27/09/2023 I 9h30 - 12h00

SUNHORIZON: Suncoupled innovative heat pumps

Final conference

Brussels Marriott Hotel Grand Place

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Agenda

9h30 – 9h40: Welcoming participants
9h40 – 9h50: SunHorizon Project Overview by Serena Scotton, Rina Consulting s.p.a.
9h50 – 10h10: Heat Pump Applications in Residential Buildings: Insights and Innovations

- A solution for decarbonisation of existing multi-family buildings: heat pumps in cascade – introducing **HAPPENING** (HeAt PumPs in existing multi-family buildings for achieving union's ENergy and envIroNmental Goals), by Jon Iturralde, TECNALIA
- **Superhomes2030** (Up scaling integrated Home Deep renovation services for Ireland), by Irene Egea Saiz, EHPA

10h10 –10h50: Monitoring outcomes, KPIs and lessons learned from the Demo-Sites

- **10h10 – 10h25: Introduction to the demo sites in Madrid, Sant Cugat and Riga**
  - Introduction and lessons learned in Madrid by Diego Romera, Empresa Municipal de la Vivienda y el Suelo of Madrid
  - Introduction and lessons learned in Sant Cugat by Gerard Riba, Ajuntament de Sant Cugat
  - Introduction and lessons learned in Riga by Zane Broka, Riga Technical University
- **10h25 – 10h40: Monitoring outcomes and KPIs** by Carolina Pastor, CARTIF
- **10h40 – 10h50: Coupling solar technologies with heat pumps in building applications: Conclusion** by David Chèze, CEA

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Agenda

10h50 –11h20: Coffee break

11h20-11h30: Smart user Interface and the role of self-learning in the SunHorizon Platform, by Dimitrios Ntimos, IES
11h30- 11h40: Maximizing the Potential of SunHorizon: an Exploitation strategy by Sílvia Jané, Veolia
11h40 – 11h50: The EU Heat Pump Accelerator to speed up the heat transition by Mélanie Auvray, EHPA
11h50 – 12h00: Closing remarks and closing of the event by Serena Scotton, Rina Consulting s.p.a.

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Serena Scotton
Project Coordinator - RINA Consulting Spa

SUNHORIZON: Sun Coupled innovative heat pumps - Final conference

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Info

- SunHorizon is a H2020 project started on the 01 of October 2018, it was supposed to end in September 2022, however due to obstacles faced due to the COVID-19 pandemic, it has been extended of 1 more year.
- Actual end of the project, 30th of September 2023.
- Moreover, lately other changes occurred, and the structure of the project changed. In the recent Amendment we abandoned 3 demo sites.

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Our vision and objectives

The SunHorizon Technology Packages (TP) aim at covering at least 80% of the Heating & Cooling needs of refurbished and new single/multi- family/tertiary buildings.

Demonstrate up to **TRL 7** innovative and reliable HP solutions that acting properly coupled and managed with advanced solar panels can **provide heating and cooling to residential and tertiary building with lower emissions, energy bills and fossil fuel dependency**.

- Increase SunHorizon H&C technologies performances
- Promote cloud based functional monitoring for H&C purposes
- Reduce SunHorizon H&C technologies CAPEX and OPEX
- Demonstration of SunHorizon Innovations indifferent EU countries and type of buildings
- Promote the replication of SunHorizon Concept
- Dissemination and Capacity Building

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Consortium

An Industry driven Consortium:

- 5 top level Academic Polytechnic Institutions
- 12 industrial partners:
- 5 Large Enterprise (LE)
- 7 Small and Medium Enterprises (SMEs)
- 4 association and stakeholders acting as demo site

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SunHorizon TPs

The demo sites needs, are supplied with 5 different technology combinations, that combines the following technologies:

Heat pumps

FAHRENHEIT
Cooling Innovation.

BDR THERMEA GROUP

BOOSTHEAT
ENERGY UNITES PEOPLE

Solar technologies

DUALSUN

Storage

ratiotherm

Needs

Space cooling

Space heating

DHW

5 technology packages

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SunHorizon: Demosites

Nº	Location	Climate	Building type	SunHorizon TP
1	Berlin (Germany)	Cold	Small residential	**TP1**: TVP+BH
2	Nürnberg (Germany)	Cold	Large residential	**TP2**: DS+BH
3	Saint Cugat (Spain)	Warm	Tertiary (Civic centre)	**TP3**: TVP+FAHR
4	Madrid (Spain)	Average	Large residential	**TP4**: DS+BDR
5	Cluj-Napoca	Cold	Dormitory	TP1: BH+TVP+DS
6/7	Riga (Latvia)	Cold	Small residential	**TP2:** DS+BDR

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Demo sites

Madrid

Social housing demo in Spain

$35.5_{SH}/83.8_{SC}/5.5_{DHW}$ MWh demand :

- 50 m² DualSun PVT panels
- $1.0_{SC/SH}$ / 1.3_{DHW} m³ Ratiotherm tank
- Reversible HP $9_{BW}/27_{AW}$ kW BDR Thermea
- $f_{sav.GHG}$ = **54-70%, 37% cost savings**

Sant Cugat

Civic center in Spain

$35.5_{SH}/83.8_{SC}$ MWh demand :

- 192 m2 TVP LTpower panels
- 10 m³ buffer tank Ratiotherm
- $50_{VCV}/20_{SORP}$ kW Fahrenheit hybrid chiller
- $f_{sav.GHG}$ = **33%, and 35% of cost sav**

RIGA

Single houses (2) in Latvia.

BDR Thermea **heat pump** Water/water heat pump GSHP 9 TR-E (**9** kW)

Back-up gas boiler MCR 24/28 MI (**24** kW)

DualSun **PVT panels** *Spring*

- 315 Wp / 375 Wp nominal power
- ~**30** panels / 50 m2 per house
- ~**10.5** kWp DC / 8 kW AC per house

•Ratiotherm thermal **storage tanks**

•**1300** L stratified storage Oskar

•**200** L cold glycol storage

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Thank you !

Serena Scotton serena.scotton@rina.org

https://sunhorizon-project.eu

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Heat Pump Applications in Residential Buildings: Insights and innovations

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Jon Iturralde
Tecnalia

SUNHORIZON: Sun Coupled innovative heat pumps - Final conference

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HAPPENING

HeAt PumPs in existing multi-family buildings for achieving union's ENergy and envIromeNtal Goals

Jon Iturralde
(TECNALIA)

SunHorizon Final Conference
September 27, 2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957007

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1. About HAPPENING: background and goals
2. HAPPENING concept
3. HAPPENING demo cases
4. Conclusions

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957007

1. About HAPPENING: background and goals

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957007

Background

- Currently, **buildings** are responsible for 40 % of the energy demand and 36% of the **CO_2 emissions** in Europe.
- **Decarbonisation** of **existing buildings** plays a key role to reach the overall climate protection targets..
- However, current **renovation rates** lie in the order of **1%**.

- **Heat pumps** are a key technology to efficiently decarbonize the heat supply of buildings.
  - They are particularly good at brining high shares of **renewable energy self-consumption** when **combined** with local clean electricity production (e.g. PV)
  - However, their current installation rates in existing multi-apartment buildings is **still marginal**.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957007

Barriers for multi-family building retrofitting

- **Technical challenges** for the implementation of **heat pumps** in existing multi-apartment buildings are e.g.:
  - High **heat losses** in the distribution pipes
  - **High temperature** level requirements in the heating system

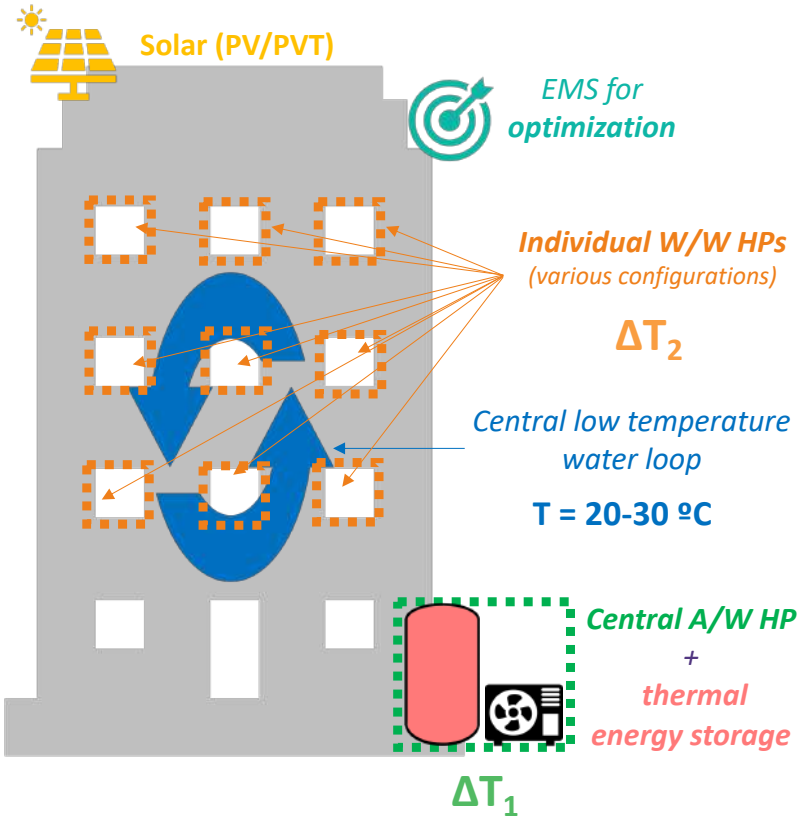
- **Non-technical challenges** arise mainly from the following points:
  - Lack of knowledge and training of installers >> high planning effort and higher risks for installation and operation
  - Lack of information on verified performance of heat pump systems in existing multi-apartment buildings
  - Higher initial cost in comparison to fossil-fueled standard technologies

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957007

2. HAPPENING concept

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957007

Proposed solution: HAPPENING concept



HAPPENING concept is based on cascade heat pumps:

1. 1st thermal gap (ΔT_1) > **Central** air-to-water HP generating "neutral temperature" water (20-30ºC)
2. **Thermal energy storage:** decoupling of generation/consumption
3. **Distribution** at low temperature (20-30ºC) to dwellings (minimization of distribution heat losses)
4. 2nd thermal gap (ΔT_2) to consumption T done **individually:**
   - Optimized demand response adjusted per dwelling
   - Balancing of different thermal loads
   - Different configurations possible for each user
5. Locally generated and consumed **renewable energy**
6. **Smart** management and **control system** for optimization

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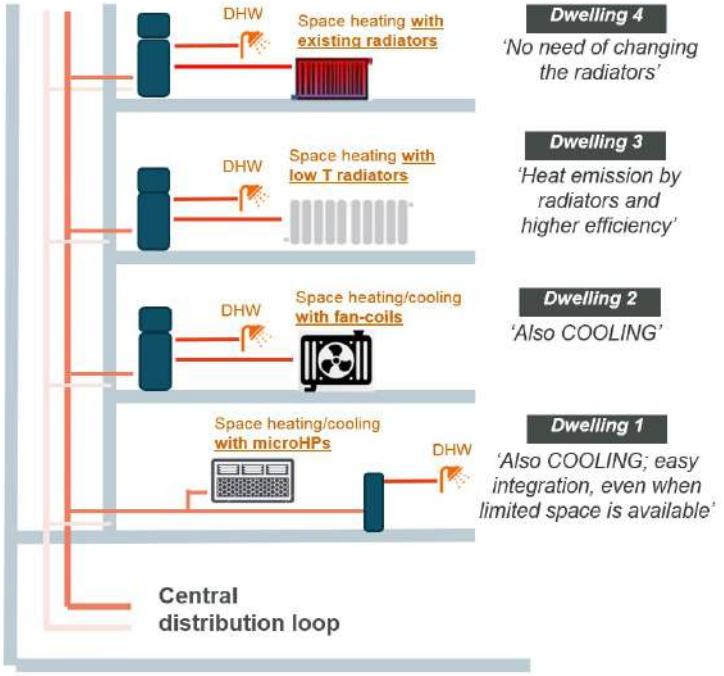
Proposed solution: HAPPENING concept

