Buildings are at the heart of the energy transition

March 2021

Buildings are drivers of the energy transition

Responsible for their own energy

They produce and consume local energy

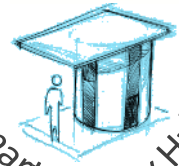
#selfconsumption #selfproduction #storage #hydrogen #autonomy

Supporting the energy transition

They contribute to greener and more resilient national grids

#smartbuildings #smartgrids #multienergy #biogas #flexibility

Sylfen



Smart Energy Hub

Sylfen

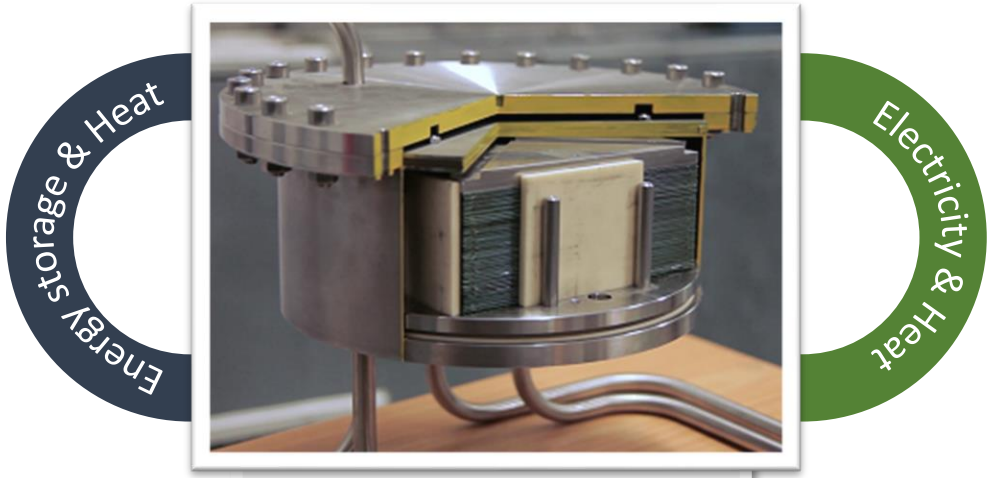
The rSOC energy processor

100% reversible technology

Electrolyser

H_2 production by water electrolysis

= Storage + heat



12 years of R&D
40 M€ invested

Fuel cell

Energy production from H_2 and/or CH_4

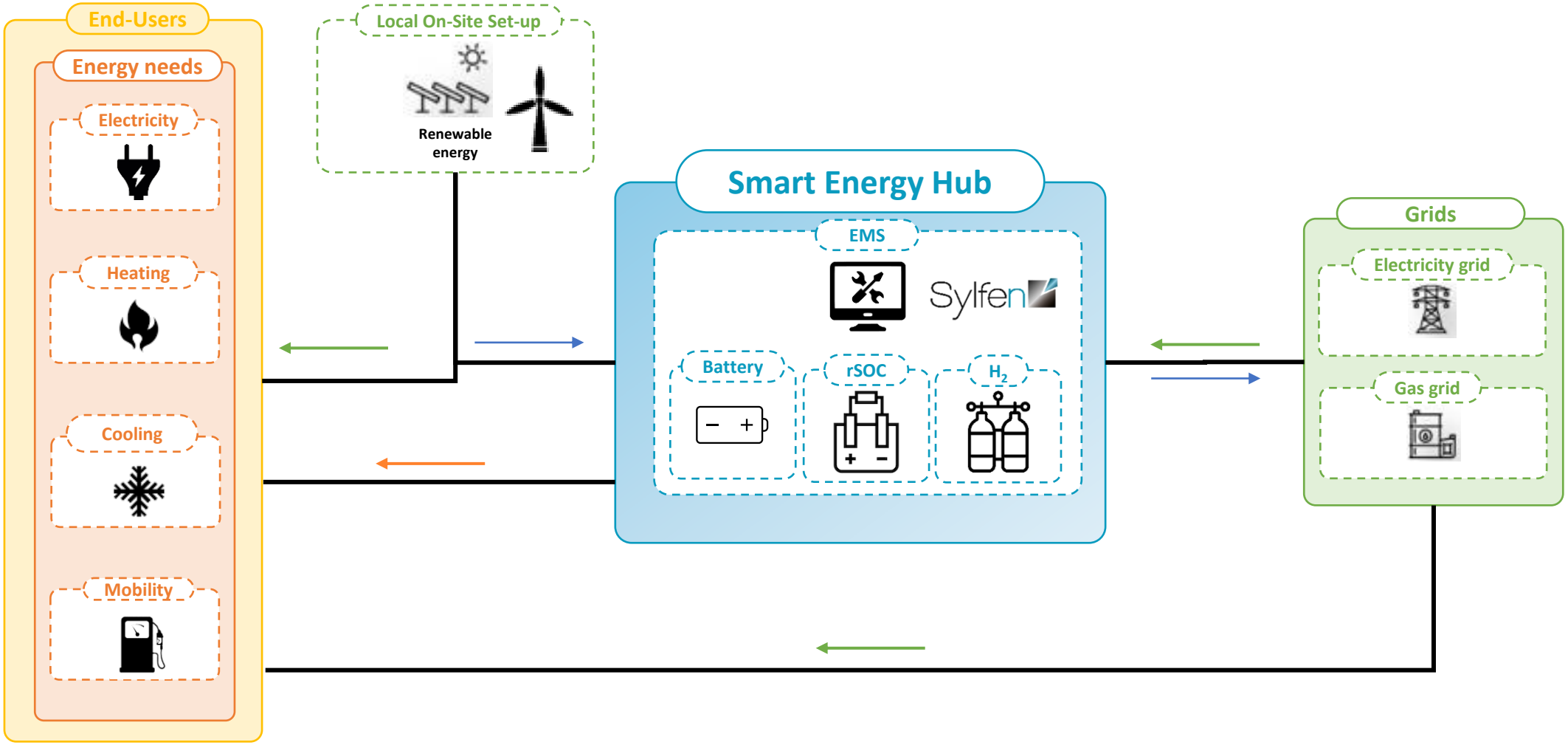
= Electricity supply + heat

Sylfen

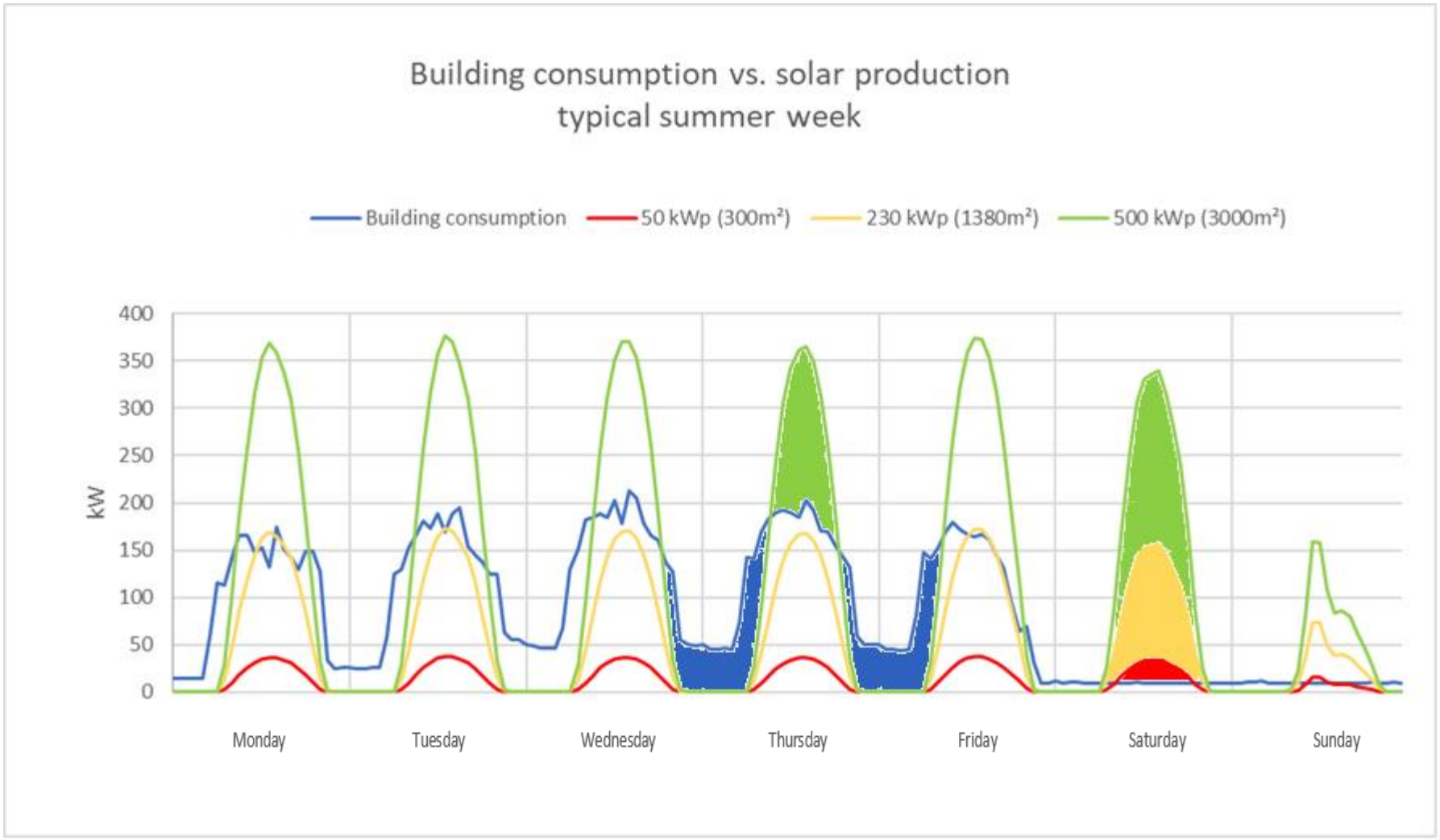
Founded in june 2015
Commercialization of a full system
Pre-industrialisation phase

