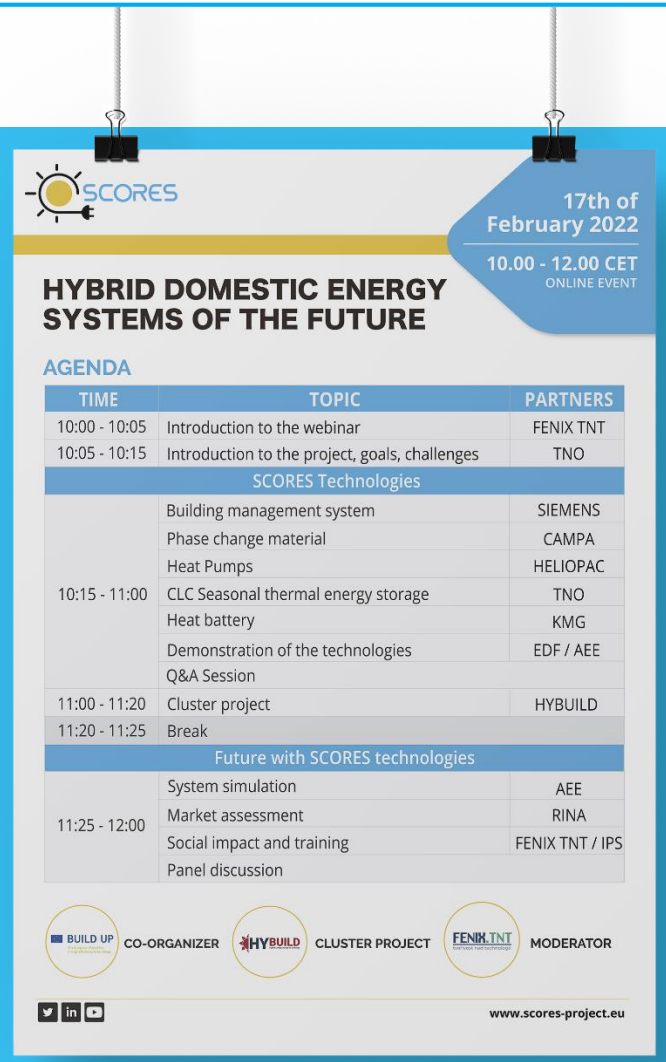
Final Event

Hybrid domestic energy systems of the future



Introduction to the webinar

SCORES

MODERATOR

SCORES

ZUZANA TATAKOVA

Business & Innovation Manager
at Fenix TNT

SPEAKER

SCORES

PAVOL BODIS

Systems integrator at TNO,
Technical coordinator of the SCORES project

Introduction to the topic

SCORES combines and optimizes the **multi-energy generation**, **storage,** and **consumption** of **local renewable energy** (electricity and heat) and **grid supply**.

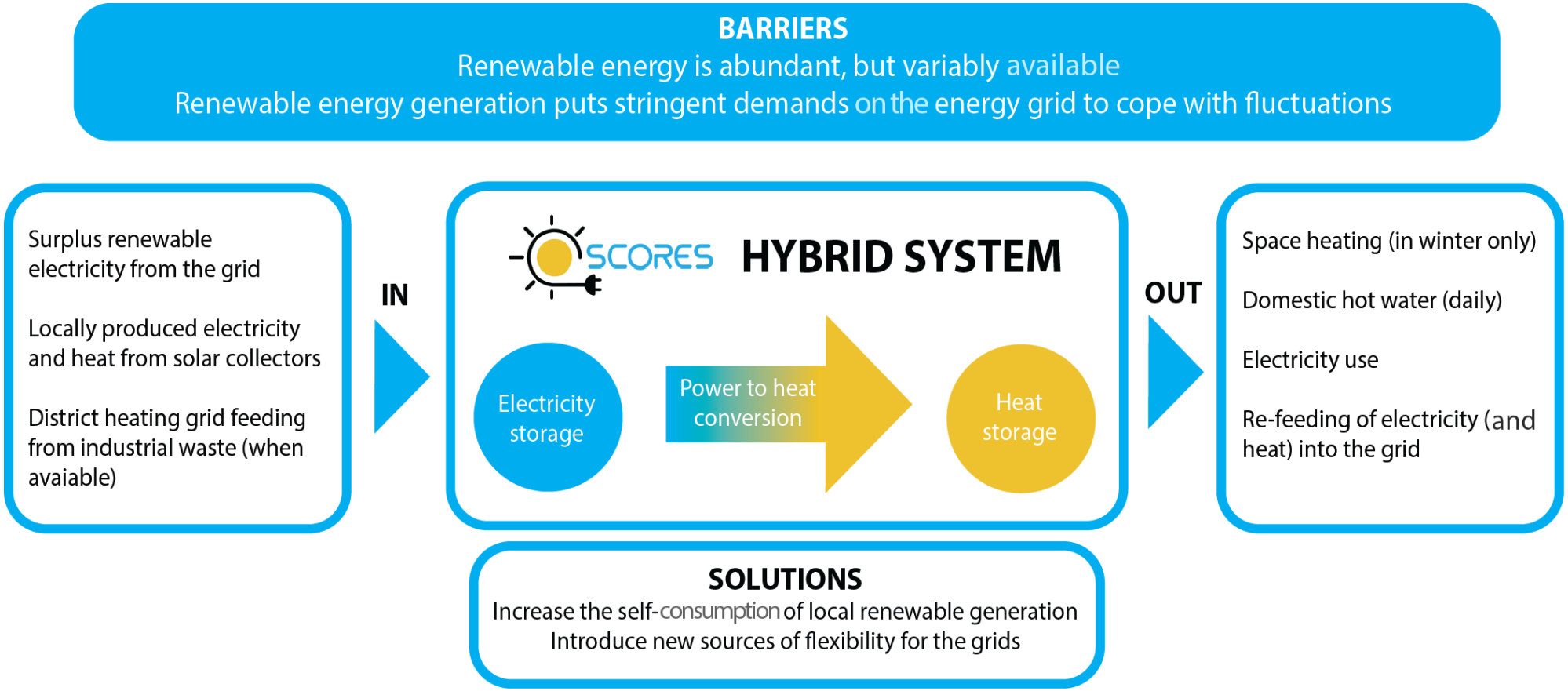
Via the development of compact hybrid storage technologies, integrated through a smart **Building Energy Management System**, the project optimizes the self-consumption in residential buildings, brings new sources of flexibility to the grid, and enables **reliable operation** with a **positive business case** in Europe's building stock.

12 Partners

9 Work Packages

Budget **€6M**

48 (54) Months

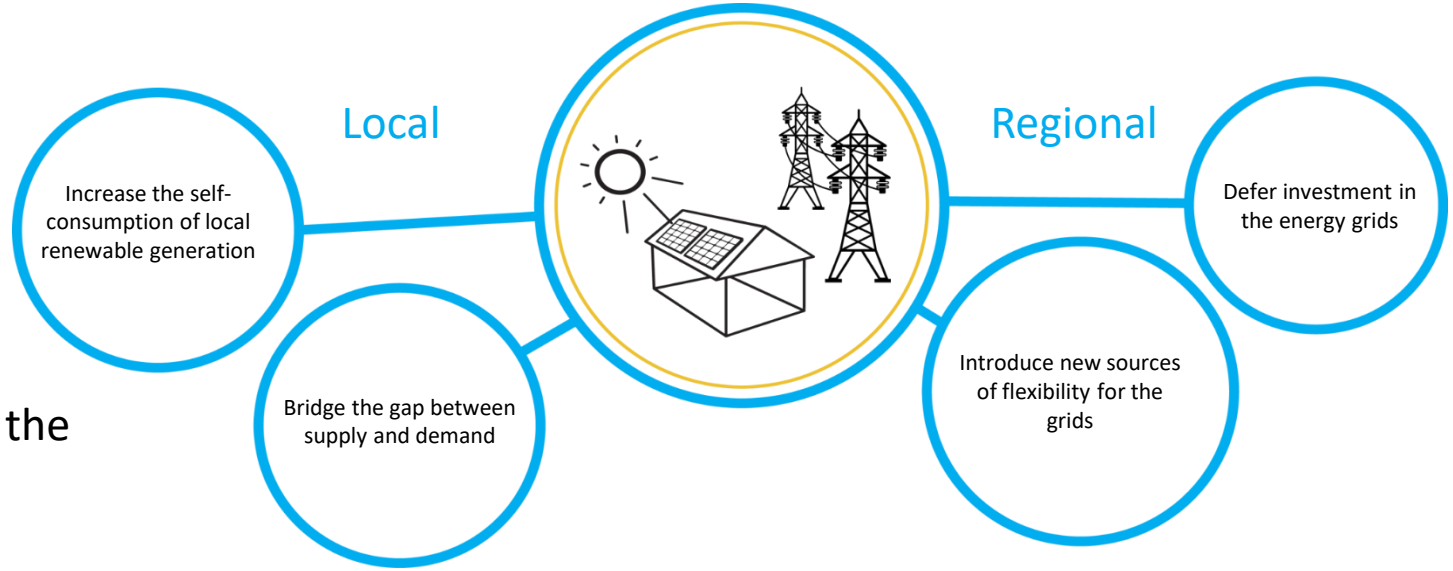


The SCORES concept is based on a hybrid system effectively and efficiently combining solutions that **harvest electricity** and heat from the sun, **store electricity**, **convert electricity into heat**, **store heat**, and **manage energy flows** in the building.

SCORES Consortium

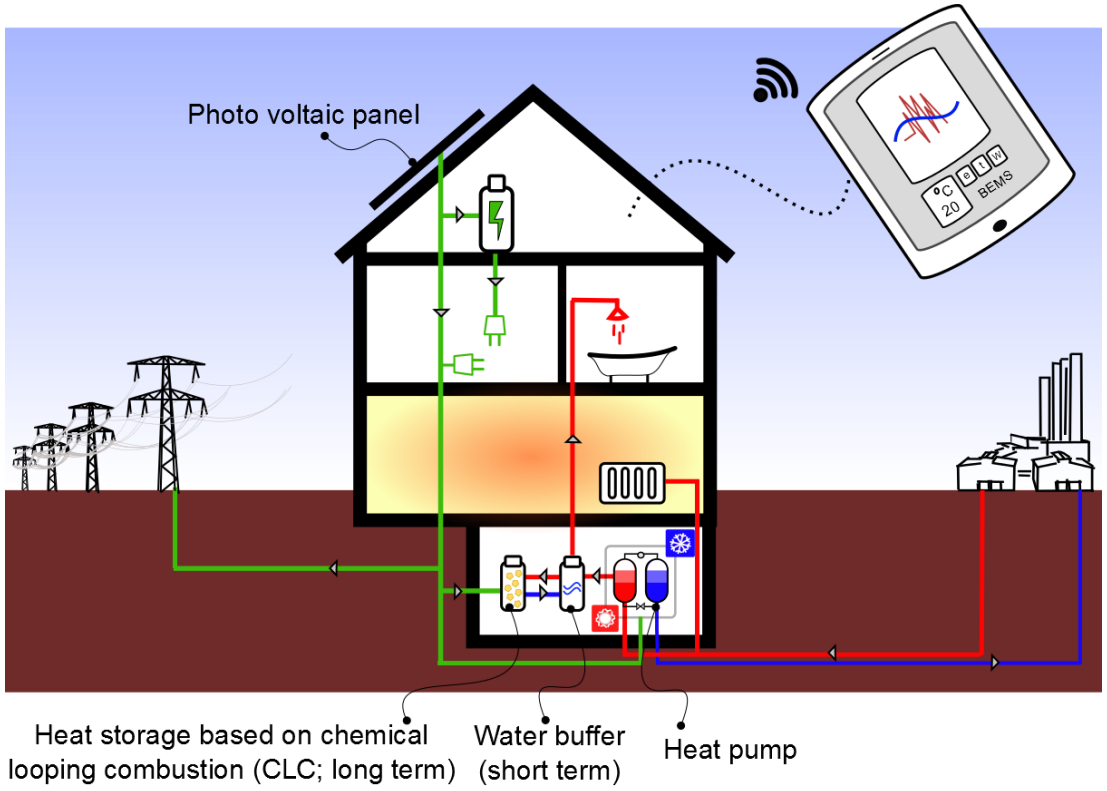
Objectives

Demonstrate in the field the integration, optimization and operation of a building energy system including **new compact hybrid storage technologies**, that optimize supply, storage and demand of electricity and heat in residential buildings and that increases self-consumption of local renewable energy in residential buildings at the lowest cost.



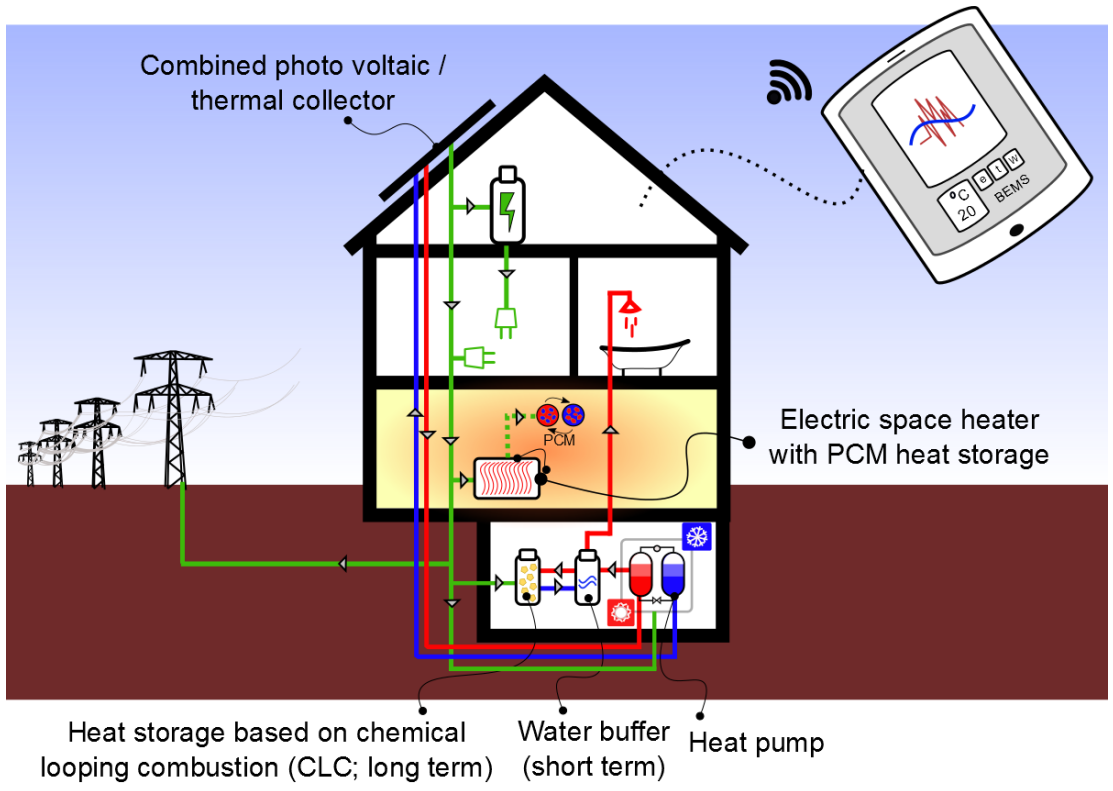
Re-use of Second Life Li-ion batteries for residential electrical storage → Optimized electric driven heating with intraday PCM heat storage → High-performance water to water heat pump supplied by hybrid PV and solar collectors. → Efficient air to air heat pump for space heating with intraday PCM storage → Improve and optimize compact, long term loss free heat storage technology → An integrated building energy management system → Asses the economical potential of the hybrid system

Connected to district heating grid:



Demo in Austria

Based on electric heating:



Demo in France

Demonstration of the integrated hybrid energy system takes place in **two real buildings** representative of different climate and energy system configurations for 3 cases:

- in Northern Europe (**Austria**) with and without a heat grid
- In Middle/Southern Europe (**France**) without a heat grid.

Agen, France

New state of the art building has been constructed, comprising of 115 small apartments and collective areas for retired people.

Gleisdorf, Austria

In Gleisdorf, an already existing residential building block is connected to both the electricity network and the local heating network.

SCORES Technologies

SPEAKER

SCORES

HANS HENNIG

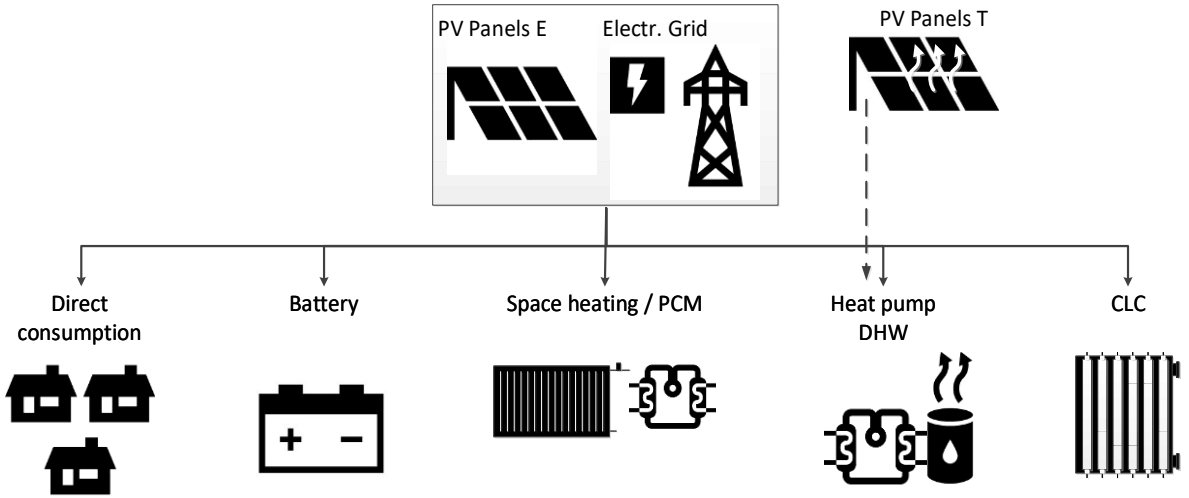
Energy Engineer at Siemens

Building energy management system

BEMS = ***B***uilding ***E***nergy ***M***anagement ***S***ystems

- Most standard building management systems rely on current measurement only (outside temperature / radiation)
- Few systems look ahead (solar load estimations mostly)
- Equipment is thus started when it can/must, not when it is optimal to start it
- A BEMS system starts the equipment at an optimal point based on available energy or energy cost

System setup Demo B (AGEN - France)



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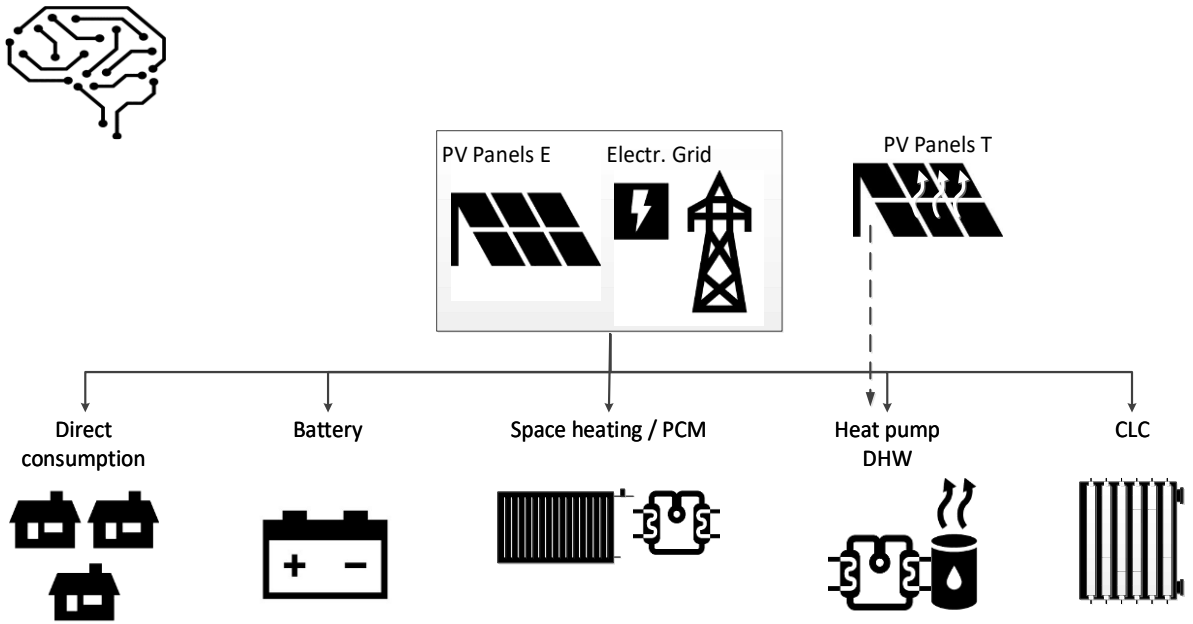

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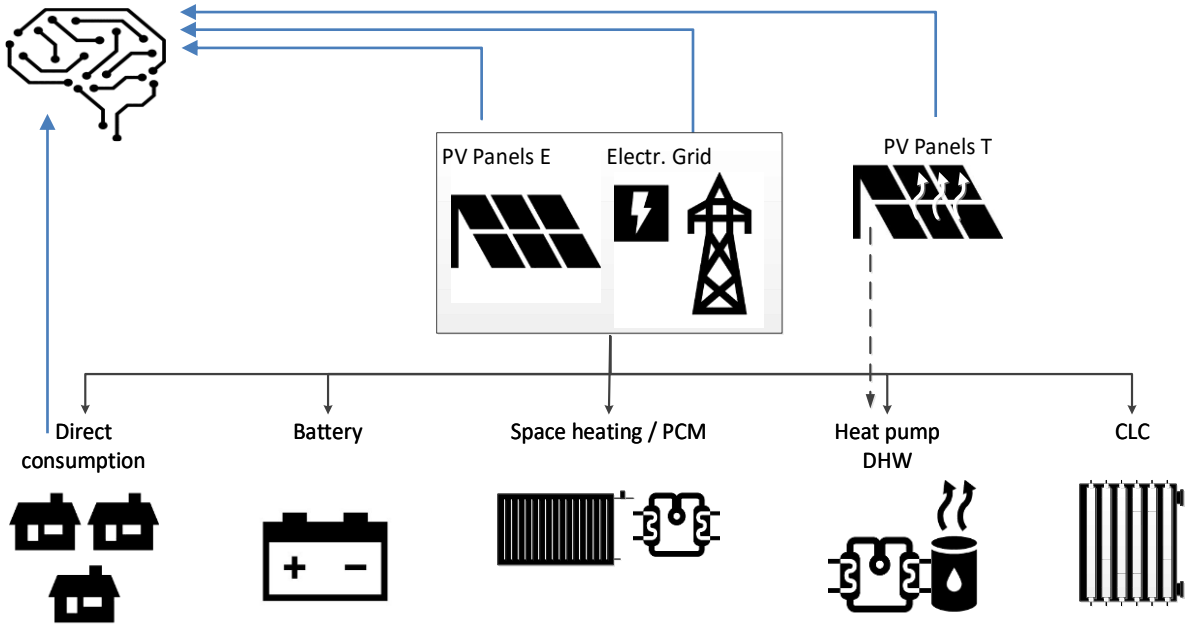

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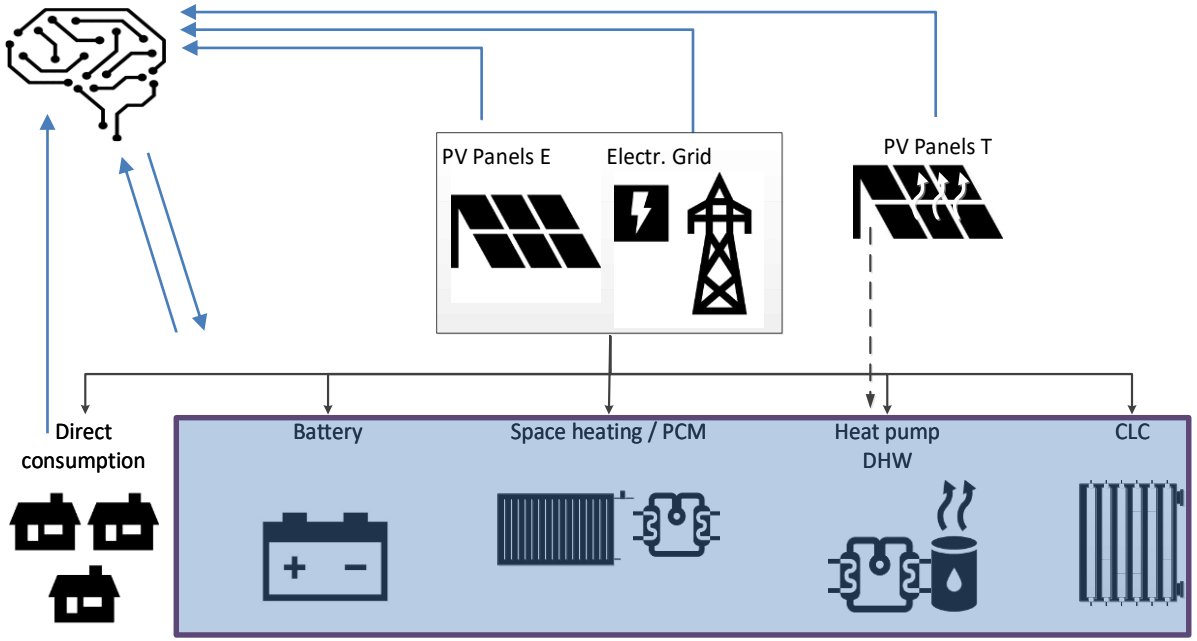
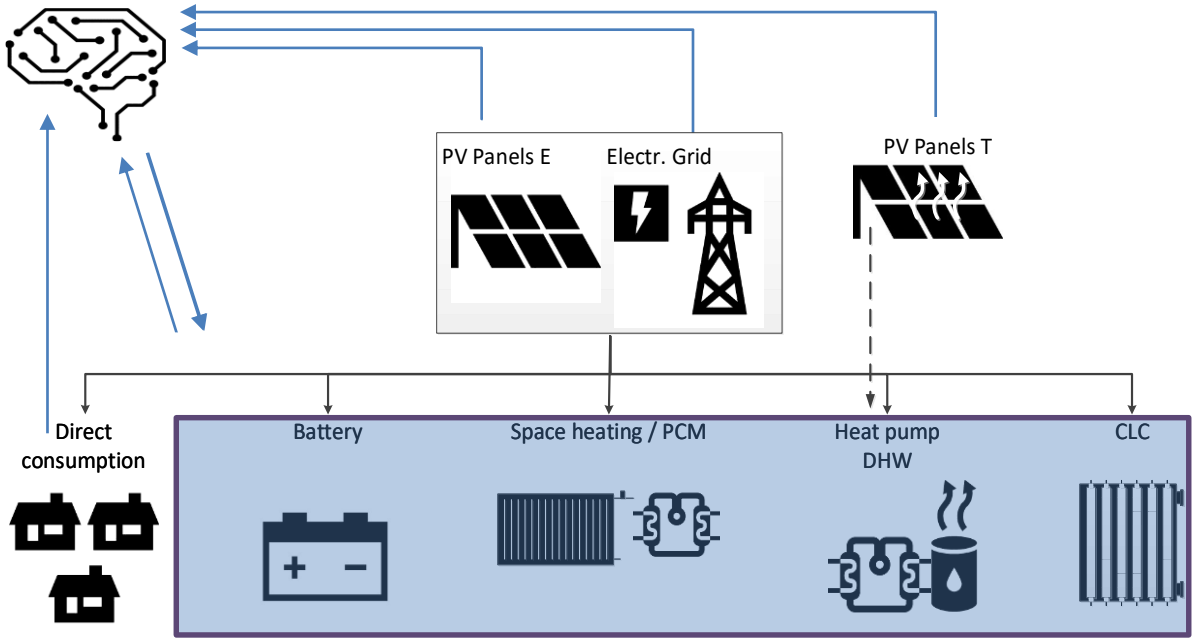
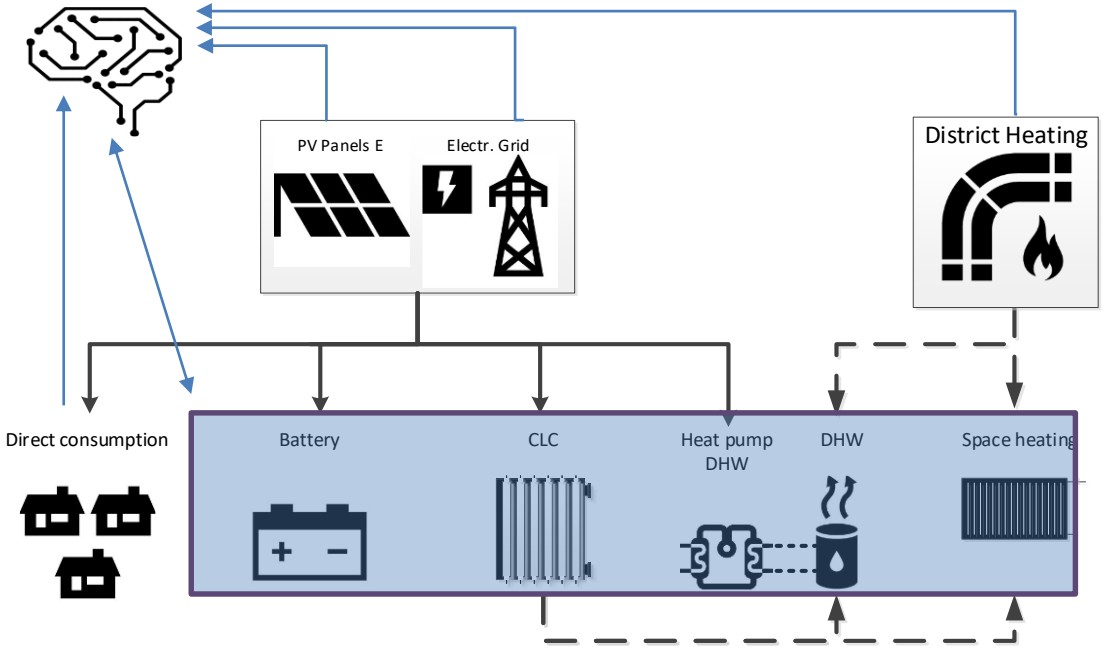


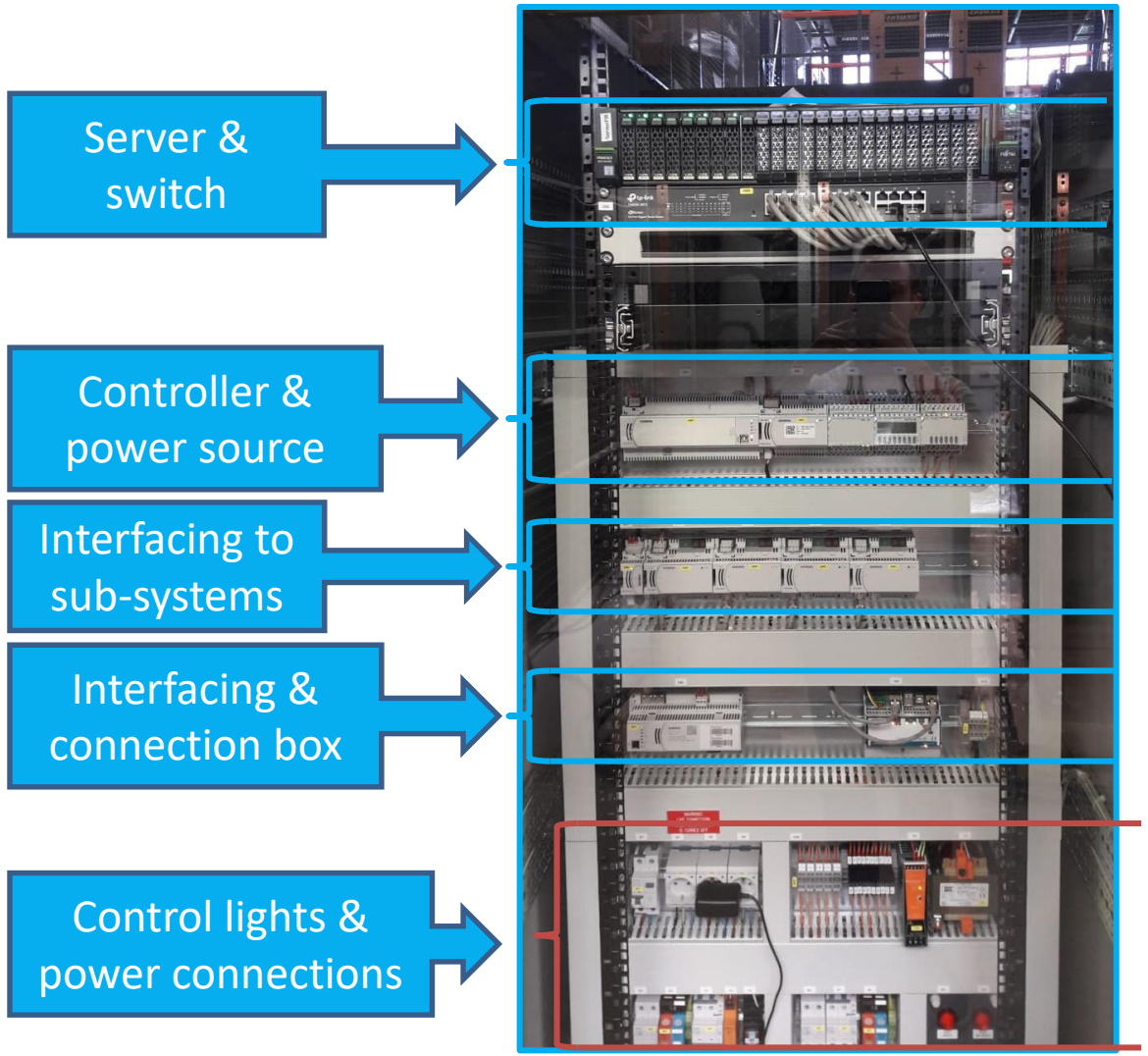
System setup Demo B (AGEN - France)