Great variety of possible **configurations** within the same building in order to meet the requirements of each user in terms of HP and emitters:

- Amount of works
- Installation cost
- Efficiency (OPEX)
- Preferred emitter

} Tailor-made solution



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3. HAPPENING demo cases

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Pasaia demo (SPAIN)

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HAPPENING PASAIA

PASAIA demo building

- North of Spain, next to San Sebastian
  - **Mild climate**
- Built in **2008**
- Owned by ALOKABIDE = **public social housing**
- **8** medium sized **dwellings**
- Current equipment
  - Individual gas boilers
  - Solar thermal (out of order)
  - Double radiators (reutilization)

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HAPPENING system in PASAIA

- **Central** level:
  - 2x18 kW air-to-water HP
  - 2000 l TES
- Low temperature distribution
- **Dwelling** level:
  - 6 kW water-to-water HP (incl. DHW tank)
  - Existing radiators
- **PV + electric battery**

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HAPPENING PASAIA

Verzuolo demo (ITALY)

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HAPPENING VERZUOLO

VERZUOLO demo building

- Northwestern Italy
  - Cold winters and **hot summers**
- **Historic building** retrofitted in 2008
- **Private** ownership
- Restaurant in the basement + **10 small dwellings**
- Current system:
  - Central gas boiler for heating + DHW
  - **Fancoils**
- New system:
  - A/W HPs (central) + TES
  - W/W HP for DHW
  - W/A **microHP for both heating and cooling (R290)**

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HAPPENING VERZUOLO

HAPPENING system in VERZUOLO

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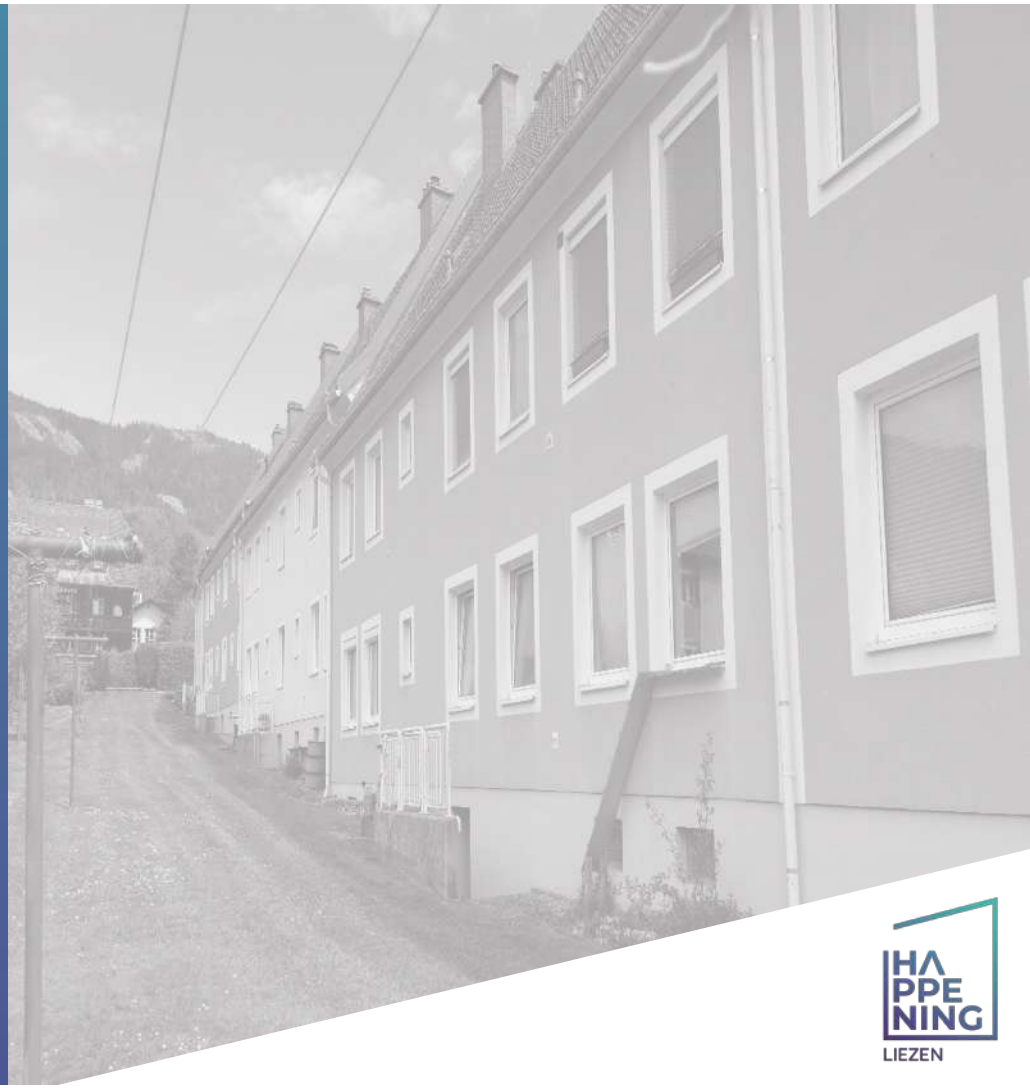
Liezen demo (AUSTRIA)



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HAPPENING LIEZEN

LIEZEN demo building

- Central **Austria**:
  - **Cold winters**
  - No cooling demand
- **18** medium sized dwellings
- Ownership: GWS, **social housing** entity
- Typical kind of building→ high **replicability** potential
- Envelope recently retrofitted

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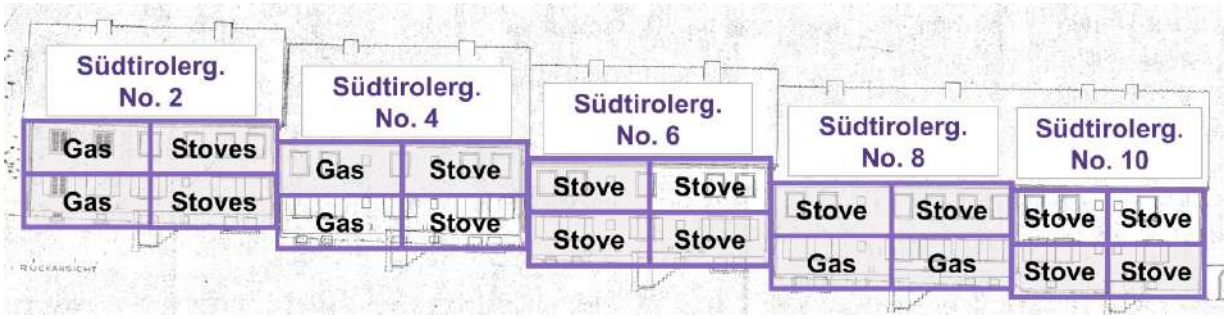
LIEZEN - Existing installation

- **Various** space heating and DHW solutions:
  - Individual gas boilers + radiators
  - Old stoves + electric boilers



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HAPPENING system in LIEZEN

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4. Conclusions

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The HAPPENING concept provides the best aspects of both central and individual systems:

- As the **generation is decoupled from consumption**, thanks to the 2 levels of generation separated by the TES, the smart controls can **optimize the COP of the central HP and maximize the consumption of locally generated renewable energy,** for example storing hot water in the central hours of the day.
- **Drastic reduction of heat losses** thanks to the distribution at low temperature
- The **COP** of the **individual heat pumps** will be very **high and constant**, thanks to the intermediate water loop
- **Versatility**, as each single dwelling can decide the configuration that better fits their needs and interests
- **Scalability**, demonstrated thanks to the 3 demo sites in the project, different in size, climate and regulation

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Thank you!

Jon ITURRALDE
jon.iturralde@tecnalia.com

More information:
https://www.happening-project.eu/
info@happening-project.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957007

Irene Egea Saiz
EHPA

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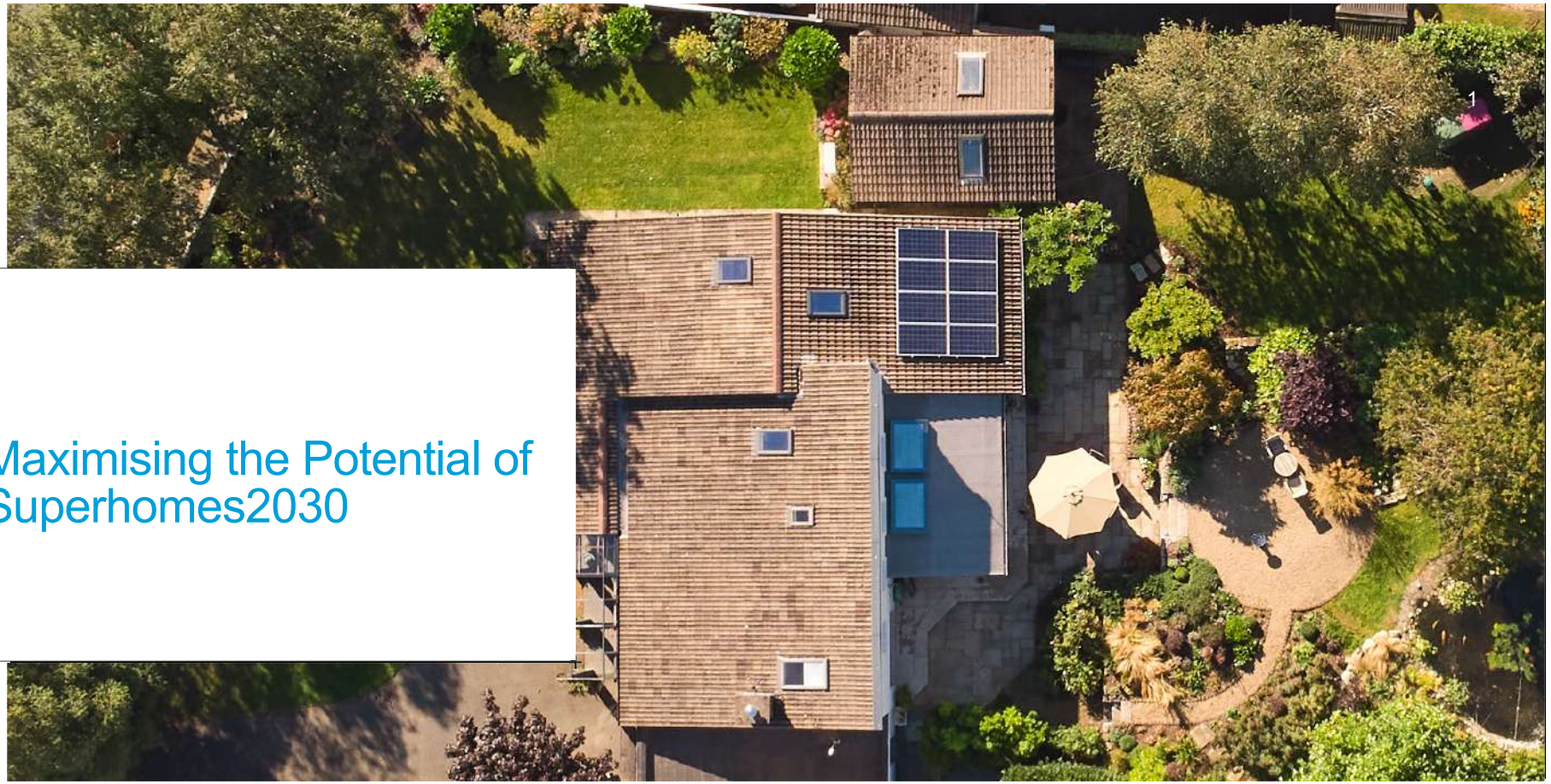
Maximising the Potential of Superhomes2030



