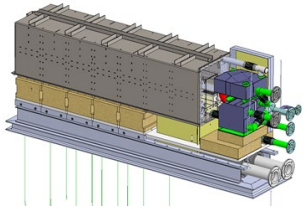
10kW PMX for Fuel Cell applications:



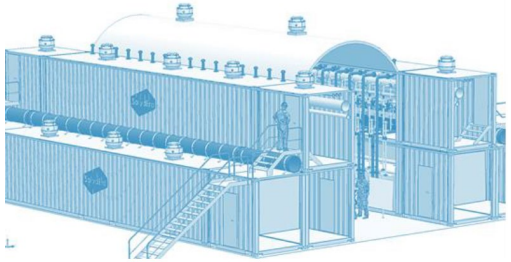
300kW SOFC container



150kW EMX for electrolyser & reversible applications:



Multi-MW electrolyser array



SolydEra received up to 50m€ of public funding and is recognized as Key Innovator in many EU projects

Business Ready

RoRe Power
ROBUST & REMOTE

Fuel Cell cogeneration system optimized for continuous power generation in remote applications

Other partners in the project:

VTT · EFCF European Fuel Cell Forum · sunfire · 3E Energy Oy

Market Ready

E2P2

Easier serviceability and maintenance compared to other large scale SOFC systems

Other partners in the project:

snam · EQUINIX · TEC4FUELS · RI.SE · Infraprime · VERTIV.

Market Ready

E2P2

Reliability of the SOFC system

Other partners in the project:

snam · EQUINIX · TEC4FUELS · RI.SE · Infraprime · VERTIV.

Tech Ready

PACE
Pathway to a Competitive European Fuel Cell micro-CHP Market

Complete, more robust stack design and overall system for Fuel Cell application in micro-CHP

Other partners in the project:

BOSCH Invented for life · COGEN EUROPE · HOCHSCHULE LUZERN · DTU · BDR THERMEA GROUP · elementenergy · sunfire

Market Ready

ch2p

System to co-generate hydrogen, power & heat using Solid Oxide Cell technology, fueled by methane-rich gases, for hydrogen refueling stations

Other partners in the project:

FONDAZIONE BRUNO KESSLER · EPFL · HYGEAR · DLR · Shell

Market Ready

comsos

Innovative SOFC-based micro-cogeneration for commercial and prime power generation

Other partners in the project:

BlueTerra · Politecnico di Torino · convion · sunfire · VTT

European Commission

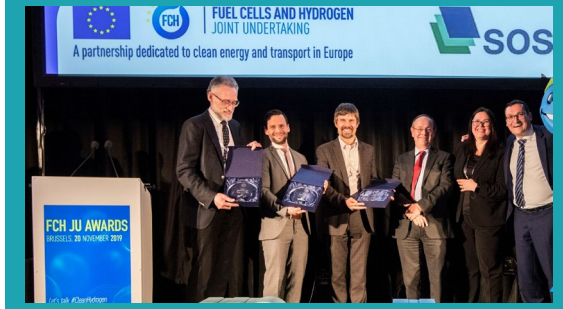
INNOVATION RADAR

SolydEra has been rewarded by the European Commission's Innovation Radar as a Key Innovator for its milestones in the above projects

SolydEra recognized with International Awards

EU Project **SWITCH**
Smart ways for in-situ totally integrated and continuous multisource generation of hydrogen

Best Technology Innovation category for the development of the **G8X Solid Oxide stack**

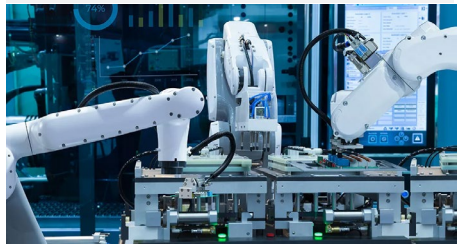


EU project **SOSLeM**
Solid Oxide Stack Lean Manufacturing

Solid Oxide Technology serves multiple markets and customers in hard-to-abate industrial sectors

Data centers prime power

Industrial CHP



Commercial CHP

Maritime APU

GAS-TO-POWER

Highest efficiency (60%) to convert multiple fuels (H2, NG, biogas, ammonia, methanol) into electricity

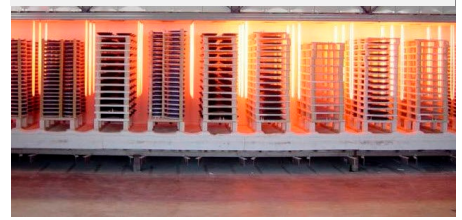
POWER-TO-GAS

Highest efficiency in producing H_2 (90% if steam is available) for hard-to-abate industrial sectors or E-fuels production with co-electrolysis

Green Ammonia

Green steel/Cement

Ceramic& Glass



E-Fuels

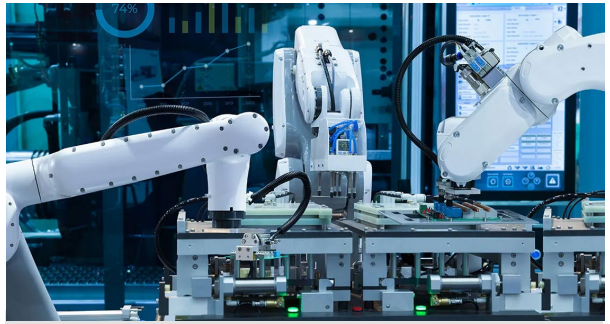
Power Applications: estimated market size by 2030

DATA CENTERS: **~€3Bn**

- Prime power
- Supply security
- Reduced emissions

COMMERCIAL CHP: **~ €0.5Bn**
(Combined Heat and Power)

- Distributed power
- Supply security
- Constant load cover



INDUSTRIAL CHP: **~ €0.4Bn**
(Combined Heat and Power)

- Lower peak demand
- Base load supply
- Back-up power

MARITIME APU: **~ €0.2Bn**
(Auxiliary Power Units)

- Base load supply
- Low emissions
- Multi-fuel operation

Source: McKinsey 2022 & other published data

Hydrogen Applications: estimated market size by 2030

GREEN AMMONIA: **~€1.6bn**

- Low-cost hydrogen supply
- Use of on-site water vapor

GREEN CERAMIC, GLASS: **~€0.5Bn**

- Firing gas supply
- Replace natural gas firing

GREEN STEEL: **~€3.5Bn**

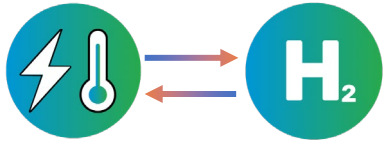
- Firing gas supply
- Replace natural gas firing

E-FUELS: **~€1Bn**

- Co-electrolysis vapor + CO2
- Syngas converted to methanol

Source: McKinsey 2022 & other published data

Reversible Applications: estimated market size by 2030



BIOGAS: **~€1.7Bn**

- Hydrogen delivery to increase biomethane production from biogas reactor during low electricity prices
- Biogas/biomethane converted to electricity & heat during high electricity prices

WASTE INCINERATION: **~€1Bn**

- Using excess heat, cheap electricity and point source CO2 for the production of e-fuel during the summer
- Converting e-fuel to heat and electricity during the winter