System setup Demo A – (Gleisdorf – Austria)



Controlling hardware



Two algorithm parts are running at different speeds

Prediction algorithm:

- Makes predictions of non-controllable variables (weather, holidays..etc)
- Uses physical formulae and regression for the predictions
- Predicts energy surplus based on calculated energy flows (physical models)

Decision algorithm:

- determines how best use energy surplus dependent on boundary conditions and algorithm settings
- Uses a set of rules to determine optimization

BEMS Algorithm – Simulation Interfacing

BEMS reads datapoints from simulation to predict generation and consumption profiles over a 24 hour prediction horizon:

PV surplus = $P_{PV} - P_{sh\_elec} - P_{dhw\_elec} - P_{gen\_elec}$

BEMS reads datapoints from simulation to predict generation and consumption profiles over a 24 hour prediction horizon:

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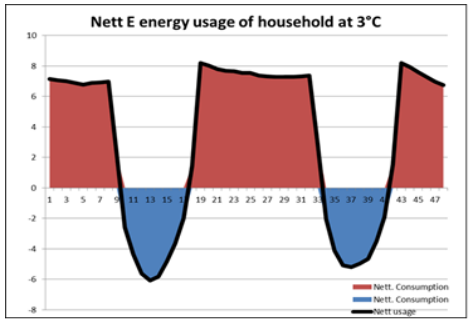
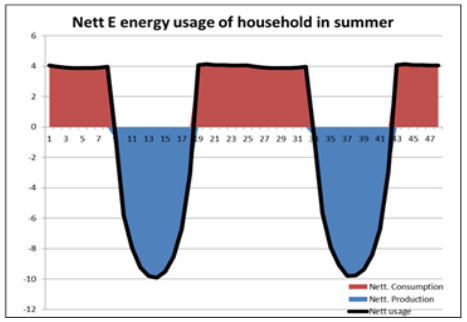
Theory





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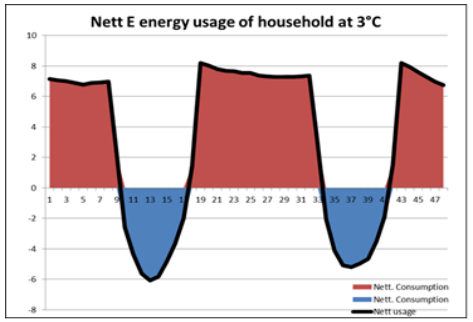
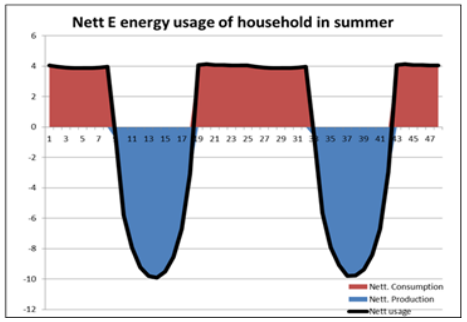
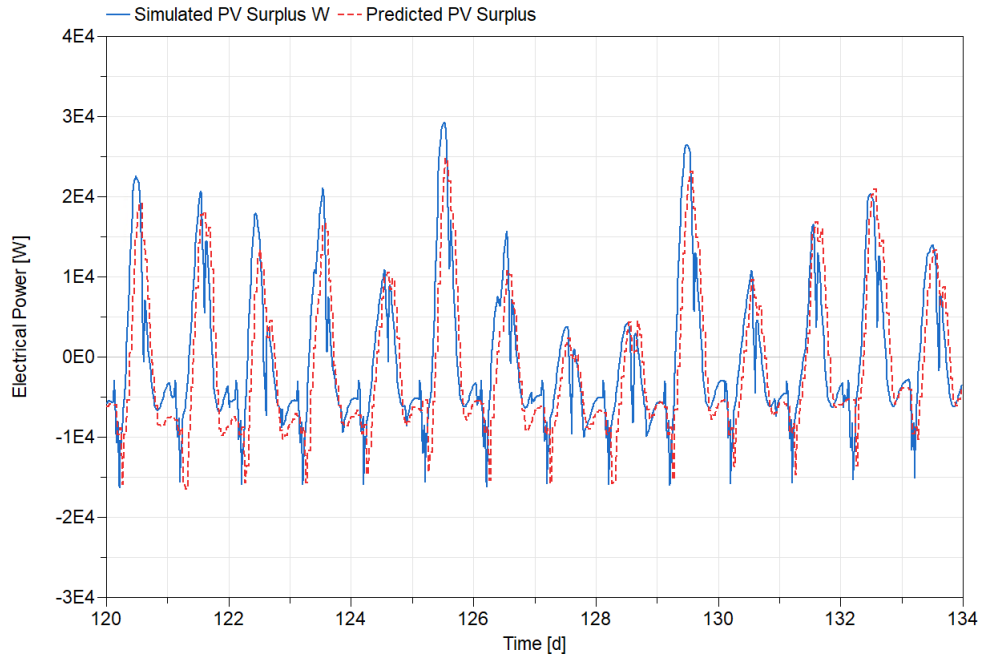
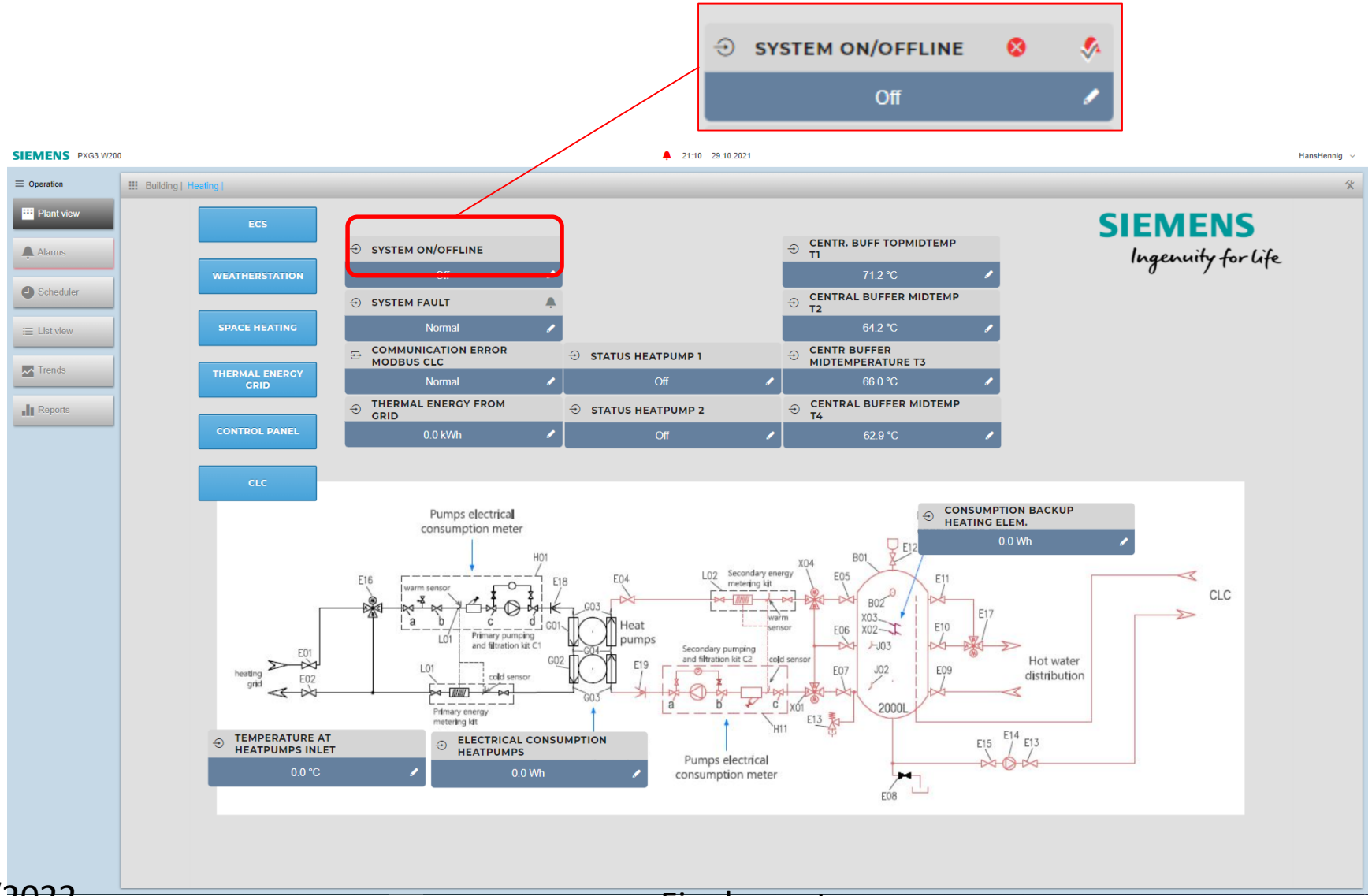


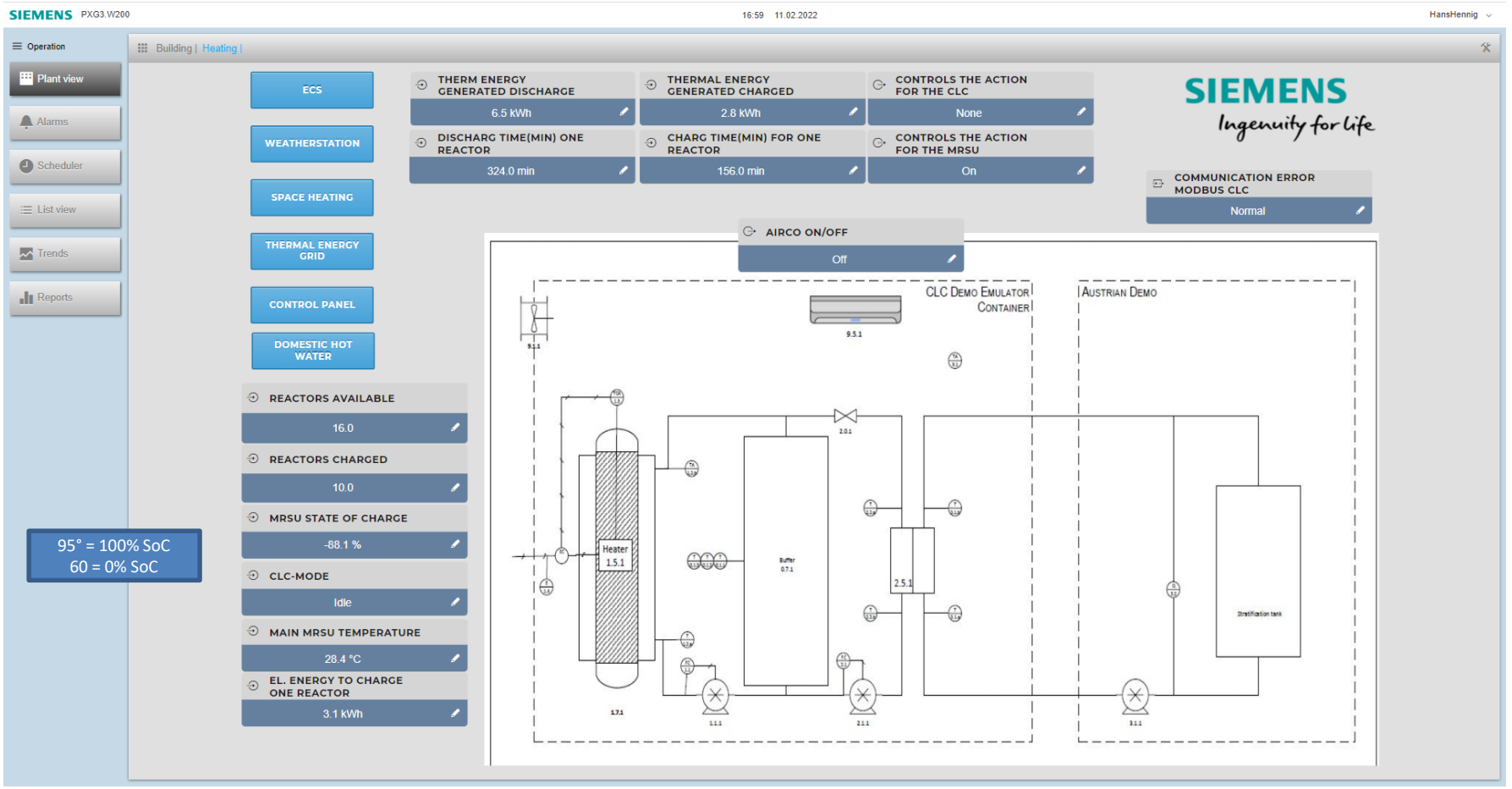




Project Execution: BEMS control panel

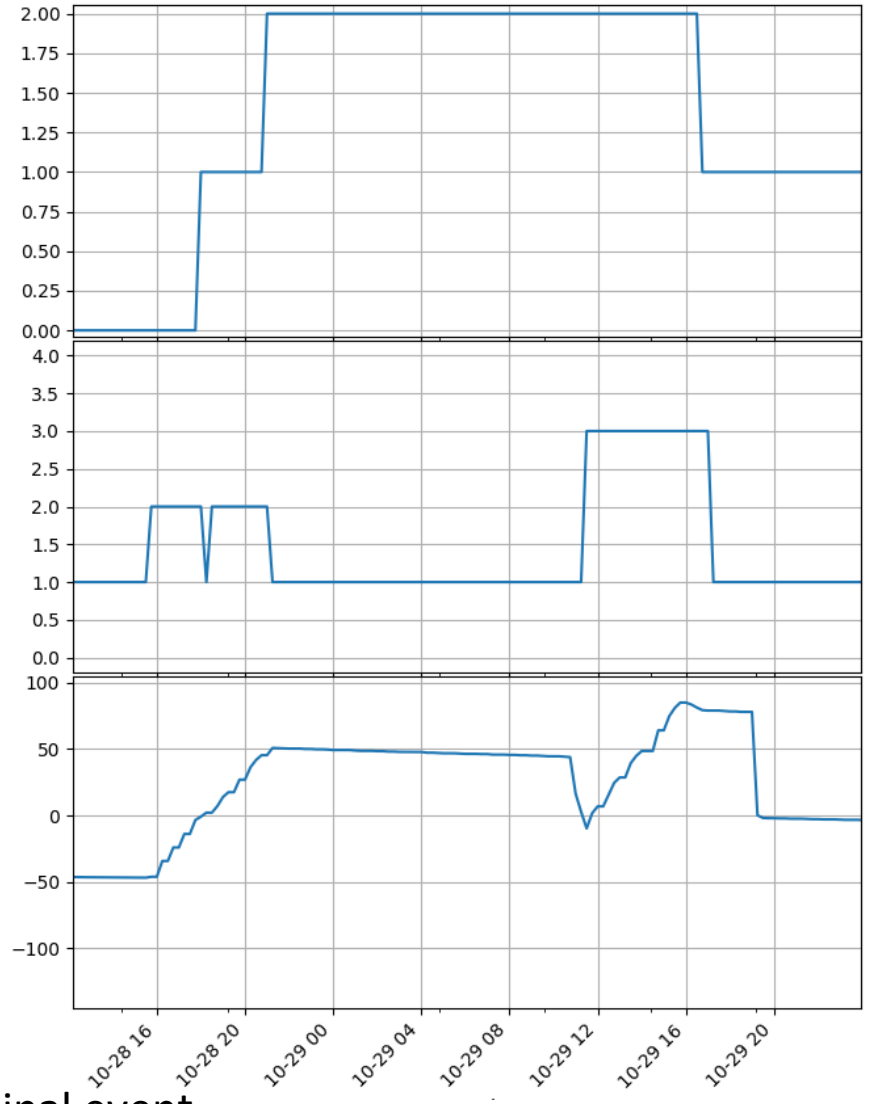


BEMS user interface



BEMS testing: Controlling of CLC

Robustness test of BEMS
Does the system behave as expected with charging and discharging



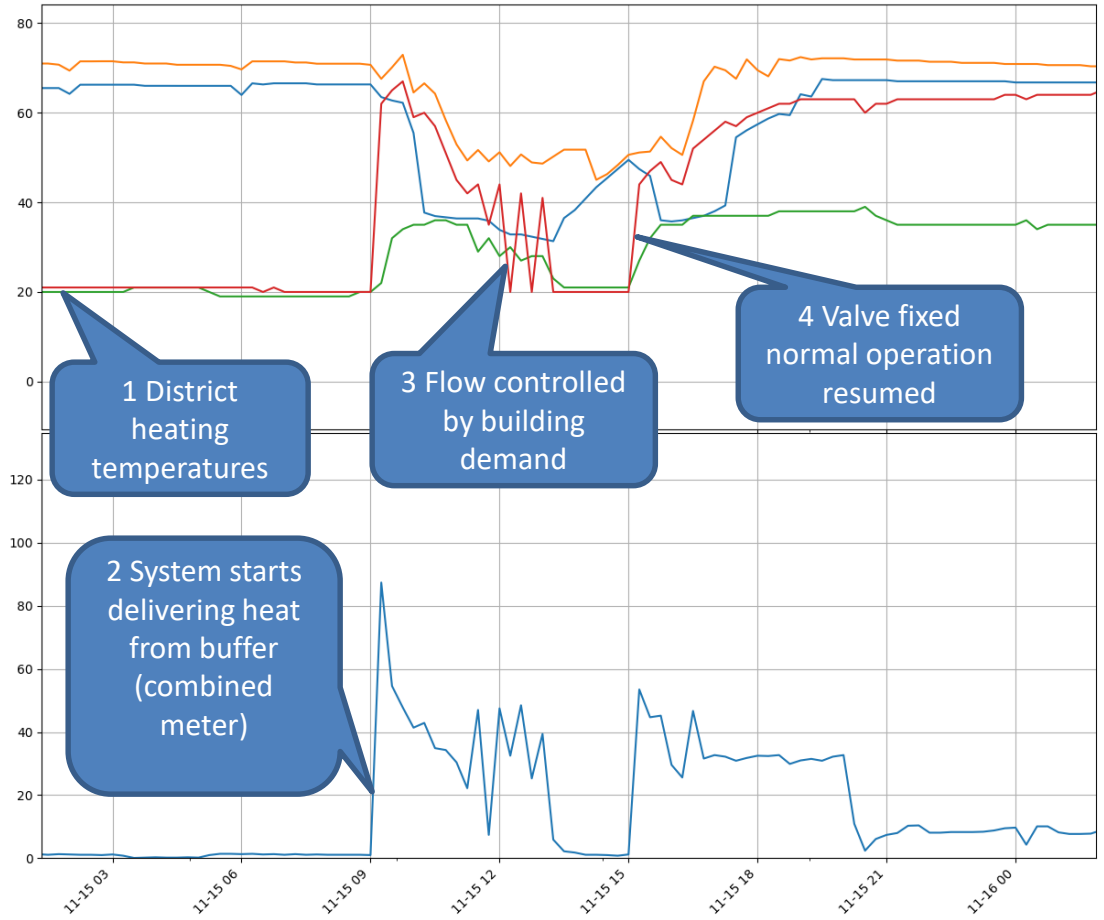
Number of charged reactors

CLC mode
1=idle,
2=charge
3=discharge
4=not-available

State of charge of device buffer (SoC also used as average temperature reading)
-50% ≈ 42°C

Live ‘testing’ at demo location in Austria: Broken district heating valve

During weekend valve broke
No hot water to building
Building had already cooled down
After a call we started the system



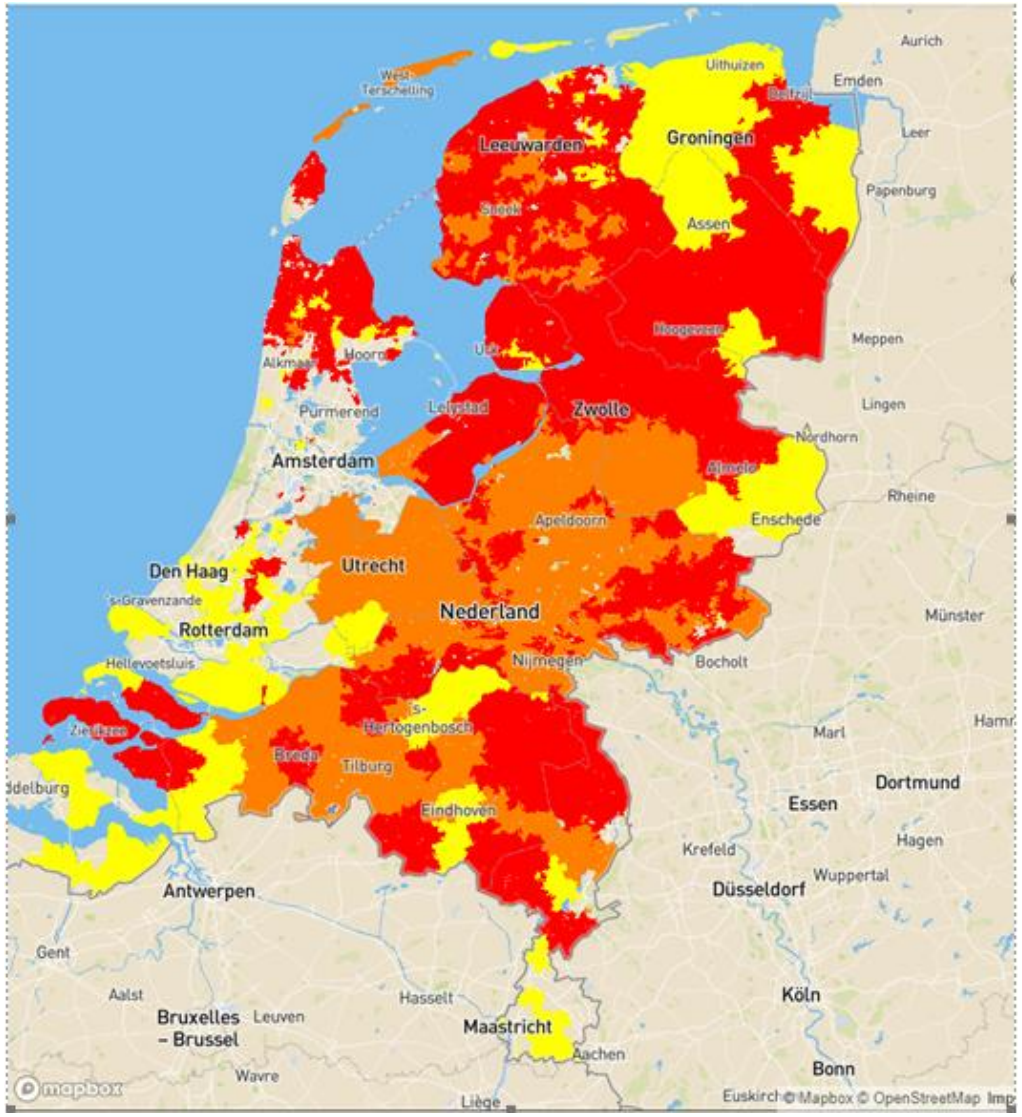
Learnings with testing still in progress

- An all-round and stable team is required for such projects
- Work from the desired outcome backwards to the design and the existing products
- Start with required interfacing signals in a very early stage

- The modeling of the system in the algorithms proved much more labor intensive then estimated in the beginning
- Interactive simulation for testing systems works quite well but takes effort to set op properly
- The level of detail for accurate predictions quickly causes complexity

- In research projects not all technologies will perform as expected
- Remote and secure connections to systems on-site is cost saving
- Local support on site (especially during testing) is a must

- Active energy - based control of components is a must with the increase of renewables in the energy mix
- It will be a matter of time before a standard building management system will be equipped with some kind of proactive energy management software
- Self-learning systems are required to drastically reduce configuration time and enable mass roll-out



Phase change material

SPEAKER

SCORES

ALEXANDRE LEBLANC

Research & Innovation Director at CAMPA

How to bring a storage unit **inside** of the home ?

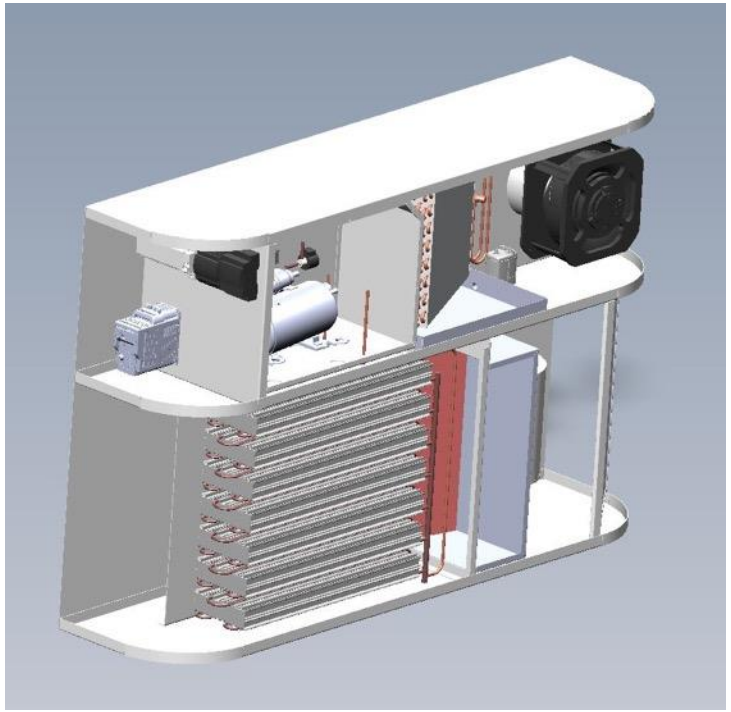
- Heat storage unit
- Manages indoor thermal comfort

Constrains :

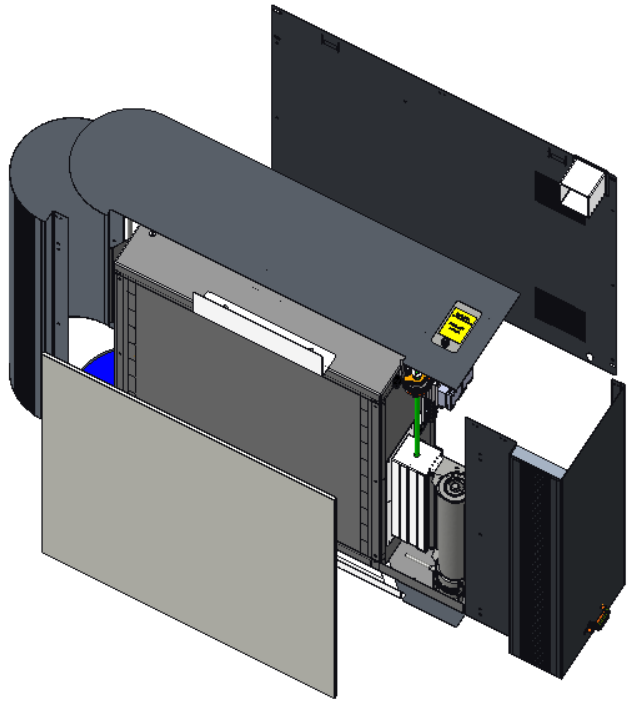
- **As small as possible**
- Aesthetic
- Quiet
- **Efficient**
- **BEMS interfaceable**

Efficient ?