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 890492 (Superhomes2030)

electric Ireland Superhomes

Electric Ireland Superhomes

superHOMES

+ Deep retrofitting homes since 2015
+ One Stop Shop
+ c.30% of market
+ Multiple contractors
+ Technical excellence

electric Ireland

+ Largest utility in Ireland
+ 1.2m retail customers (Ireland & UK)
+ Clean Energy & Decarbonizing Heat

electric Ireland Superhomes

Our target is

35,000 homes

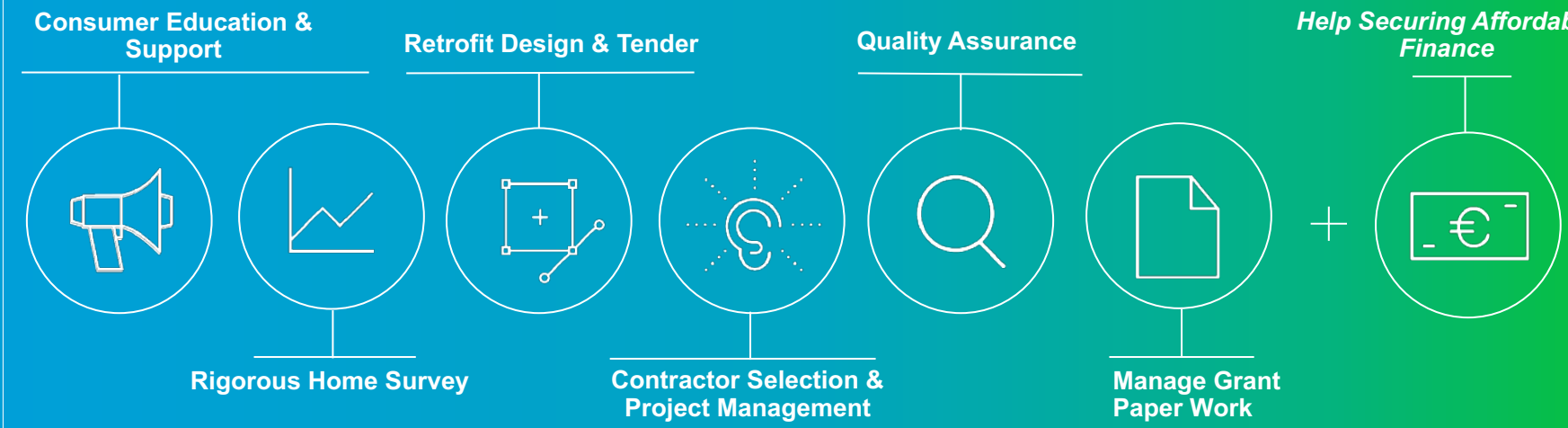
by 2030

Objective: Develop the Electric Ireland Superhomes approach as a trusted model in the Irish Deep Retrofit Market with minimum 500 retrofit completions per annum by 2023

Key Indicators of Success:

- One-Stop-Shop established which provides services & advice to the value chain
- Growth of technical and support staff
- Increased awareness, trust in and engagement with the brand across all communication channels
- Residential retrofit completions as per plan (within 24 months of this project, Superhomes2030 surpassed 200 retrofits and at the end of this year, it will be over 500. The plan is to keep increasing the number after the completion of the project)

We are a Retrofit One Stop Shop – this is what we do:

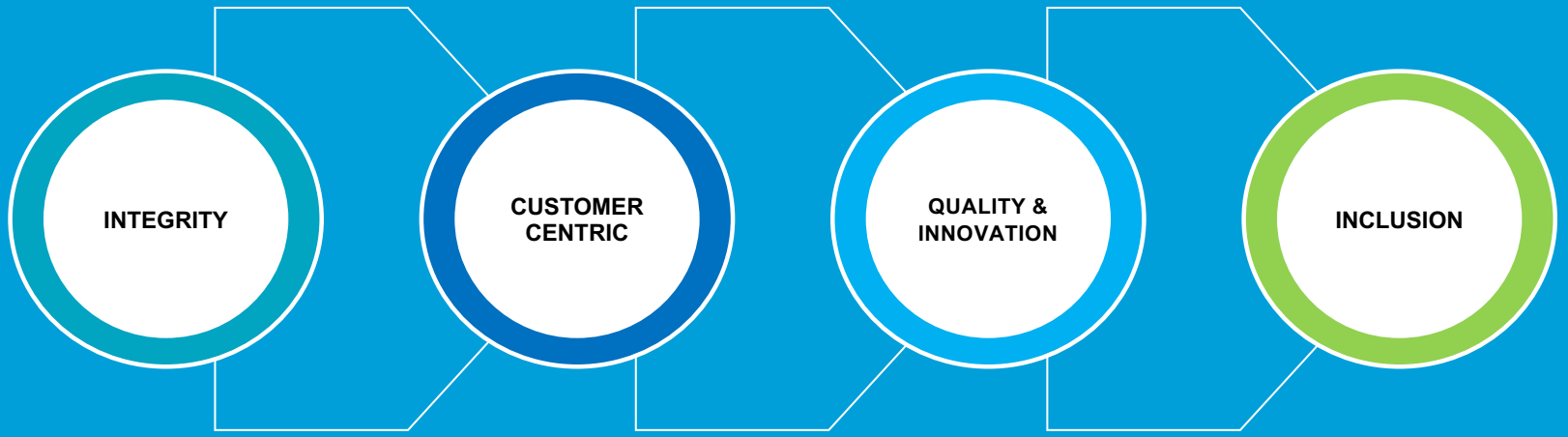


electric Ireland Superhomes

Who?

We empower our customers to achieve warmer, healthier, low-carbon homes.

Our Values


INTEGRITY
CUSTOMER CENTRIC
QUALITY & INNOVATION
INCLUSION

What?

Technical Standards & Delivery Partner Development

- What is Needed to Deliver Consistently?
  - + High Quality & Standardisation
  - + Knowledge Transfer & Upskilling
  - + Partnership Approach (building up collaborations and working with others)

Objective: To ensure that Electric Ireland Superhomes adopts and implements best practice solutions and technologies in line with new innovations in technology and processes

Technologies and solutions which are appropriate to deep retrofitting are constantly evolving and developing. Standards and best practice procedures need to be developed and applied to ensure that Electric Ireland Superhomes is at the forefront of technological innovation.

Key Indicators of Success:

- 1 Guideline on Best Practice Standards and solutions
- >1,000 unique users of Electric Ireland Superhomes Knowledge Portal website
- Training 200 Contractors/SME staff (that has been surpassed,, it needs to continued on. We would like to keep increasing the deep retrofit community in Ireland once the project is finished)

Objective: Develop a network of High Performing Contractors across Ireland, supported by Superhomes One Stop Shops, to deliver high quality deep retrofits

Contractors and SMEs working in the construction sector need to be enabled to engage in the retrofit market.

Key Indicators of Success:

- Scaling Number of Electric Ireland Superhomes Contractors from 40 (2021) to >80 (more than a 100 contractors at the moment)
- Training of 50 SMEs and 200 professionals and workers on Electric Ireland Superhomes Standards (we surpassed that as well)
- Input to National Standards and Policies on Residential Deep Retrofit

electric Ireland Superhomes

How?

electric Ireland Superhomes

Objective: Expand the Electric Ireland Superhomes Solution Regionally to cover 70% of the population and Optimise Business Processes thereby improving efficiencies

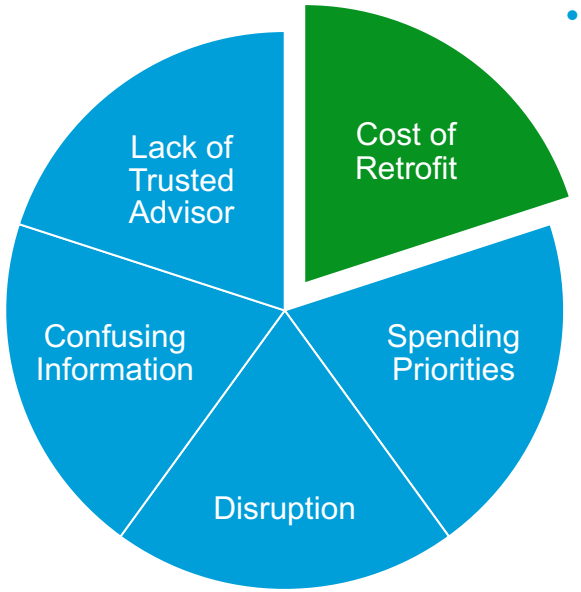
The fragmented nature of deep retrofit projects introduces inefficiencies and high overhead costs in the process. Applying Lean Solutions and Design Thinking methodologies can enable improved performance and high-performance projects to be delivered

Key Indicators of Success:

- Opening of Regional One Stop Shops hubs plus increased Electric Ireland Superhomes staff resources delivering the OSS service (done, and will continue doing that)
- Maintained high levels of customer satisfaction rates from Electric Ireland Superhomes customers (done, and will continue doing that)
- Implement Process Solutions to reduce Superhomes “Journey” time by a minimum of 10% (done, and will continue doing that)

Key Barriers?

Barriers for Customers



- Cost of Retrofit and Upfront Costs of Homeowner Investment is a Key Barrier!

electric Ireland Superhomes

Partnerships Model:
Helping Customers Break- Down Key Barriers

- Registration as a SEAI One-Stop-Shop in Ireland to support homeowners access government grant subsidies for residential retrofits
- Partnerships with Finance Lenders to support homeowners access low-cost green loans with easy access routes
- Educate and Raise Awareness

electric Ireland Superhomes

Objective: To design and pilot an innovative deep retrofit finance solution which aligns with market demand and policy objectives and supports €50m of residential retrofit investments

Outside of government grant funding, to date the dominant source of finance from Electric Ireland Superhomes customers who have completed deep retrofits since 2015 has been savings/own funds with some utilising a mixture of secured and unsecured loans. However, many of those applying for and subsequently dropping out of Electric Ireland Superhomes have cited finance as the key barrier. 40% have indicated that they would avail of a suitably designed financing solutions if one was available.

Key Indicators of Success: (Pilot it is still running at the moment, we are in development stage)

- An agreed proposal for an Electric Ireland Superhomes Finance Solution to be offered to by finance providers to our customers as part of a pilot programme
- Testing the financial solution with Electric Ireland Superhomes customers in a Pilot Superhomes Finance Programme to finance up to €10m, within 1 year, of residential retrofits and support the transition from public funded retrofit programmes to market financed solutions. The pilot is due to commence in Q2 of 2022 with one bank and one credit union group.
- €10m of financing availed of from the market by end of the project, increasing to €50m by 2030

electric ireland Superhomes

Watch recording here

electric Ireland Superhomes

Thank you

Monitoring outcomes, KPIs and lessons learned from the Demo-sites

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Diego Romera

Empresa Municipal de Vivienda of Madrid

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EMVS

Speaker: Diego Romera

27/09/2023

SUNHORIZON

Demo: Tres Peces 9, Madrid, Spain

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Madrid Housing and Land Agency (EMVS)

- Limited company with 100% municipal capital, linked to Madrid City Council.
- Develop the SOCIAL housing policy of the City of Madrid.
- Building Stock: 7000 Dwellings

Demo Building Selected

- Owner: EMVS
- Activity: Residential Building for Social Rental
- Location: Tres Peces 9, Madrid
- Year of construction: 1.948
- Number of Floors: 5
- Number of Dwellings, 9
- Built Area. 1.072,16 m2

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Demo Madrid – INTRODUCTION OF THE BUILDING

Initial State

- General bad state of envelope (façade, roof, internal courtyard)
- No insulation layer
- Basic single glazed windows
- Moisture problems inside the dwellings
- Bad Accessibility
- Individual old Energy systems.