*rSOC = reversible Solid-Oxide Cell

The Smart Energy Hub: a turnkey solution for buildings



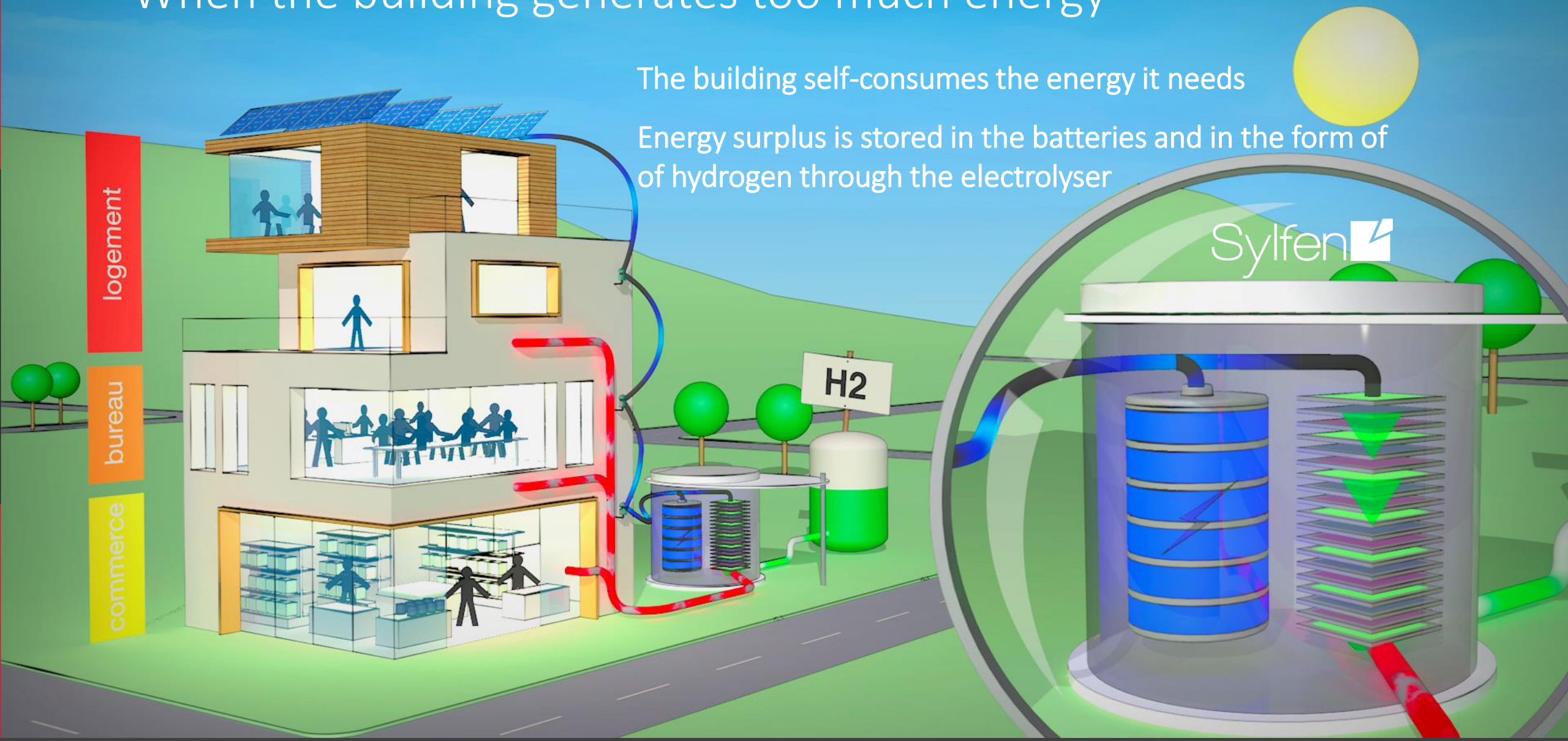
Example of solar production coupled with building consumption



When the building generates too much energy

The building self-consumes the energy it needs

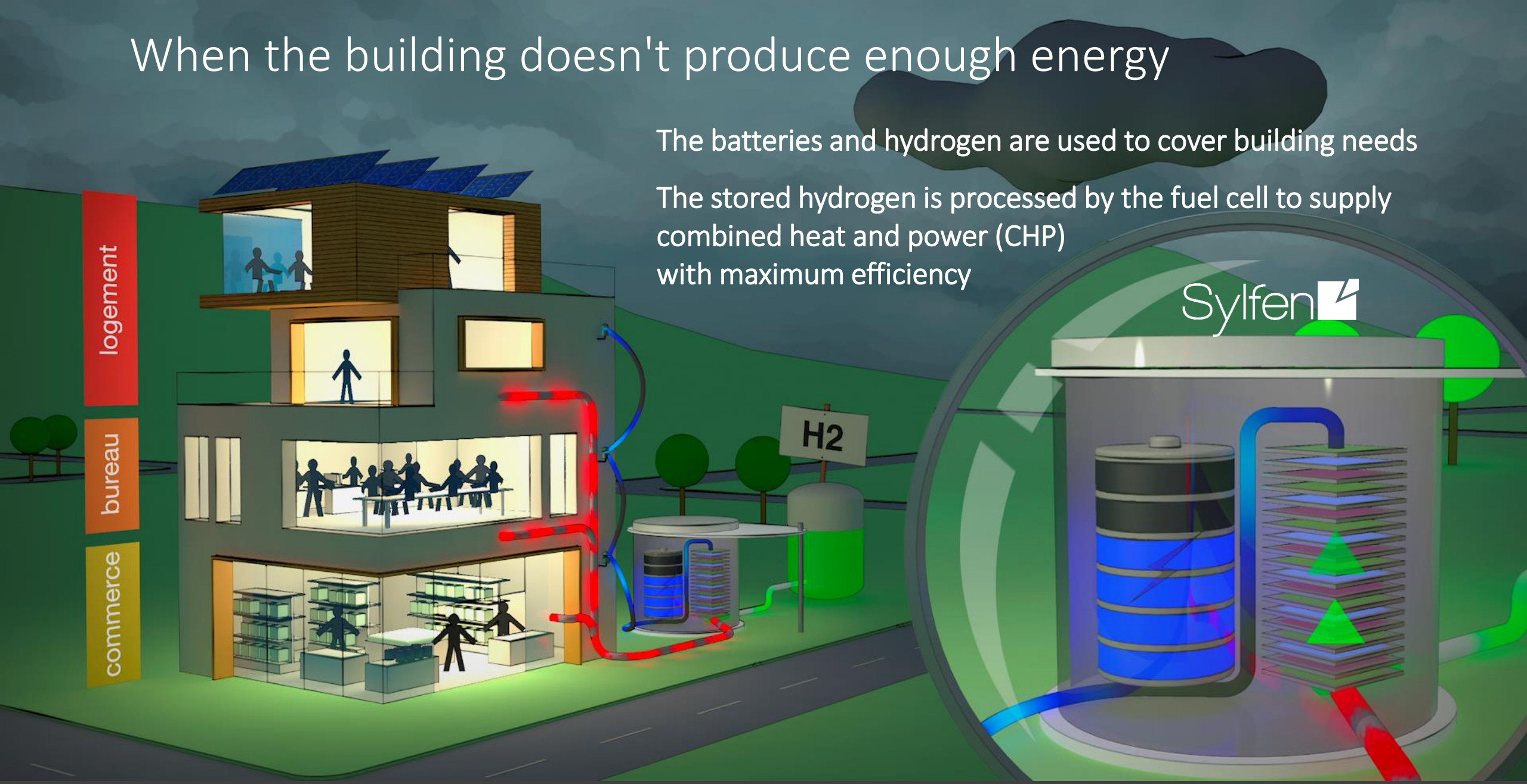
Energy surplus is stored in the batteries and in the form of of hydrogen through the electrolyser