2 versions studied to generate heat



Heat pump based

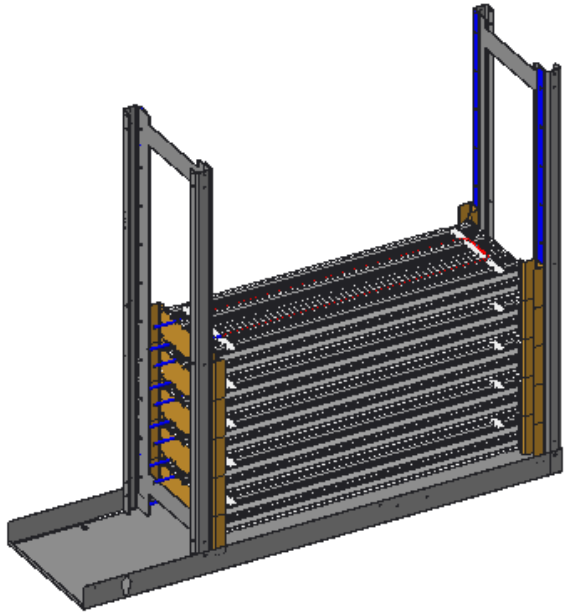


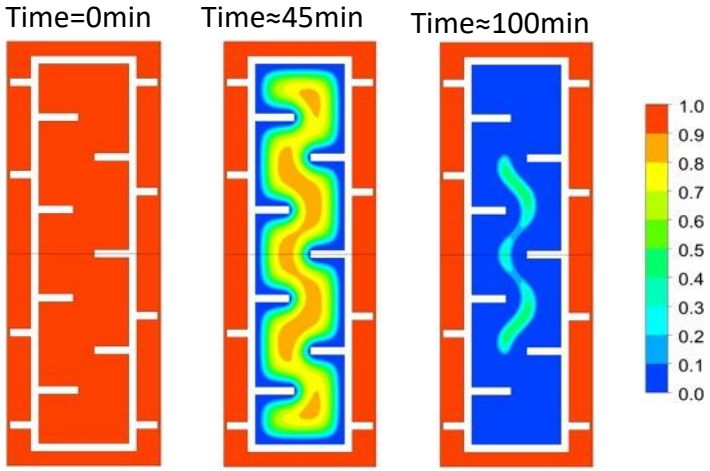
Joule Effect based

As small as possible

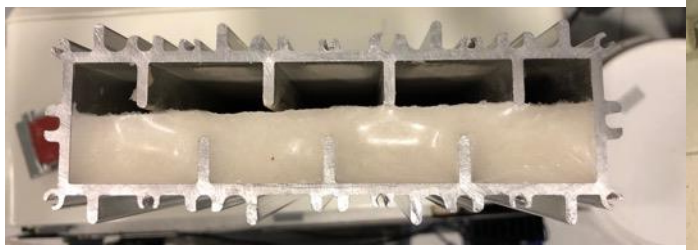
Use of phase change material to :
- Leverage the phase change material enthalpy as heat storage mechanism
- Keep low temperature heat storage core to limit heat losses

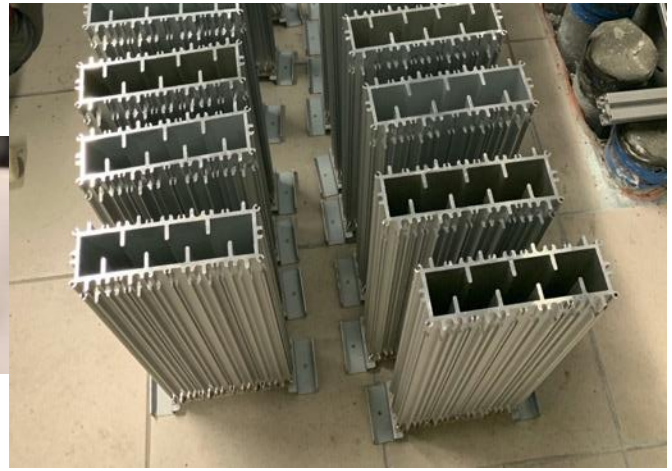
But :
- Brings strong thermo mechanical constrains
- Brings heat conductivity issues for charge / decharge optimization





CFD Simulations





Specific design to manage thermo mechanical constrains

BEMS interfaceable

How to store the right amount of heat in the core depending on :

- Presence / absence in the home
- Weather
- Energy availability

→ Optimized load management with the BEMS

Demo site B demonstration

SPEAKER

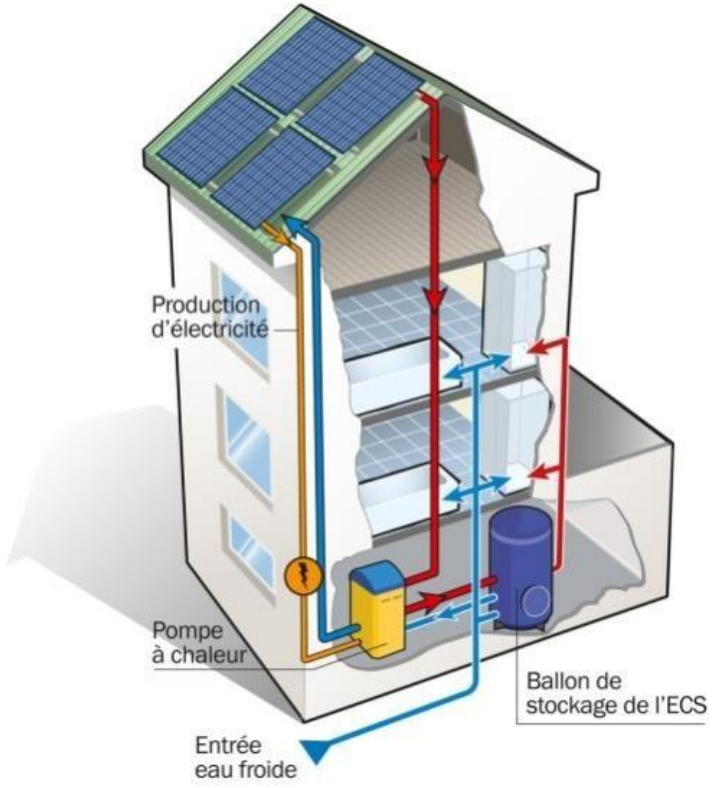
SCORES

CLEMENT DUMONT

Mechanical Engineer at HELIOPAC

Heat pumps

Installation on AGEN

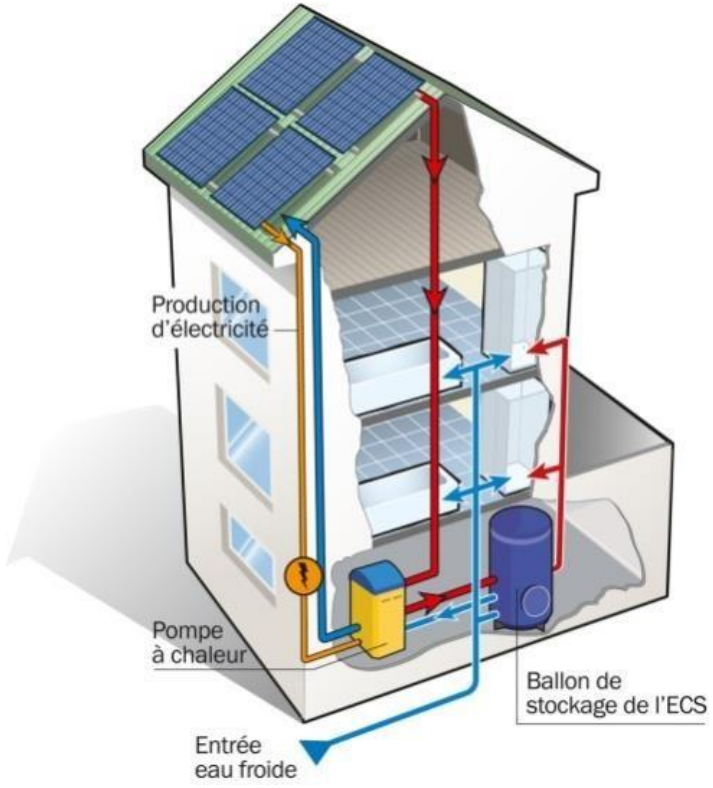


heliopacsystem+®

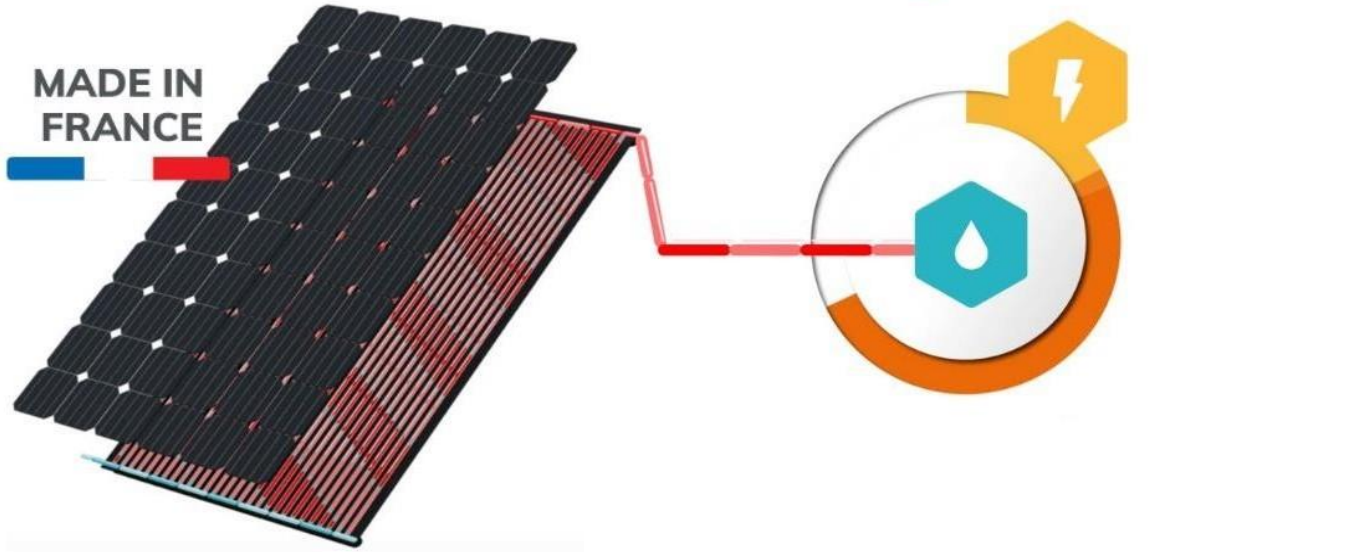
Production of domestic hot water by means of a 3 heat pumps linked to PVT panels as a heat source.

This hybrid system improves the efficiency of the photovoltaic panels through heat transfer.

Installation on AGEN

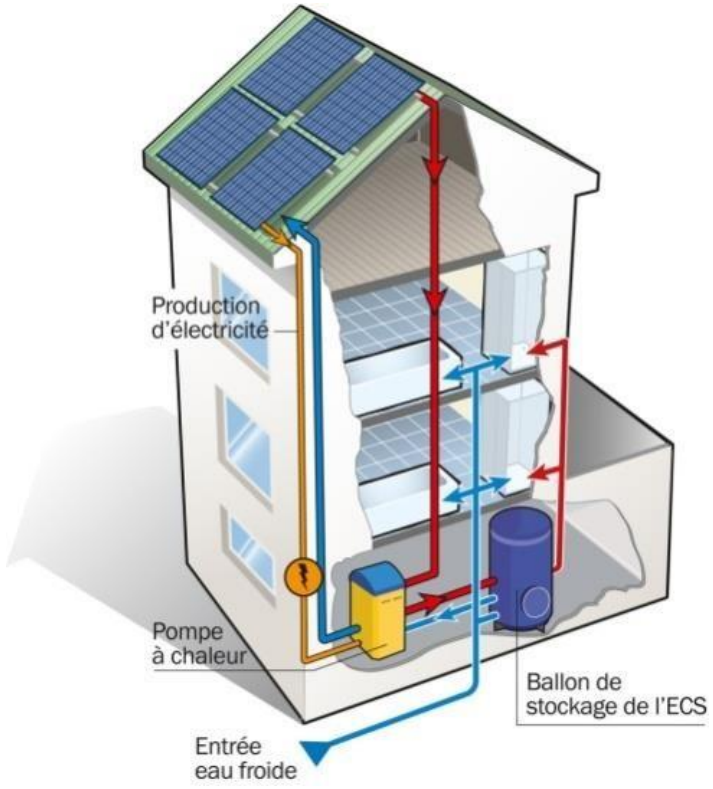


heliopacsystem+®



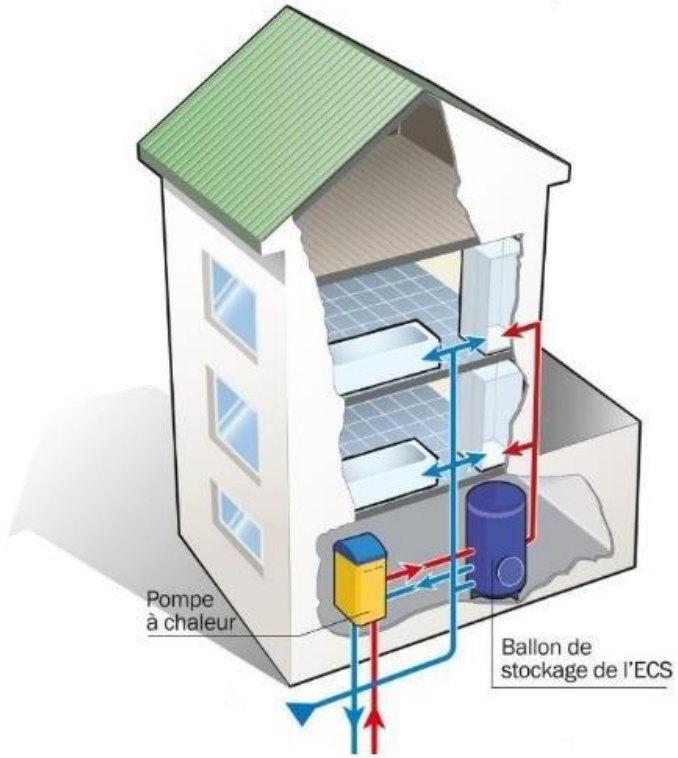
DUALSUN

Installation on AGEN



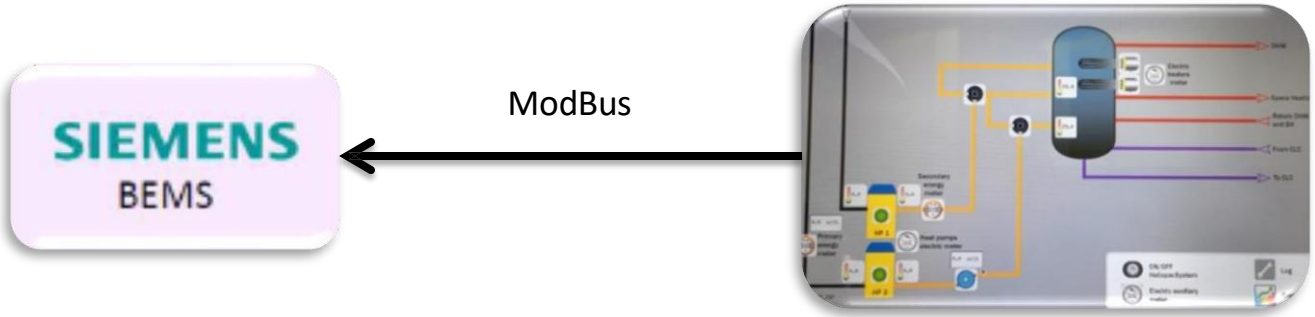
heliopacsystem+®

Installation on GLEISDORF



District heating

Dedicated system developed for the SCORES project: The thermal source of the heat pumps is a low-temperature water grid.



Main learnings

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- **ModBus communication with the BEMS**
  - Definition of the relevant variables
  - Adaptation of the regulation software

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- **Use of variable flow circulators in AGEN**
  - Improve the precision of the regulation
  - Replace the usual on/off circulators

Main learnings

- **ModBus communication with the BEMS**
  - Definition of the relevant variables
  - Adaptation of the regulation software

- **Use of variable flow circulators in AGEN**
  - Improve the precision of the regulation
  - Replace the usual on/off circulators

- **Dynamic stratification in GLEISDORF**
  - Departure for the DHW and SH are in the same water tank but at different height therefore at different temperatures.

CLS Seasonal thermal energy storage

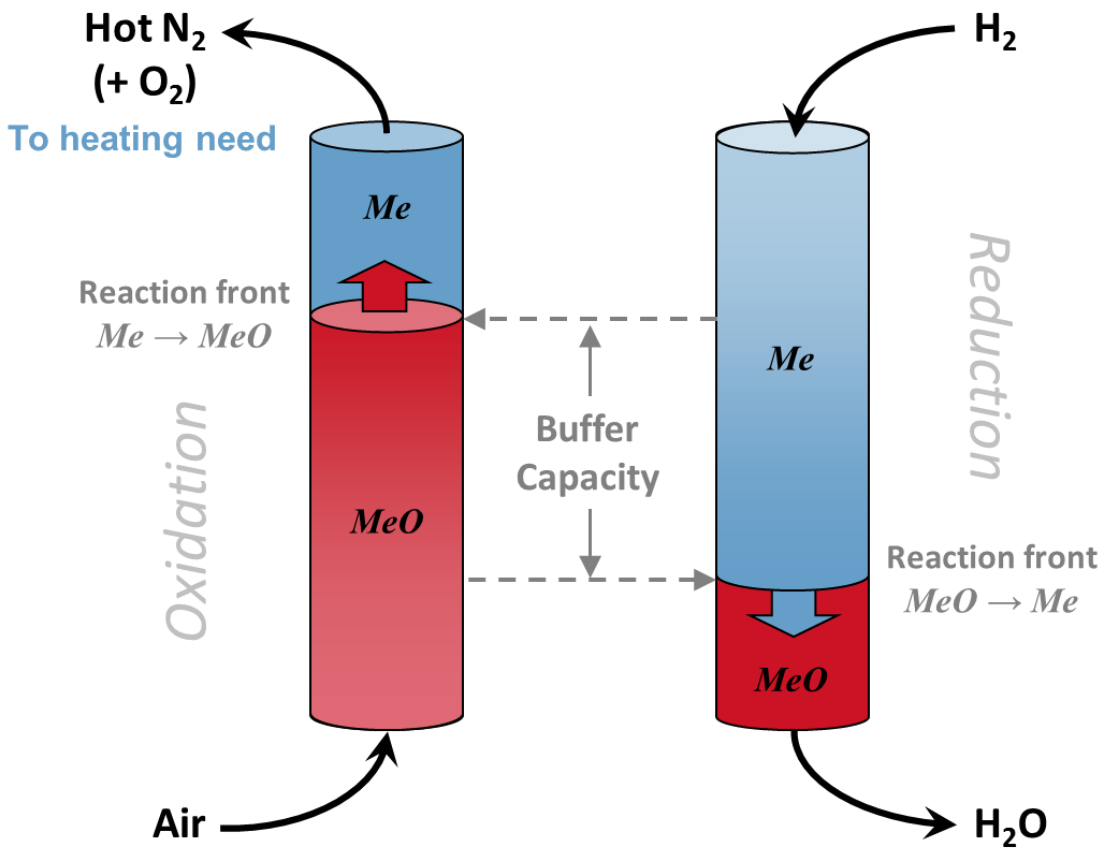
SPEAKER

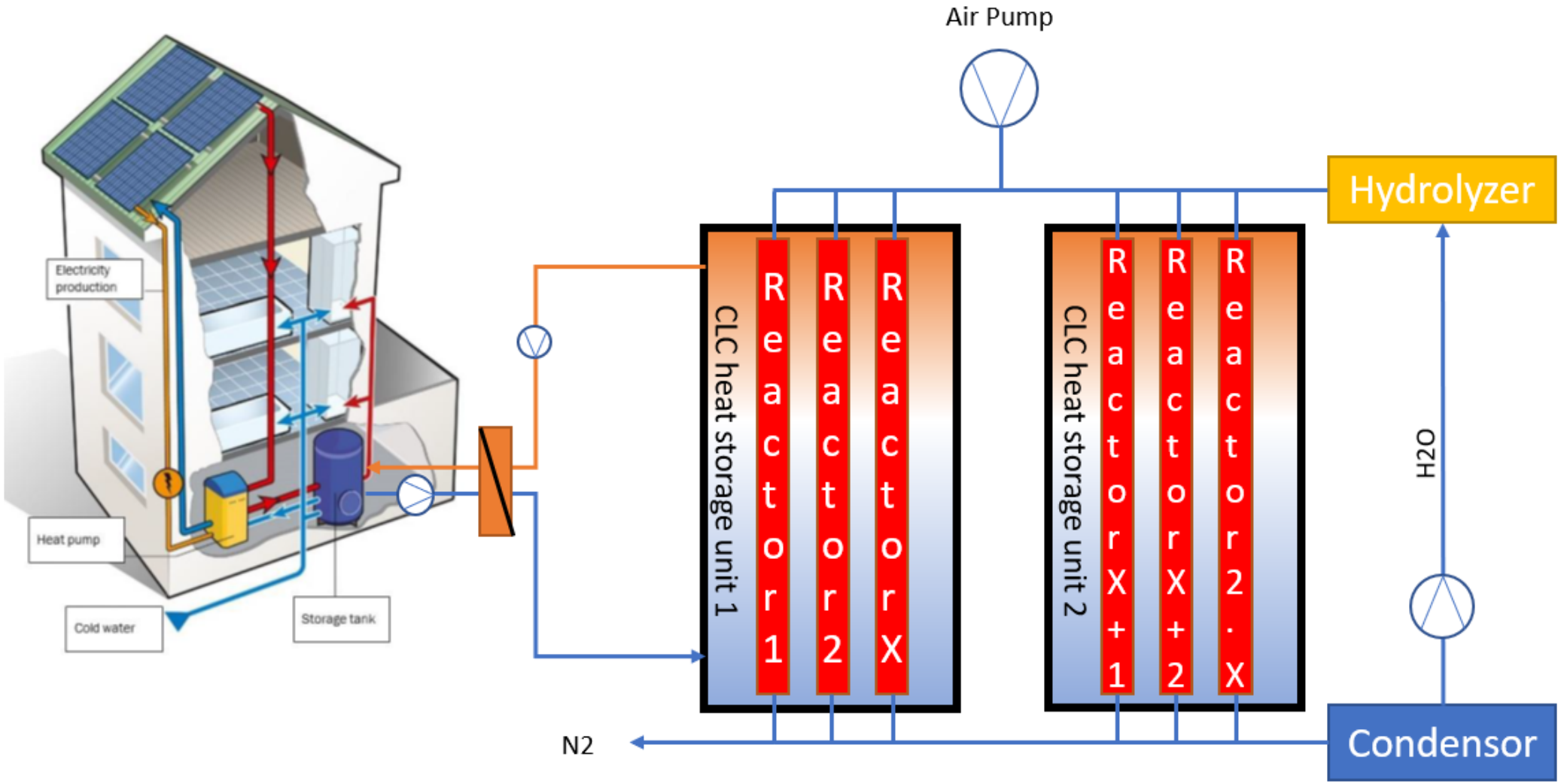
SCORES

PAVOL BODIS

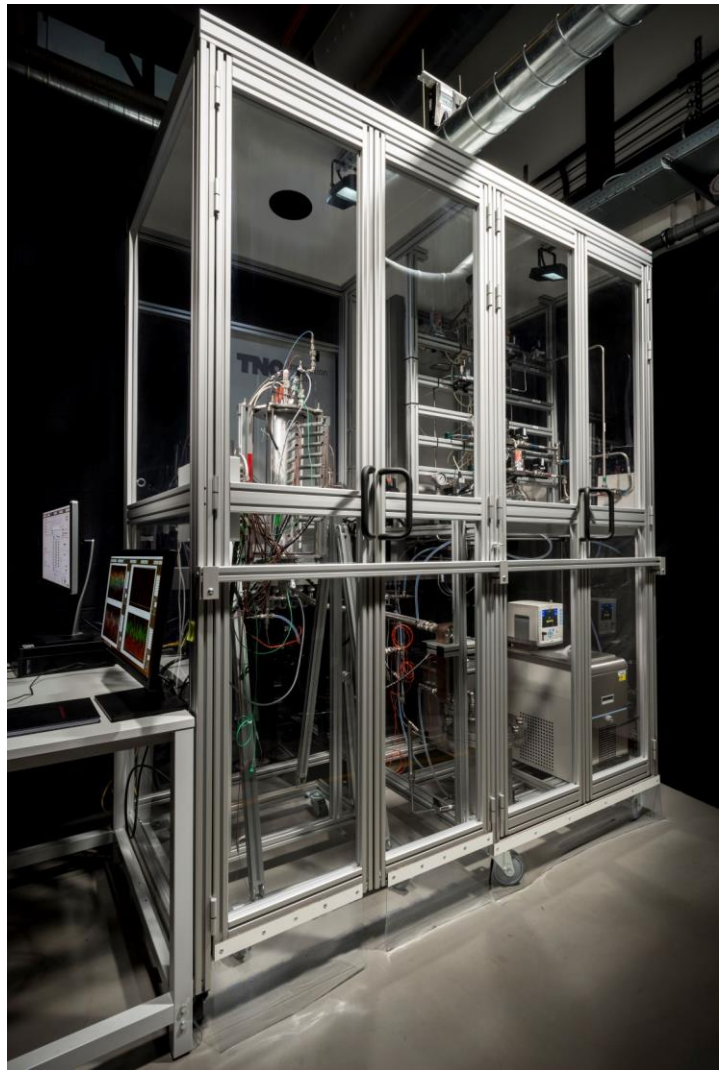
Systems integrator at TNO,
Technical coordinator of the SCORES project

- CLC has been developed recently for power generation with inherent CO_2 separation
- A metal with specific characteristics is “looped” through oxidized and reduced states to release or store energy, respectively
- CLC technology has been adapted into Technology based on Redox reaction and thus we call it Redox Heat
- **Targeted energy storage density on system level of >1GJ/m³**

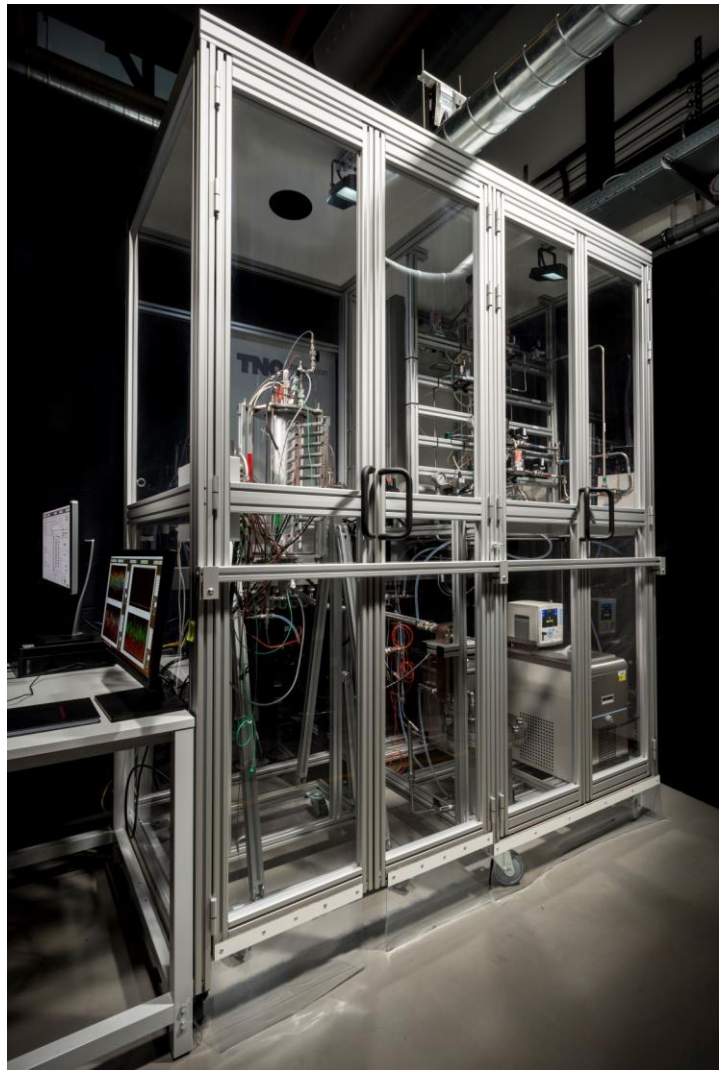


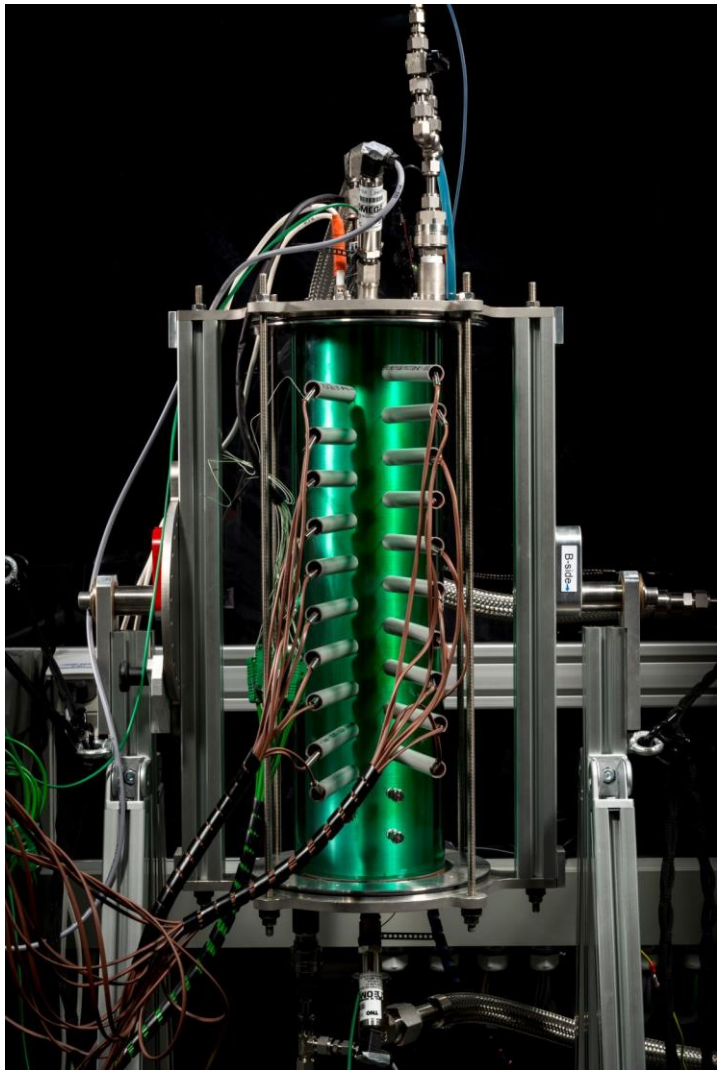

Air Pump
Hydrolyzer
Electricity production
Heat pump
Cold water
Storage tank
CLC heat storage unit 1
Reactor 1
Reactor 2
Reactor X
CLC heat storage unit 2
Reactor X+1
Reactor X+2
Reactor 2.X
H2O
N2
Condensor

Redox Heat – How does it look like?

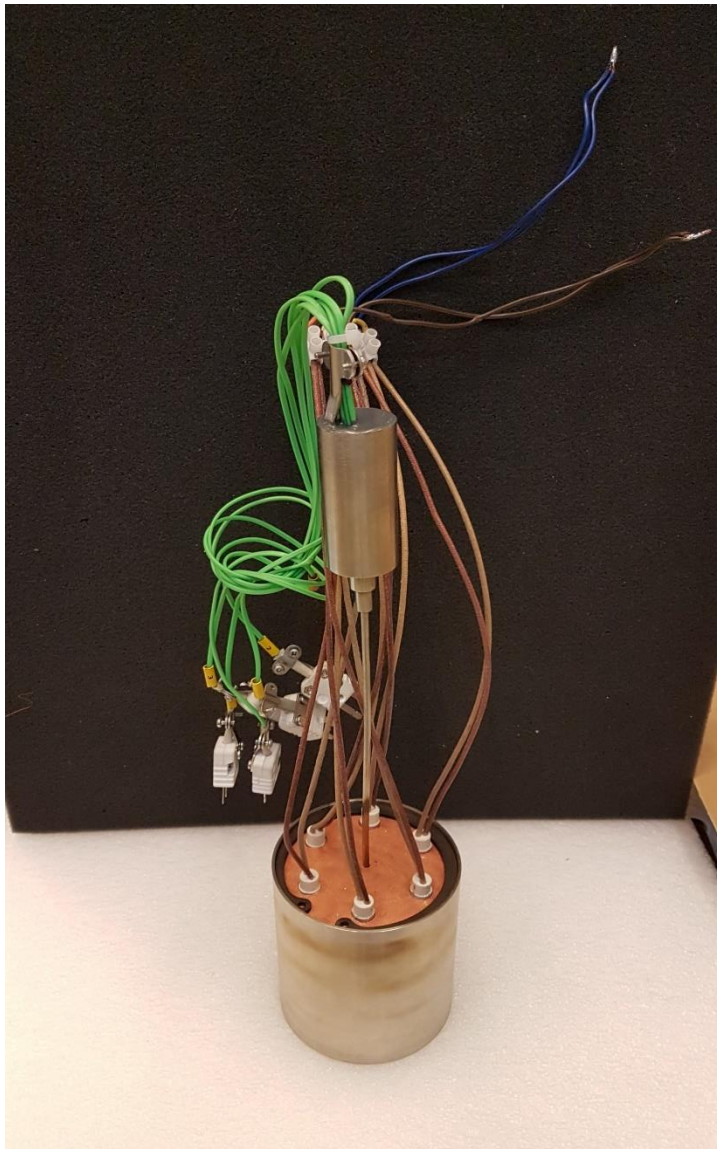


Redox Heat – How does it look like?