ISLAND MODE RENEAWABLE POWER SUPPLY: **~€5Bn**

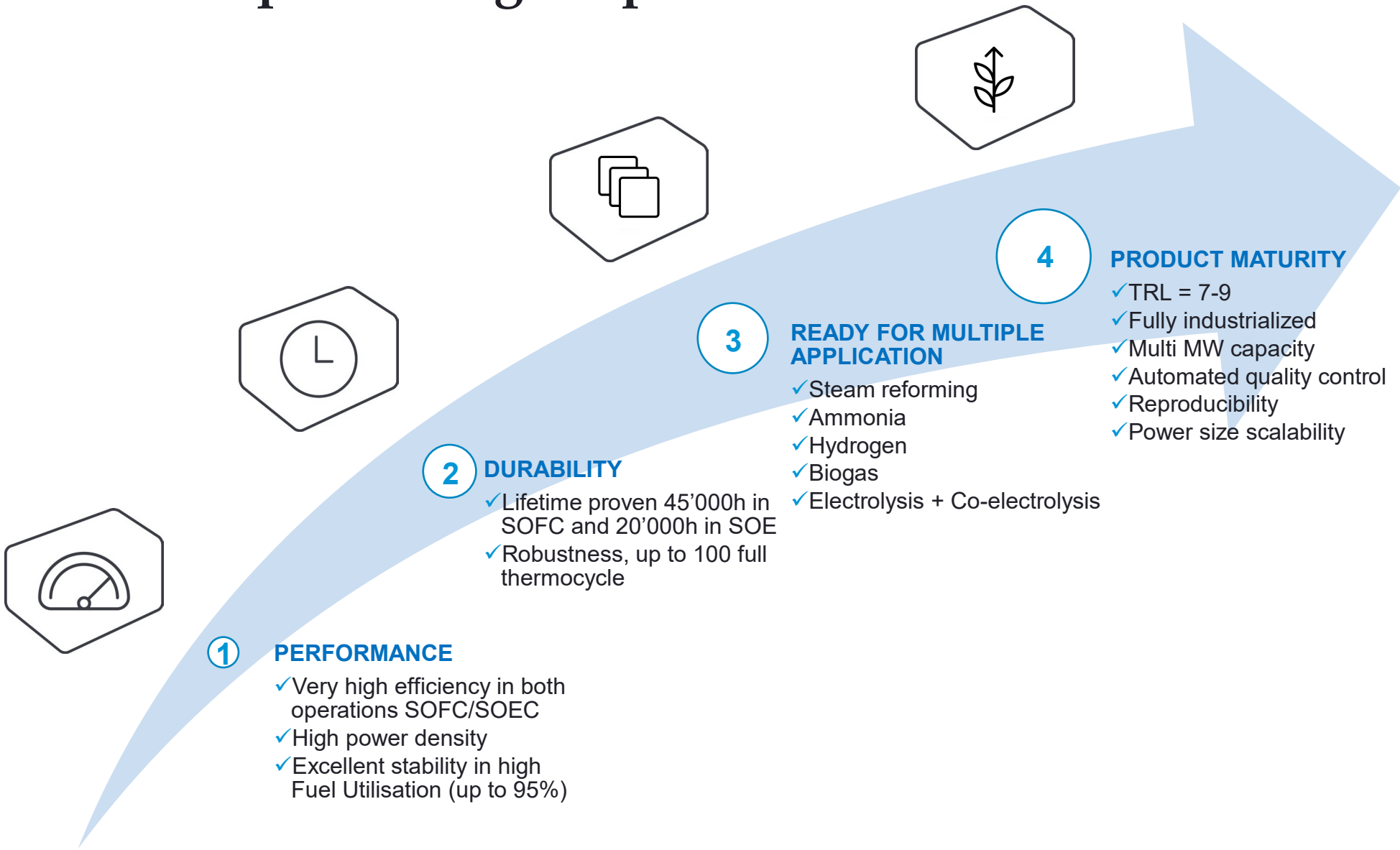
- 24/7 delivery or storage of the required electricity to the island grid

SEASONAL STORAGE: **~€1Bn**

- Converting excess renewable electricity into gas for the grid
- Converting gas into electricity for the electric grid and heat for district heating

Source: EU biogas data, Statista Energy Storage Market 2022, Global Market Insight 2024

SolydEra's Unique Selling Proposition



1 PERFORMANCE

- ✓Very high efficiency in both operations SOFC/SOEC
- ✓High power density
- ✓Excellent stability in high Fuel Utilisation (up to 95%)

2 DURABILITY

- ✓Lifetime proven 45'000h in SOFC and 20'000h in SOE
- ✓Robustness, up to 100 full thermocycle

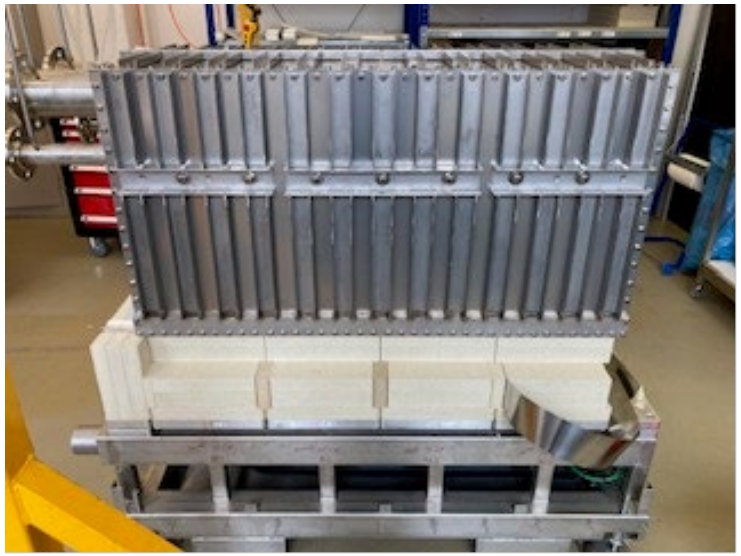
3 READY FOR MULTIPLE APPLICATION

- ✓Steam reforming
- ✓Ammonia
- ✓Hydrogen
- ✓Biogas
- ✓Electrolysis + Co-electrolysis