When the building doesn't produce enough energy

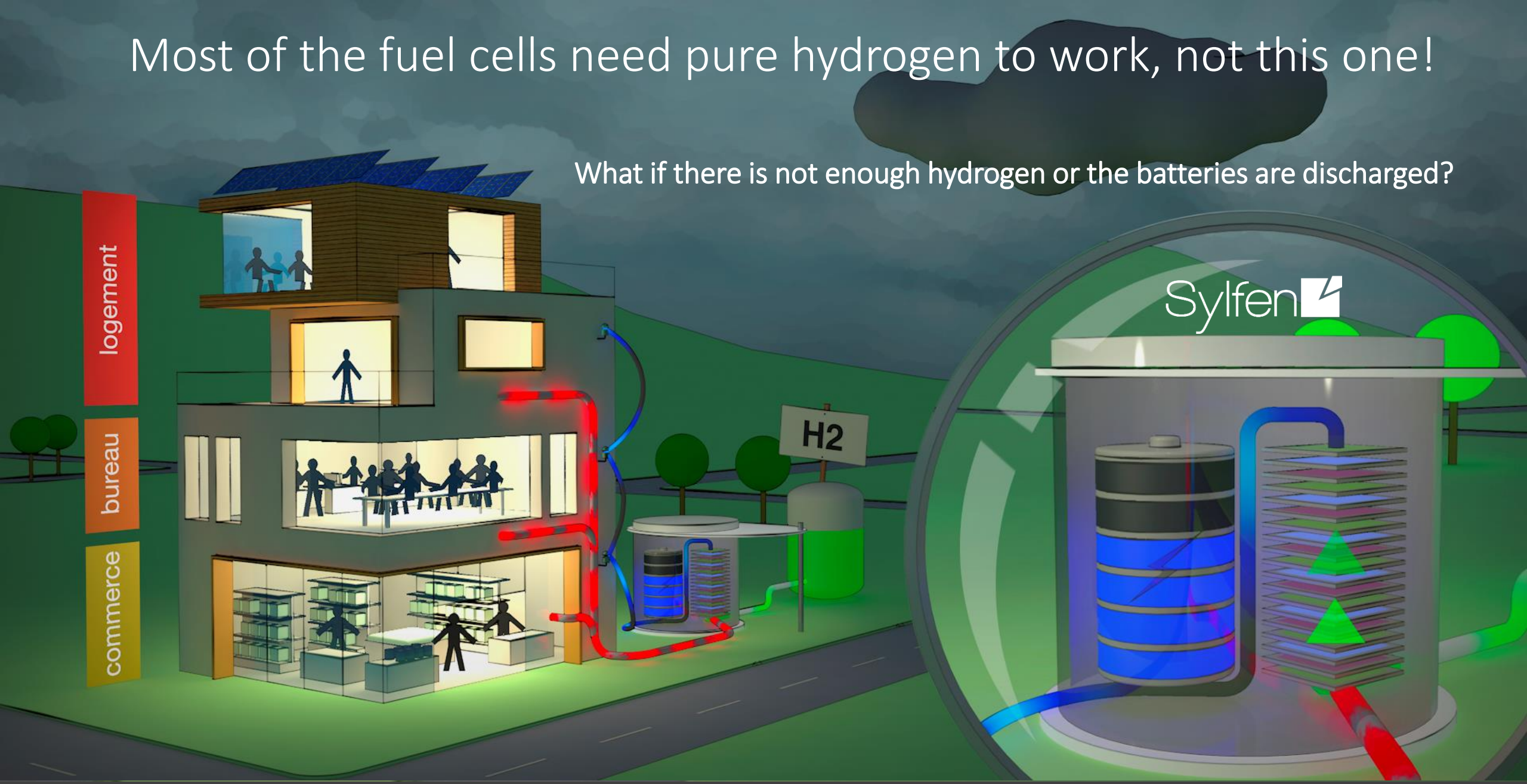
The batteries and hydrogen are used to cover building needs

The stored hydrogen is processed by the fuel cell to supply combined heat and power (CHP) with maximum efficiency



Most of the fuel cells need pure hydrogen to work, not this one!

What if there is not enough hydrogen or the batteries are discharged?



For which buildings?