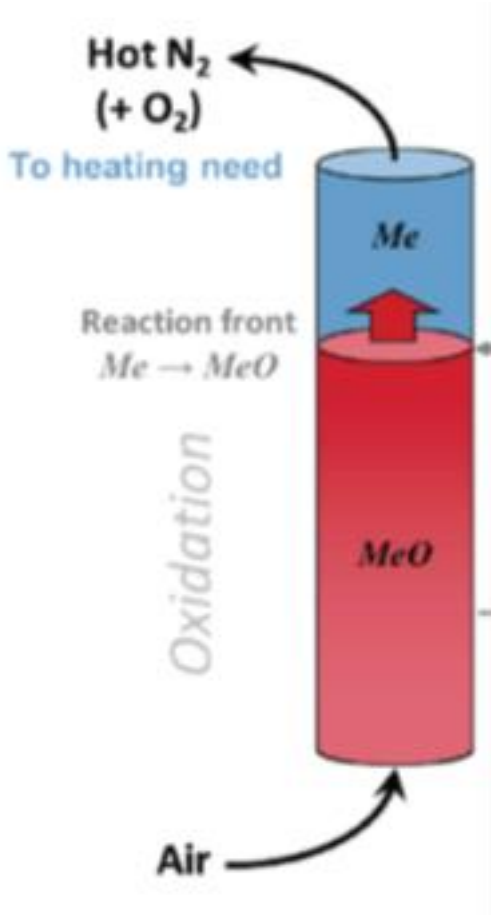




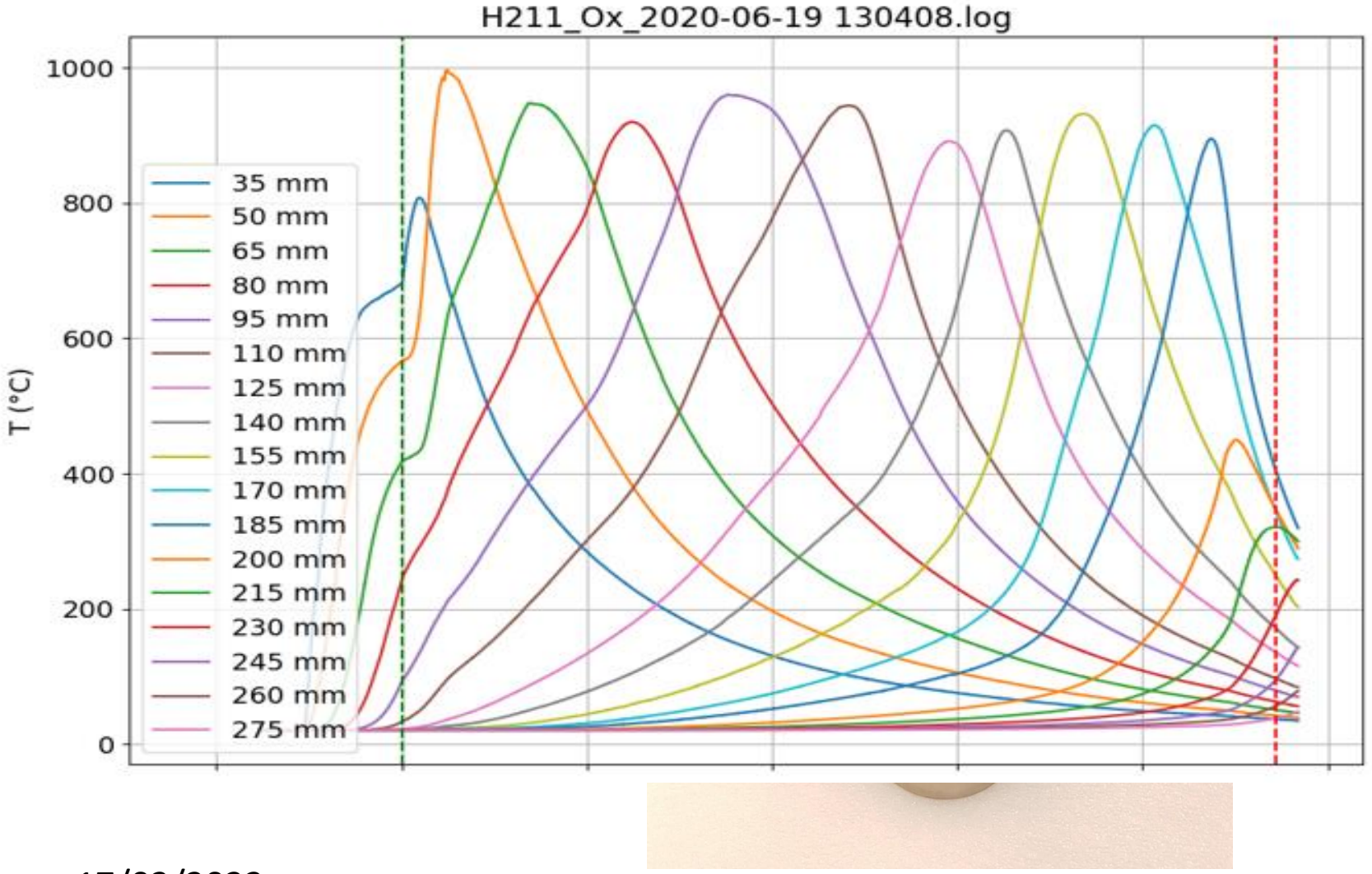
Redox Heat - Results

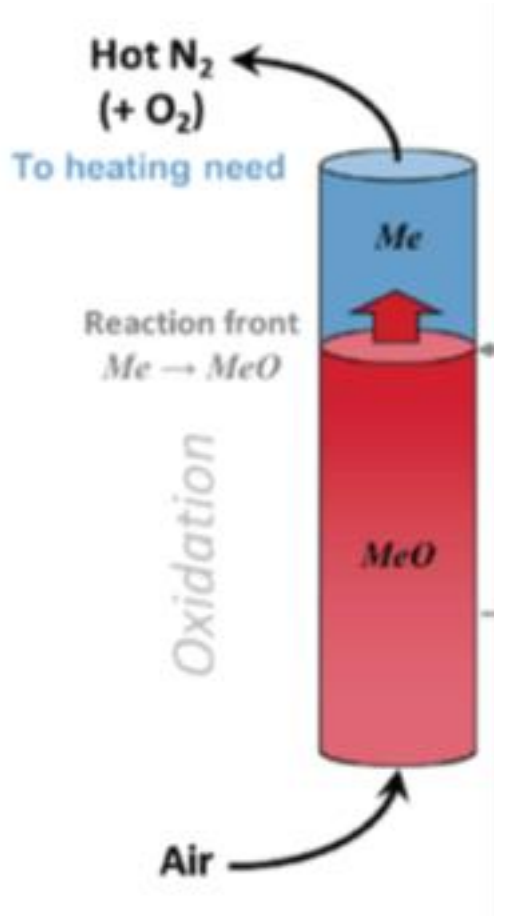


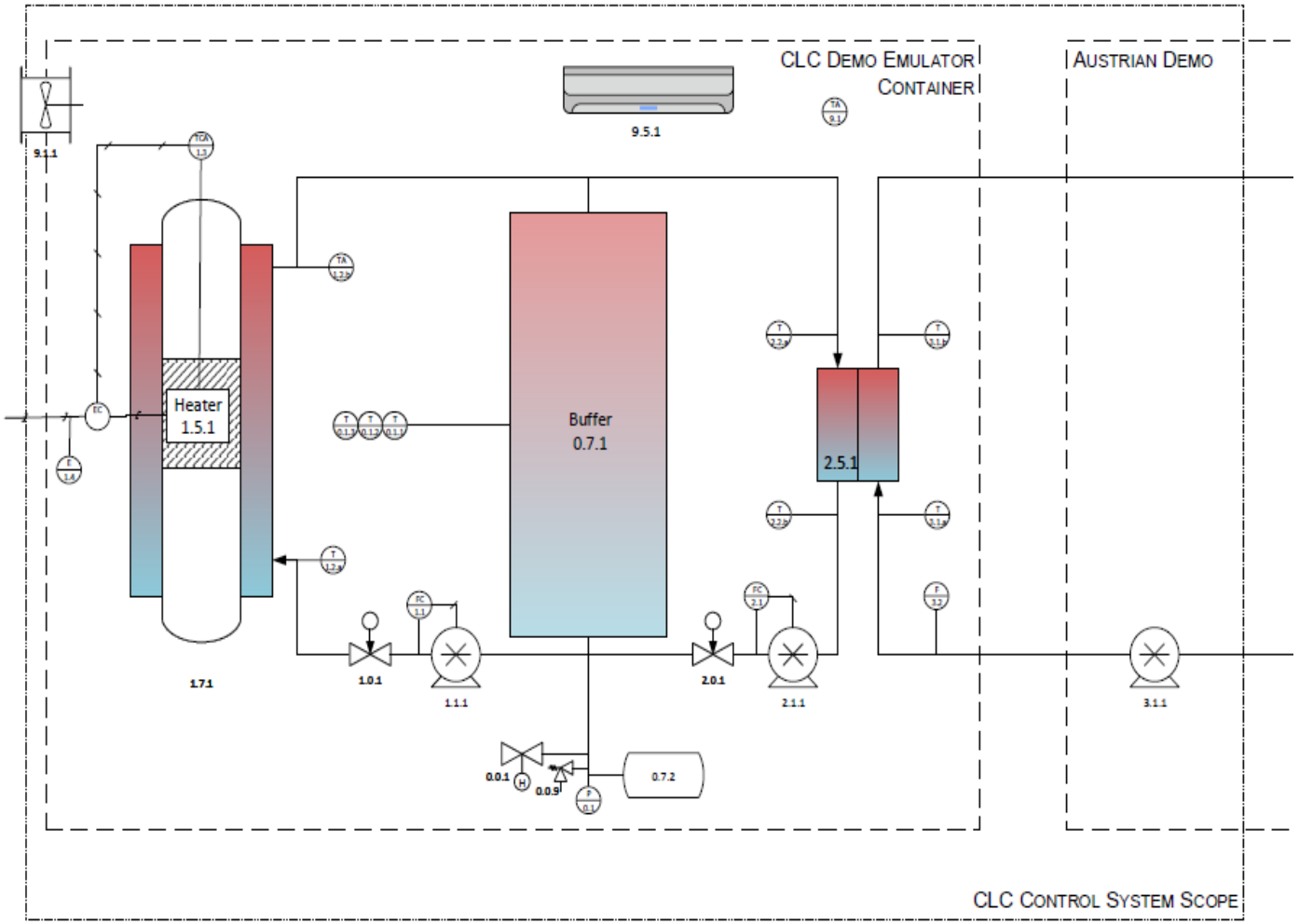
Final event

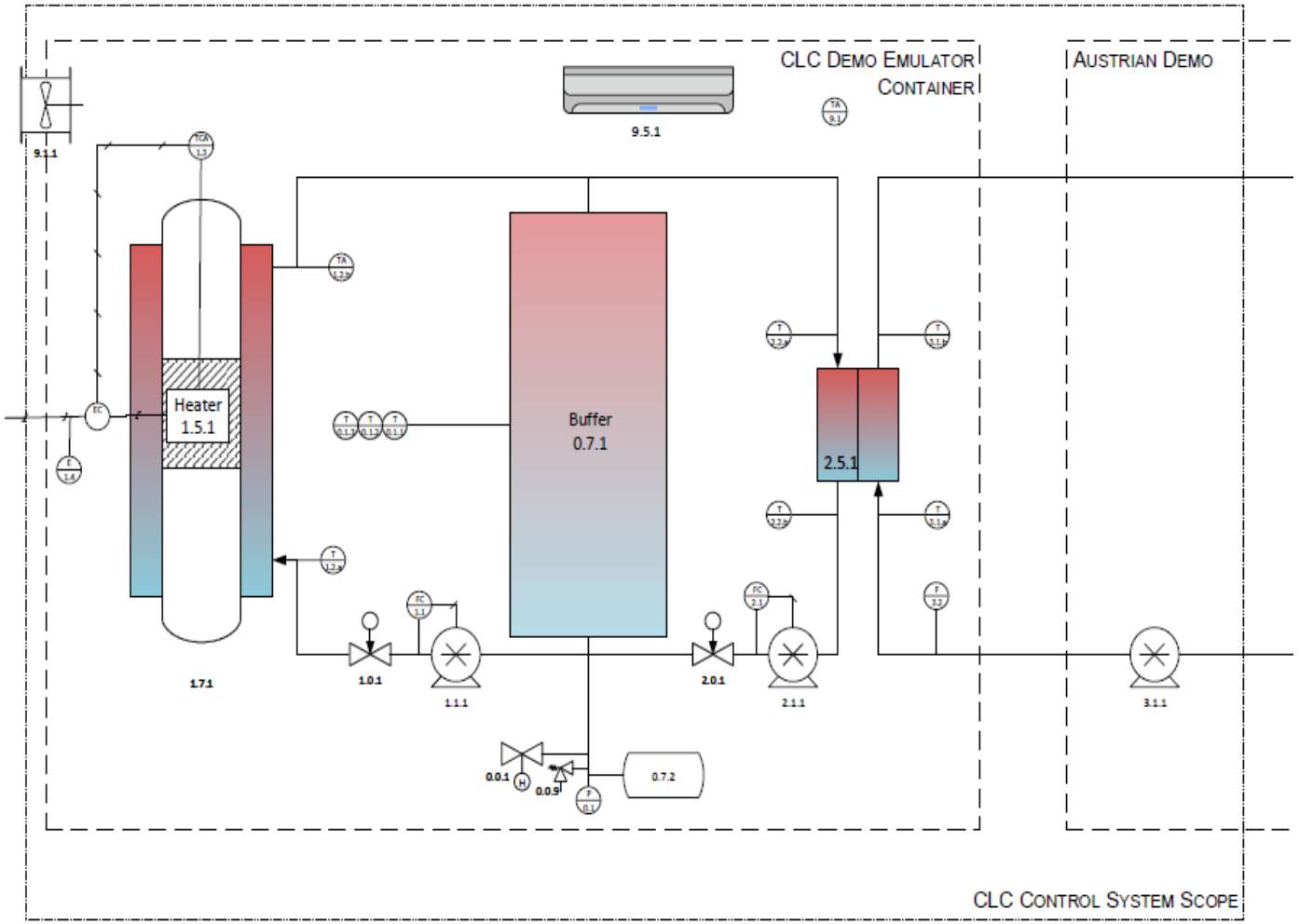


Redox Heat - Results






CLC Demo Emulator Container
Austrian Demo
9.5.1
9.1.1
Heater
1.5.1
Buffer
0.7.1
2.5.1
1.7.1
1.0.1
1.1.1
2.0.1
2.1.1
3.1.1
0.0.1
0.0.9
0.7.2
CLC Control System Scope


CLC Demo Emulator Container
Austrian Demo
9.5.1
9.1.1
Heater
1.5.1
Buffer
0.7.1
2.5.1
1.7.1
1.0.1
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3.1.1
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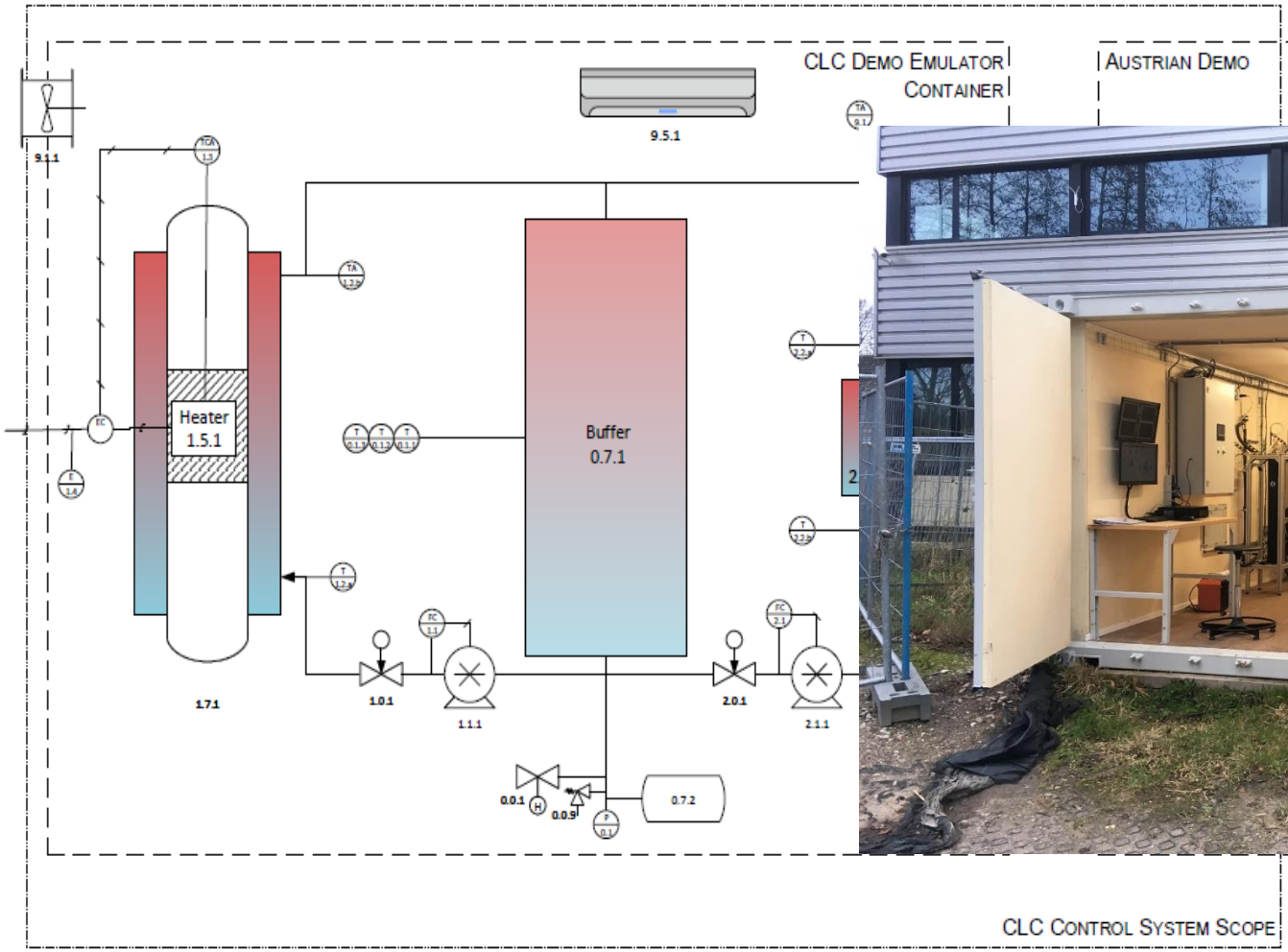
CLC Control System Scope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1.7.1
1.0.1
1.1.1
2.0.1
2.1.1
0.0.1
0.0.9
0.7.2
CLC Control System Scope

Conclusion and the way forward

Prototype of the Redox-Heat reactor was built

Redox-Heat technology was successfully demonstrated in the lab

Emulator system has been installed in Austria

Further development is needed to increase number of cycles

Further scale-up and Cost reduction are required

SPEAKER

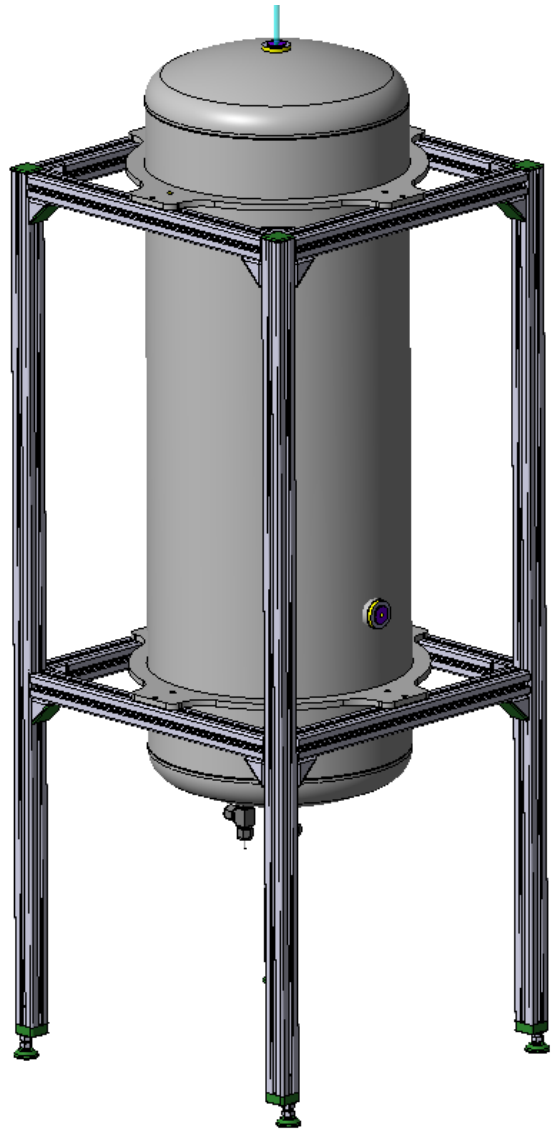
SCORES

MICHAEL FISCHER

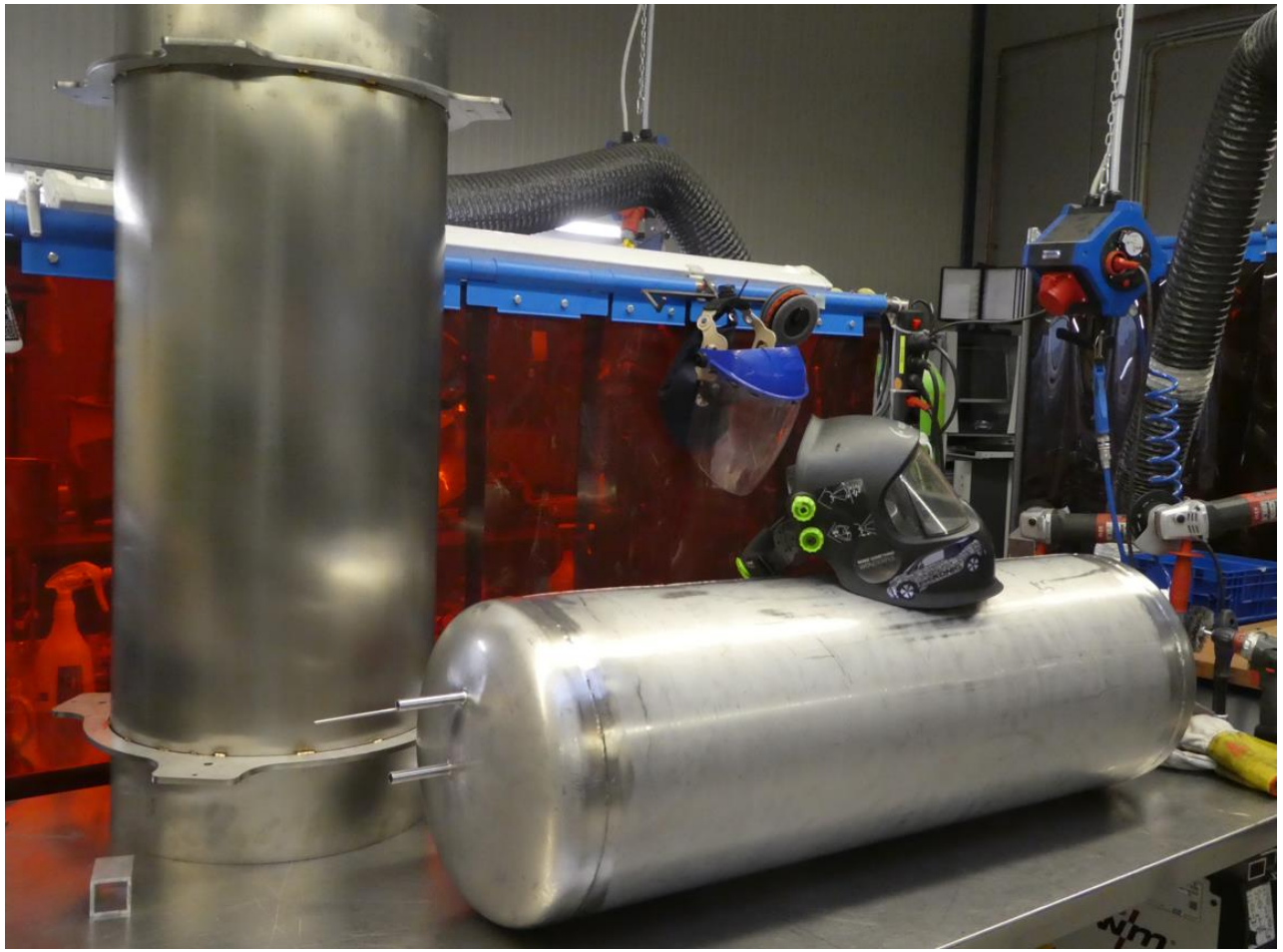
Business Unit Manager at
KÖNIG METALL GmbH & CO. KG

Heat battery

Heat Battery – Project Name “MK1”
Design-Phase



Heat Battery – Project Name “MK1”
Construction-Phase



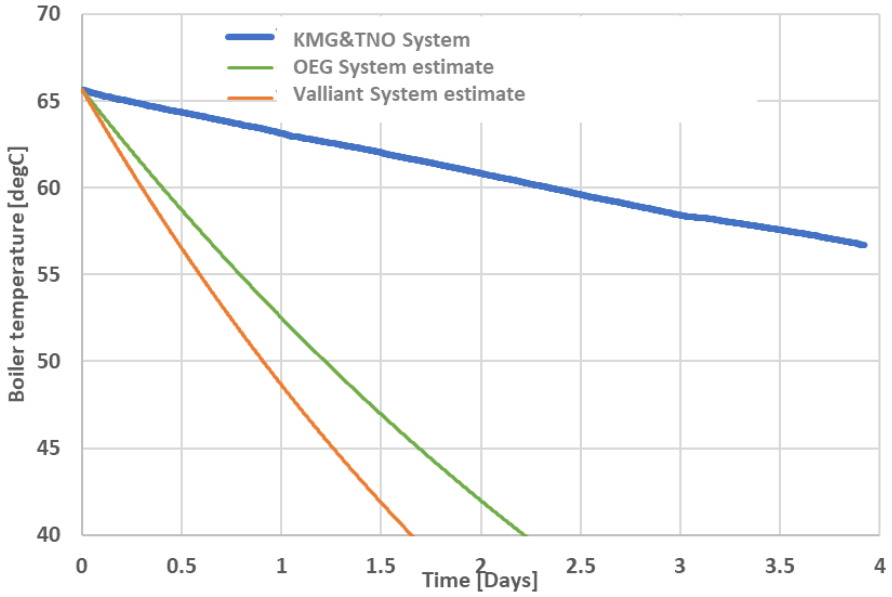
Heat Battery – Project Name “MK1”
Construction-Phase

Heat Battery – Project Name “MK1”
Ready for commissioning

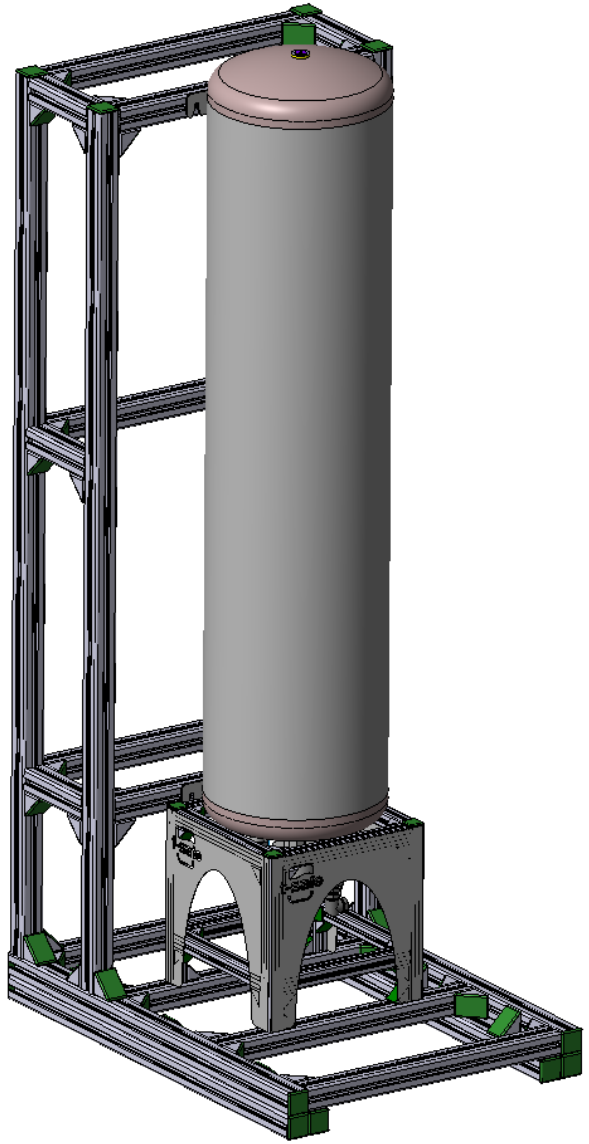
Heat Battery – Project Name “MK1”
Installation in Austria

Heat Battery – Project Name “MK1”

Performance values

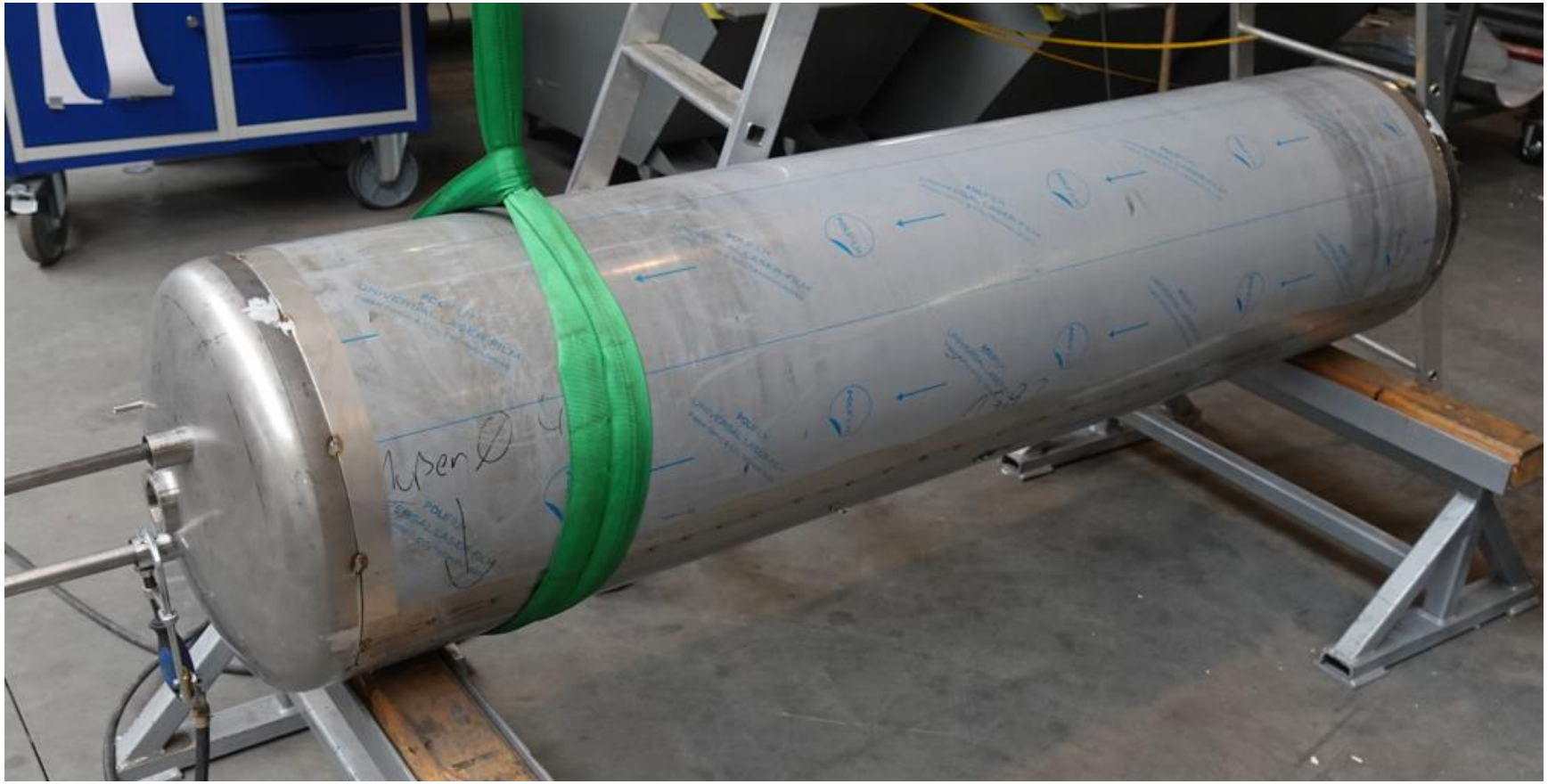


Heat Battery – Project Name “MK2”
Design-Phase



Heat Battery – Project Name “MK2”

Construction-Phase



Heat Battery – Project Name “MK2”

Ready for sending to TNO

Heat Battery – Project Name “MK2”

Arrival at TNO ☺

Heat Battery – Project Name “MK2”
Installation at TNO

Heat Battery – Project Name “MK3”

This design is confidential

There is the goal to industrialize this design

Company NES has been founded for industrialization

KMG will act as supplier and shareholder

This is direct outcome from the SCORES Project

Demonstration of the technologies

Demo site in France

SPEAKER

SCORES

GILLES PLESSIS

Research Engineer, EDF R&D

Demonstration of the SCORES technologies in Southern Europe

Southern Europe case

- Warm oceanic climate → Low space heating need: ≈ 2000 HDD (Europe average ≈ 2800 HDD)
- No district heating
- France : high share of electric heating for both DHW and space heating → high thermosensitivity of the electric system

Challenges

- ↗ energy efficiency, ↗ renewable electricity, ↗ flexibility

WP 8 - Demonstrate

- Integration, optimisation and operation of the developed hybrid energy system
- Increase self-consumption, self-production
- Economically viable system

Demo characteristics

- Residential collective building - Home for retired people
- 115 Small flats + collective area : 6 552 m2
- Compliance to the thermal regulation for buildings after 2012 (RT2012).