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Demo Madrid – INTRODUCTION OF THE BUILDING

Building Renovation Overview:

- 2017- Retrofitting Project: Consist of improvement of the building envelope (façade, roof, windows) and the accessibility
- 2018 – European RD Project SUNHORIZON: Renovation of HVAC systems, moving from individual to centralized. Integration of renewable energy systems.






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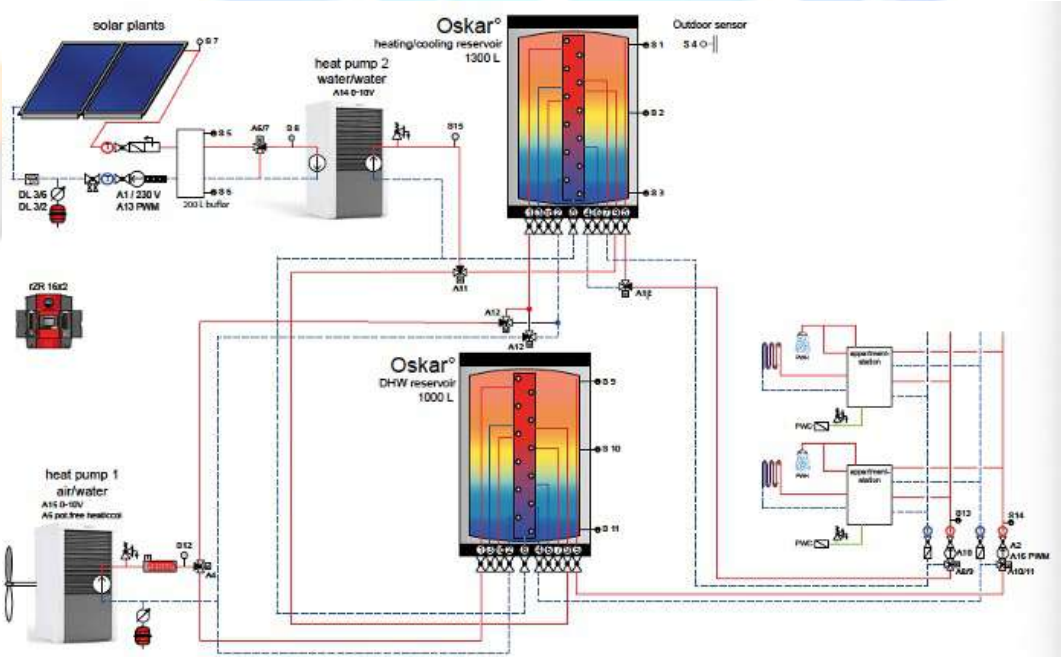
Demo Madrid – INTRODUCTION OF THE BUILDING

SUN HORIZON TECHNOLOGY PACKAGE

- 50m² DualSun PVT panels on the roof
- 1.0 SHC / 1.3DHW m3 Ratiotherm tank
- Reversible HP 9BW/27AW kW BDR Thermea
- Monitoring & Controls Schneider

DWELLING LEVEL TECHNOLOGY IMPLEMENTATION

- Adapt dwelling Energy terminal units for the new centralized systems: Fan Coils for SHC, Heat Recovery Units for Ventilation, Heat Exchanger for instataneous DHW preparation



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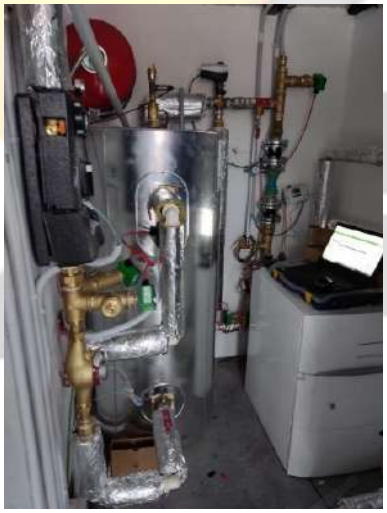
Demo Madrid – INTRODUCTION OF THE BUILDING



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DESIGN PHASE

- Reduction in unforeseen event during the renovation works and commissioning phases:
  - Reduction of Deadlines
  - Reduction of Costs
- Improvement of quality
- Local Design Team

TENDER PROCESS

- Public Administration must follow very specific contracting laws ⟶ Long process
  - Foresee in the general Planning of the Project
- R&D Projects with considerable technical complexity
  - Detailed definition of the Technical requirements of the bid specifications
  - Main contractor must have wide experience and proven skills

Involvement of R&D Project Partners:

- Project partners (Technology Manufacturers) must be very collaborative and work very closely with the Demo partners, Design local team and Main Contractor during all phases

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MONITORING & CONTROL SYSTEM

- Asses and Ensure the success of the Project
- System Operation Continuous improvement
  - Reach maximum efficiency of the Energy Generators
  - Maximize use of Renewable energy. Adapt consumption an generation curves.
    - Storage the excess of electric generation from PV in Thermal energy
  - Reduction of energy consumption
  - Improvement of the comfort condition inside the dwellings
- Optimization of the Maintenance:
  - Fast detection of malfunctioning thanks to the alarms system
  - Preventive maintenance.
  - Extend the useful life of the equipment

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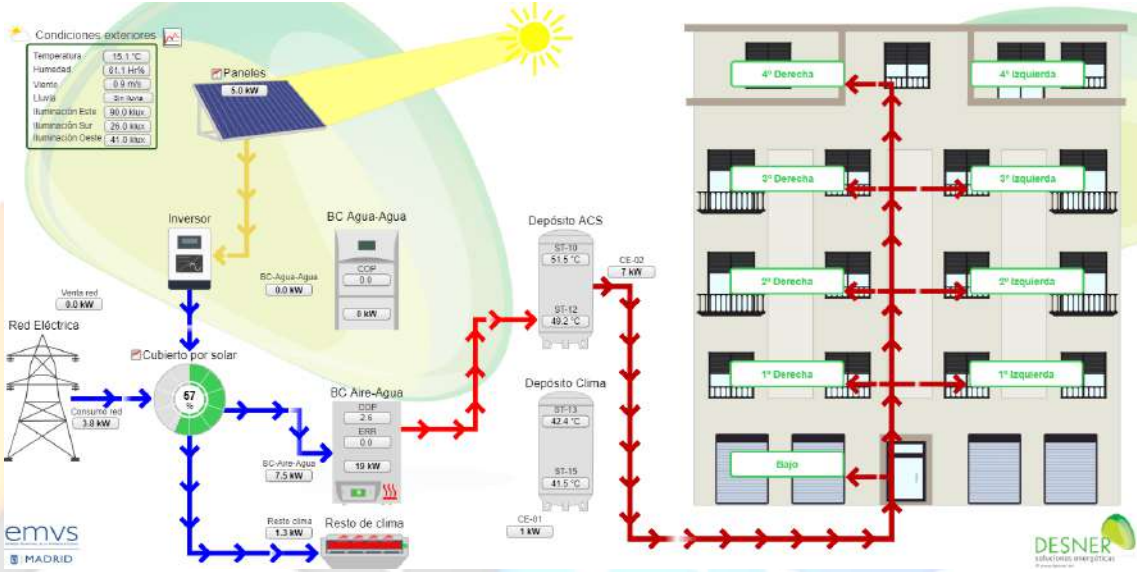
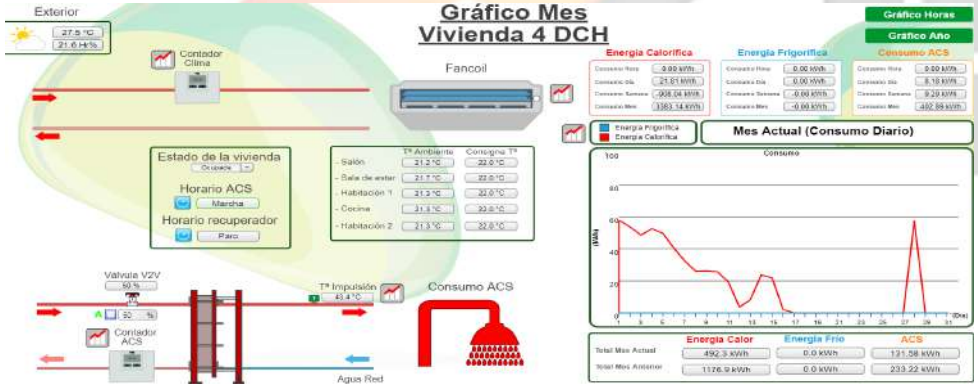
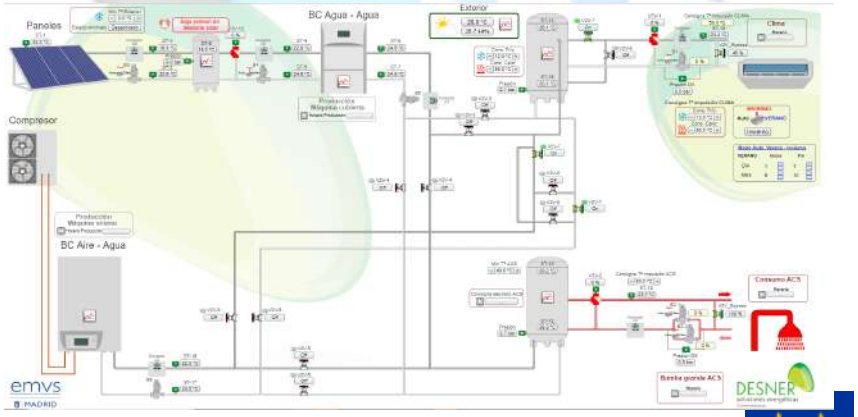
Demo Madrid – LESSONS LEARNED

- Development of a Scada platform ad hoc for:
  - System Operation
  - Monitoring Data Visualization and Collection
  - Energy Billing







This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

CONCLUSION

- Prove great results in **coupling Heat Pump technologies with PV renewable systems**.
- Test the use of **Water/ Water Heat Pumps for retrofitting**. High efficiency COP:5-6.
- **75%** Primary Energy Consumption Total Reduction
- High **potential for improvement and replicability** in building retrofitting projects.