- Current offering: nZEB buildings – ranging from 1 000 to 10 000 m²

  Europe | new build or renovation | public or private | various types possible*

- Starting 2023: larger buildings or group of buildings > 10 000 m²

  Ecodistricts| Industrial parks | Commercial centres | University campuses | Hospitals|…

*offices, public administration, sports halls, schools, hotels, collective housing, retirement homes, student residences, businesses, and industrial or commercial buildings, …

Introducing

The Smart Energy Hub

THE PRODUCT_

A system that combines energy storage and heat and power generation

THE PROMISE_

Produce locally the energy you need and consume renewable energy all year long thanks to hydrogen energy storage

Power, storage capacity and energy supply

Hybrid energy storage

Li-ion batteries

Featuring high reversal speed, the batteries provide short-term storage (a few hours) to ensure that energy is always available.

Battery configuration	Min	Max
Stored electrical energy (kWh)	50	300
Output capacity (kW)	25	150

Hydrogen storage

Hydrogen allows the storage of large amounts of energy locally and through long periods of time without disruption.

Amount of hydrogen (kg)	1	30	600
Storage capacity (kWh)	40	1 200	24 000
Floor area (m^2)	0,5	4	70

rSOC energy processor

The rSOC energy processor works alternatively as a:

Electrolyser

Hydrogen production and heat from temporary surplus of local renewable electricity.

Storage mode (electrolysis)	per module
Storage power (kW)	40
Hydrogen production (kg/h)	0,8
Thermal production (kW-th)	4

Fuell cell

On demand electricity supply and heat.

Energy production mode (fuel cell)	per module
Electric power (kW)	6
Thermal power (kW-th)	4

Sylfen overview

- ✓ Founded in Grenoble in 2015
- ✓ Staff: 18
- ✓ Turnover 2019: 457 k€

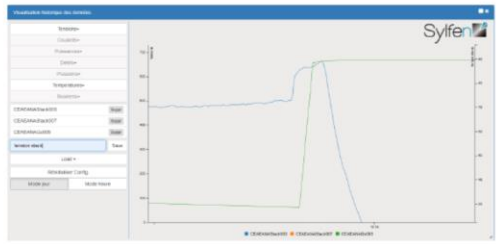
- ✓ Manufacturing (450m²) +
- ✓ Offices (250m²)

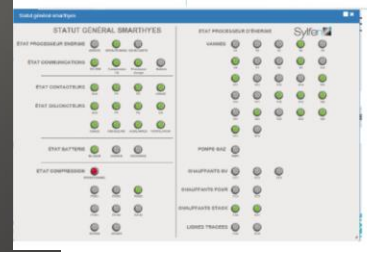
  Le Cheylas, Isère (30 mn Grenoble or Chambéry, 1h30 Lyon or Genève)

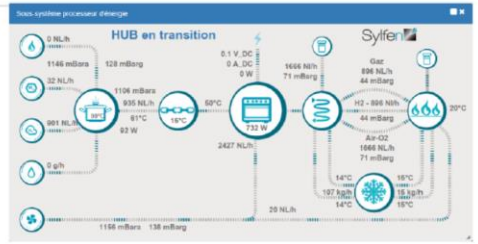
- ✓ 3 signed pilot units
- ✓ **2 signed sales**

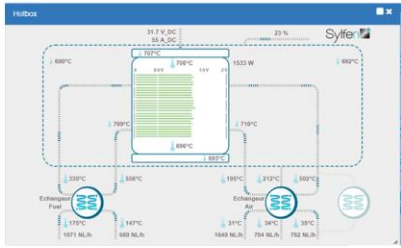
First product launches on the European market

Smarthyes PoC prototype delivered to ENGIE Lab in 2018









- Validation of **rSOC technology** coupled to **hydrogen compression and storage** & **batteries**
- Validation of Sylfen's **innovative Energy Management System PASEO**
- Validation of **rSOC control&command strategies** to shift between electrolysis and hydrogen or natural gas fuel cell modes
- Remote access and system control validated