Aerial views and preview of a typical Type 2 apartment (Source: Domitys)

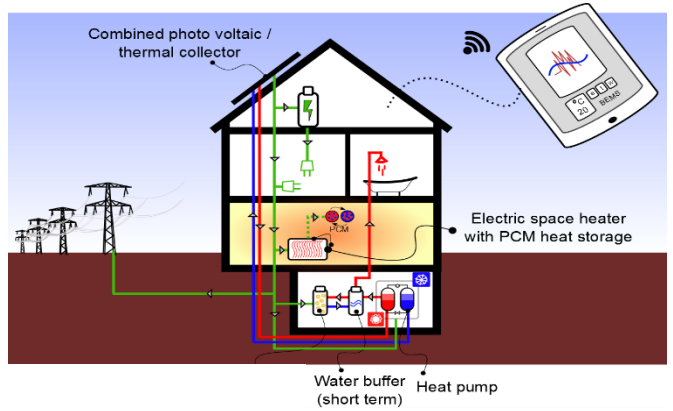
SCORES technologies in DEMO B

Energy system

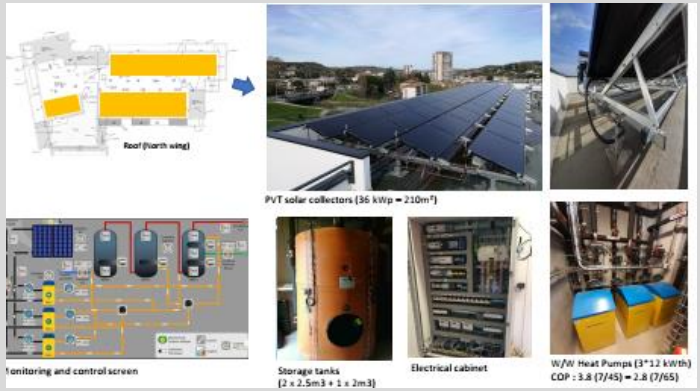
- Heating and air conditioning system based on a VRV A2A HP

Key technologies demonstrated in the SCORES project

- PVT collectors combined with water-to-water heat pumps (3x12 kW HP, 7000 L hot water storage, 36 kW_p PV / 200 m^2)
- 2nd life electrical batteries – 10 Lithium-ion NMC battery - 64 kWh
- Electric driven heaters (EHP) with PCM heat storage in the flats (2 kW/unit, 4 kWh)
- Building Energy Management System (BEMS)

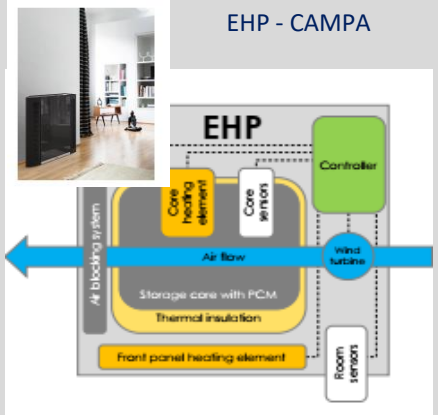


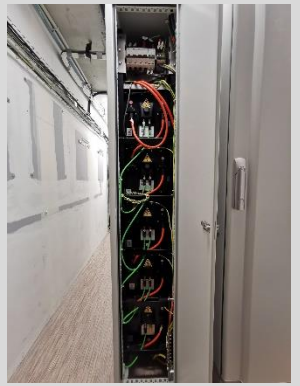
Schematics of the overall system



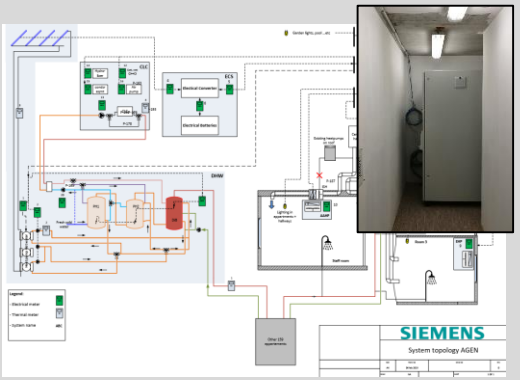
PVT / DHW system - HELIOPAC

EHP - CAMPA





2nd life battery - FORESEEPOWER



BEMS and converter cabinet - SIEMENS

DEMO B – Performances analysis

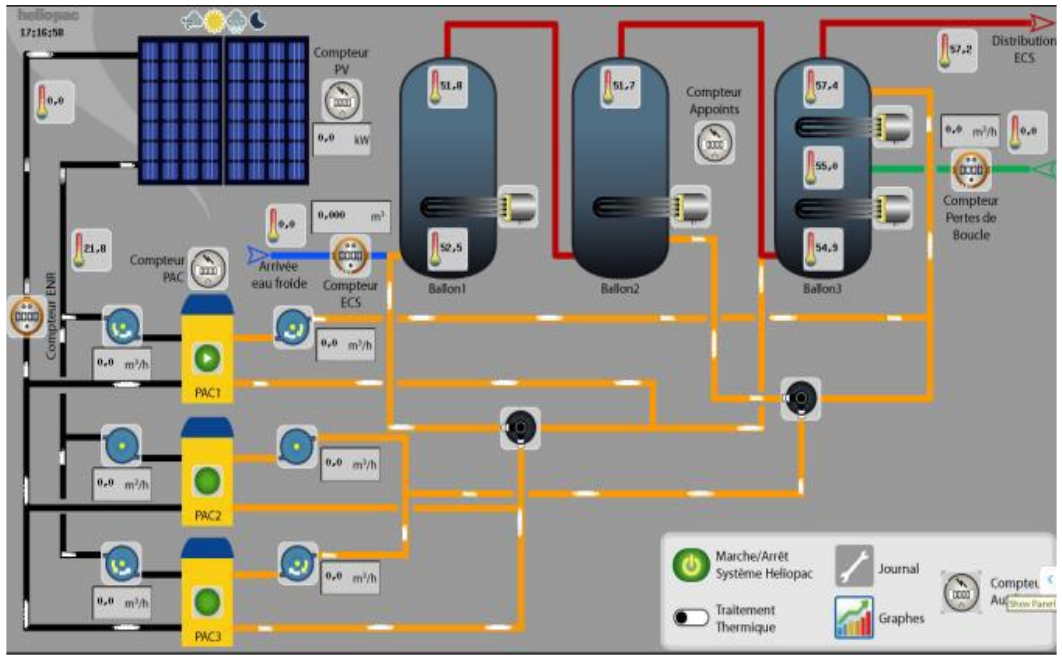
Test phase still in progress

DHW

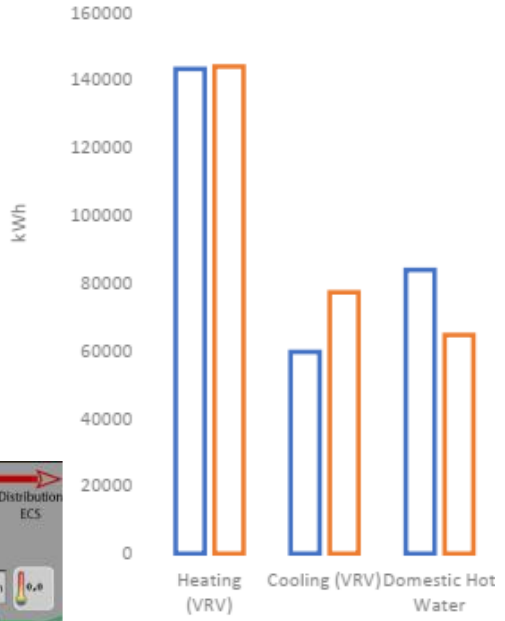
Performances inline with expectation.

Gain on 2020 consumption compare to 2019

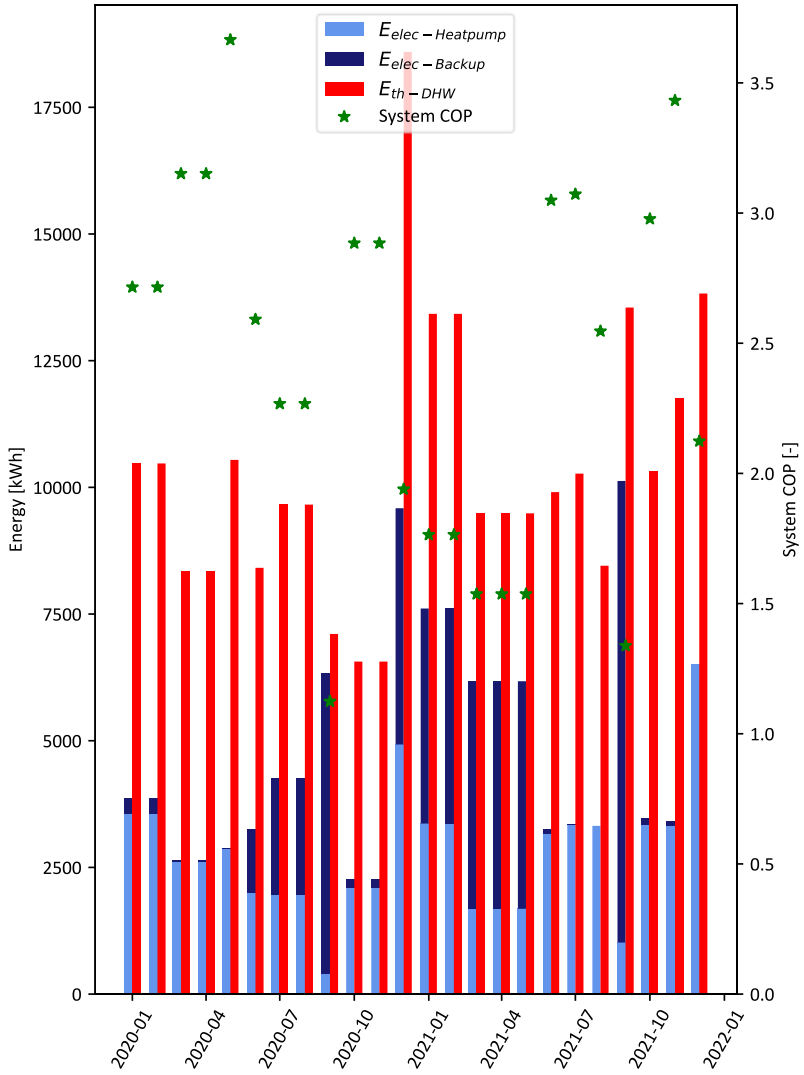
Nearly no backup



DHW schematics – source HELIOPAC



Energy consumption per usage. 2019 (blue) vs 2020 (orange)



Energy and performances of the DHW system

SPEAKER

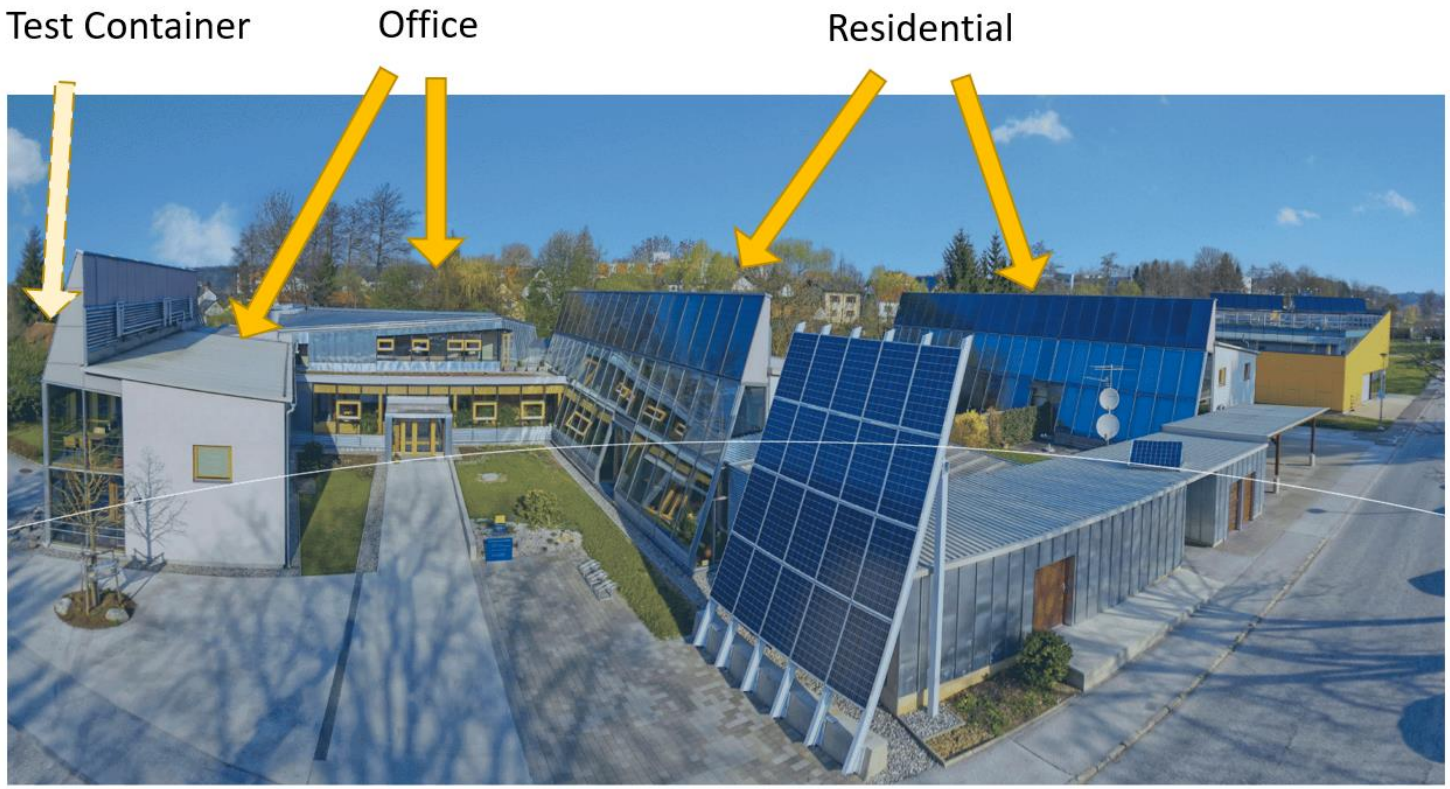
SCORES

WIM VAN HELDEN

Head of the department of Technology Development at AEE INTEC

Demo site in Austria

Demo site - Austria



Demo characteristics

- Office buildings plus two single family houses
- Low energy consumption
- Back-up from district heating network

Demo site - Austria

SCORES technologies in DEMO Austria

Energy system

- Heating (wall and floor heating), balanced ventilation with heat recovery, cooling through heating system

Key technologies demonstrated in the SCORES project

- PV system collectors combined with water-to-water heat pumps, 2000 L hot water storage
- 2nd life electrical batteries – 5 Lithium-ion NMC battery
- Electrically driven chemical looping combustion (CLC) storage unit (emulated)
- Building Energy Management System (BEMS)

Q&A session

What happens with the heat production during the night?

What happens with the heat production during the night?

The roof collectors recover the heat from the ambient (80%, only 20% from radiations) so it can work also during the night.

Rain, wind, and fog are elements that favourize the recovery of renewable energy by the system, by enhancing the convective transfert.

Can a BEMS be technically implemented in any building?

Can a BEMS be technically implemented in any building?

No, there will be a couple of things that need to be in place before you can use a BEMS system.

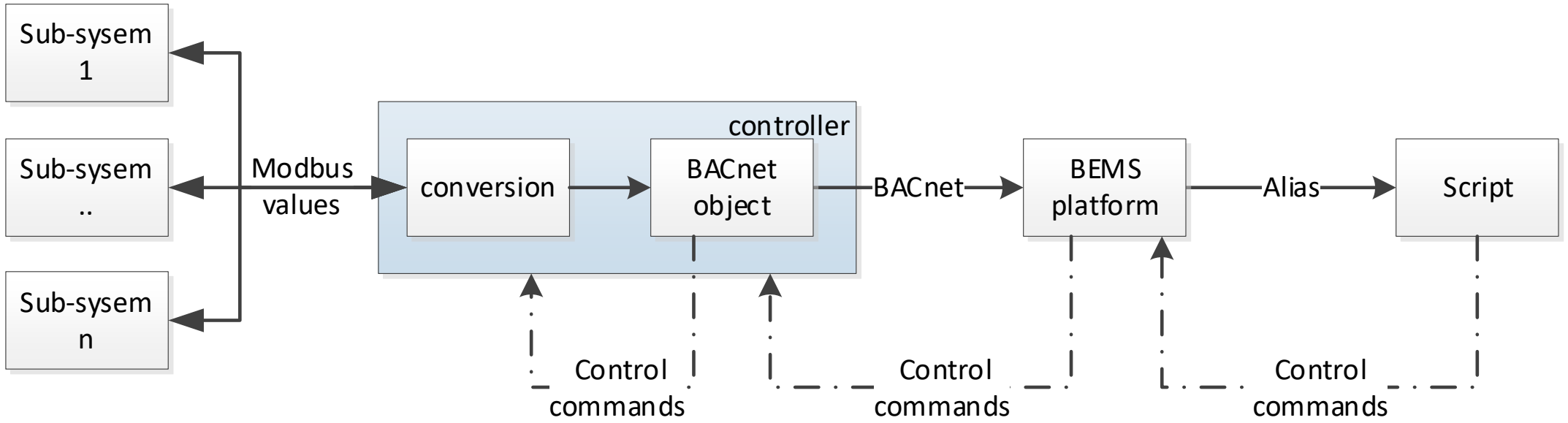
Must: Energy storage (thermal and/or electrical) that can be controlled or equipment that can be switched off

N2H: Smart energy meters (for energy profiles)
Building management system
Favorable energy pricing conditions (e.g. good price for delivering back to the grid at certain times or good netting conditions)

What does the control loop of the system look like and what systems can be connected?

What does the control loop of the system look like and what systems can be connected?

BEMS is script based (java) and running on on-site server
Results will be transferred back via controller to sub-systems



What happens when I want to connect a new non-standard to the BEMS?

What happens when I want to connect a new non standard to the BEMS or need to change my existing setup due to replacements?

- The BEMS is build up in modules (separate modules for separate equipment)
- Moduls can be configurated according to customer needs
- If the equipment is new or non standard, a new module can be created and connected to the BEMS

SPEAKER

HYBUILD

MIREIA FERNANDEZ NUALART

COMSA Corporación. Head of the Technological Innovation and Energy Unit in the R&D Department.

Presentation by the cluster project

HYBUILD project in a nutshell

M. Fernandez, G. Zsembinszki, M. Morata, A. Frazzica, V. Palomba
R. Decorme, C. Barrère, J. Emhofer, T. Barz, Carmine Pascale L.F. Cabeza

COMSA, University of Lleida, CNR ITAE, AIT, STRESS, R2M Solution

HYBUILD

INNOVATIVE COMPACT HYBRID ELECTRICAL/THERMAL STORAGE SYSTEM FOR LOW ENERGY BUILDINGS

SCORES Final Event
Hybrid Domestic Energy Systems of the Future
Online Event supported by BUILD UP

This is part of the project that has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824.*
The content of this document reflects only the author's view and the Commission is not responsible for any use that may be made of the information it contains.

0 Outline

1. HYBUILD in a nutshell
2. Overall concept
3. Implementation
4. Transition from energy efficient buildings to a sustainable built environment
5. Impact: key figures
6. Conclusions

This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824*

1 HYBUILD in a nutshell

- Project type: RIA
- Project start: **10/2017**
- Project end: **03/2022**
- Overall EU contribution: **5,995,840 €**
- Consortium: **20 partners, 9 countries**
- Coordinator: COMSA

Kick-off meeting Brussels - 10/2017

www.hybuild.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824*

1 HYBUILD in a nutshell

- HYBUILD aims to develop **two innovative hybrid storage concepts**
  1. For **Mediterranean climate** primarily for **cooling energy** supply
  2. For **Continental climate** primarily meant for **heating and DHW** supply

- The concepts are based on innovative components such as:

DC-powered reversible HP

DC bus generator

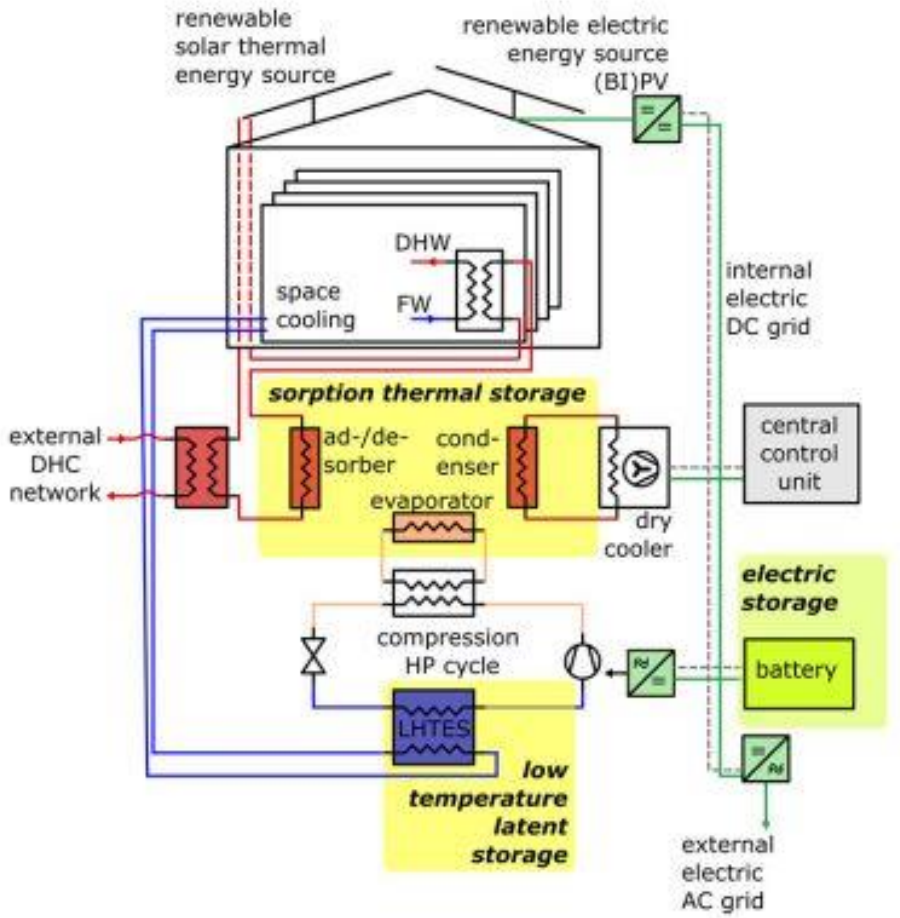
Compact sorption module

High-density latent storage

This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824*

2 Overall concept

Mediterranean system (main focus on cooling)



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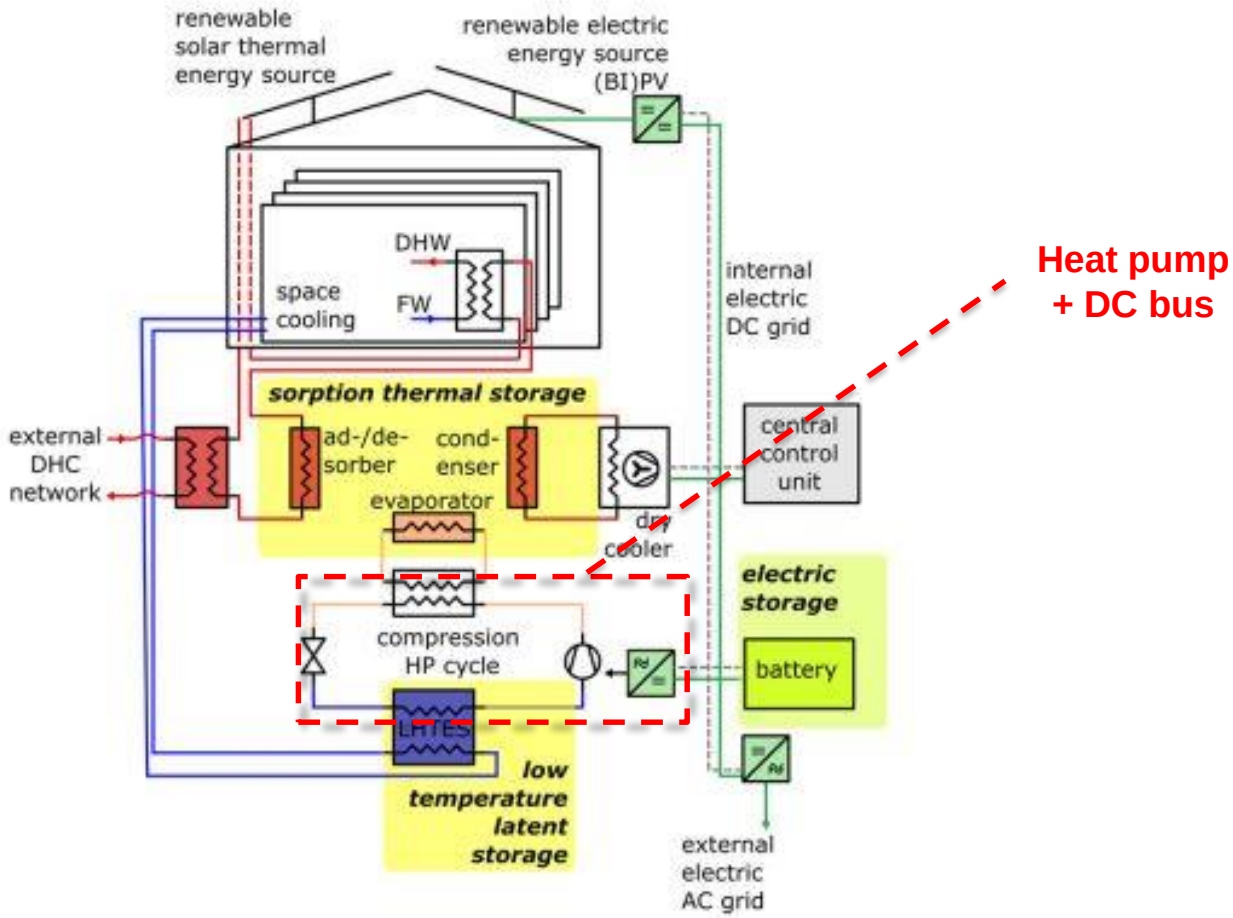

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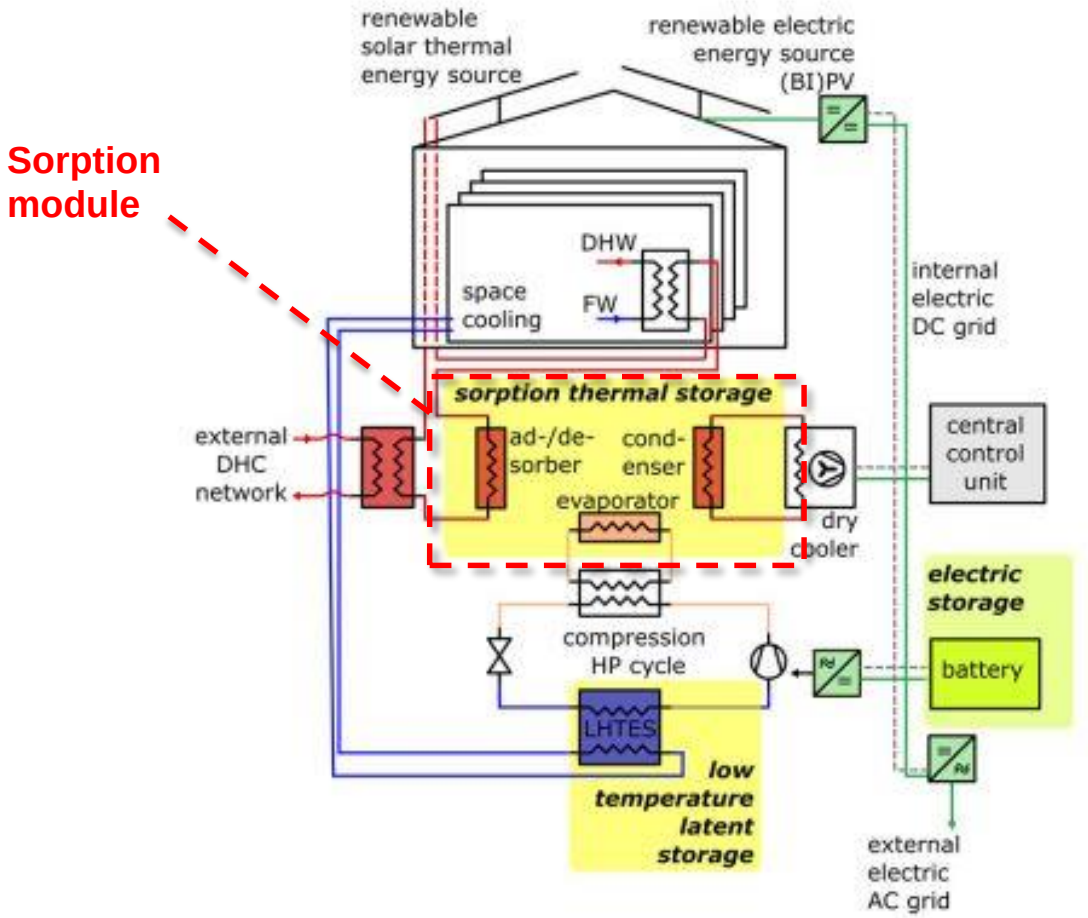

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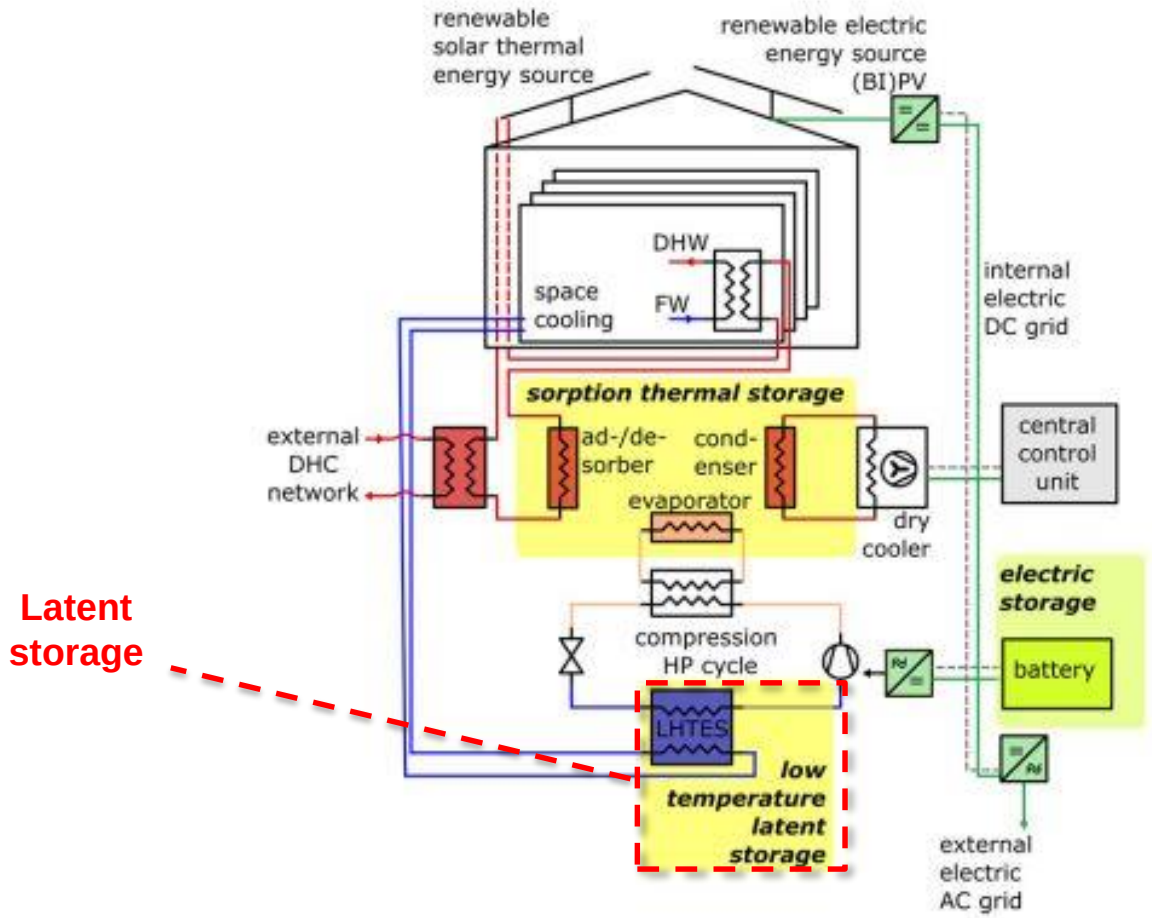