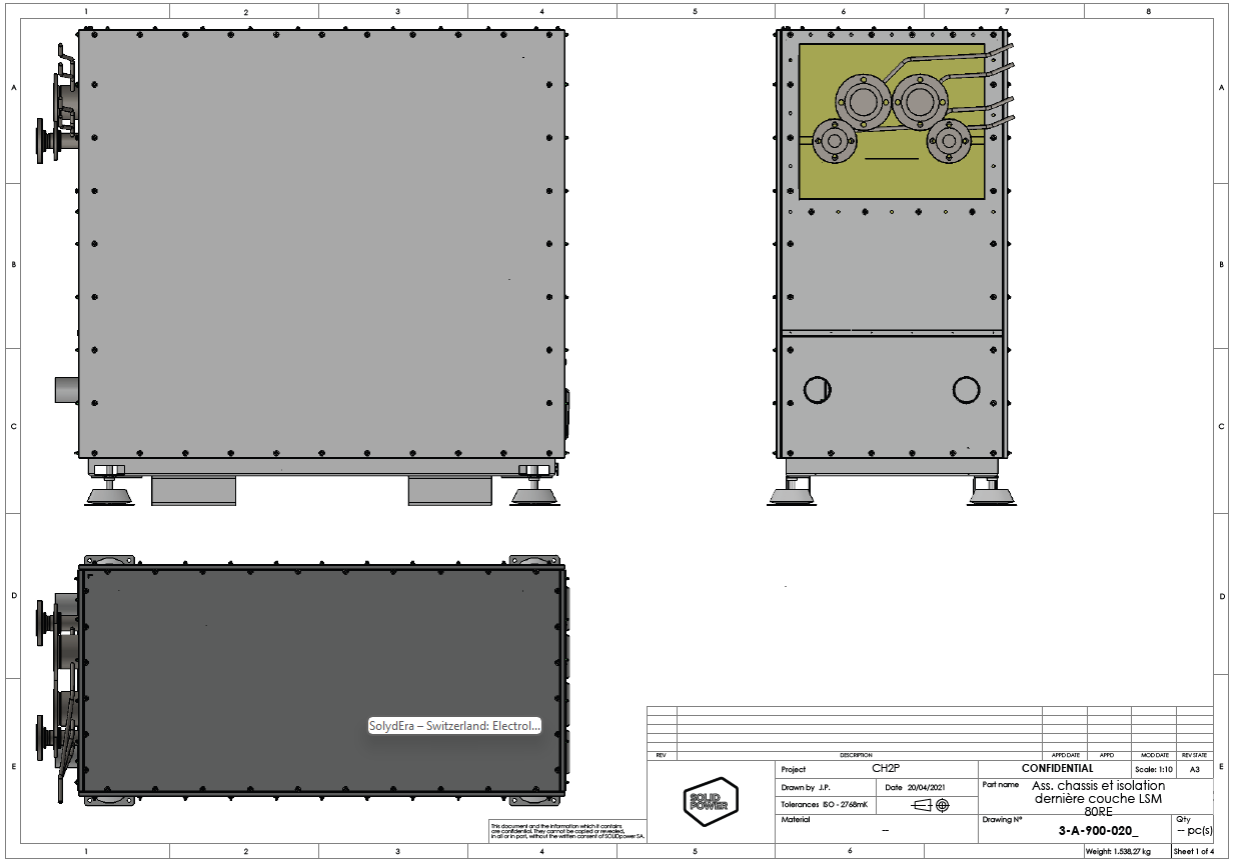
4 PRODUCT MATURITY

- ✓TRL = 7-9
- ✓Fully industrialized
- ✓Multi MW capacity
- ✓Automated quality control
- ✓Reproducibility
- ✓Power size scalability

SolydEra – Switzerland: Electrolyser Module Production (2/3)



SolydEra – Switzerland: Electrolyser Module Production (3/3)

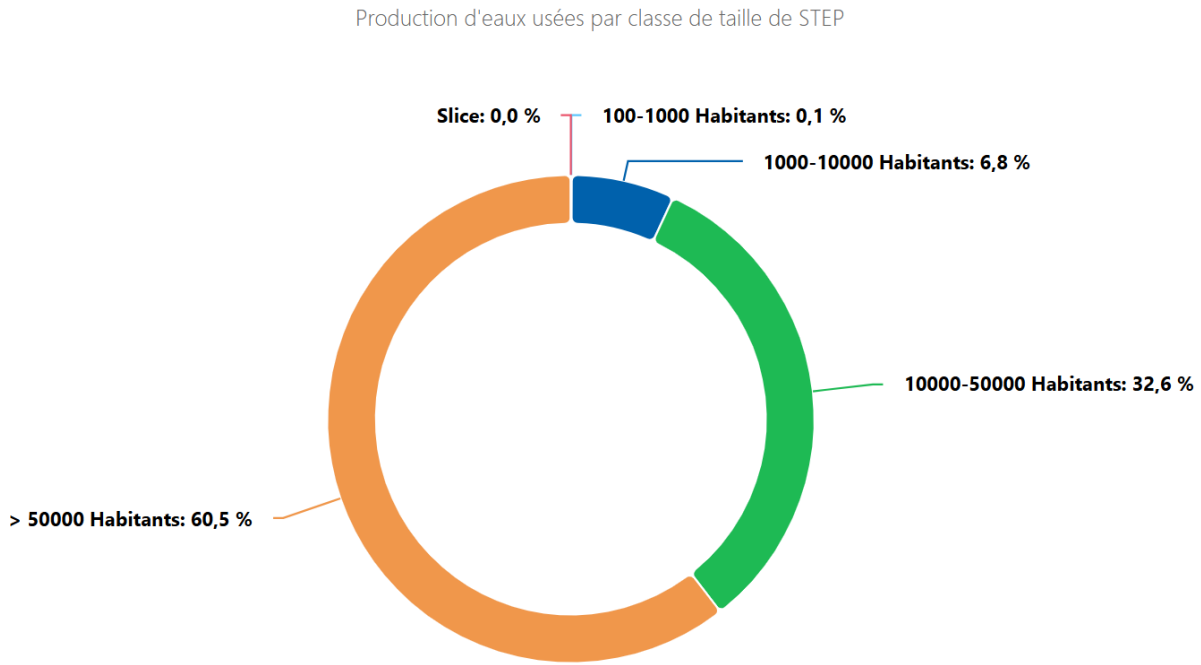


STEP - Suisse

Données sur les STEP en Suisse

Statistiques Générales

- + 750 STEP de plus de 100 habitants en Suisse
- Sur près de 750 STEP, 80 sont plus grandes que 50’000 équivalents-habitants. Cette valeur a augmenté de 6 stations depuis 2010. Il s’agit d’agrandissements de stations existantes.
- Un total de 1,35 milliard de mètres cubes d’eaux usées sont traités chaque année. Les petites et très petites stations représentent 63% des stations, mais n’épurent que 8% des apports d’eaux usées. En 2010, ce chiffre était encore de 15%. On note donc un décalage important vers de plus grandes stations. Cette tendance va perdurer dans les années à venir.



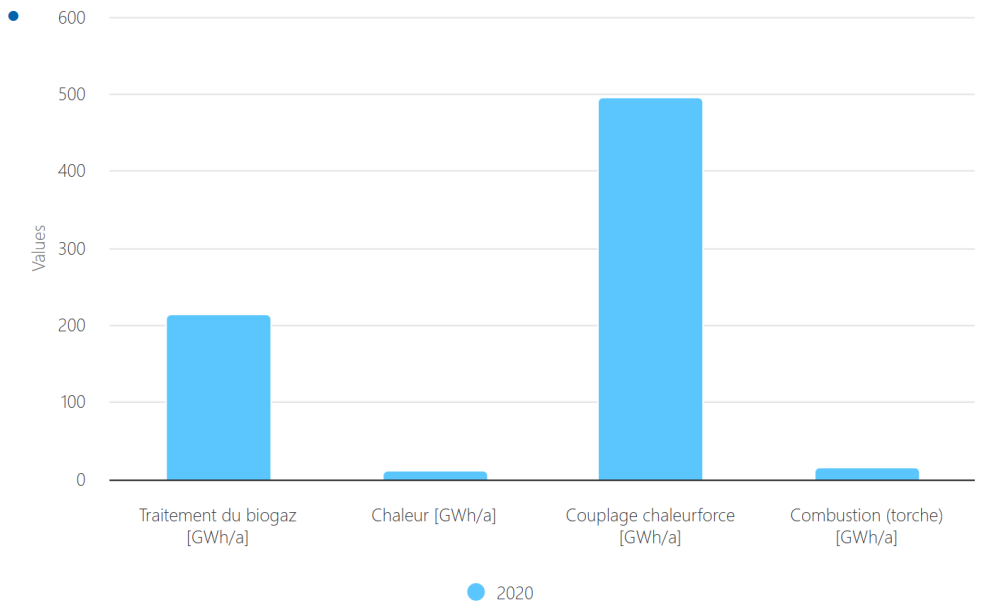
- Inf-Eau. (s. d.). *Branche – chiffres-clés : vue d’ensemble*. Inf-Eau. Consulté le 8 octobre 2025, sur https://inf-eau.ch/branche-chiffres-cles-vue-densemble/