Availability
> 95%

Signed commercial orders to deploy first products

Signed orders

Gouvernement Princier
PRINCIPAUTÉ DE MONACO

Tour Carmelha

Residential building

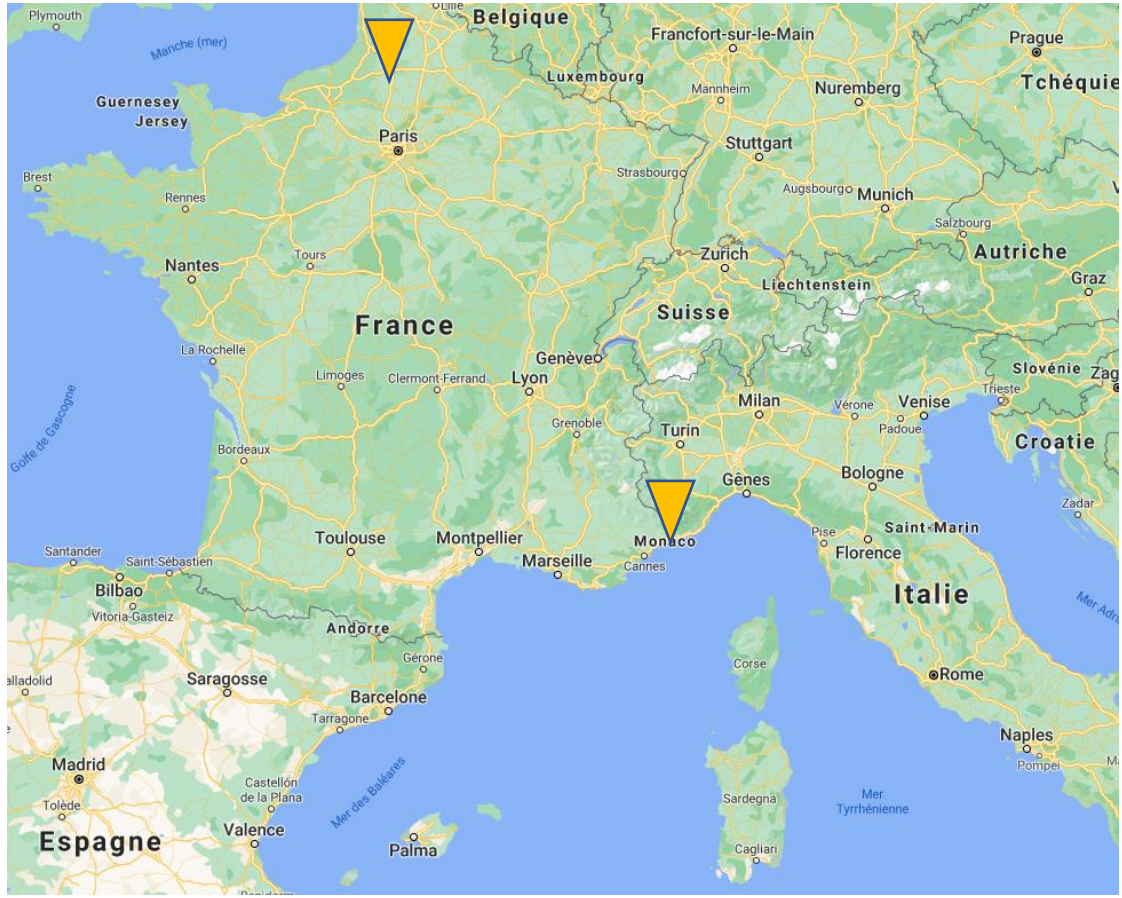
Environmental performance improvement and innovation demonstration for Monaco's energy transition policy
A 1 module unit (Q2 2022)

sicae
L'énergie de nos campagnes

Smart Grid Capitole

Industrial building

Qualification of hydrogen based energy storage solution to support grid flexibility and large scale renewable power management
A 1 module unit (Q3 2021)



Signed subsidised projects to field-test pilot units

Building confidence with demonstration units

Altaïr project
A 1 module unit in
Le Cheylas (2021)

BPI France

Reflex project
A 3 modules unit in
Torino (2021)

FCH-JU Program

Gift project
A 1 module unit
in Procida (2021)

H2020 Program

The REFLEX project

Reversible solid oxide Electrolyzer and Fuel cell for optimized Local Energy miX

https://cordis.europa.eu/project/id/779577/it

Achieving ***high efficiency***, ***high flexibility*** in operation, and ***cost optimum*** is duly addressed through improvements of ***rSOC*** components (cells, stacks, power electronics, heat exchangers) and ***system***, and through ***advanced operational strategies***.

An in-field demonstration will be performed in Torino at Environment Park facilities, where the ***Smart Energy Hub*** will be coupled to local ***solar*** and ***mini-hydro*** renewable sources and will provide electricity and heat to the headquarters of the park. ***First of its kind in Europe***

16 kWp PV plant

670 kWp hydroelectric plant

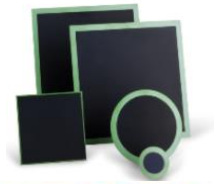
The REFLEX Consortium

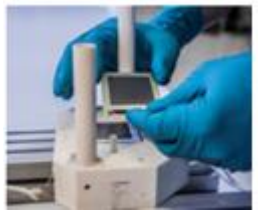
Sylfen

cea

Fuel cell technology elcogen

DTU Technical University of Denmark





Cells and stacks development and testing

VTT

System modeling

System power electronics

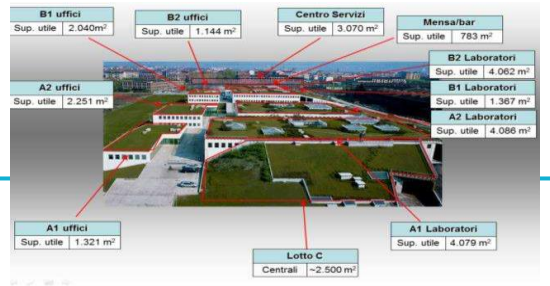
GPTech

Universidad de Sevilla

System design and manufacturing

ENGIE

Techno-economic and market analysis



Field tests

ENVIRONMENT PARK Parco Scientifico Tecnologico per l'Ambiente

Sylfen projection study – Methodology and tools

Understanding the energy mix by taking into account dynamic building energy consumption throughout the year

Simulation of energy supply, costs & savings, and environmental impacts at the building level
Contextualization to align with objectives based on energy, economic, and environmental KPIs
Optimization of the Smart Energy Hub size and operation strategy based on the customer's needs

Projection into the autonomous building's life: a final report to tell the story, highlight and value the KPIs of the project.

A clear action plan to move forward

ProfilBât®

Dynamic modeling of the energy needs (electrical and thermal)

Data collection, integration, and validation

ConfigDym®

Simulation of scenarios considering the potential for dynamic self-consumption as well as the needs for power and capacity storage.

Alignment with project objectives.