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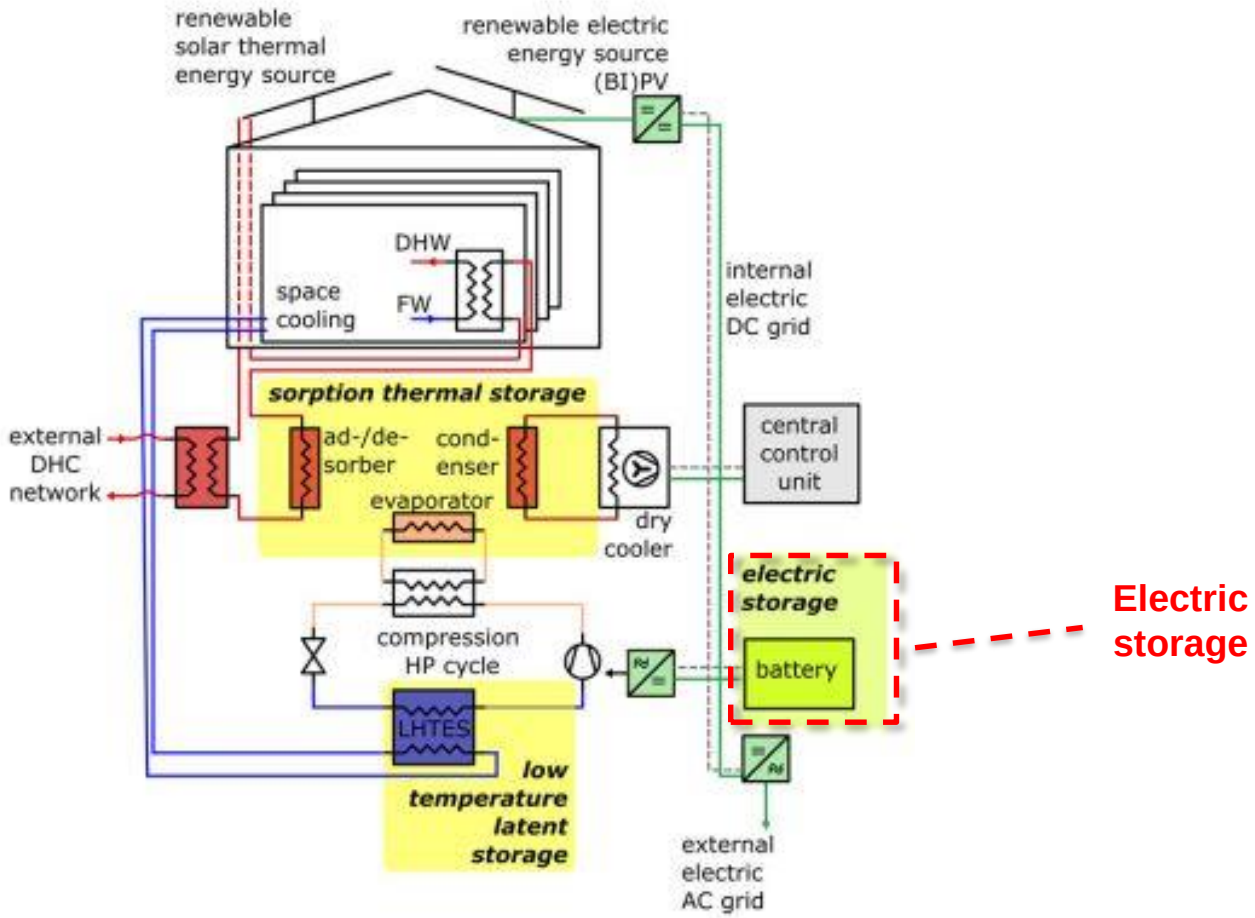
2 Overall concept

Mediterranean system (main focus on cooling)



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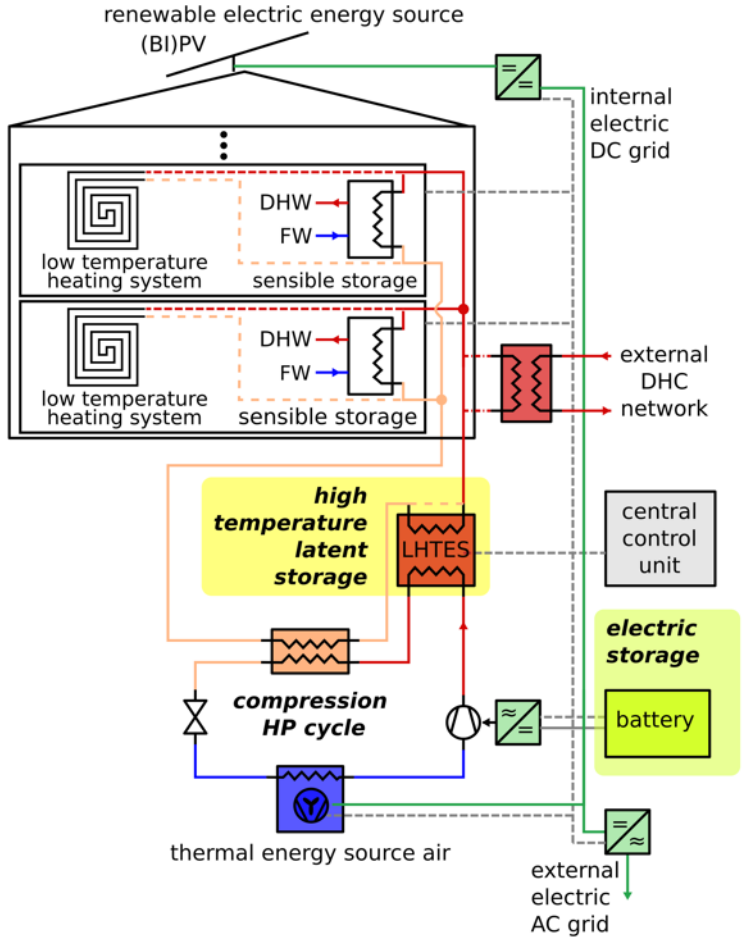
2 Overall concept

Continental system (main focus on heating & DHW)



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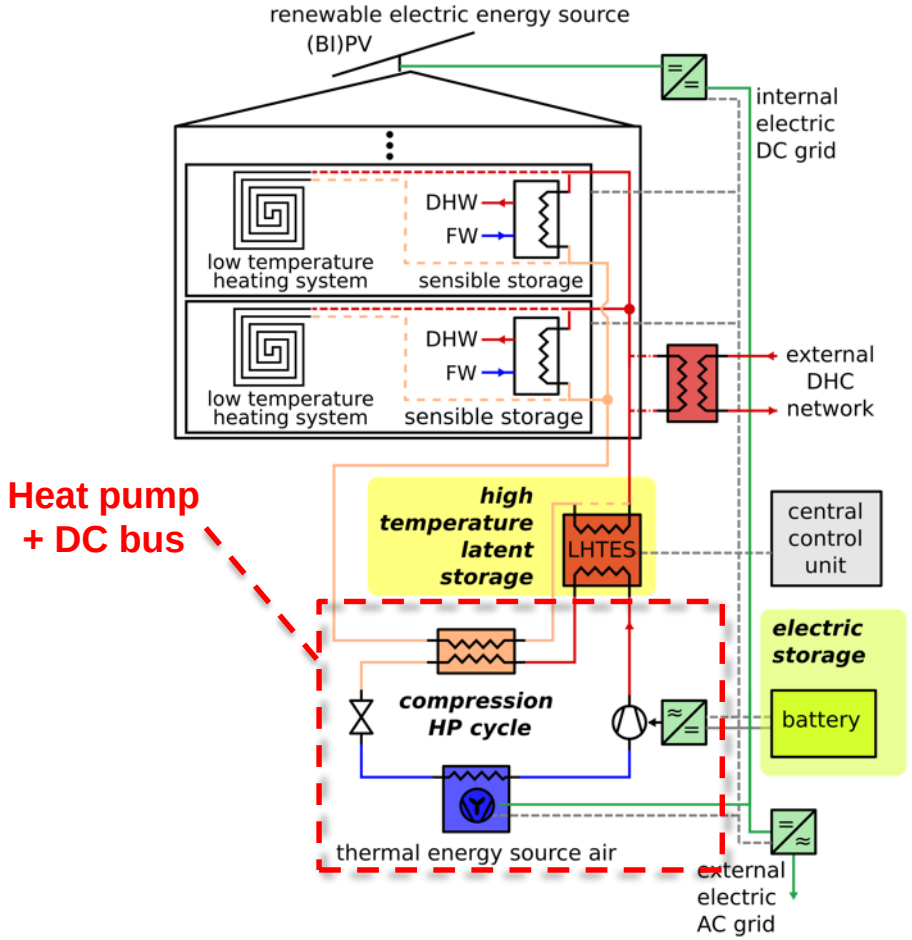
2 Overall concept

Continental system (main focus on heating & DHW)



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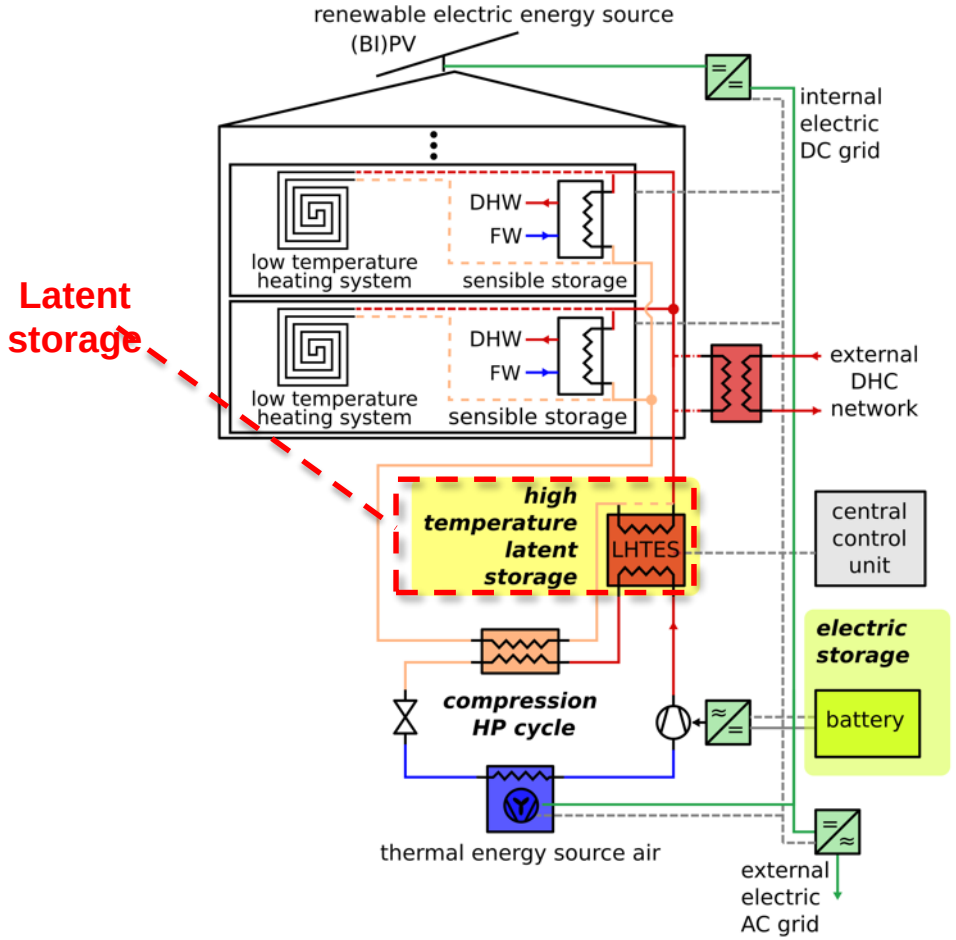
2 Overall concept

Continental system (main focus on heating & DHW)



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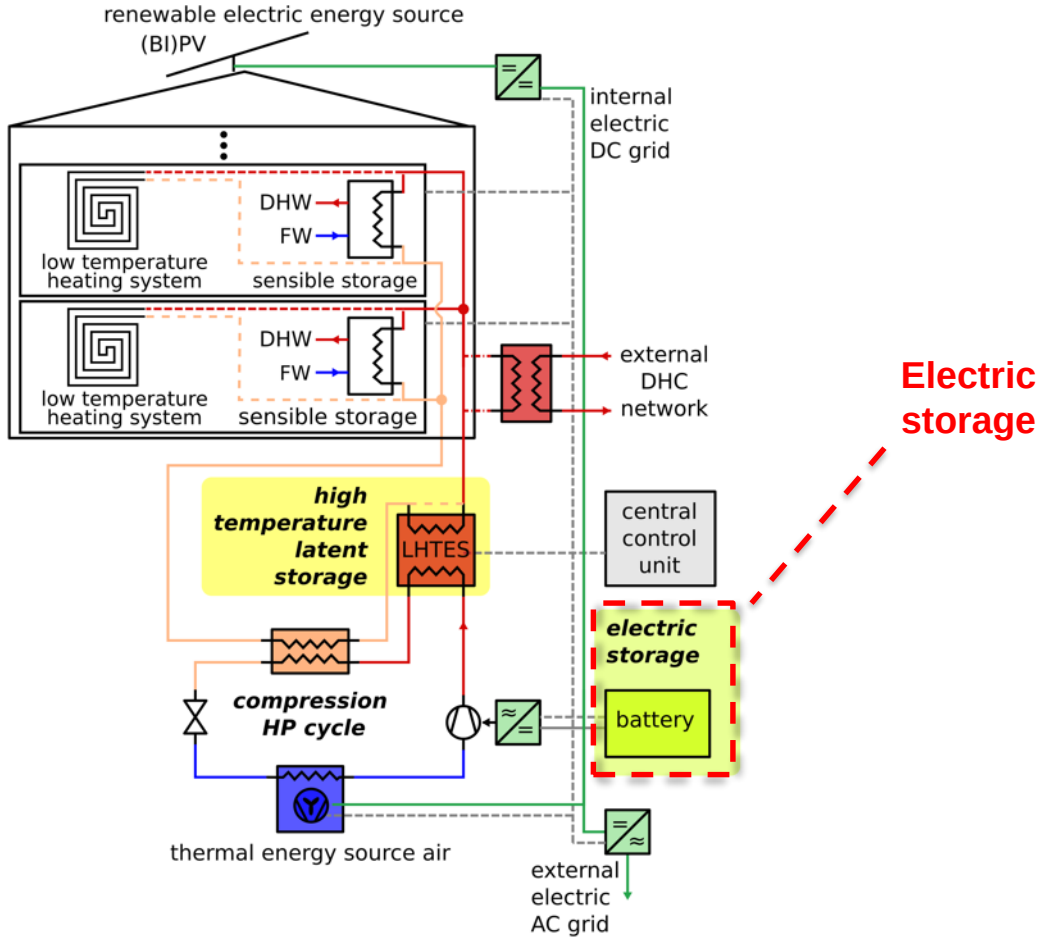
2 Overall concept

Continental system (main focus on heating & DHW)



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2 Overall concept

- The systems will be properly managed by **advanced control** and **Building Energy Management Systems (BEMS)**
- The systems are **tested** in **three different demo-sites**

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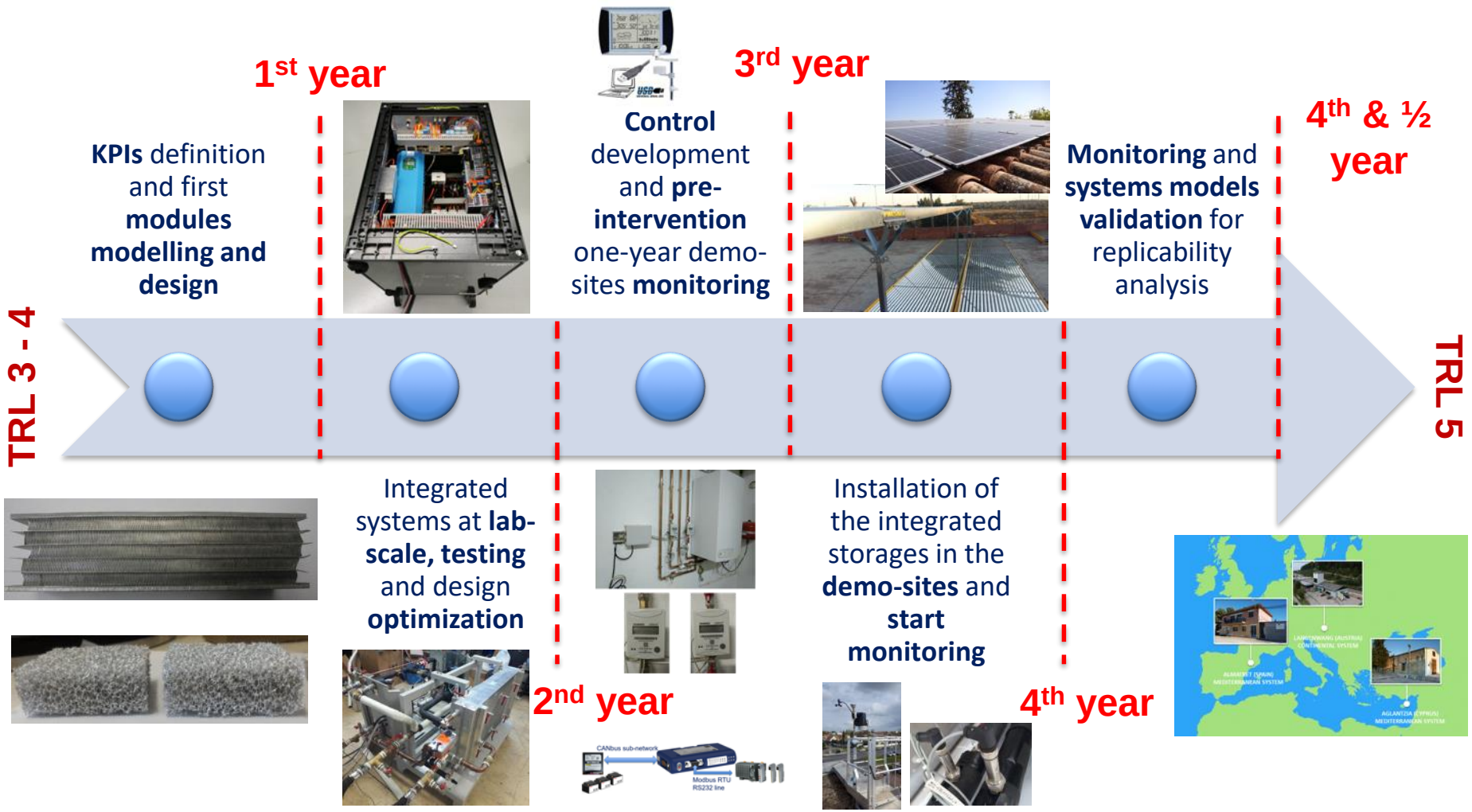
3 Implementation



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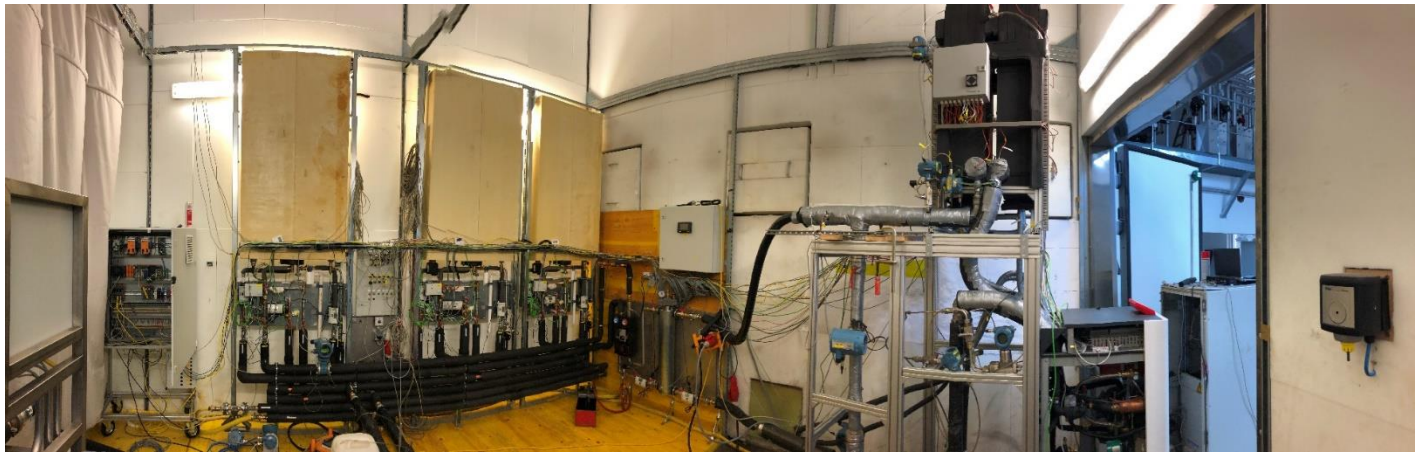
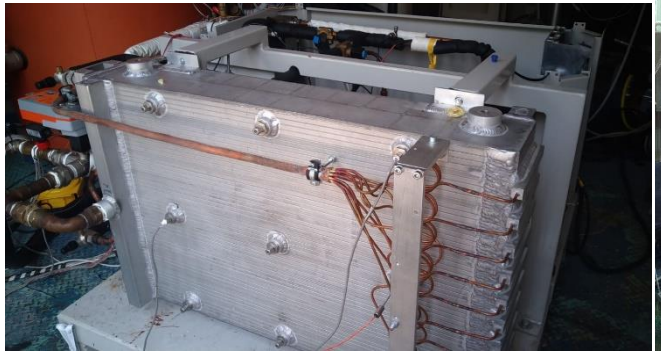
3 HYBUILD PROTOTYPES

Continental system



Mediterranean system



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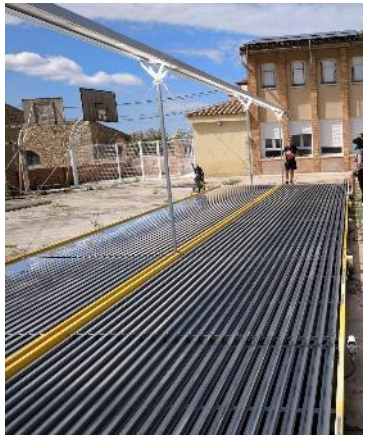
4 INSTALLATION IN DEMO SITES

Mediterranean system - Almatret





Mediterranean system - Aglantzia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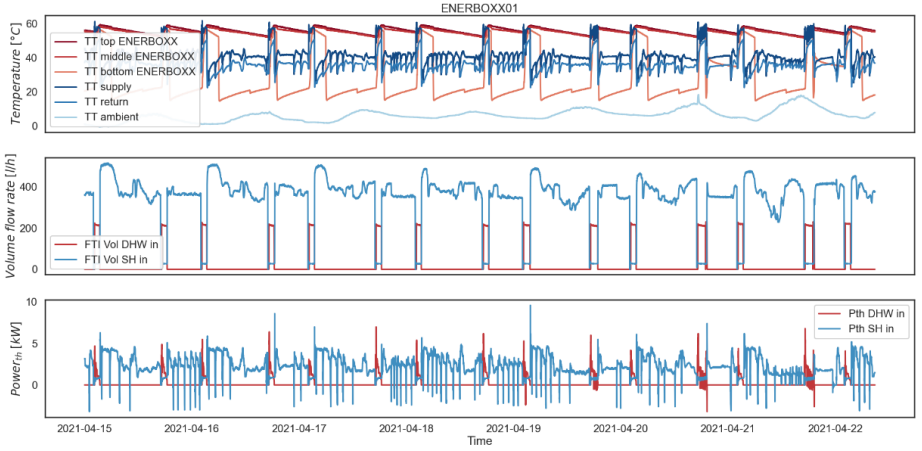
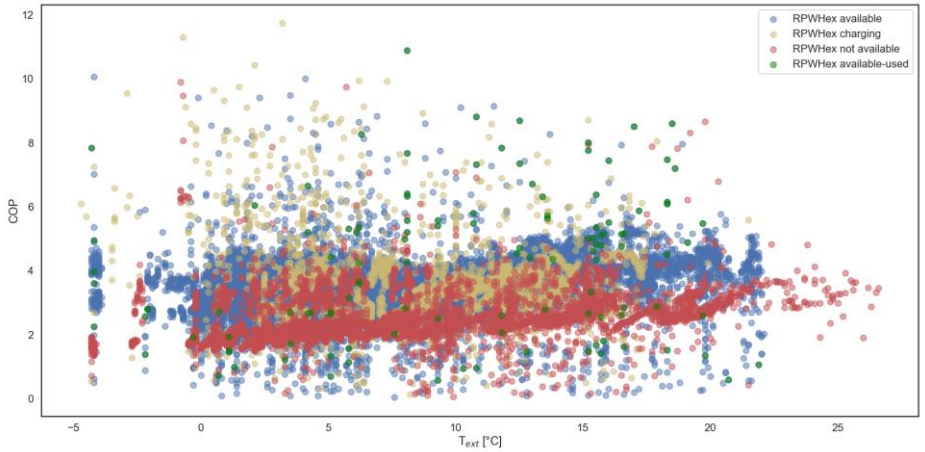
4 INSTALLATION IN DEMO SITES

Continental system - Langenwang



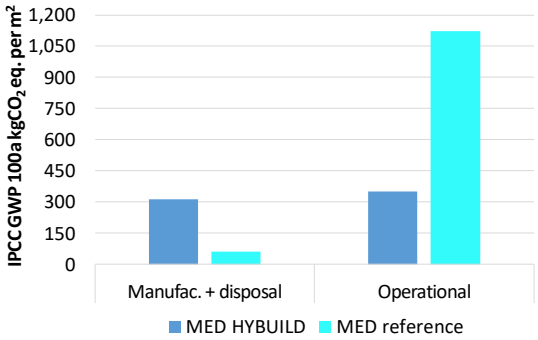


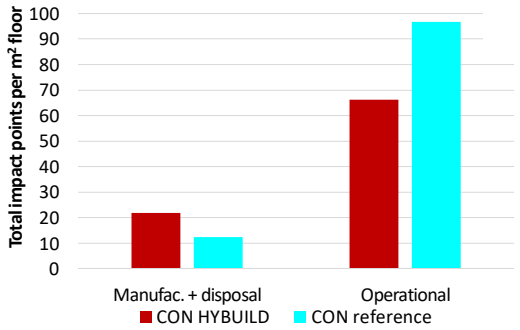
Monitoring data

This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824*

5 Transition from energy efficient buildings to a sustainable built environment

The systems have been analyzed through an holistic approach including environmental and economic evaluation but also a specific Social Life-Cycle Assessment





LCA

S-LCA Results - Mediterranean HYBUILD System

		A1-A3	A4-A5	B4	C1	C2	C3	C4
Components	DC-Bus							
	Master controller							
	Batteries							
	Low temperature latent heat thermal energy storage							
	Solar field of Fresnel collectors	3,25	3,33	3,33	4	4,5	5	5
	Heat pump							
	Sorption storage (sorption module + evaporator condenser)							
	Sensible heat storage (decentralized PINK tank)							
	TOTAL Social Impact			**4,06**				

The Total Social Impact evaluated for the Mediterranean HYBUILD system is

4.06

The Total Social Impact evaluated for the Continental HYBUILD system is

3.93

The results indicates that the HYBUILD system can be socially accepted, even if some social improvements are needed.

This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824*

6 INNOVATIONS REACHED IN HYBUILD

high efficiency conversion and storage of surplus renewable electricity into heat:

- System based on reversible heat pumps to convert electricity into heating/cooling energy;
- Innovation @ heat pump level fully integrated with the sorption and latent storage.

multifunctional use in both heating and cooling applications at different temperature grades:

- Two systems specifically optimized for cooling and heating season;
- Mediterranean concept able to increase the electric COP of the chiller thanks to the sorption storage;
- Continental concept able to recover and store energy from super-heated gas out from the compressor to provide DHW, increasing the overall COP.

different time scales, e.g. in seasonal storage of high temperature solar heat and peak-shaving in lower temperature heat–pump applications:

- Possibility to operate the sorption module both as short-term or long-term storage;
- Latent storages to increase flexibility in operation and efficiency of the heat pumps on daily basis;
- Electrical storages to further increase the flexibility and self-consumption of the system.

This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824*

6 Impact: key figures

HYBUILD is a relatively **low-TRL** EeB project

Start TRL**4** → End TRL**6**

Key **scientific impacts**:

19 papers submitted

in high impact-factor journals

(18 already published)

Find them here: http://www.hybuild.eu/publications/scientific-articles

And on OpenAire

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6 Impact: key figures

Key **scientific impacts**:

14 conference papers published

Grown a strong **community of EU sister-projects** around RHC for buildings:
Joint publications, collaboration on horizontal topics, etc.