Statistiques Générales

Production du gaz de digestion

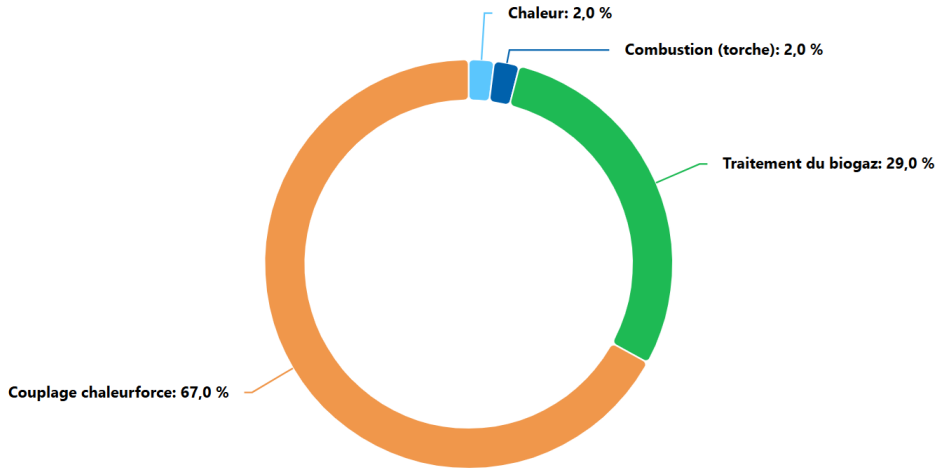
Les stations d'épuration suisses produisent du gaz de digestion avec une capacité énergétique de près de 740GWh. Un tiers est traité et injecté sous forme de biogaz dans le réseau de gaz naturel. 13% du gaz de digestion produit repose sur des substrats ajoutés en plus (p. ex. graisses alimentaires).).

- **300 STEP produisent de l'électricité grâce au biogaz de STEP**



Valorisation du gaz de digestion:

214 GWh/a sont injectés dans le réseau gazier sous forme d'énergie chimique. **143 GWh/a sont produits sous forme d'électricité** avec des couplages chaleur-force (CCF). En même temps, le **CCF est aussi le plus grand producteur de chaleur, avec 229 GWh/a**. L'utilisation à seul titre de chauffage est de 10 GWh/a. Sur la base de la production d'électricité et de chaleur des CCF, **122 GWh/a ne peuvent pas être imputés de manière univoque** à un type d'utilisation spécifique ou à une perte. Les pertes par torchère sont de l'ordre de 16 GWh/a, ce qui correspond à 2% de la quantité totale d'énergie. **Le taux d'exploitation du gaz de digestion est donc de 81%.** 12% (85 GWh/a) de la quantité d'énergie ne peuvent être imputés à aucun type d'utilisation ou de valorisation et présentent donc un potentiel d'optimisation.



- Office fédéral de l'énergie (OFEN). (s. d.). *Publication n° 2119* [PDF]. Confédération suisse. Consulté le 8 octobre 2025, sur https://pubdb.bfe.admin.ch/fr/publication/download/2119
- Inf-Eau. (s. d.). *Branche – chiffres-clés de l'énergie*. Inf-Eau. Consulté le 8 octobre 2025, sur https://inf-eau.ch/branche-chiffres-cles-de-lenergie/
- Inf-Eau. (s. d.). *Branche – chiffres-clés : vue d'ensemble*. Inf-Eau. Consulté le 8 octobre 2025, sur https://inf-eau.ch/branche-chiffres-cles-vue-densemble/

La technologie solid oxide appliquée au STEP

SolydEra

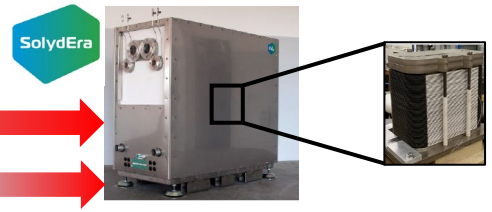
We stack it.

Piles à combustible à Oxide Solide

Biogaz

494 GWh/an

Air

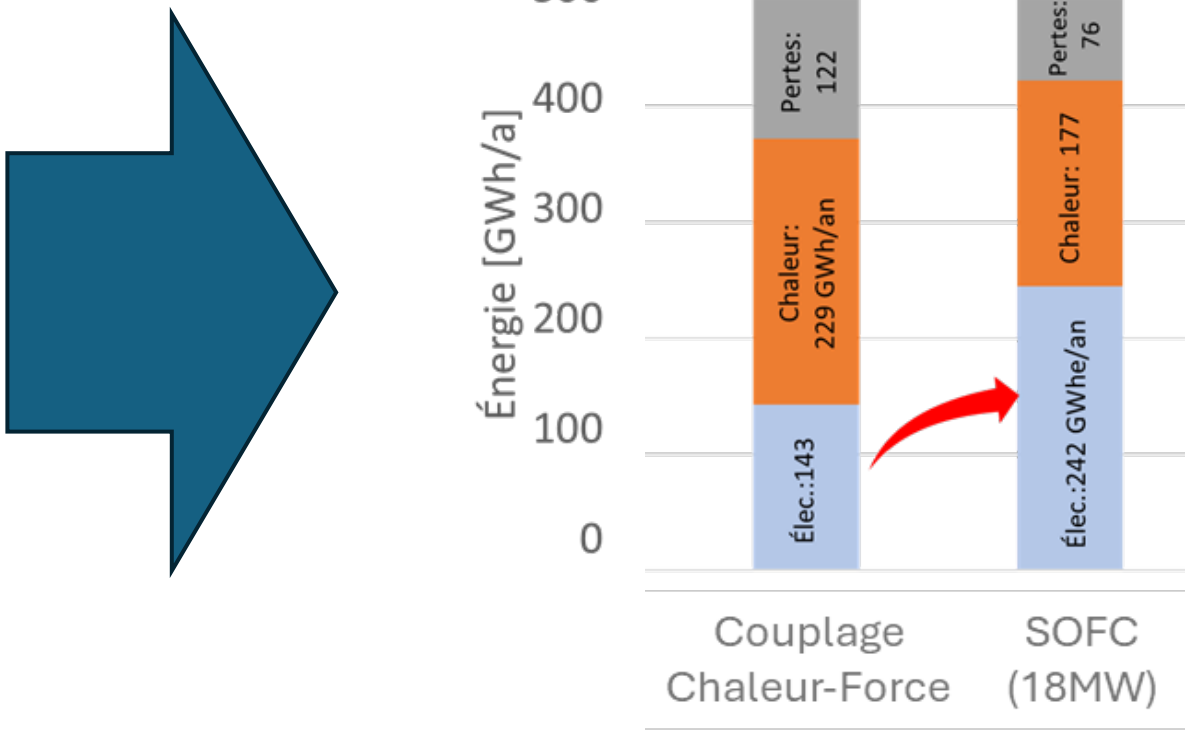


242 GWhe/an

177 GWht/an

$\mathrm{Eff}^{\mathrm{e}}_{\mathrm{LHV-AC}} \approx 48.9\%$ *

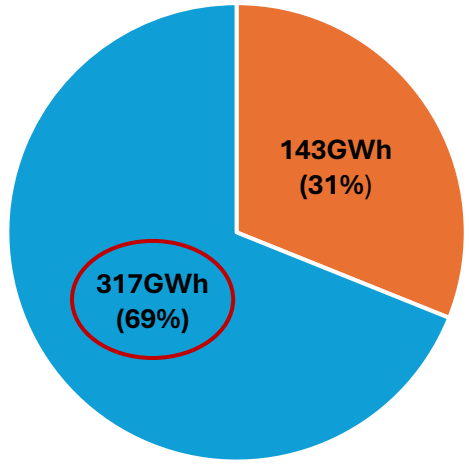
$\mathrm{Eff}^{\mathrm{t}}_{\mathrm{LHV}} \approx 35.8\ \%$ *