Post-Analysis

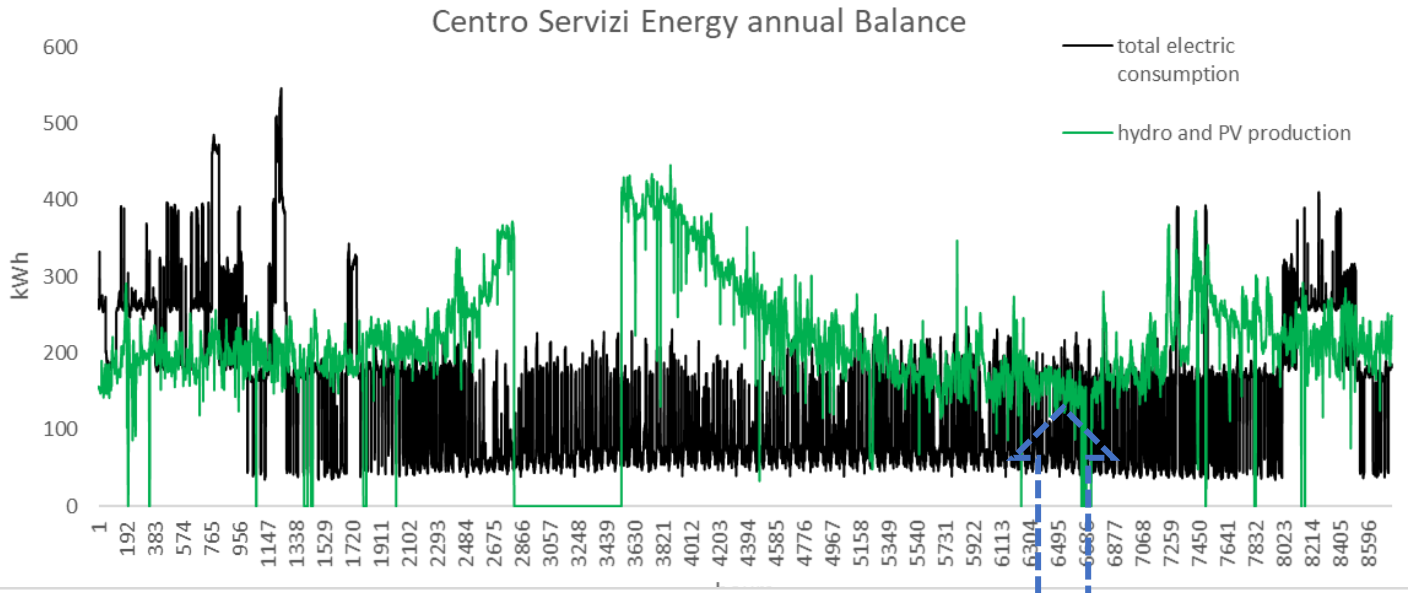
Clarification of the methodologies used and discussion with the client to address any doubts regarding successful completion of the project.

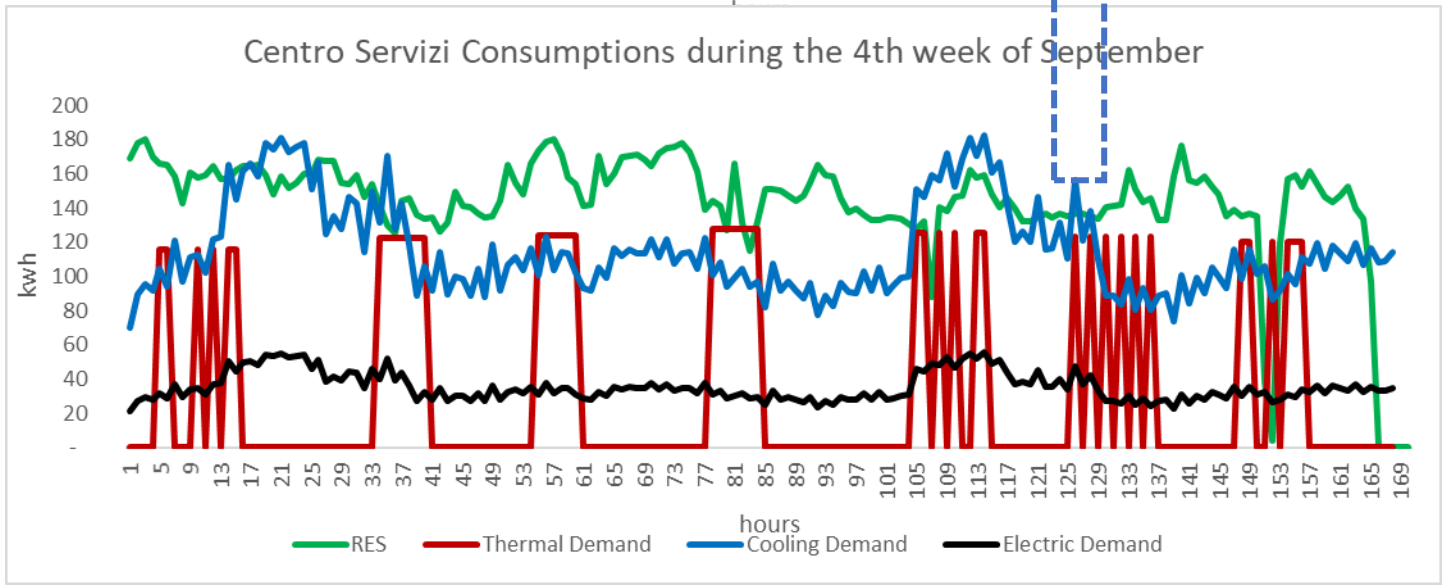
ProfilBat Sylfen software for energy analysis applied to ENVIPARK

Supply	Service	Consumption (kWh)	Surface (m2)	Indicator (kwh/m2)
Electricity	lighting, cooling, aux	3,788,707	22,764	166.4
Biomass	heating & DHW	2,742,762		120.5
Natural gas	heating&Cooling and DHW	2,574,259		113.1

Offices	Surface (m2)	% m2
Centro Servizi (CS)	3,070	13%
A1 uffici	1,321	6%
A2 uffici	2,251	10%
B1 uffici	2,040	9%
B2 uffici	1,144	5%