2020 – 15 projects → 2021 – 21 projects

This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824*

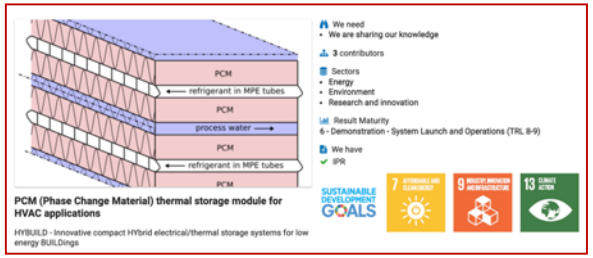
6 Impact: key figures

Key **exploitation impacts**:

2 patents | related to PCM-heat exchangers

9 KERs (Key Exploitable Results)

3 of them uploaded on the Horizon Results platform



This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824*

6 Impact: key figures

Key **exploitation impacts**:

HYBUILD overall system (Med & Cont)

further research required – opportunities through Horizon Europe and National R&D programmes (already 1 R&D project funded by Austria FFG with several HYBUILD partners engaged to continue part of the developments)

HYBUILD sub-systems / individual components

1 KER shall be ready for commercialization at the end of the project.
For 2 other KERs, TRL9 foreseen by 2-3 years.

This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824*

6 Conclusions

- HYBUILD project develops innovative fully-integrated components for hybrid electric/thermal storage solutions at domestic level
- The developed solutions were optimized for both heating and cooling applications. Three demo sites have been used to validate the solutions
- The full-scale systems were successfully tested under lab-controlled conditions but the partnership agrees that further research is needed for full market exploitation of the entire systems
- Market exploitation of the entire system requires specific Business models to be developed among the entire partnership, single exploitable results are already mature for market exploitation

This project has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 768824*

THANK YOU

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SCORES

HYBRID DOMESTIC ENERGY SYSTEMS OF THE FUTURE

17th of February 2022

10.00 - 12.00 CET

ONLINE EVENT

Break

5 minutes

Future with SCORES Technologies

System simulations

SCORES

SPEAKER

SCORES

KEITH O'DONOVAN

Researcher at AEE INTEC

System Simulations

System Simulations to Serve two main purposes:

1. Test robustness of **BEMS algorithm** in a virtual environment before commissioning of the Demonstrators

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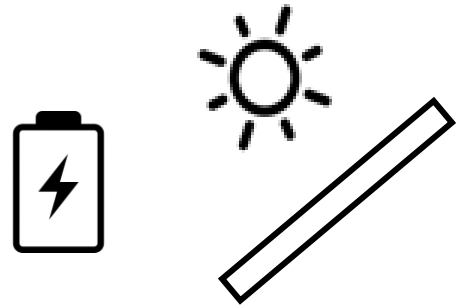
2. To evaluate the technical performance of a number of **SCORES Future System Scenarios** through variation of key parameters including:
   - **PV(T) area**
   - **Storage capacities –** Battery, PCM, CLC
   - **Electricity Tariffs –** i.e Flat Tarrif, Time of Use, Day Ahead



System Simulations

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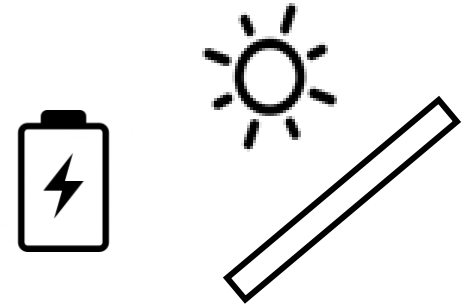
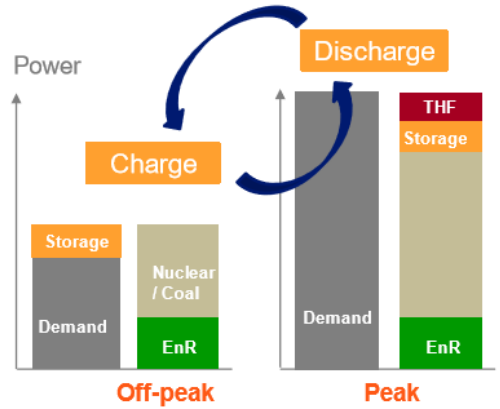
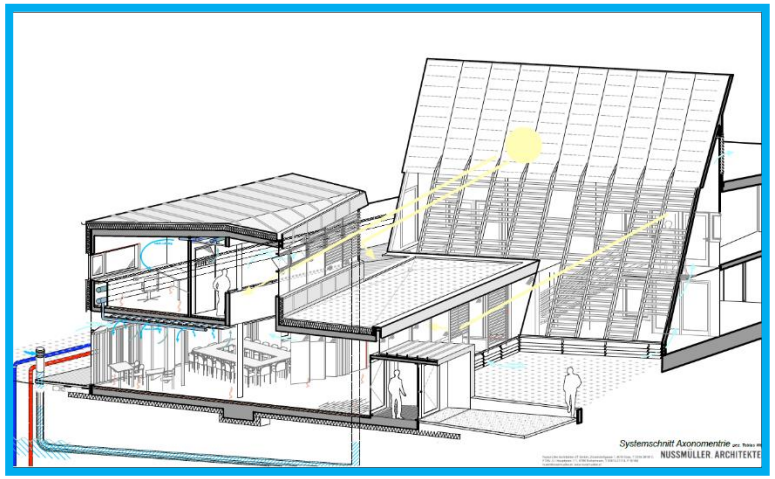


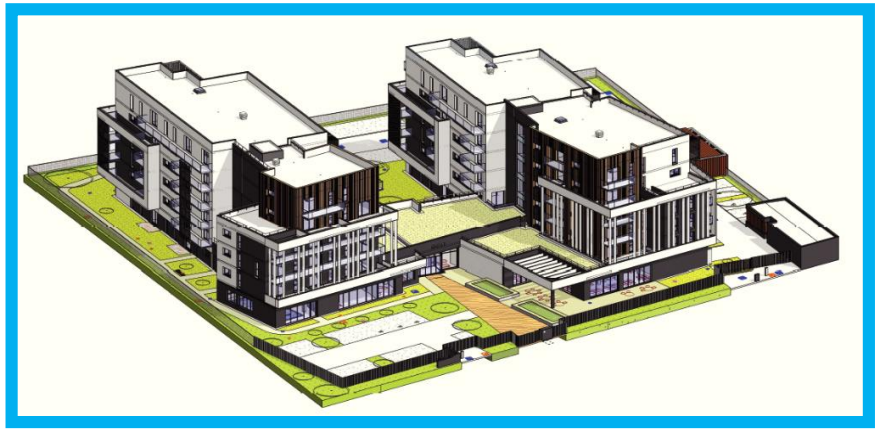


System Simulations

Scores System A: Gleisdorf, Austria

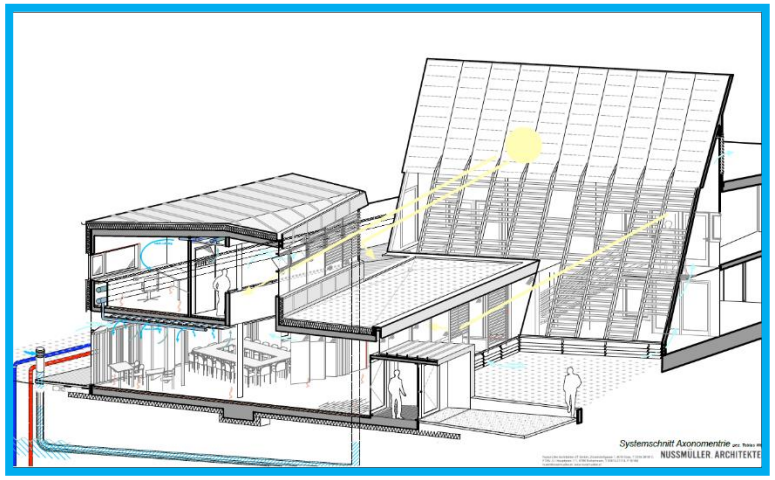


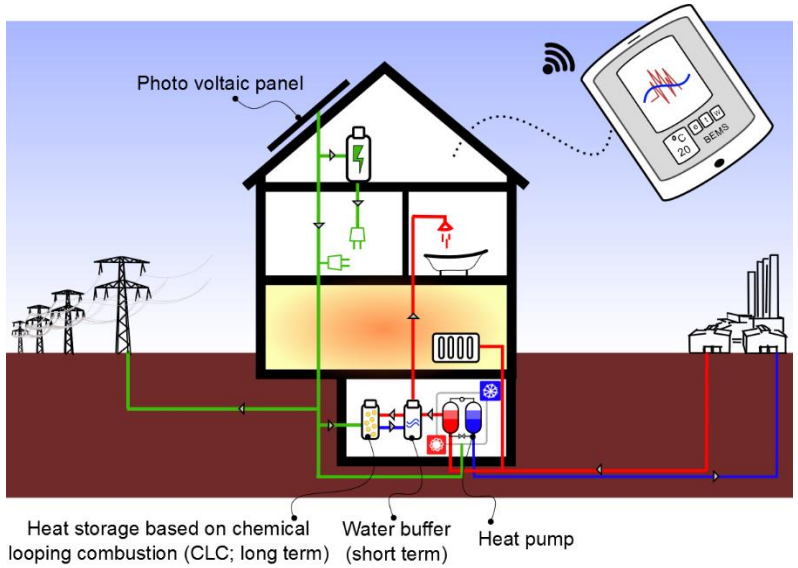
Scores System B: Agen, France



System Simulations

Scores System A: Gleisdorf, Austria





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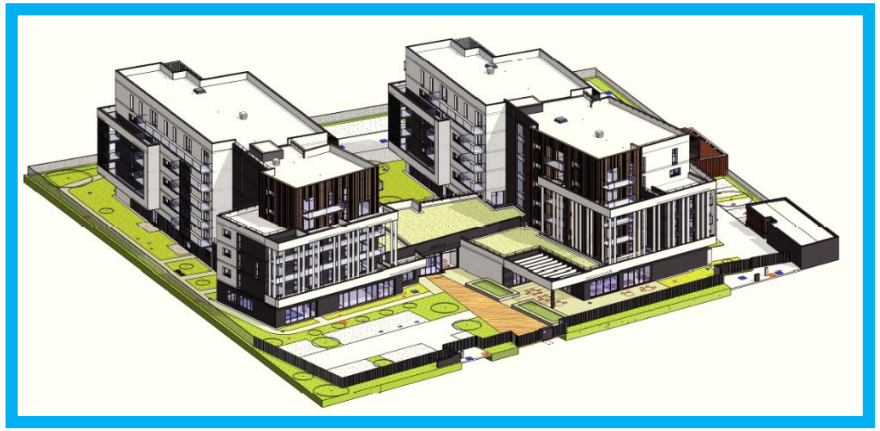
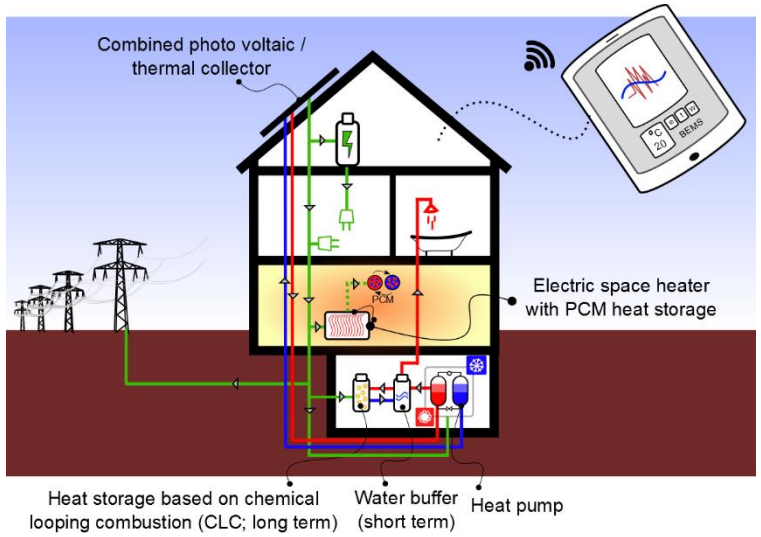
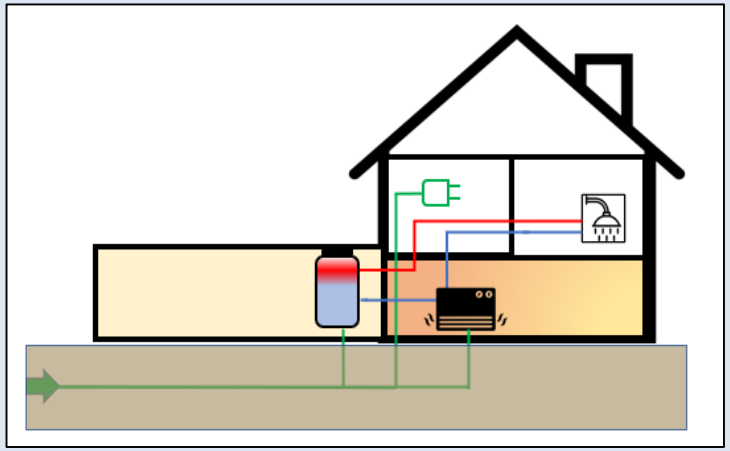




System Simulations – France

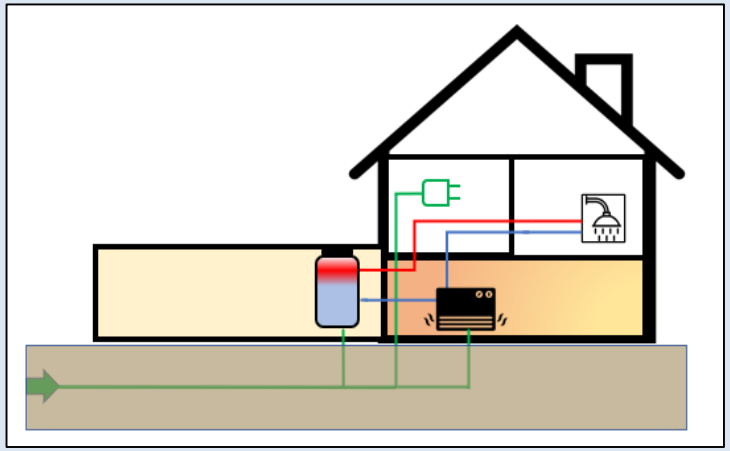
Reference Case



- all electricty from the grid
- electric heaters for heating
- hot water buffers for DHW

System Simulations – France

Reference Case



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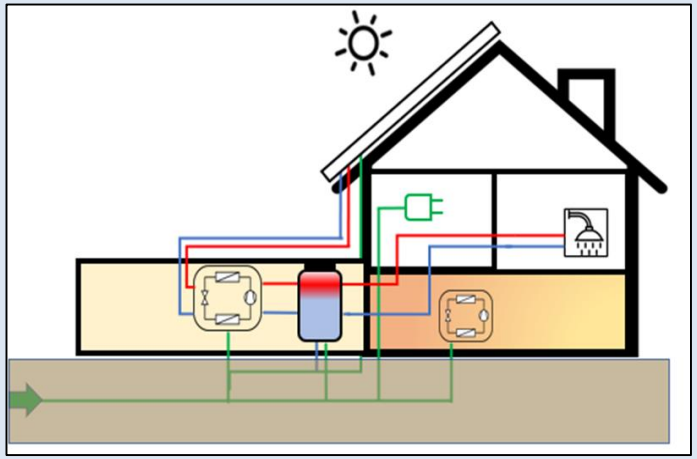
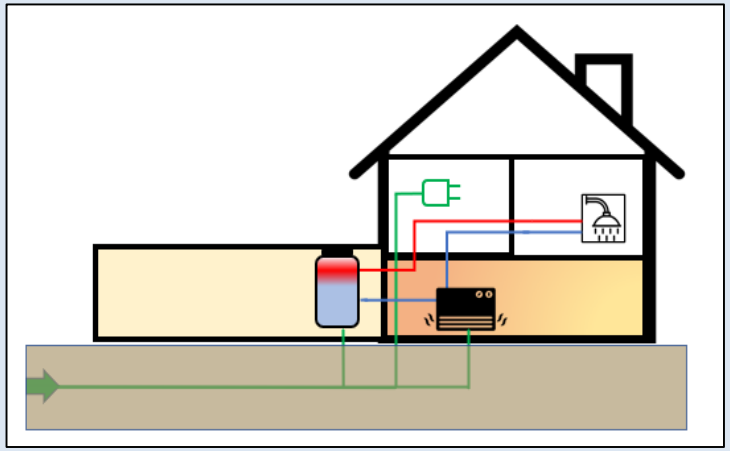
Self-Generation Case



- roof mounted PVT (800m^2)
- heat pumps for DHW (36kW$_{th}$)
- air-to-air heat pumps for heating

System Simulations – France

Reference Case



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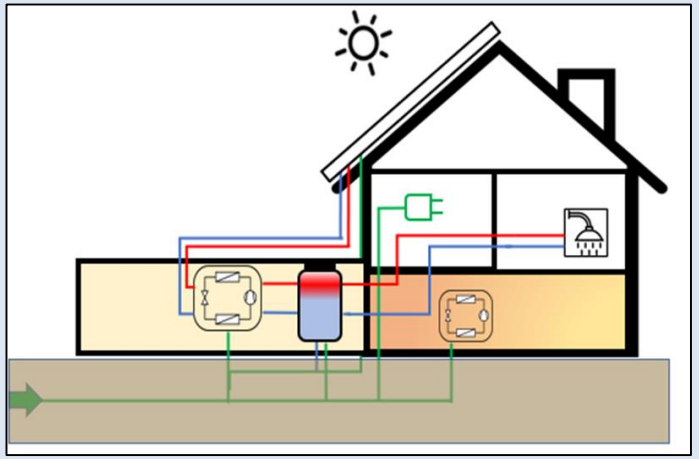

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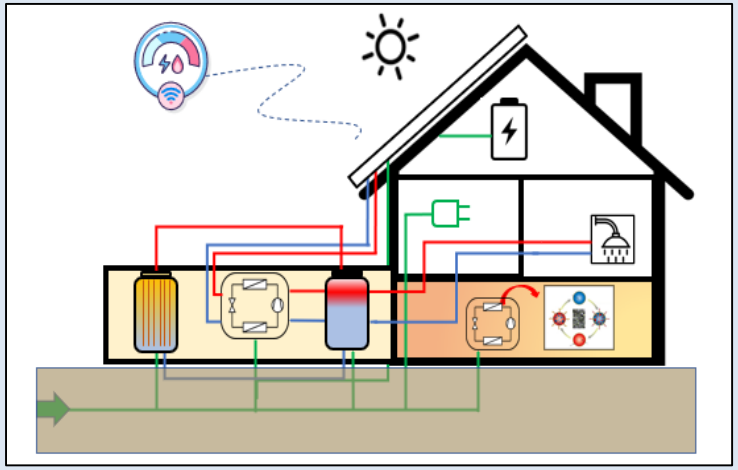
Scores Future System

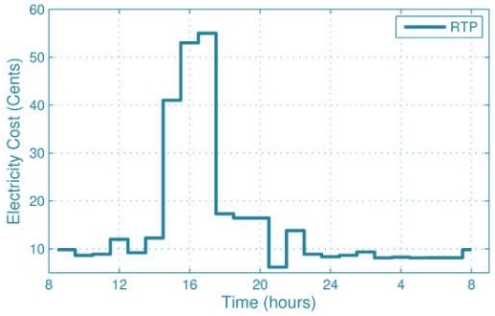


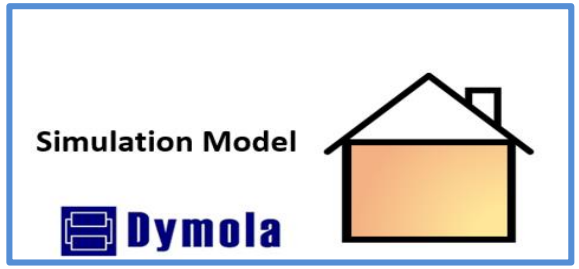
- Electrical battery storage
- PCM storage in air-to-air heat pumps
- REDOX heat battery
- BEMS control algorithm

Simulation Workflow

Parameter Inputs

- CLC capacity
- Electric Battery capacity
- PCM Storage Capacity
- PV(T) Area
- Electricity Tariff Model





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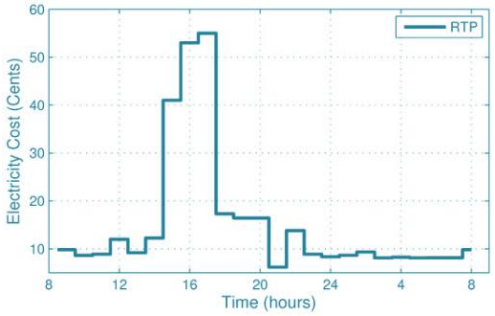

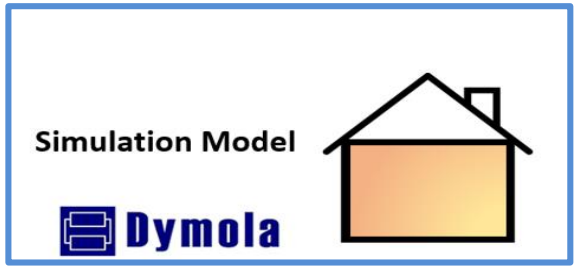

BEMS
Prediction/Decision
Scripts

Simulation Workflow

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- CLC capacity
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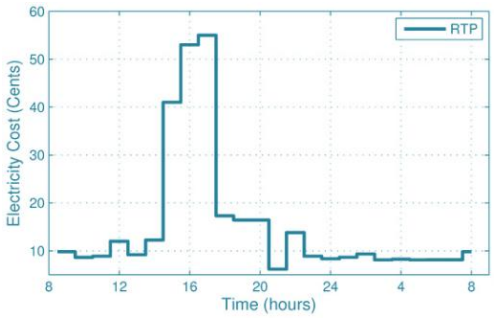
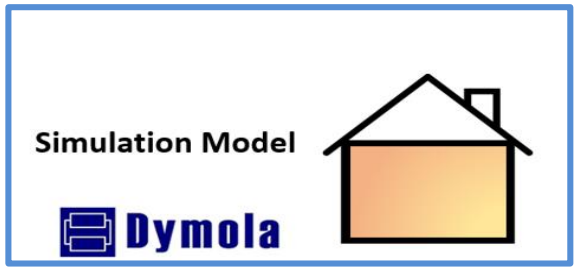
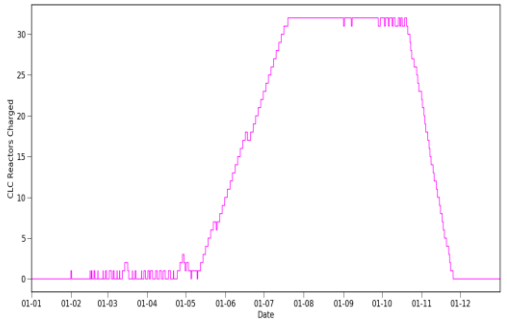
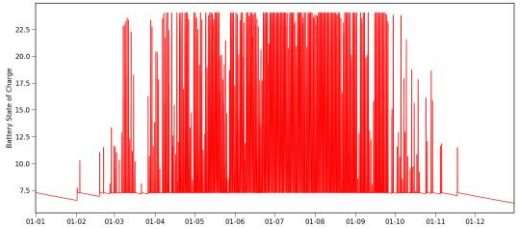




BEMS
Prediction/Decision Scripts





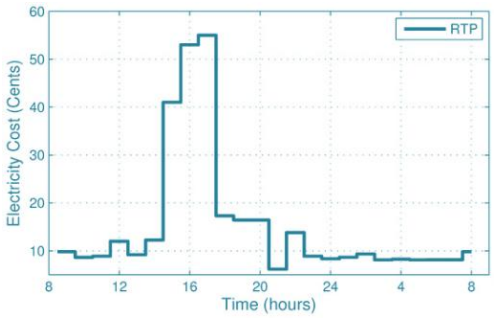
Simulation Outputs

- Storage Cycles
- Utilised PV/Grid Electricity
- Self-Consumption Factor

Simulation Workflow

Parameter Inputs

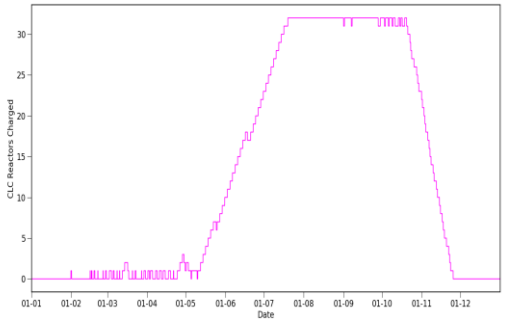
- CLC capacity
- Electric Battery capacity
- PCM Storage Capacity
- PV(T) Area
- Electricity Traiff Model

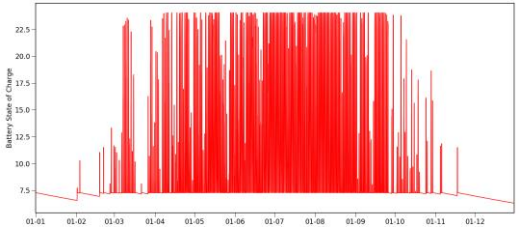


Simulation Model

Dymola

BEMS
Prediction/Decision Scripts





Simulation Outputs

- Storage Cycles
- Utilised PV/Grid Electricity
- Self-Consumption Factor

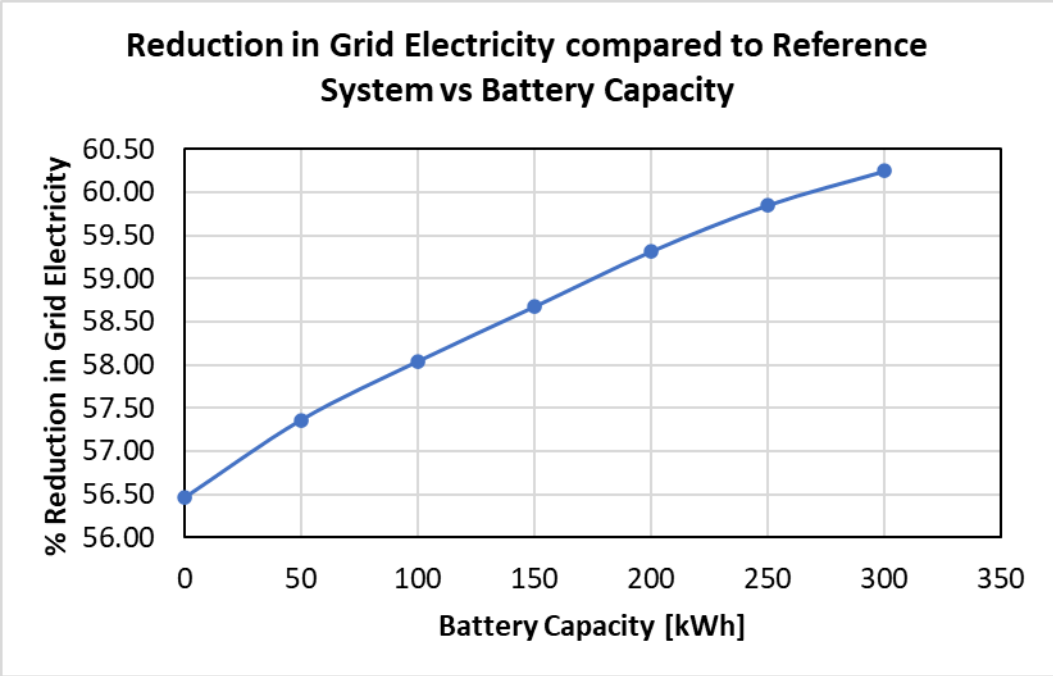
Techno-Economic Analysis

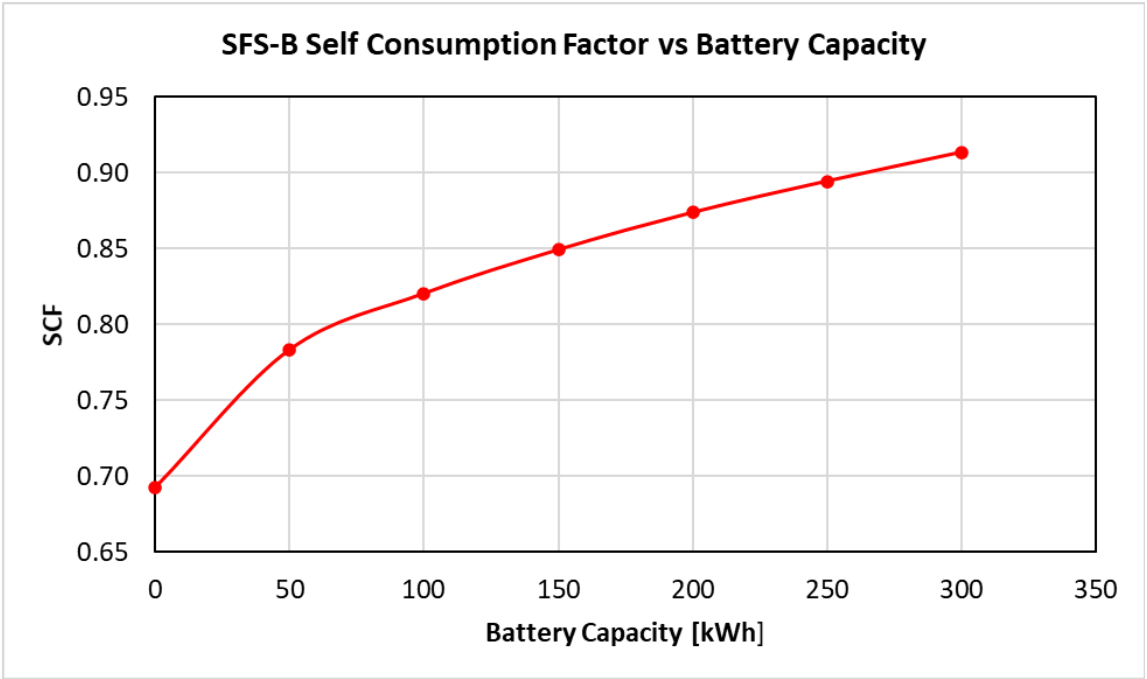
Outputs

- Total Cost savings per annum
- Peak Load Shavings
- LCOS (€/kWh)

Parameter Variation Studies

Scores Future System – Agen Building, France

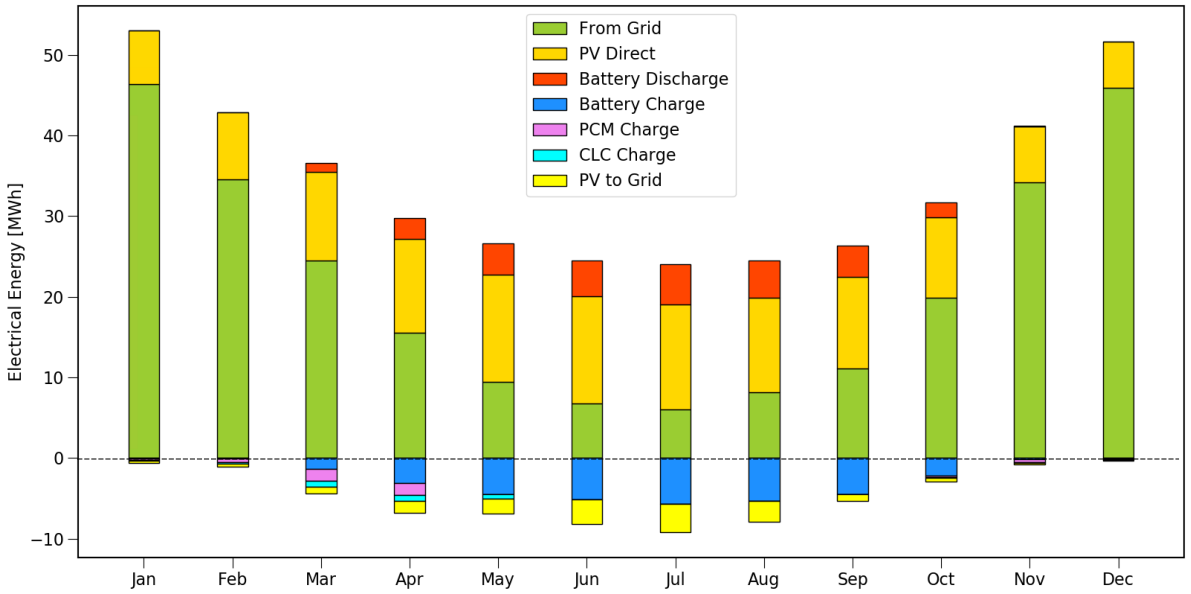




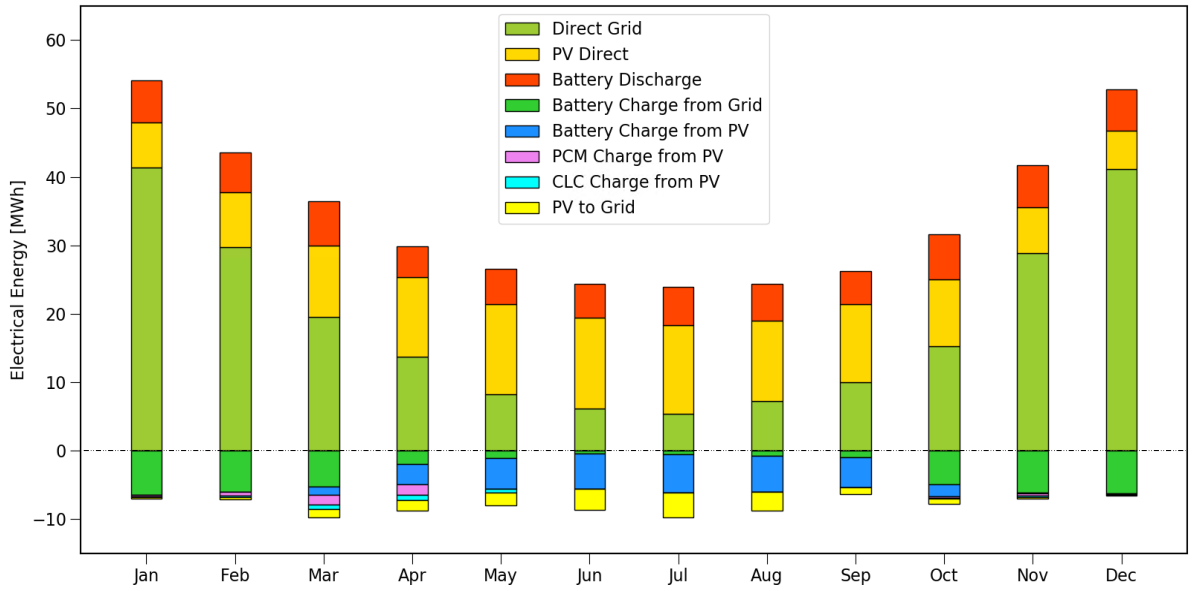
- Scores Future System with largest battery (300kWh) **over 60% reduction in electricity from grid** compared to the reference case with 100kWh of PCM and 214kWh REDOX heat battery

Future System Results

Scores Future System – Agen Building, France



Flat Electricity Tariff



Day Ahead Electricity Tariff

*Example Scores Future System configuration: 300kWh Electrical Battery + 100kWh PCM + 214kWh REDOX Battery

Outlook

- Simulated SCORES future systems project very high reductions in electricity from the grid through self-consumption of locally generated PV electricity and effective storage management through the BEMS algorithm.
- BEMS enables effective participation in electricity markets through charging electrical batteries from the grid during low grid prices.
- Subsequent techno-economic projections with estimated CAPEX and OPEX for each technology play a role in selecting cost optimal Scores configurations.
- Validation of simulation models and BEMS against monitoring data from both Demos ongoing.