Consommation électrique des STEP et répartition auto-production / achats

- Les stations d'épuration consomment environ **460GWh** d'électricité par an, dont 31 % au total sont produits à partir de gaz de digestion (groupes chaleur-force). Remplacer cette technologie par la technologie SOFC pourrait permettre **d'atteindre 53% d'auto-production** pour **une économie de CHF 15 millions par an**

Part de consommation d'électricité des STEP **actuel (CFF)**

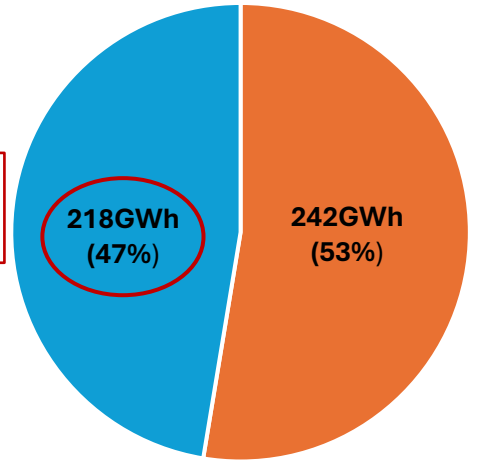


Coût de l'électricité
≈ CHF 48 millions/an

Auto-produite (CCF) Electricité achetée

Part de consommation d'électricité des STEP **proposé (SOFC)**

Coût de l'électricité
≈ CHF 33 millions/an



Auto-produite (SOFC) Electricité achetée

- Inf-Eau. (s. d.). *Branche – chiffres-clés de l'énergie*. Inf-Eau. Consulté le 8 octobre 2025, sur https://inf-eau.ch/branche-chiffres-cles-de-lenergie/

Production d'CH_4 avec Réacteur biologique & SOE

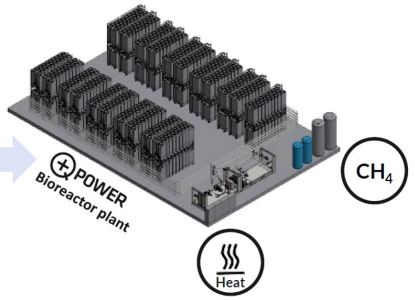
GN

STEP d'Aïre

Biogaz

5.4 MW

47.3 GWh/an



0.1 MWe

Compression + PSA

Méthane

8.53 MW

74.8 GWh/an

0.13 MWe

0.98 MWt

Pompe à chaleur P_{HP}^{e+}

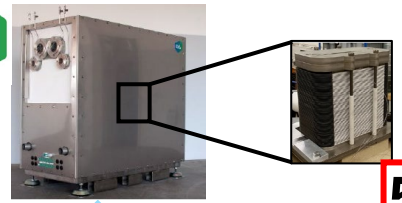
0.71 MW

H_2O

EVAP

SolydEra

Air



0.39 MWt

$\sim 3.1\ kW_e/Nm^3H_2$

3.95 MW

5.4 MW Biogaz + 4.2 à 4.8 MWe = 8.53 MW CH_4

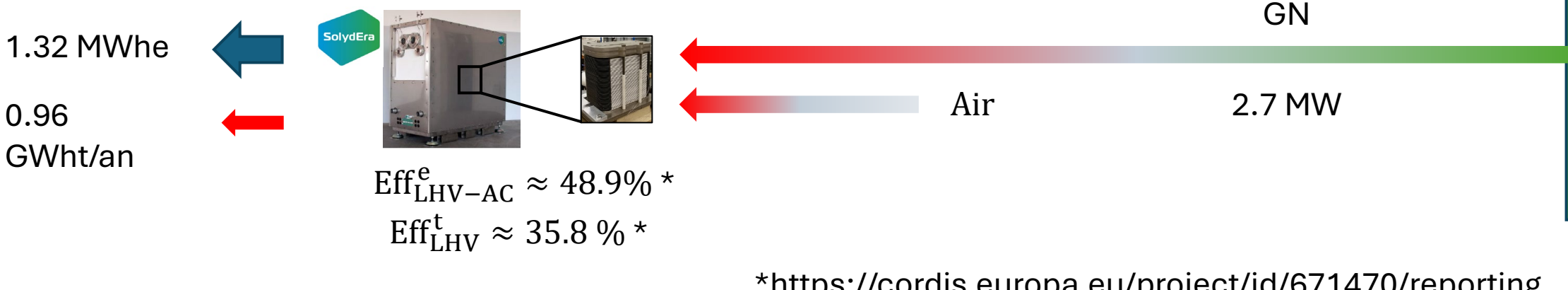
Éfficacité = 80+%

MODE: SOFC

STEP d'Aïre

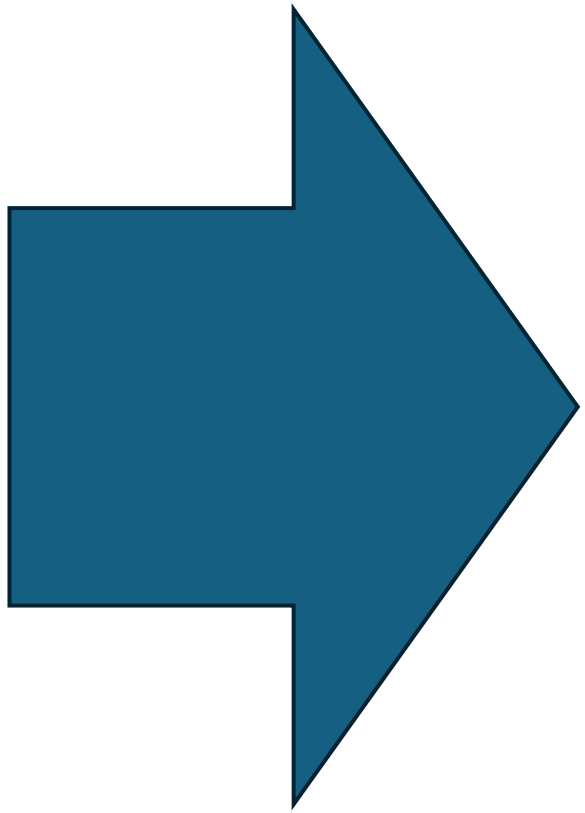
Système Réversible - Augmentation de la flexibilité:

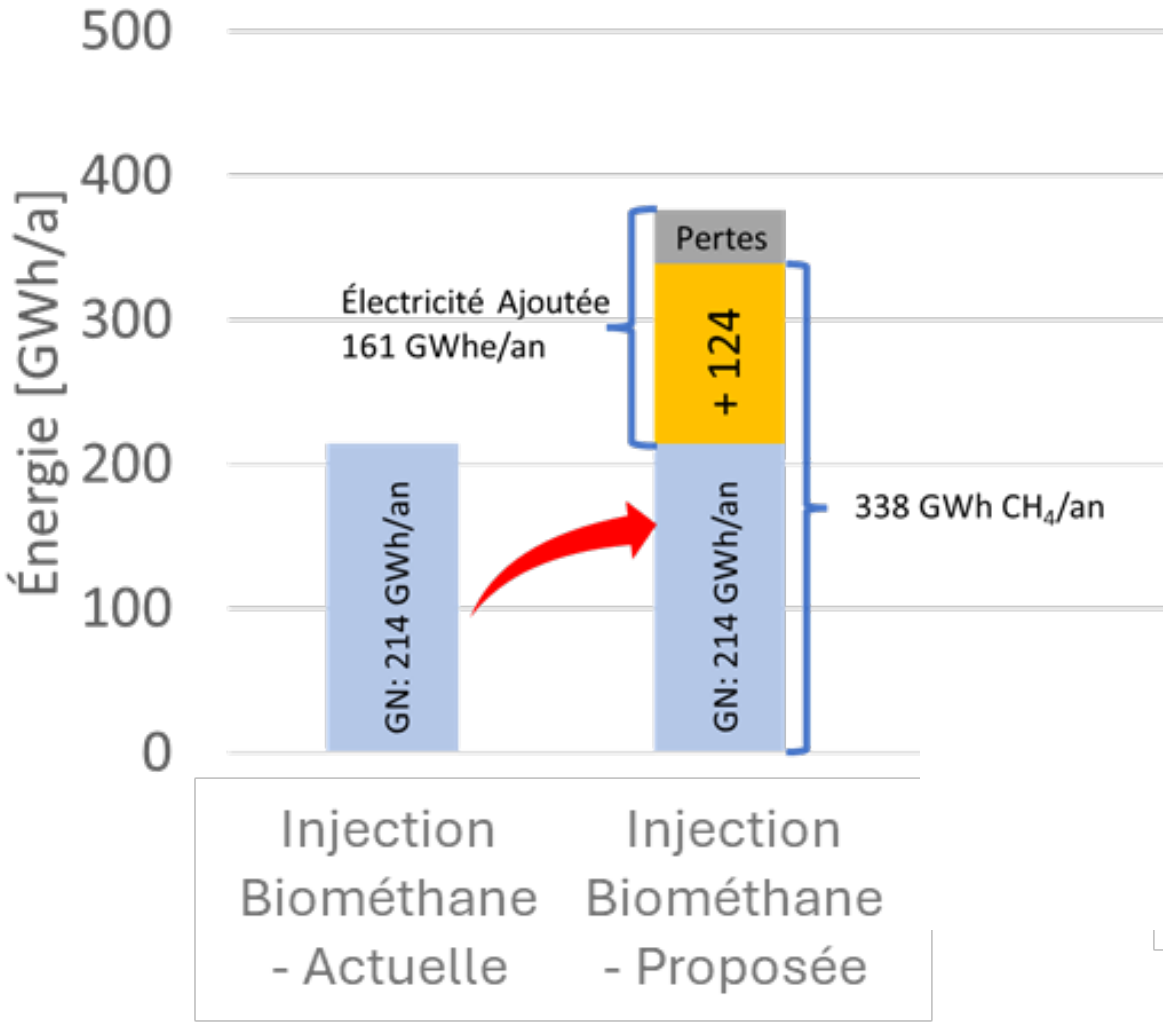
- Quand le **prix de l'électricité est bas**: Valorisation du biogaz
- Quand le **prix de l'électricité est élevé**: Stocker du Biogaz et Mode SOFC



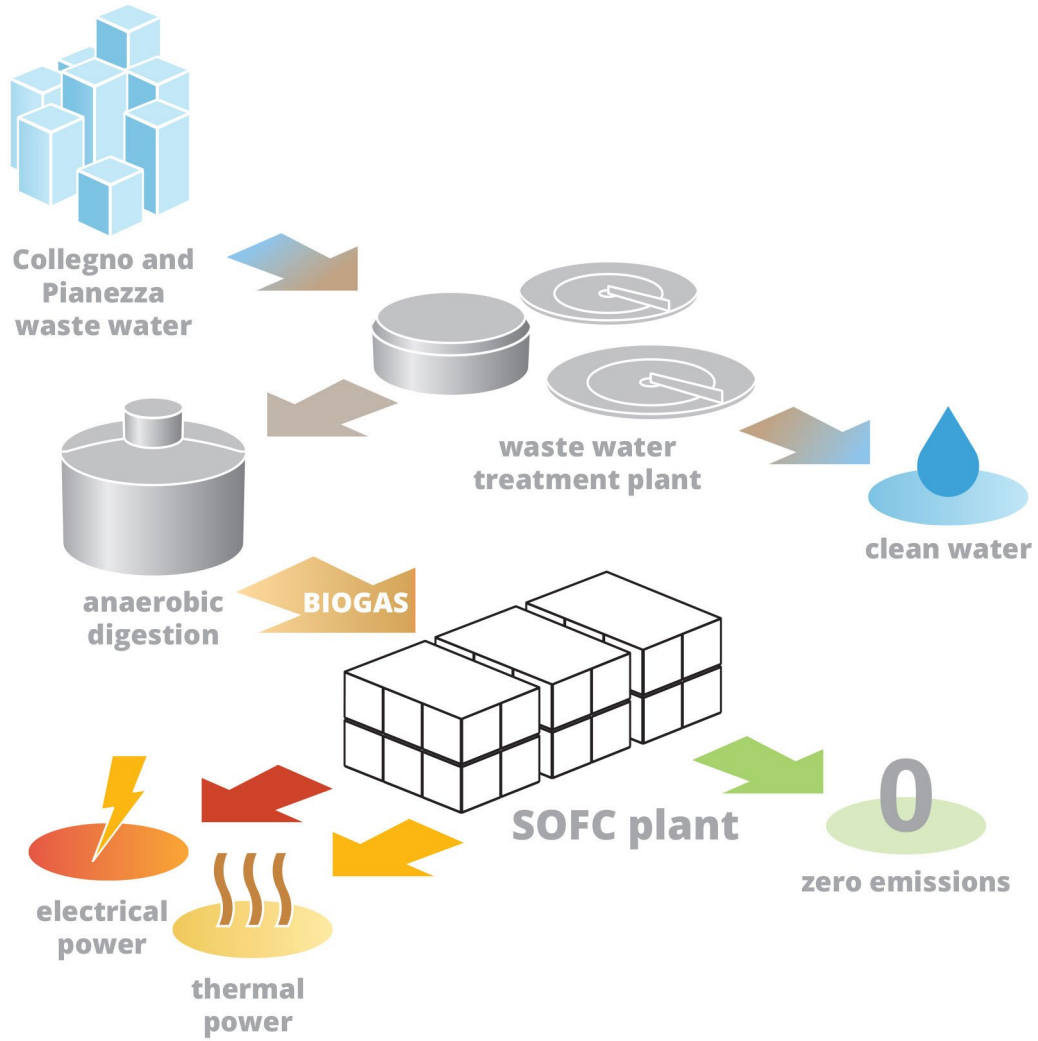
*https://cordis.europa.eu/project/id/671470/reporting