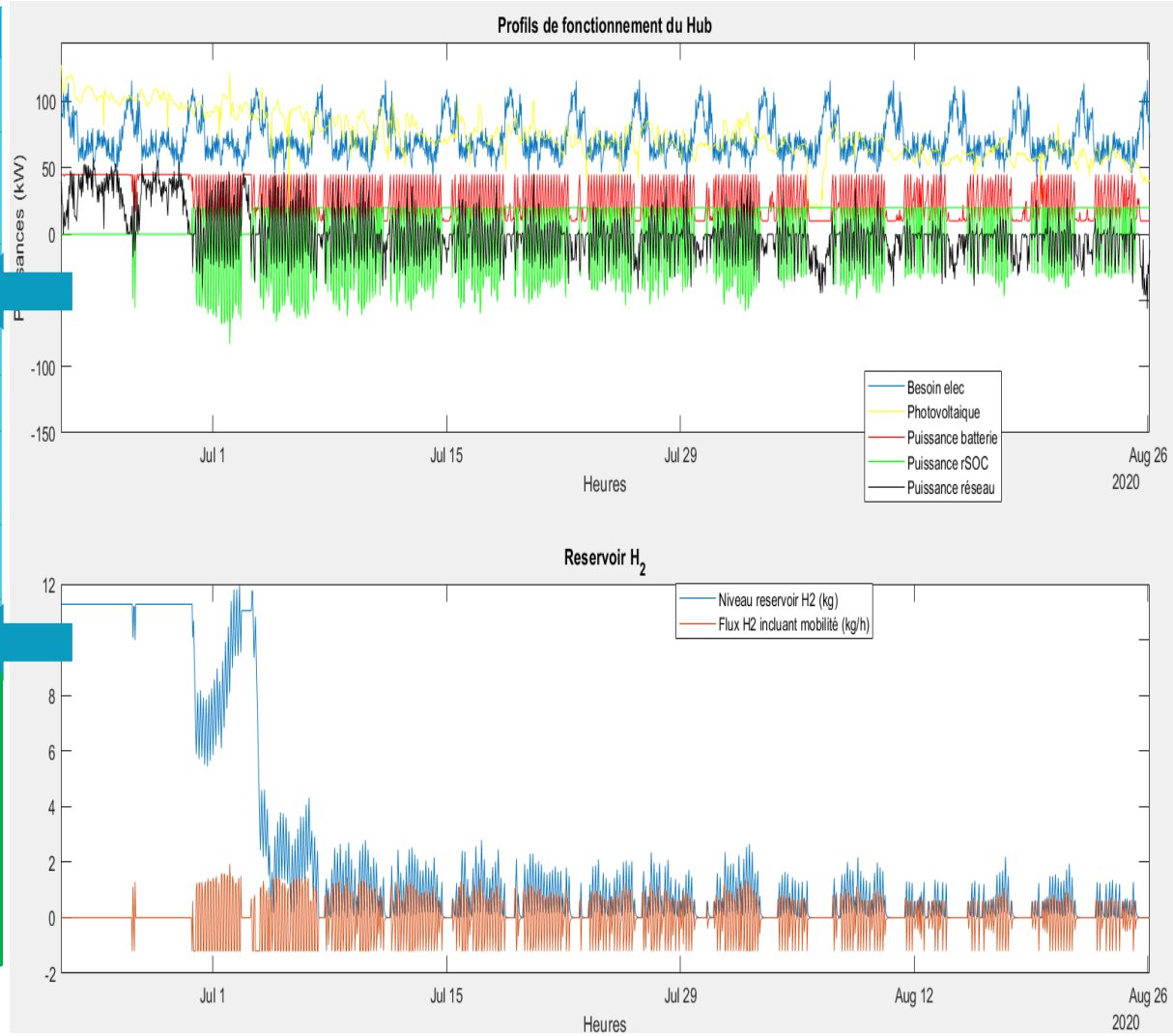
Offices	Audit indicator (kWh)	Sylfen ProfilBat (kWh)
CS Electric	510,953	505,844
CS Thermal	717,064	696,388
A1 Electric	219,860	217,661
A1 Thermal	308,548	299,651
A2 Electric	374,643	370,897
A2 Thermal	525,769	510,609
B1 Electric	339,526	336,131
B1 Thermal	476,486	462,747
B2 Electric	190,401	188,497
B2 Thermal	267,206	259,501





ConfigDym Sylfen software for energy analysis and feasibility

Case Study	25% RES	30% RES	50% RES
Self-consumed (kWh)	384,945	424,028	447,221
Self-consumed/produced (%)	86%	71%	50%
Overproduced (kWh)	28,830	109,600	416,981
SOFC H2 (kWh)	33,036	44,280	17,485
SOFC CH4 (kWh)	84,903	48,983	19,981
SEH heat valorised (kWh)	46,060	41,655	13,050
Gas from the grid (kWh)	325,979	321,406	341,536
Elec. from the grid (kWh)	76,453	59,939	44,242
CO_2 emissions (tons)	139	116	106
CO_2 reduction (%)	67%	72%	75%
Primary energy (kWh)	527,294	482,529	465,678
Primary energy savings (%)	70%	75%	77%



Project deployment and perspectives

- With 30 % RES production the Smart Energy Hub contribution is maximized. We observe:
  - The highest contribution from hydrogen production in terms of electricity and heat,
  - The lowest gas purchase from the grid,
  - The optimal emissions reduction, due to the use of green hydrogen.
- New piloting strategies are being refined for this specific case
- The plant layout is being adapted to respect the Italian regulatory framework in collaboration with Dr. Sabina Fiorot from Environment Park

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