SCORES

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SPEAKER

SCORES

CLAUDIA PORTULANO

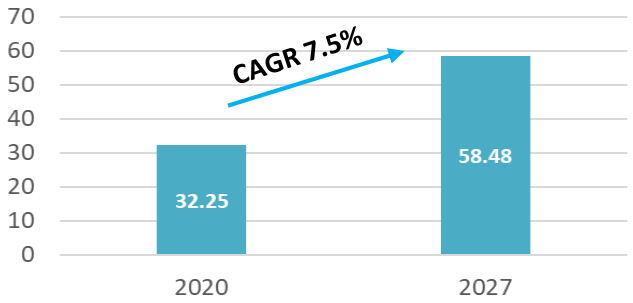
Business Consultant in Market & Business Strategy Unit at RINA Consulting

Market assessment

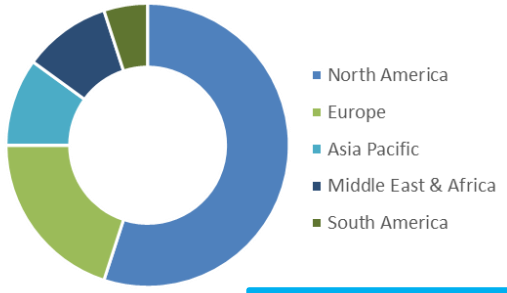
A Preliminary Market Assessment in 4 points

Self Consumption Of Renewable Energy by hybrid Storage systems

Global Hybrid battery energy



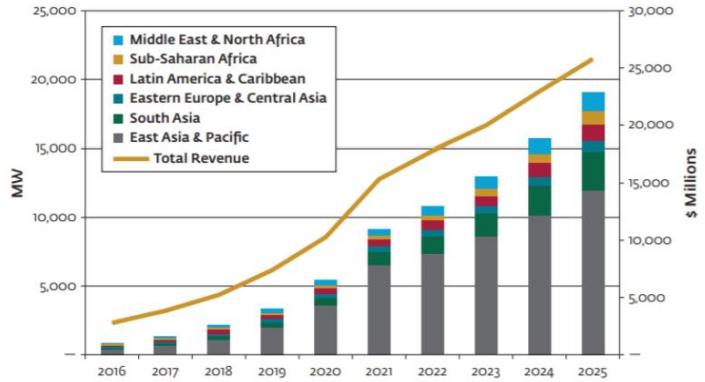
Regional Analysis in 2020 (%)



Source: RINA-C Elaborations based on Maximize market research

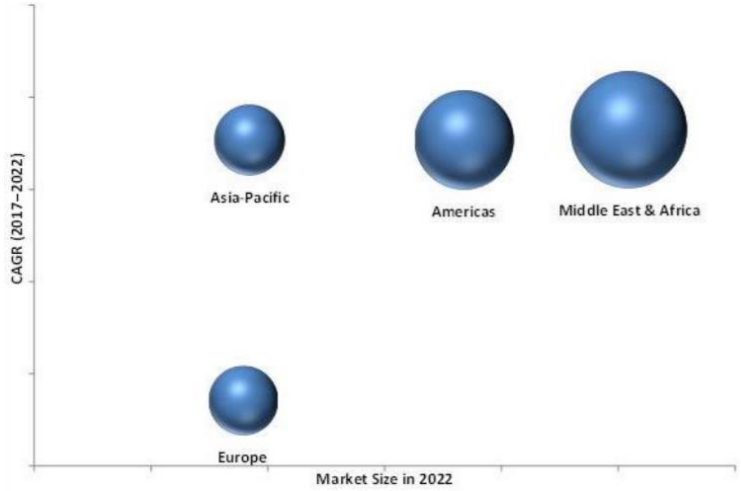
Energy storage market

Annual stationary energy storage deployments. Power capacity and Revenue by region, 2016-2025



Source: Energy storage trends and opportunities, https://www.ifc.org/wps/wcm/connect/ed6f9f7f-f197-4915- 8ab6-56b92d50865d/7151-IFC-EnergyStorage-report.pdf?MOD=AJPERES

Thermal market



Source: Thermal Energy Storage Market, https://www.marketsandmarkets.com/Market-Reports/thermal-energystorage-market-61500371.html

Market Drivers & Barriers

Market Drivers

- Back-up power (electric/thermal);
- Solar photovoltaic (PV) and other distributed generation (DG) systems;
- The recent sharp increase in prices .

Barriers to the growth of stationary energy storage market

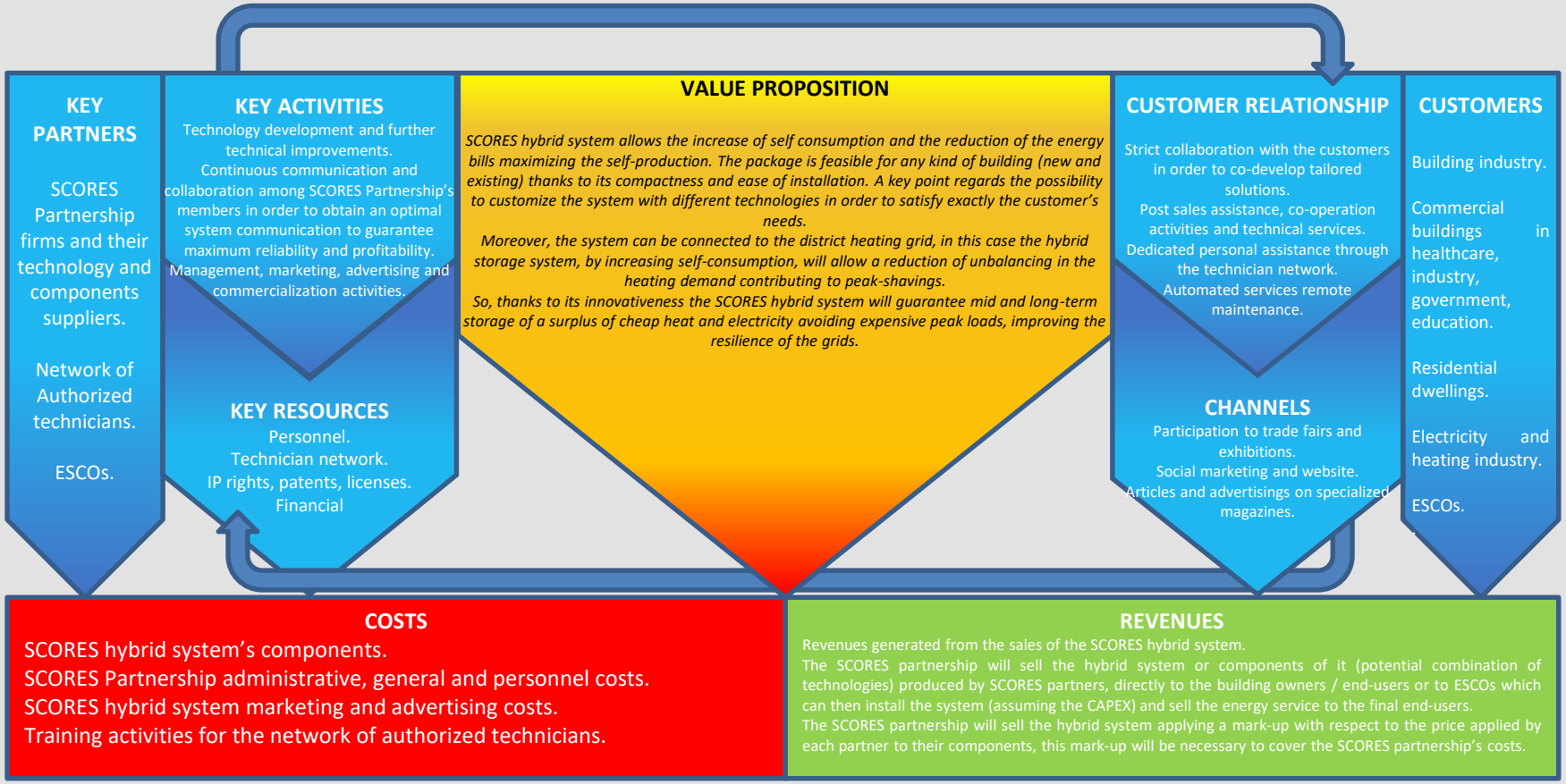
- Lack of familiarity with storage technology
- High upfront costs
- The need for highly skilled and experienced technicians
- Regulations preventing third-party or customer ownership of certain DERs and preventing storage from competing in energy, ancillary services, or capacity markets

Barriers to deployment of current PCM heat storage products

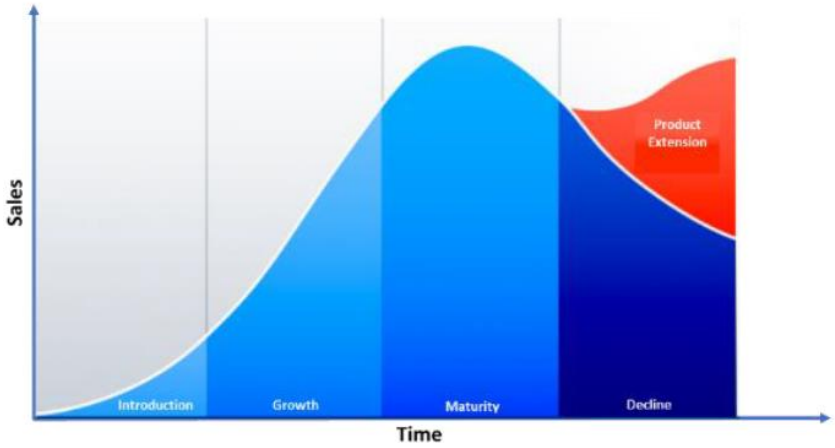
- Limited customer knowledge.
- A lack of a supply chain for PCM products.
- The availability of safe, reliable PCM materials with melting points suitable for most heating technologies.
- PCM stores are also limited to applications where a small temperature range between input and output is tolerable further narrowing the overall market potential.

Business Model for SCORES Hybrid Storage System

INNOVATIVE CONTENT: the hybrid system allows the increase of self consumption and the reduction of the energy bills maximizing the self-production. Possibility to customize the system with different technologies in order to satisfy exactly the customer's needs. The SCORES hybrid system will guarantee mid and long-term storage of a surplus of cheap heat and electricity avoiding expensive peak loads, improving the resilience of the grids.
TECHNOLOGY MATURITY BY THE END OF THE PROJECT: depends on the single ER.

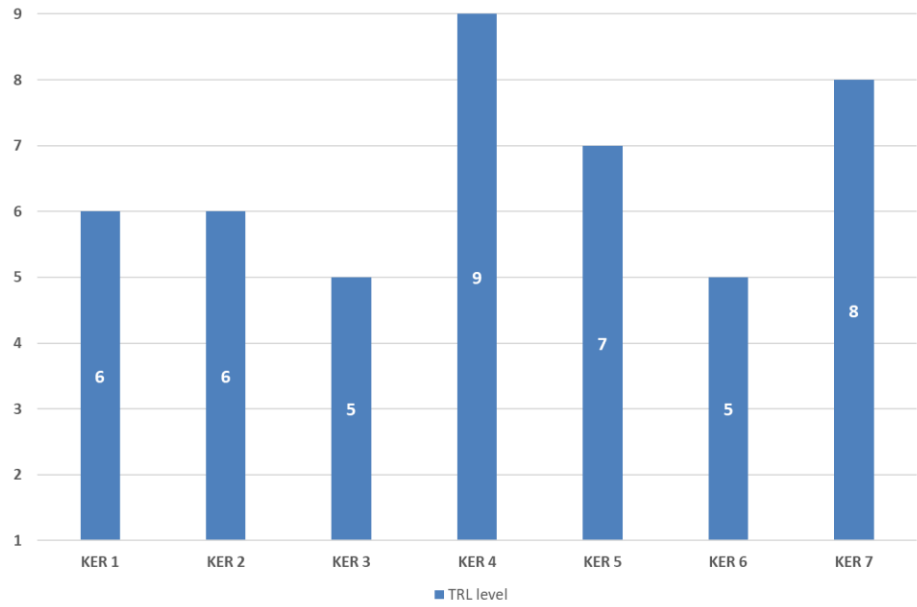


- As the overall SCORES hybrid system is at an early development stage showing a quite low TRL most of the key technologies needs further technology developments have to be done after the end of the project in order to reach a proper technology readiness level necessary for the market entrance.
- Once higher TRL will be achieved, the companies producing the SCORES hybrid components needs to scale up their production process in order to reach the mass production scale volumes and be able to experience a reduction in production costs and be allowed to commercialize its products at more competitive prices. This will represent the growth stage of the SCORES product life cycle.
- Once the technologies will be reliable and its prices more competitive, it is hopefully foreseen a widespread diffusion of the SCORES hybrid system, allowing it to enter in its maturity stage.



Product Life Cycle

SCORES technologies TRL



Social impact

SPEAKER

SCORES

ADELIA GAFUROVA

Project Manager at Fenix TNT

T9.5: To ensure acceptance by market participants and end-users, individual behaviors and choices to be analyzed in a socioeconomic context within the European region (form of questionnaires; target audiences to be effectively mapped and their needs to be assessed).

D9.9 Potential social impact of the Project and users engagement → **M54 April 2022**

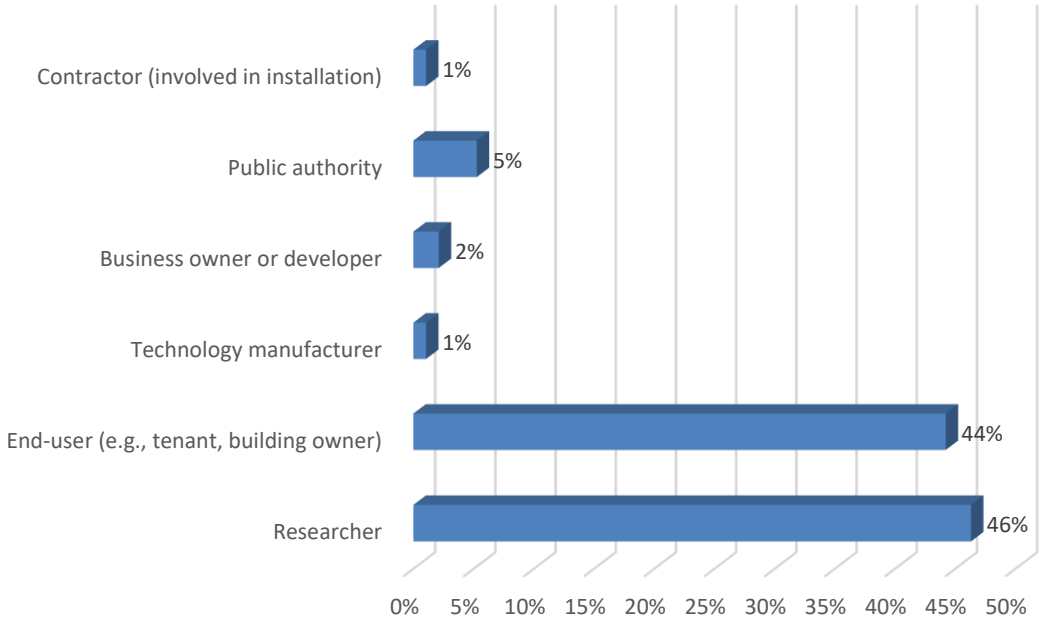
- The purpose of the survey: to collect the views of different stakeholders and identify their needs, habits, and preferences related to Hybrid Energy Storage systems.

- 8 simple understandable questions
(7 multiple choice questions and 1 open question)

- The questionnaire took 2 minutes to complete

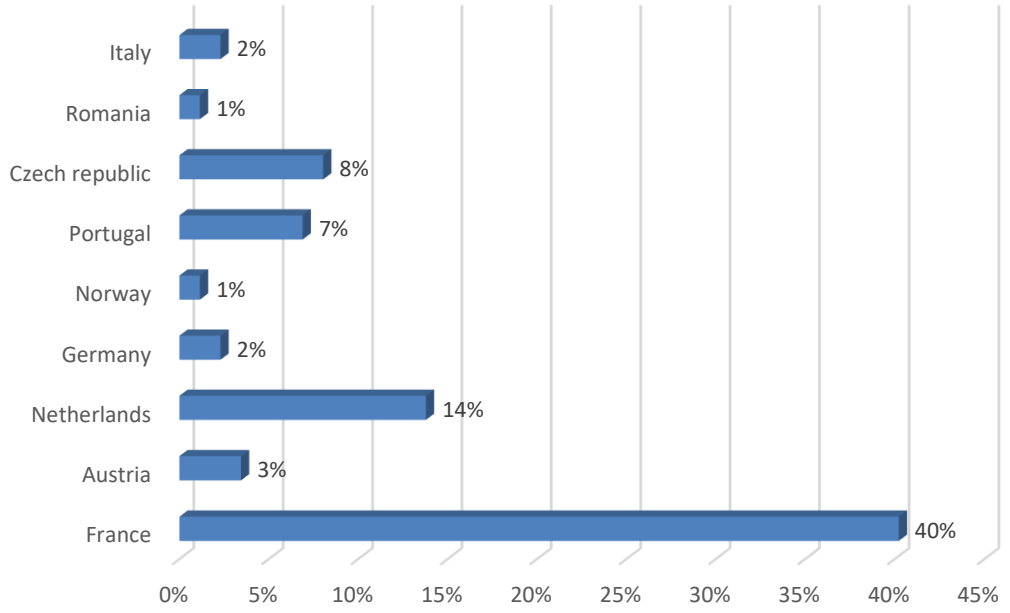
- Promoted through Social media channels (Twitter, LinkedIN, Project website, Partners' channels)

Please specify, which group represents you most?



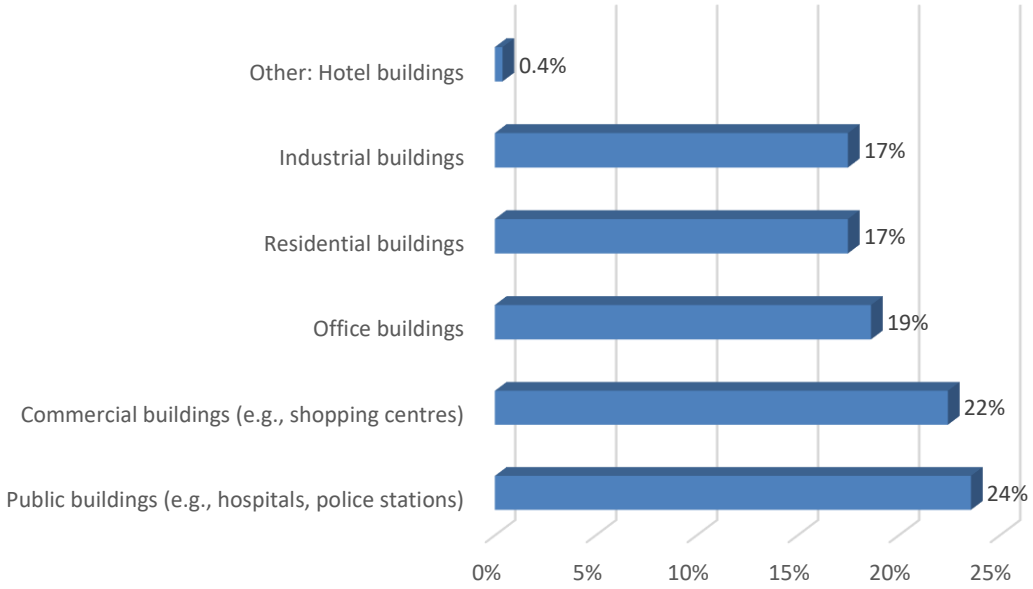
95 answers

What is the country of your residence?



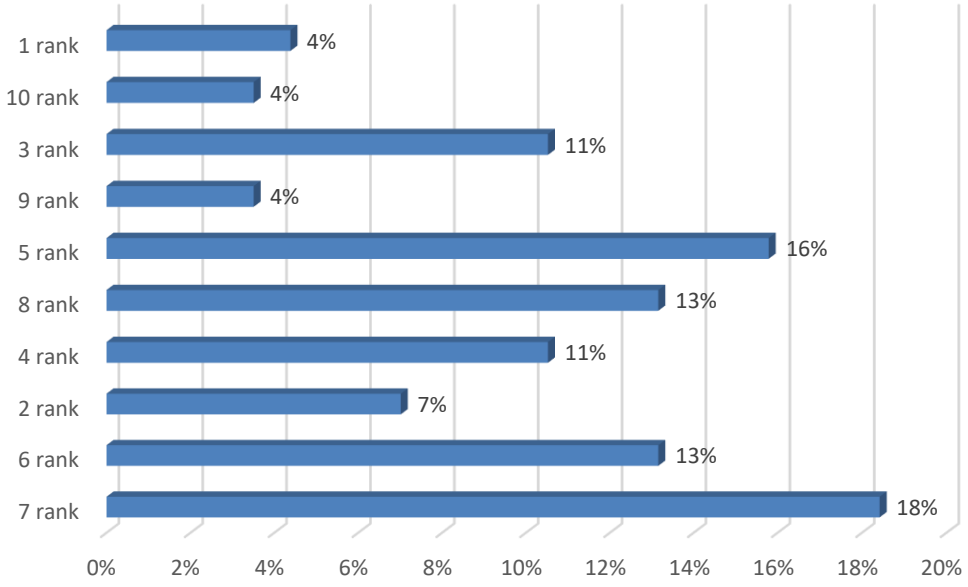
87 answers

Which buildings do you think are most suitable for the integration of Hybrid Energy Storage Systems? (several options are possible)



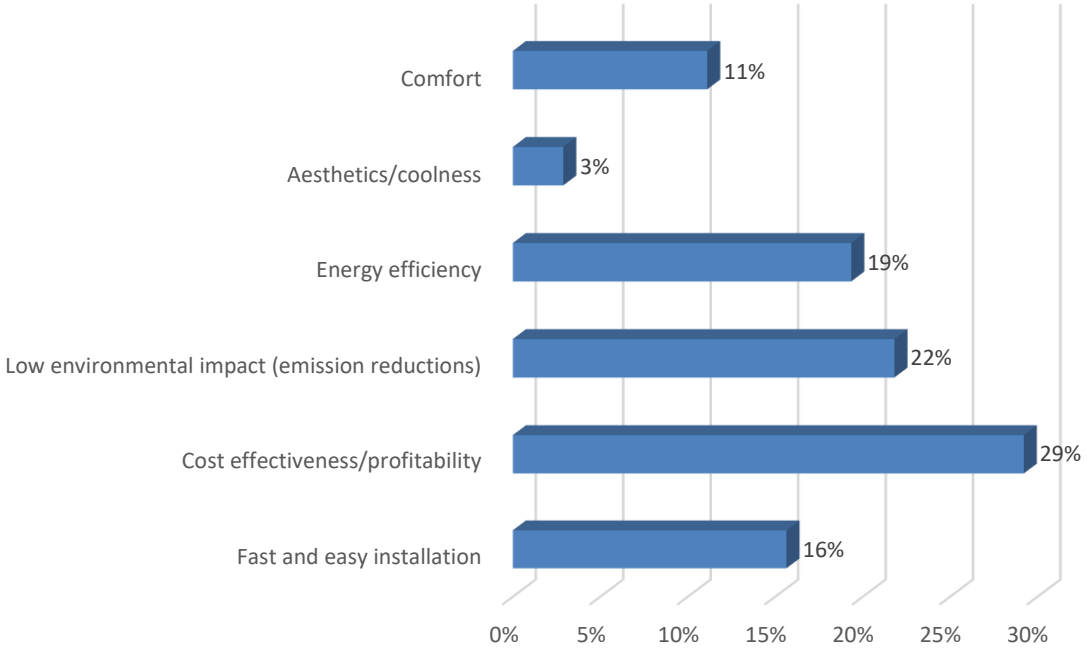
263 answers

Please rank your level of knowledge regarding Hybrid Energy Storage systems (1 - is absolutely unaware, 10 - is totally aware)



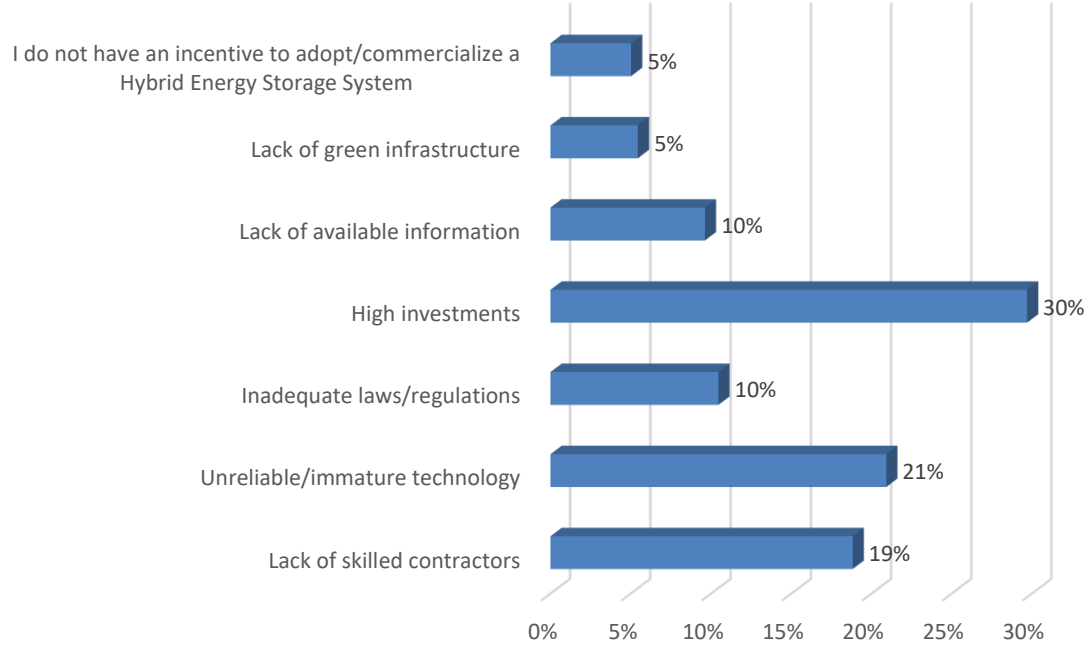
114 answers

Which criteria would be the most important for you when/if deciding to adopt/commercialize a Hybrid Energy Storage System? (several options are possible)



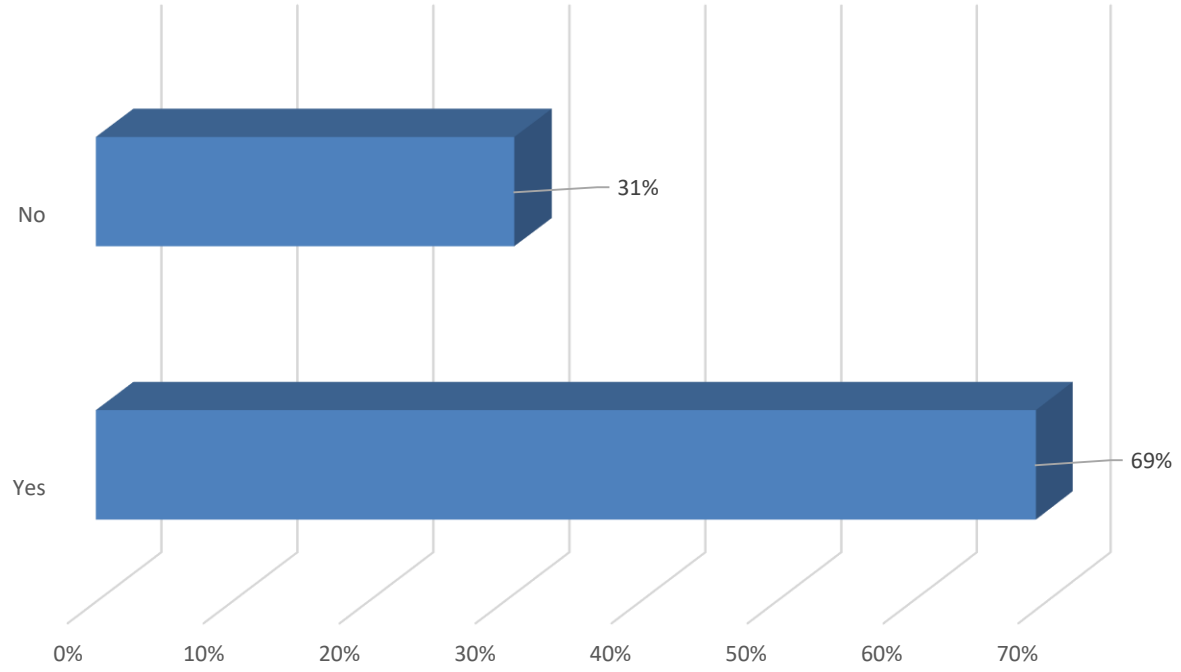
243 answers

Which of these barriers would most likely prevent you from adopting/commercializing a Hybrid Energy Storage System? (several options are possible)



239 answers

Would you like to be involved in manufacturing, installing, or using Hybrid Energy Storage Systems?



91 answers

Feel free to share your opinion on Hybrid Energy Storage Systems

It is not an option, it is a necessity. The point is "how to make it sexy?" as the financial benefit for the user is quite low, and the understanding of the necessity is very difficult to catch for a non-involved citizen.
I think it is a must-have for everyone. It should be common practice.
Let's continue to develop it, integrated into an efficient energy management system.
It has good potential.
With hybrid energy storage it will be possible to convince people that they can meet their needs without compromising future generations, as well as reducing their ecological footprint. Therefore, it is essential to guarantee system reliability to customers. That is, above all honesty!
Crucial for 100% renewable energy. All the best for your project! Thank you
That's what all buildings should have in the future. The initial investment is high compared to conventional systems. Greater incentives are needed to make technologies competitive.
It is a very promising technology in line with the creation of RES communities.

Feel free to share your opinion on Hybrid Energy Storage Systems

I see your proposed systems for the future. We need systems like these where buildings can be independent from public energy resources with an impact on nature as low as possible.
Public information is scarce and there has to be capacity building for professionals as this will be another system that might have problems if people are not well trained to design and install therm.
Should be as efficient as possible.
Seems to be a great option for intermittent renewable sources.
Required if it reduces carbon emissions.
Hybrid energy storage systems are necessary to improve green energy use, but I think they might be difficult to industrialize because each situation is different.
Could be interesting to avoid costly or even non-environmentally friendly solution.
Good idea on the paper but...
The gains would not be worth the effort in many cases.
Interesting concept but no skilled labour in France. Each time there is something interesting they increase the price but their performance.

SCORES

SPEAKER

SCORES

LUIS COELHO

Professor at Instituto
Politecnico de Setubal

Training

The objectives of the training activities are:

- To perform **training activities**, exploiting instructions, processes and tools developed in the framework of the Project and distribute them to a wider community of professionals, relevant for the **production, design, application and installation**.
- Supporting activities to include **videos, seminars, webinars and courses**.
- **Two training demo site seminars** will be organized.

- **Videos – Training (8 available videos)**

  01 SCORES Integrated Solutions

  02 Building Energy Management

  03 Phase Change Material

  04 Air-to-air Heat Pumps with PCM Storage

  05 Water-to-water heat pumps

  06 CLC Seasonal Thermal Energy Storage

  07 Heat Battery Based on GVI

  08 Demonstrations

Link: will be available on the SCORES YouTube channel next week,

https://www.youtube.com/channel/UCdGq18dy8Et2xyQGoEToYxA/featured

- **Webinars (1,5 hours each)** (*online, more Information soon).*

Webminar 1: Innovative renewable solutions for residential buildings

Done: 25th of June 2021, 14.00 – 17.00

Organized within the event **World Sustainable Energy Days (WSED) 2021**;

Webminar 2: Towards total decarbonisation of buildings by 2050 - the role of the SCORES solution (1,5 hours).

(more Information soon)

- **Training Course on Thermal Energy Storage for Heating, Cooling And DHW for Buildings** *(physically)*
  - Date: 09h30 - 17h30 (WET), Friday, 1st of April (*tbc*) of 2022
  - Venue: ADENE, Lisboa, Portugal
- Organized with the collaboration of ADENE (National Energy Agency)

  (more Information soon).

- **Two training demo site seminars (1,5 hours each)** (*online, more Information soon).*

  Training Demo Site Seminar – Demo Site A, Gleisdorf, Austria

  Training Demo Site Seminar – Demo Site B, Agen, France

Panel discussion

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