Potentiel Suisse de d’e-methane de STEP avec production locale d’hydrogène



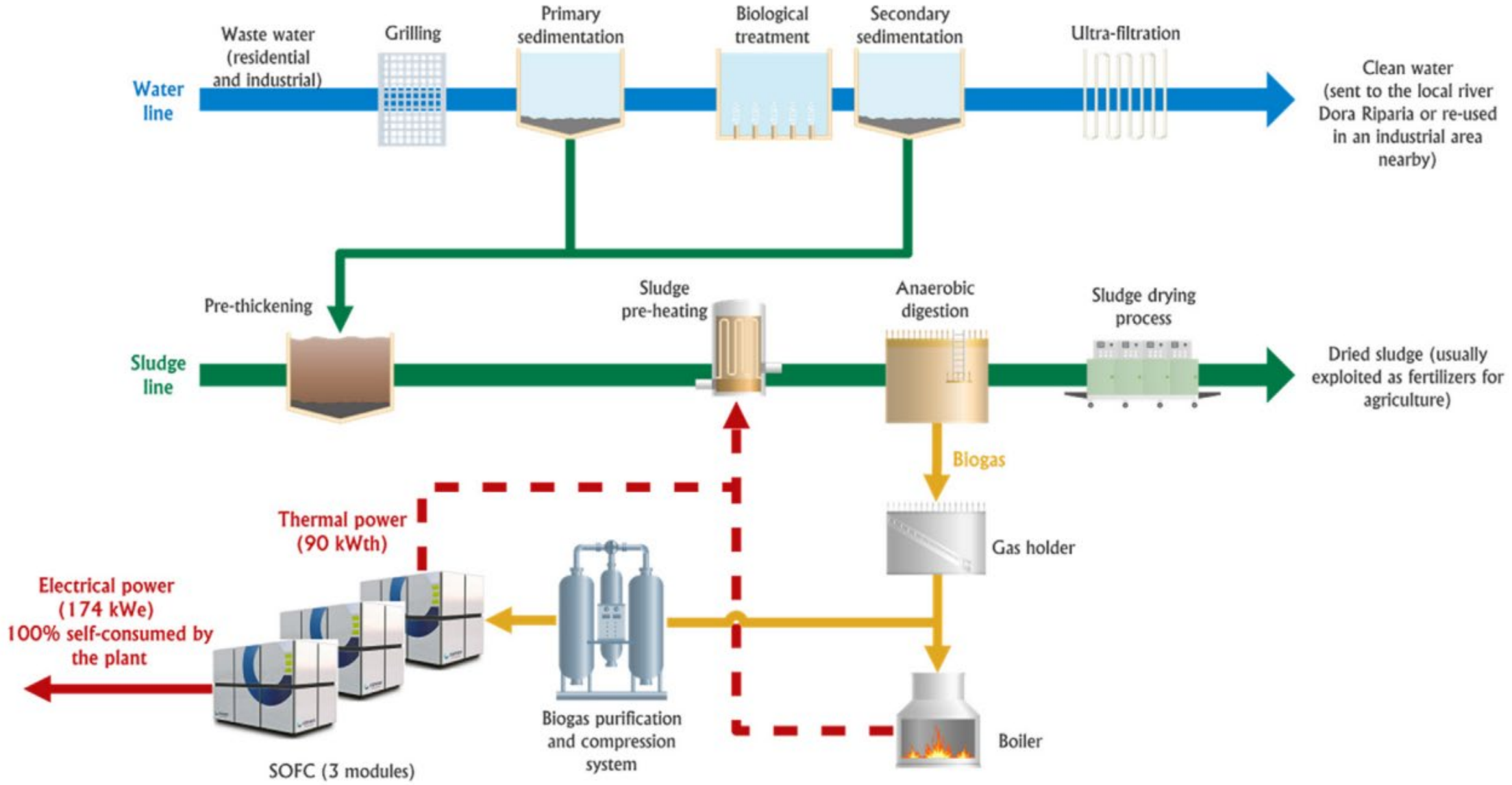


SOFC applied to WWT plants: conversion directe du biogaz

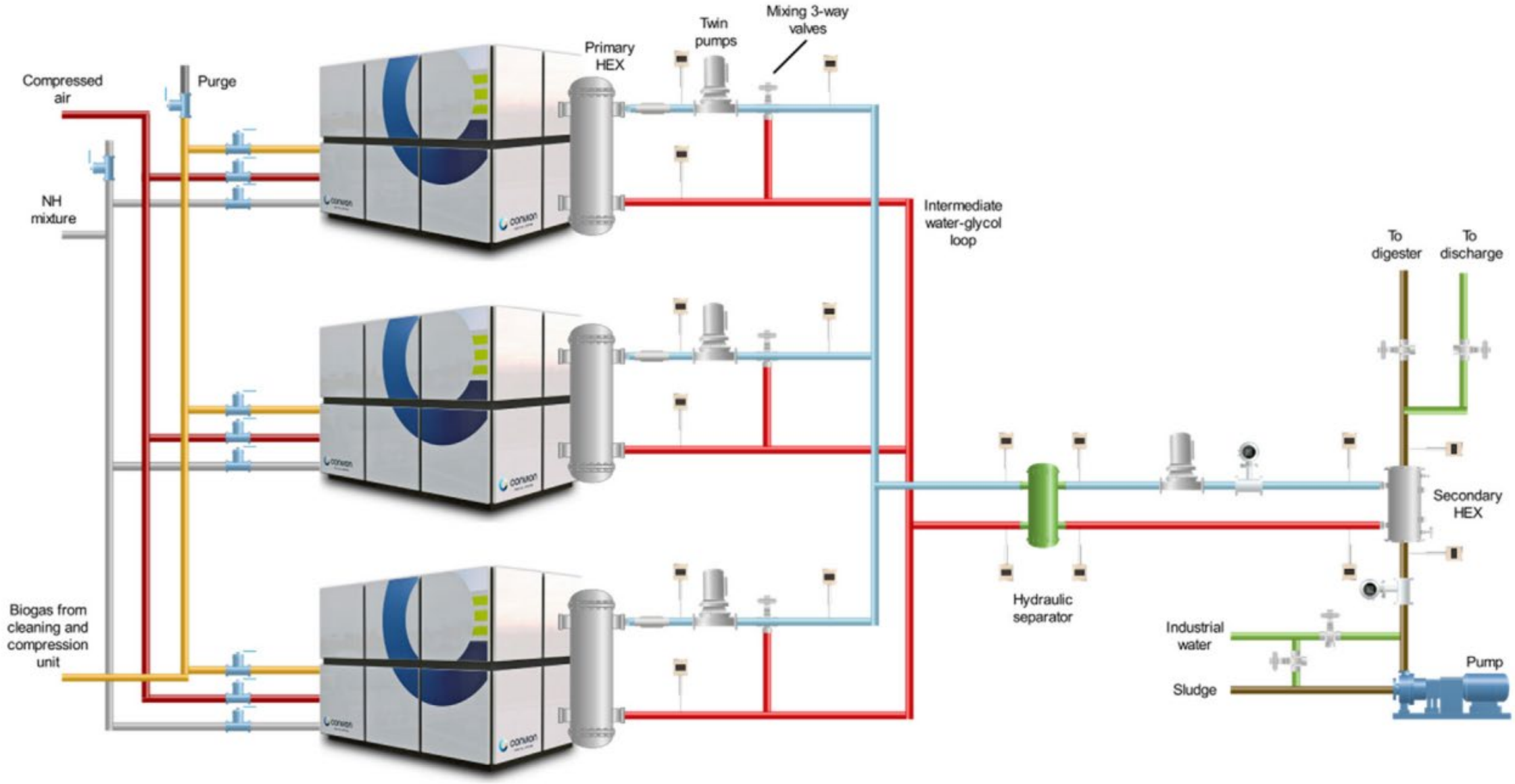


The example of SMAT Collegno WWTP

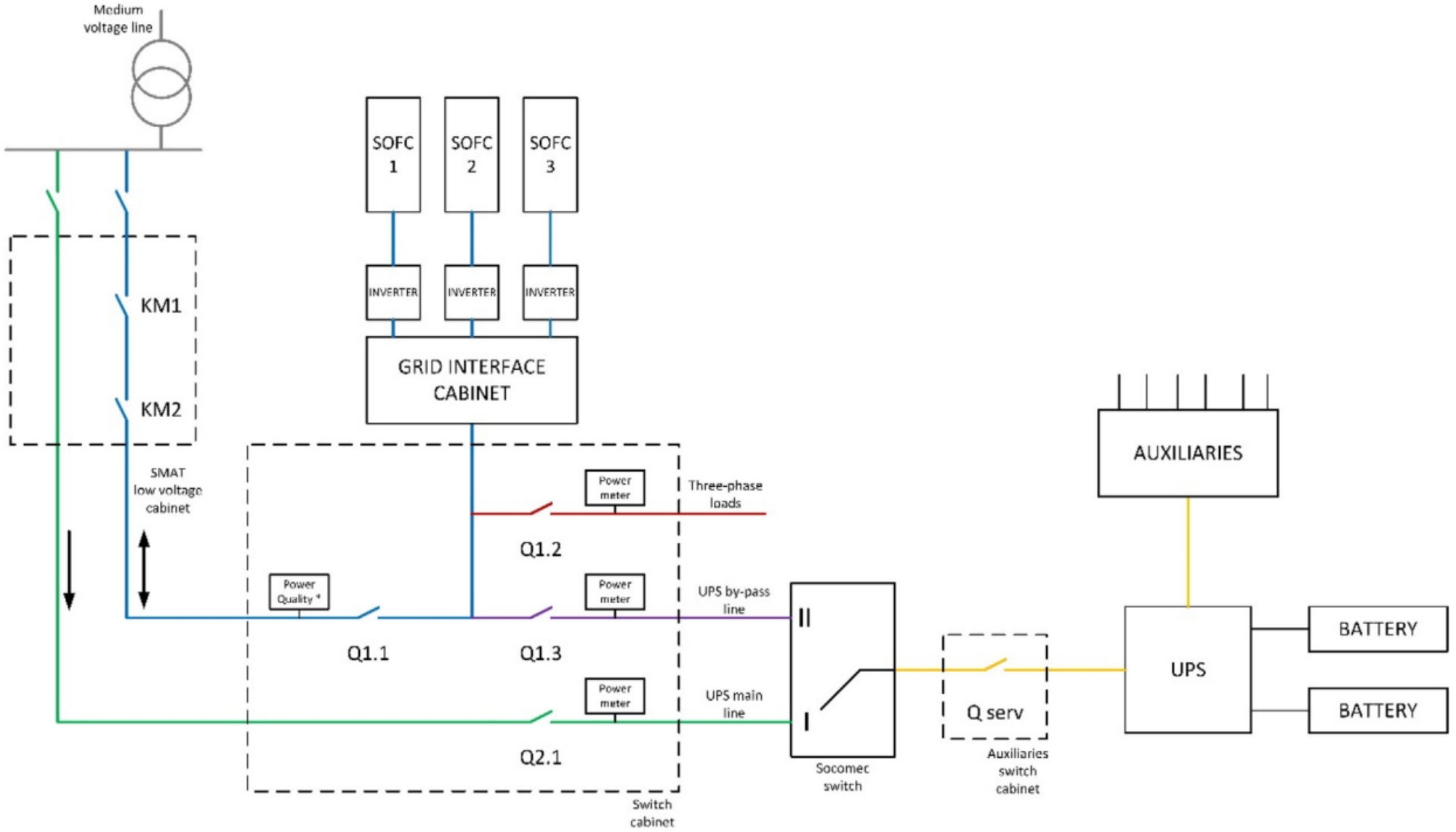
Schematic of SOFC integration into the WWT plants



SOFC module and heat recovery section P&ID



Electrical layout



SOFC performance from biogas at the WWT plants

Loading	:	4170.2	hours	Heat produced	:	118787.7	kWh