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

Thanks for your attention

Diego Romera Pascual

romerad@emvs.es

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Gerard Riba

Ajuntament de Sant Cugat del Vallés

SUNHORIZON: Sun Coupled innovative heat pumps - Final conference

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Speaker: Gerard Riba (AJSCV)

27/09/2023 – Final Conference – Brussels

SunHorizon
Work Package 6 - Demonstration at TRL7
"Demo site 3 : Sant Cugat"

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Content

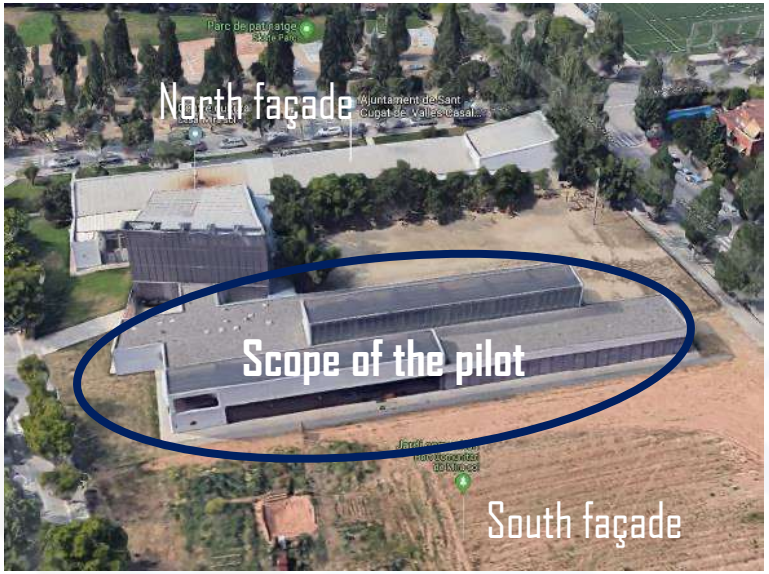
1. Pilot Description
2. HVAC before the pilot
3. SunHorizon Technology
4. Design Installation
5. Conclusions & Lessons Learnt
6. Photos of the installation

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

Pilot description

System before the pilot:

- Year of construction: 2006
- Occupancy: between 40-150 people
- Type of building: Tertiary Civic Center. Municipality
- Surface: 2.440,25 m2
- Number of floors: 1
- Roof; accessible, unobstructed and shaded-free



Weather Conditions

- Mediterranean climate
- Yearly Averaged Insolation on a Horizontal Surface: 4,31 kWh/m2/day

Energy demand

- 202.517 kWh/year (electricity) No gas consumption, No renewable sources

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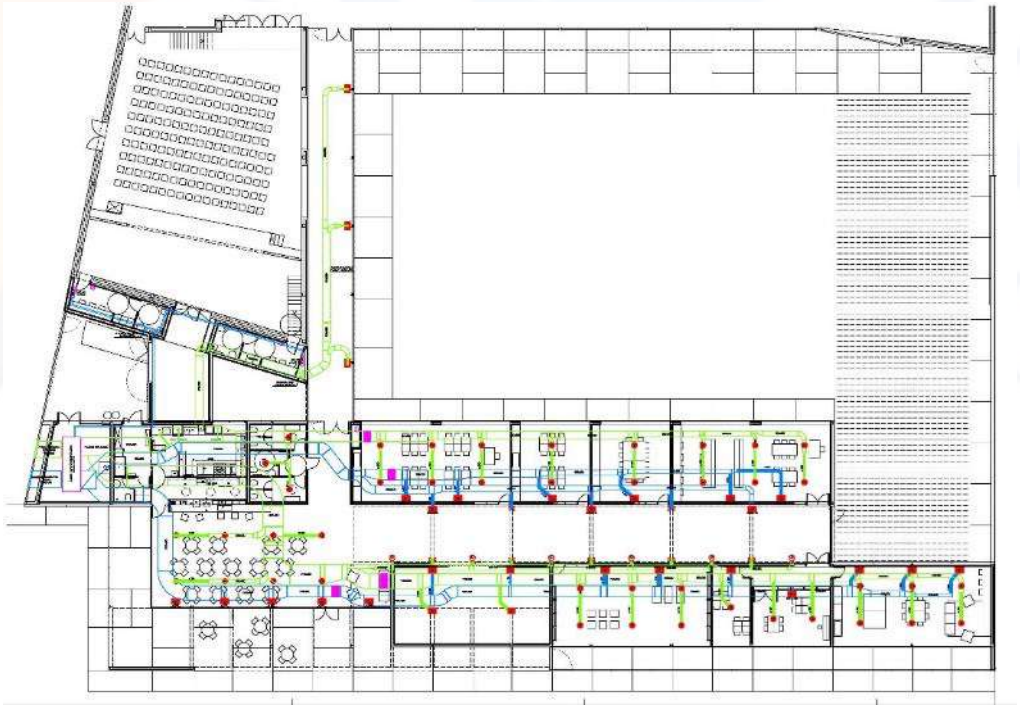
HVAC System before the pilot

Currently, the heating and cooling installation is formed by the following equipments:

- **Reversible air to water heat pump:** 93.6 kW (cooling capacity) – 96.3 (heating capacity)
- **Air handling unit (AHU):** 110 kW (cooling capacity) – 67.78 (heating capacity)



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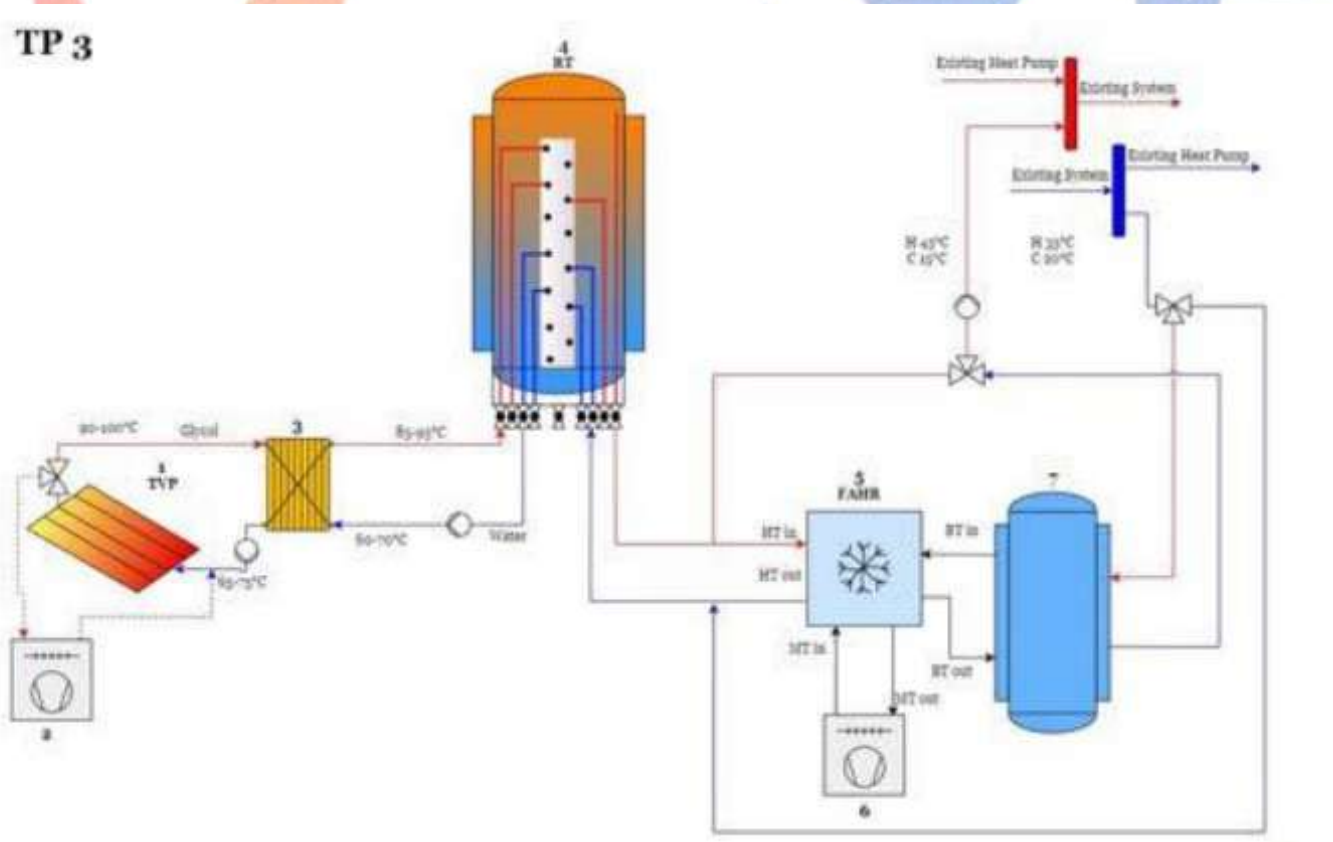
SunHorizon Technology (TP3)

TP3: Solar-driven HP for cooling; Farenheit hybrid chiller is driven by solar thermal collectors from TVP, which are also used for heating in winter



This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

Design installation

VEOLIA

Design & Installation

TVP SOLAR

Solar Pannels

192 m2 (98 panels)

FAHRENHEIT

Hybrid chiller

125 kW

ratiotherm

Thermal Tank

10,000 l

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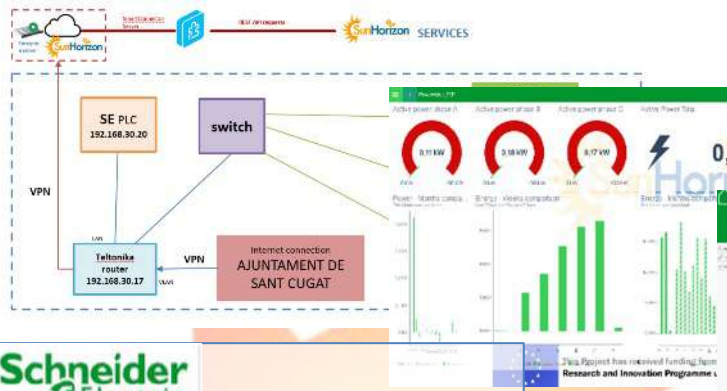
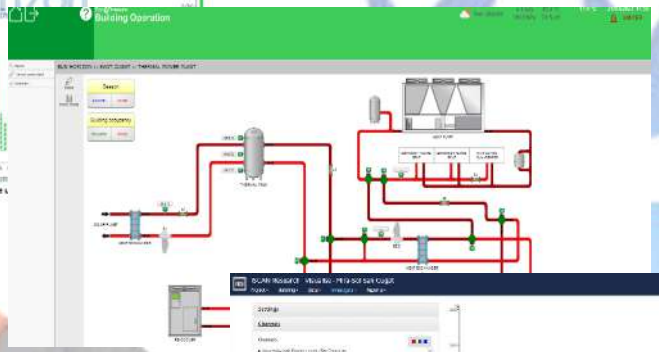
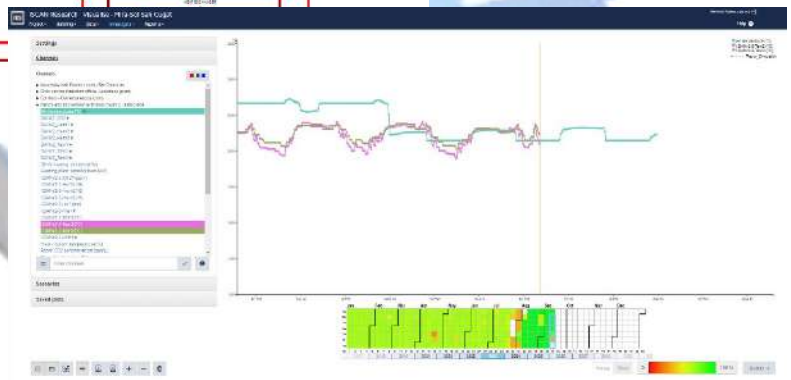
Design installation







Schneider Electric

Snsoration, SCADA & BMS Design

CARTIF IES Consiglio Nazionale delle Ricerche ITAE

Monitoring & KPI calculation

RINA ehpa european heat pump association

Coordination & Dissemination

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Conclusions – Lessons learnt

- The importance of **teamwork**. There are always unforeseen events.
- Design **review after commissioning** (e.g. alarm signals)
- **Particularities in each country** for its processing. Permits, licenses, certifications.
- Sant Cugat as **public administration**. Match the project timeline.
- **Data management** once the project is finished.
- Very technological and innovative systems that require **greater follow-up and preventive maintenance actions**.
- **Robustness of the sensors**.