AC electricity produced	:	206350.4	kWh	CO2 saving (ref. EU28)	:	56.7	ton
DC electricity produced	:	242834.8	kWh				

Fuel in

61.9	%-CH4
17.1	Nm3/h
105.4	kW (LHV)

Air in

477	Nm3/h
29.2	°C

Power output

60.5	kW-DC Gross
51.6	kW-AC Net
48.9	% Eff. El (AC)

HRU water in

45.9	°C

Heat Output

498	Nm3/h
274.1	°C
37.7	kW
84.7	%-tot (LHV)

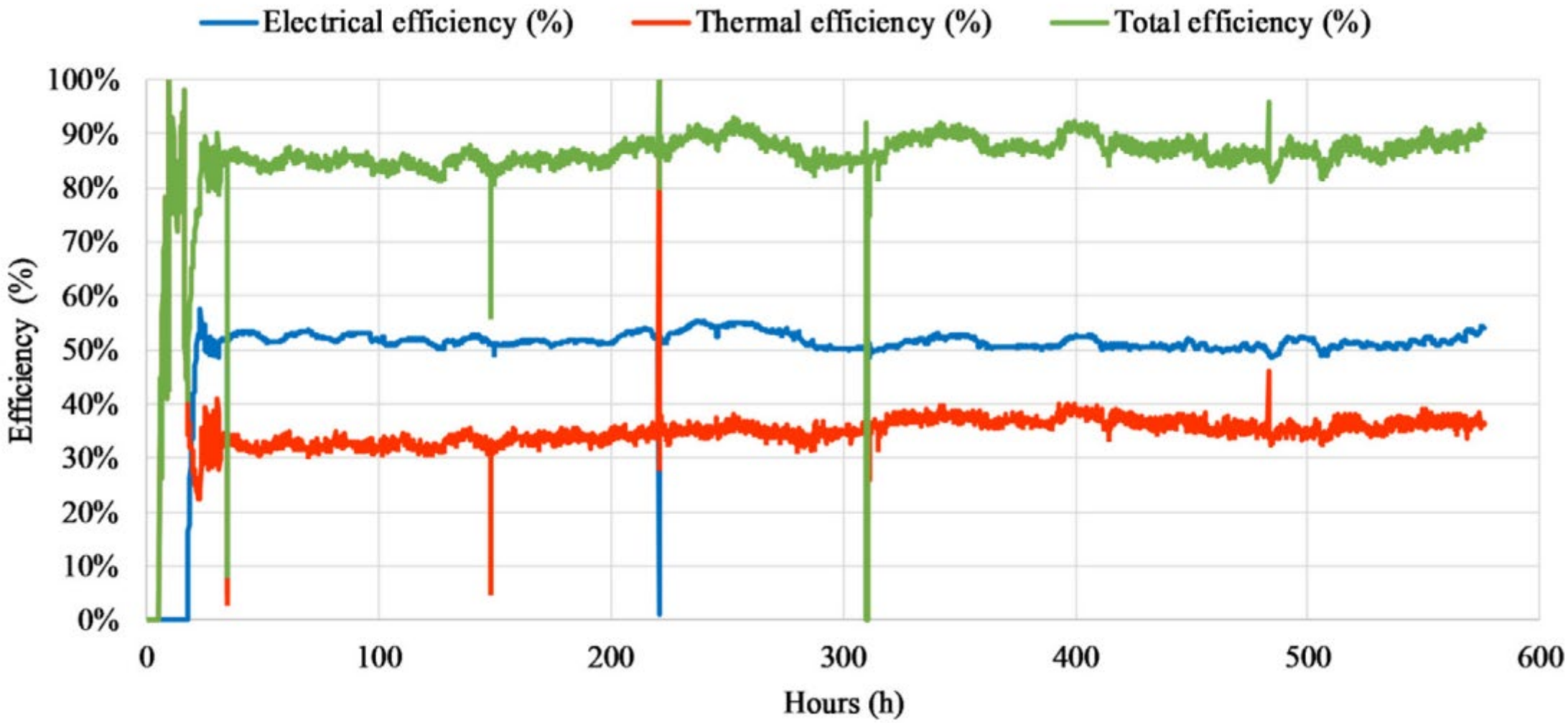
Exhaust gas out

73.6	°C

HRU water out

70.5	°C

Efficiency plot for the 600-h operation period



Thank you!