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Photos of the installation

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

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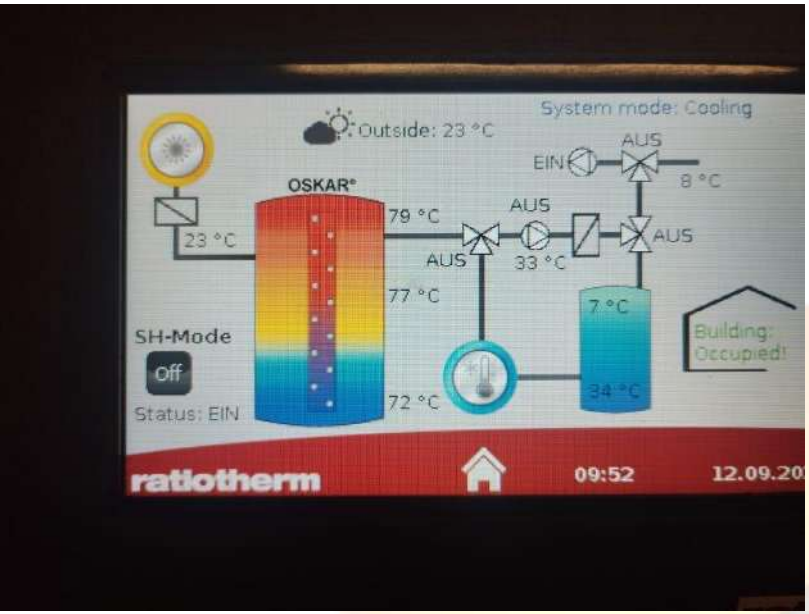

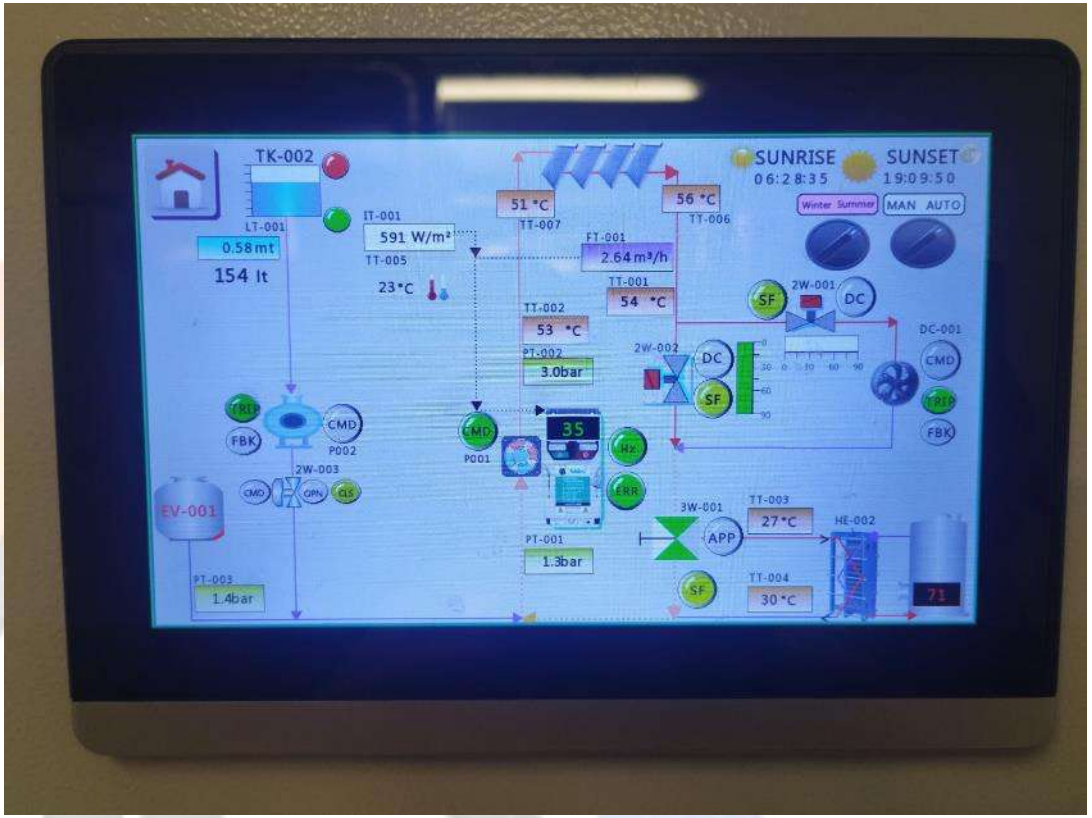

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Thanks for your attention

Gerard Riba (Sant Cugat City Council)
gerardriba@santcugat.cat

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Zane Broka
Riga Technical University

SUNHORIZON: Sun Coupled innovative heat pumps - Final conference

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

SunHorizon: Suncoupled innovative heat pumps

Introduction to the demo sites and lessons learned

Demo 8 – Riga, Latvia

Demo manager: **Riga Technical University**
Speaker: Senior Researcher **Zane Broka**

27/09/2023 – Final conference – Brussels

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Outline

- Riga demo site overview
- Technology package 2: layout and components
- TP2 installation in pictures
- Lessons learned

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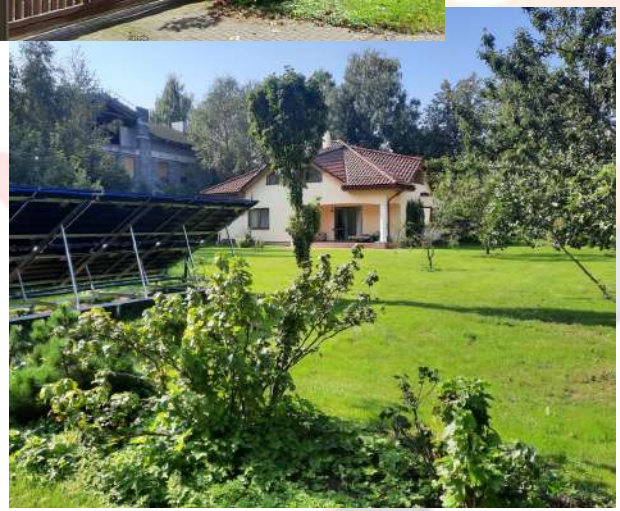
Demo site overview: Riga, Latvia



Imanta demo site (built in 2013)

235 m^2 heated space

4.4 MWh/year electricity consumption

39.6 MWh/year = **168.5** kWh/m^2 gas consumption

Sunīši demo site (built in 2012)

96 m^2 heated space

7.2 MWh/year electricity consumption

21 MWh/year = **218.8** kWh/m^2 gas consumption

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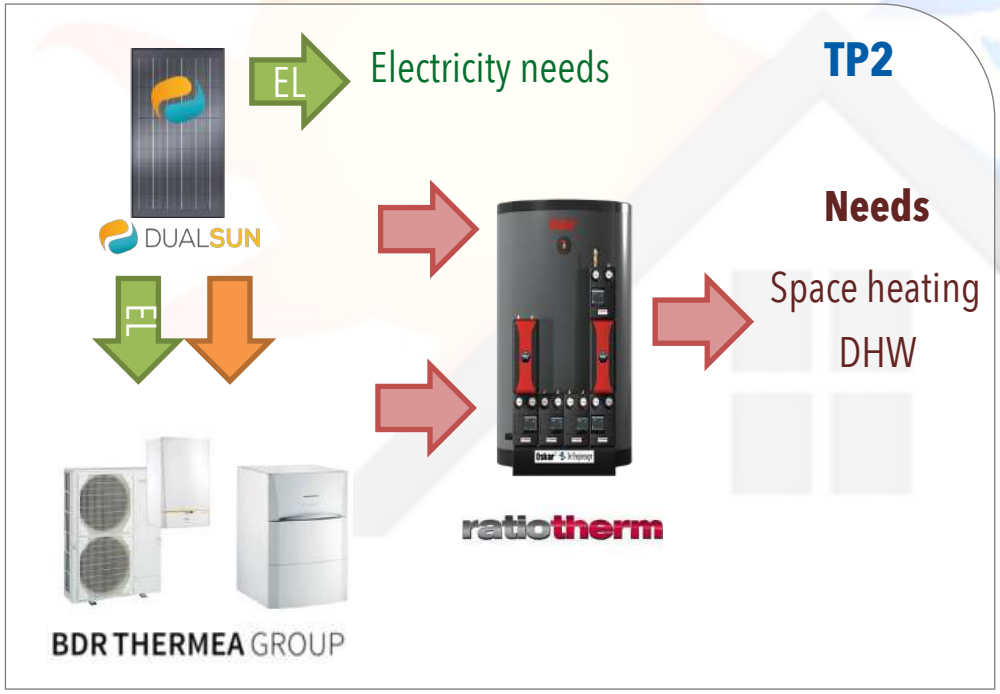
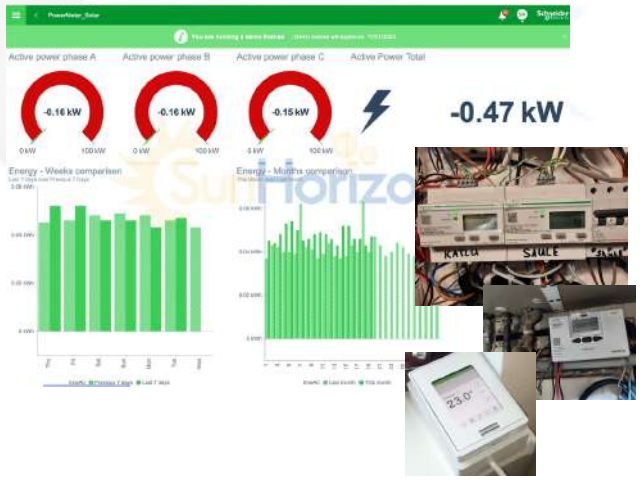
SunHorizon technology package 2 in Riga demo

- BDR Thermea **heat pump**
  - Water/water heat pump GSHP 9 TR-E (**9** kW)
  - Back-up gas boiler MCR 24/28 MI (**24** kW)
- DualSun **PVT panels** *Spring*
  - 315 Wp / 375 Wp nominal power
  - ~**30** panels / 50 m2 per house
  - ~**10.5** kWp DC / 8 kW AC per house

- Ratiotherm thermal **storage tanks**
  - **1300** L stratified storage Oskar
  - **200** L cold glycol storage
- **Additional components** from Ratiotherm:
  - DHW station (HX + pump) TWK-S70-VA
  - Solar station (HX + pump) SOK 40-60
  - Electrical heater Smart Energy (PV)
  - rZR16x2 **central controller**



Schneider **monitoring system**



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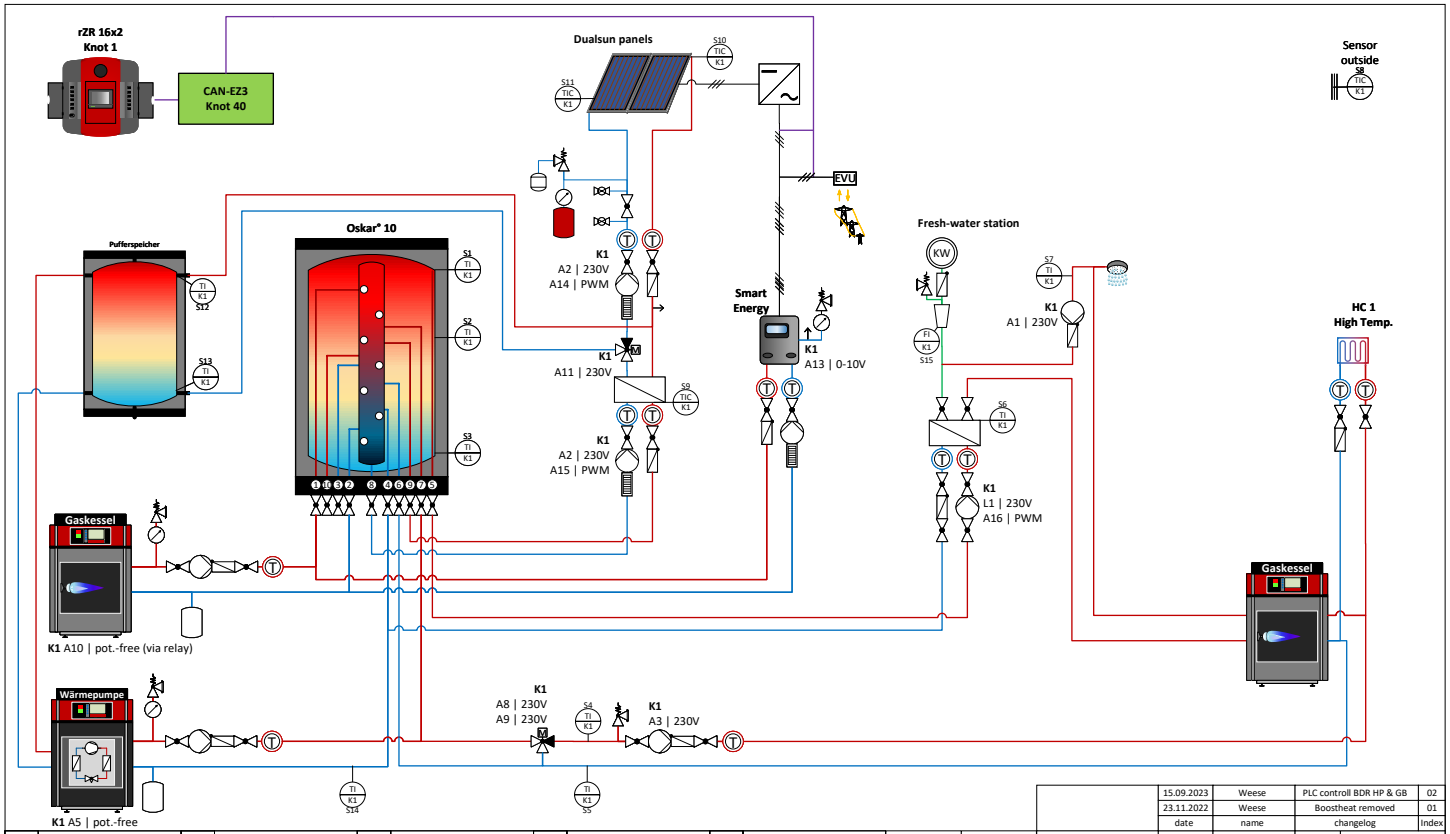
TP2 diagram in Riga demo



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TP2 installation & commissioning in Riga

Installation of **buried heat piping** in summer 2021

Imanta




Sunīši



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TP2 **installation & commissioning** in Riga

Installation of **TP2 components** in Imanta and Sunīši in autumn 2021










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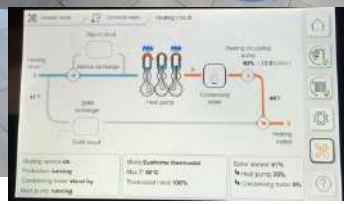
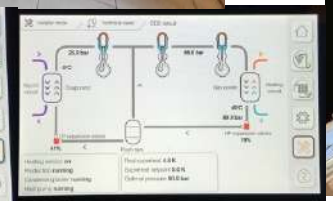
TP2 installed in Imanta, Riga







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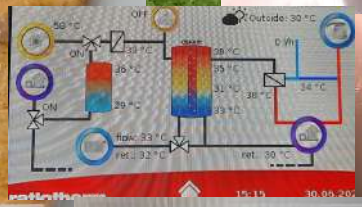
TP2 installed in Sunīši, Riga



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Stakeholder engagement

- public tender:
  - thorough **market research** as early as possible
  - still, **very few** interested installers
  - **unsuitable** for innovative projects due to uncertainties
- project-wide **aligned process** for demo deployment
- a project partner in charge for the **detailed engineering** and technical support of all demos
- **all technical parties** to be involved as project partners
- comprehensive, **user-friendly information** to the demo participants / end-users
- agreement on the **post-project ownership, maintenance and warranty** of technologies at the very beginning of the project between the technology providers and demo owners

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Lessons learned from Riga demo (2/2)

Challenges due to the innovative nature of the TP2:

- **hands-on training** of the installer
- continuous **communication** with **all** the technology providers
- technology providers to **participate** in commissioning
- **real-time monitoring**

Flexibility, transparency and cooperation vital for risk mitigation:

- delays in due to the **pandemics** (R&D, manufacturing, lab testing, supply and staff shortages)
- **legislation** changes
- partner **interchangeability**
- flexible **monitoring** architecture
- adaptable **control** system

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Carolina Pastor de Paz
CARTIF

SUNHORIZON: Sun Coupled innovative heat pumps - Final conference

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Sun Horizon

T6.4 – Demonstration Campaign and Monitoring

CARTIF

Carolina Pastor

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Content

Overview of Project's monitoring data for each of the demosites:

- Measured data
- Monthly energy balances and KPIs

Yearly KPIs will be included within the next **Public** deliverable **D6.6** and compared with SunHorizon KPIs defined threshold:

Costumer's bills reduction [€]	GHG savings [kg CO2]	Non-renewable primary energy savings [%]	Renewable energy ratio [%]	Electricity self-consumption fraction [%]
up to 60%.	40 to 60% *	50% to 70% *	40 to 70% *	up to 80%

(*) expressed in relative values

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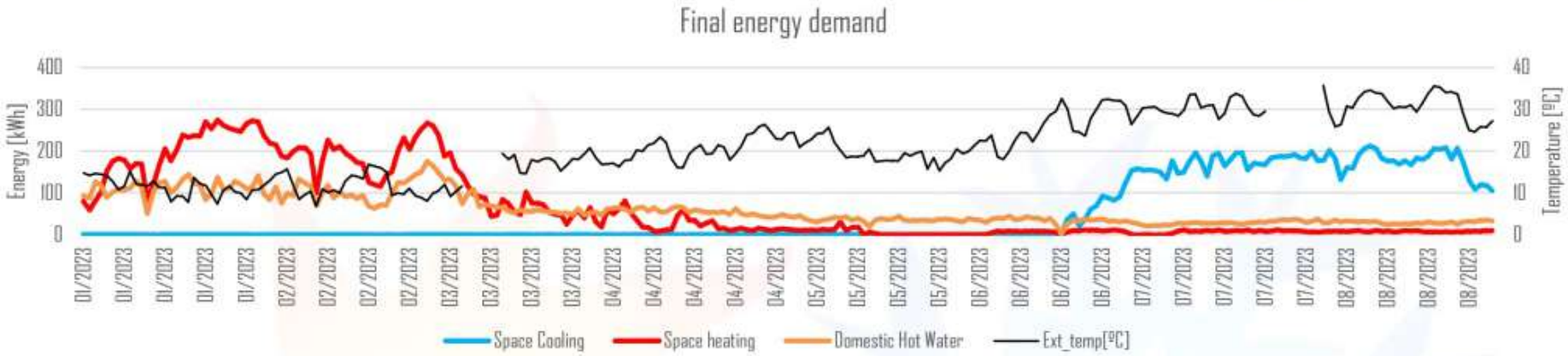
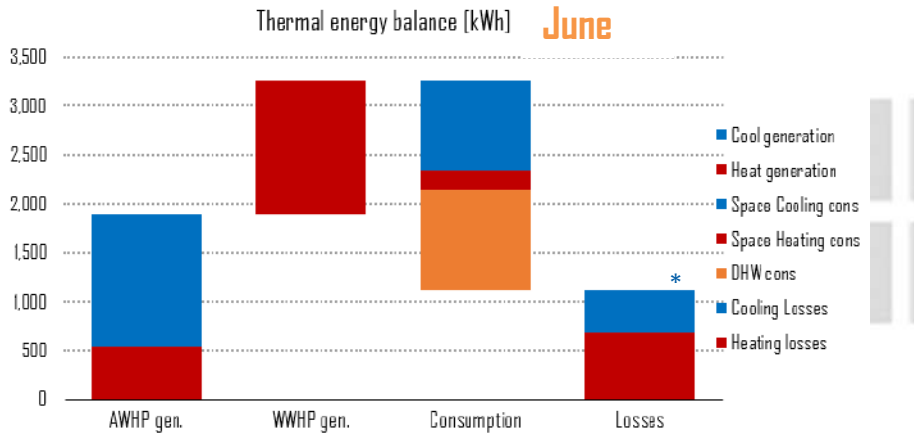
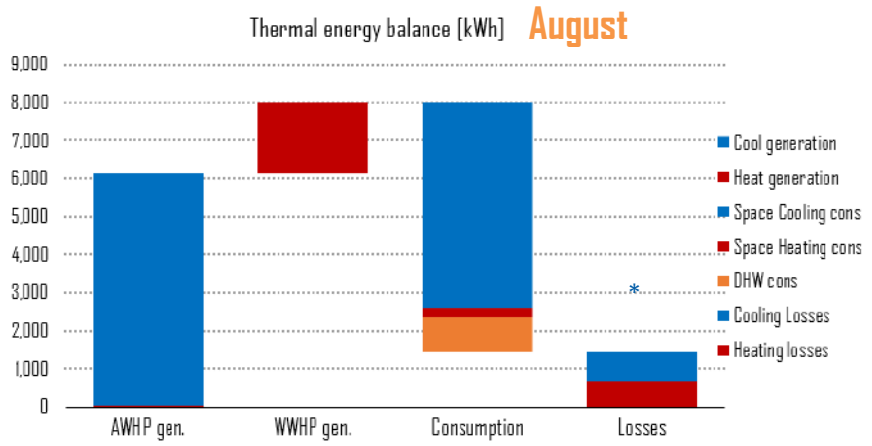
Madrid- Thermal energy for 2023



The monitoring started in 2023

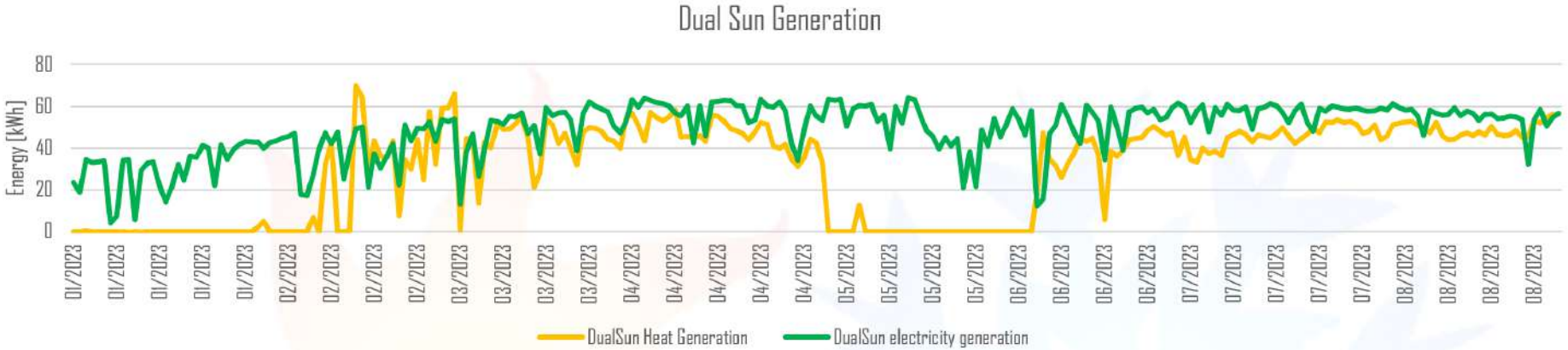
Sum of **Thermal energy consumption** of all dwellings; compared to ambient exterior temperature

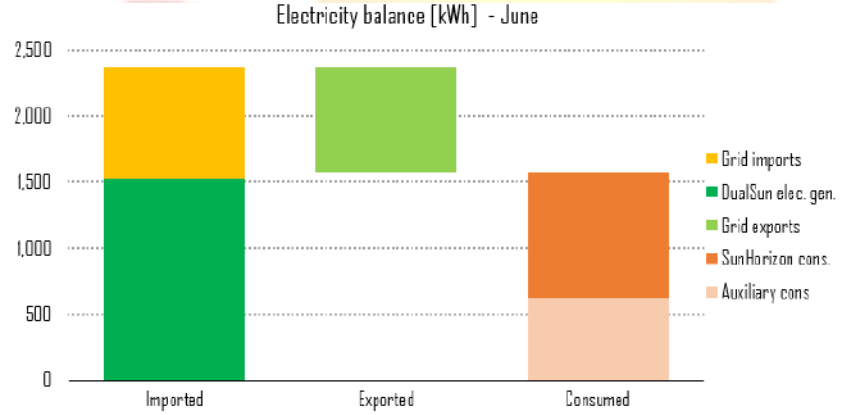


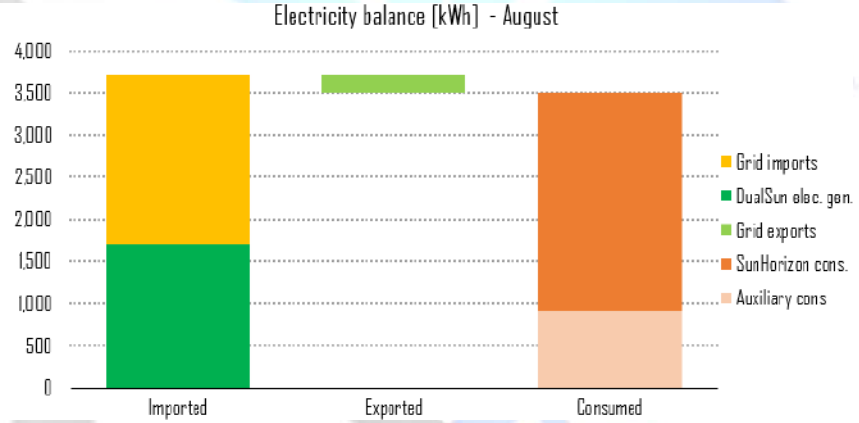


This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

Madrid –Electricity for 2023







Electricity self consumption ratio in June and August, has increased from 48% to 88%

That means that the **Grid exports** have been reduced, to cover higher electric consumption (mainly due to **Space Cooling generation** with the **AWHP**)

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Madrid – Monthly indicators

Madrid 2023	Grid imported [kWh]	DualSun elec gen [kWh]	Grid exported [kWh]	SunHorizon elec. cons. [kWh]	AWHP COP	WWHP COP	Energy bills Savings [€]	GHG savings [kg CO2]	PE_nren savings [kWh]	Renewable Ratio [%]	Elec. Self-cons. Ratio [%]
1	4137.4	933.0	156.7	3660.6	2.42	0.00	700.31	1576.68	6167.00	23.15%	83.20%
2	3583.2	1098.9	107.9	3122.5	2.83	4.48	596.24	1311.59	5077.42	28.34%	90.19%
3	2176.3	1540.7	693.9	2068.3	2.84	4.12	395.18	1162.45	5013.26	44.13%	54.96%
4	855.9	1711.4	917.7	1033.2	2.85	4.07	184.12	810.24	3845.98	52.14%	46.38%
5	715.6	1581.6	1036.8	658.0	3.20	2.17	99.16	539.13	2643.04	52.91%	34.44%
6	850.1	1518.9	790.0	950.9	2.99	3.73	90.56	496.13	2440.44	53.79%	47.99%
7	1904.6	1776.4	203.9	2595.7	2.86	4.22	82.30	510.21	2551.38	41.81%	88.52%
8	2001.6	1714.3	211.5	2588.5	2.96	4.29	86.98	500.74	2480.12	40.83%	87.66%
Total	6327.8	8302.6	3159.9	7826.3	2.87	3.38	543.12	2856.45	13966.97	42.14%	66.67%

(*) This savings have been estimated based on the impact the current energy demand would have generated with the original system configuration, that is:

- Natural gas boiler with a in efficiency of 80%; for Domestic Hot Water and Space Heating
- Split Air Conditioning unit with a COP of 2.5 for Space Cooling
- Current hourly electricity cost and mean natural gas cost

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SANT CUGAT Measured data since 2022

Elec.	kWh	General	Hybrid chiller	Pumps	ReCooler	TVP
2022	1	7764.7	0.0	0.0	0.0	0.0
2022	2	6819.3	0.0	0.0	0.0	0.0
2022	3	7304.8	0.0	0.0	0.0	0.0
2022	4	6102.0	0.0	0.0	0.0	0.0
2022	5	4195.2	5.6	325.7	1482.4	442.9
2022	6	4287.1	5.2	881.0	4008.8	482.0
2022	7	4040.1	5.1	972.2	4700.1	499.7
2022	8	1533.8	4.0	700.9	1225.0	494.0
2022	9	4649.9	2.2	293.6	1800.6	195.8
2022	10	4495.2	1.6	115.6	696.0	365.5
2022	11	4686.7	5.0	53.0	586.8	97.8
2022	12	7683.4	1.6	70.4	591.8	38.6
2023	1	7795.8	37.0	30.2	281.6	157.8
2023	2	6442.1	42.1	11.5	146.9	94.8
2023	3	3157.4	21.7	12.4	161.8	404.7
2023	4	2304.2	6.8	11.7	151.8	428.3
2023	5	4074.7	0.1	12.0	162.1	72.9
2023	6	6313.1	0.0	11.0	13.9	4.2
2023	7	8643.8	0.6	11.5	68.0	183.5
2023	8	9880.3	0.7	12.0	148.3	356.4

Heat	kWh	Clima cool	Clima heat	FAHR	General cool	General Heat	HyChill cooling	Tank cooling	TVP heat
2022	1	0.0	0.0	0.0	10.0	12180.0	0.0	0.0	0.0
2022	2	0.0	0.0	0.0	0.0	13590.0	0.0	0.0	0.0
2022	3	0.0	0.0	0.0	0.0	14000.0	0.0	0.0	0.0
2022	4	0.0	0.0	0.0	10.0	9340.0	0.0	0.0	0.0
2022	5	0.0	0.0	0.0	5470.0	1400.0	0.0	0.0	0.0
2022	6	0.0	2531.2	3504.0	14090.0	0.0	0.0	1558.2	494.0
2022	7	0.0	20284.8	27034.0	15240.0	0.0	0.0	10745.5	4276.7
2022	8	0.5	5429.9	7960.0	340.0	0.0	0.0	8692.2	3526.5
2022	9	1165.8	8822.2	11479.0	7930.0	110.0	0.0	3964.0	1613.5
2022	10	474.9	2992.5	4930.0	2290.0	650.0	0.0	2408.7	1318.8
2022	11	395.6	99616.5	1126.0	10.0	4530.0	0.0	768.2	172.1
2022	12	0.0	159853.4	1426.0	0.0	14460.0	0.0	81.6	0.0
2023	1	0.0	149314.2	539.0	0.0	16620.0	2567.6	4529.9	2861.2
2023	2	0.0	86540.7	0.0	10.0	11180.0	0.0	2794.2	1527.2
2023	3	0.0	121941.3	0.0	0.0	3410.0	0.0	3068.9	2814.9
2023	4	163.6	45474.5	1.0	0.0	1280.0	0.0	953.8	987.5
2023	5	3.1	0.0	0.0	10.0	1720.0	0.0	0.0	95.7
2023	6	0.0	0.0	0.0	20.0	9040.0	0.0	0.0	0.0
2023	7	0.0	0.0	0.0	10.0	16620.0	0.0	0.0	440.3
2023	8	0.0	0.0	1.0	40.0	18680.0	0.0	0.0	273.3

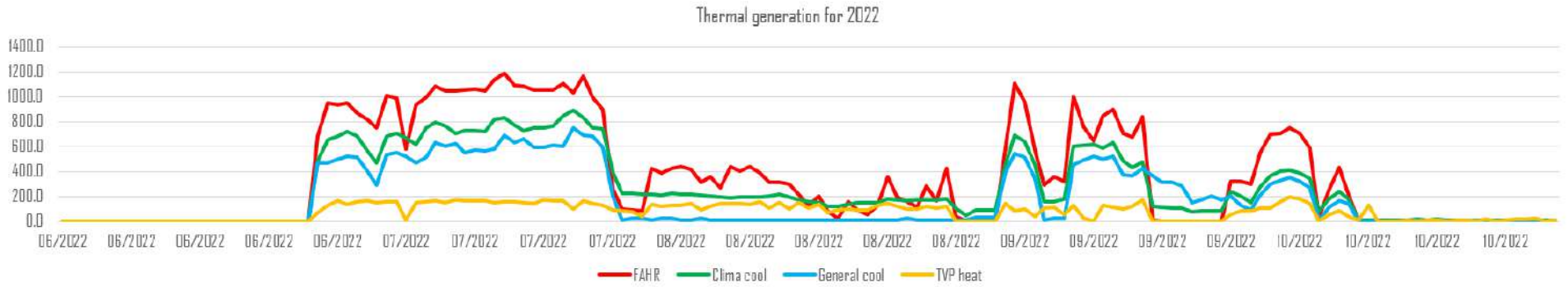
Installation status

- **Hybrid mode has started in mid august**
- Cooling installation has been operating just with **Recooler** due to **PVT** overproduction and high temperatures.
- The **PVT installation** running again since September

Suitable period for **2022** June to October (except for **Pumps** electricity consumption).

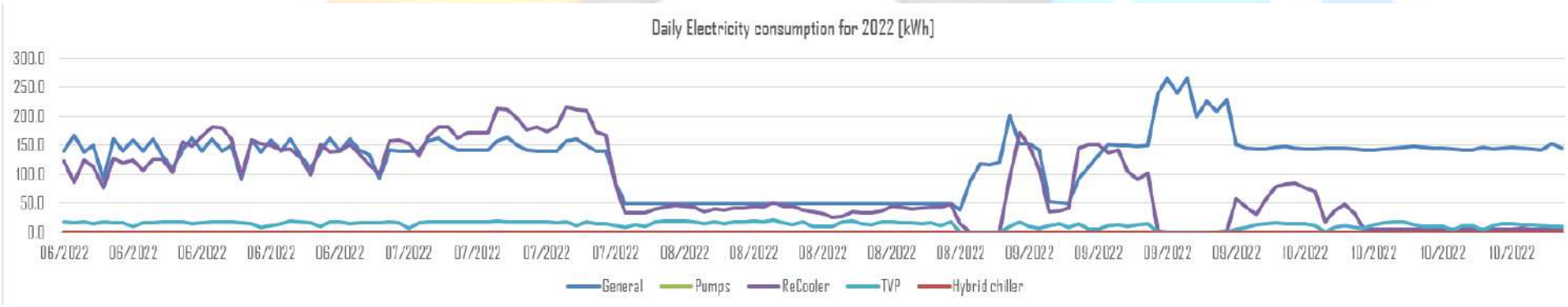
This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

SANT CUGAT Thermal data for June - October 2022



We can see in the plot trend that in August, the building remains closed

For this period the **TVP fraction** over FAHR is about a **20%**; plus the **Renewable energy** ratio is around a **30%**



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Sant Cugat – Monthly indicators

Sant Cugat	June - October 2022	TVP thermal	FAHR thermal	General elec. Meter	TVP fraction over FAHR	Renewable energy Ratio
2022	6	494.0	3504.0	4287.1	12%	18%
2022	7	4276.7	27034.0	4040.1	5%	29%
2022	8	3526.5	7960.0	1533.8	31%	39%
2022	9	1613.5	11479.0	4649.9	12%	24%
2022	10	1318.8	4930.0	4495.2	21%	24%

In case of normal functioning, the modelled results for 2022 would be:

Sant Cugat Model	Energy bills Savings [€]	GHG savings [kg CO2]	PE_nren savings [kWh]	Heating Comfort Index [ºC·h]	Cooling Comfort Index [ºC·h]
Annual	6605	9809	55168	494	1843

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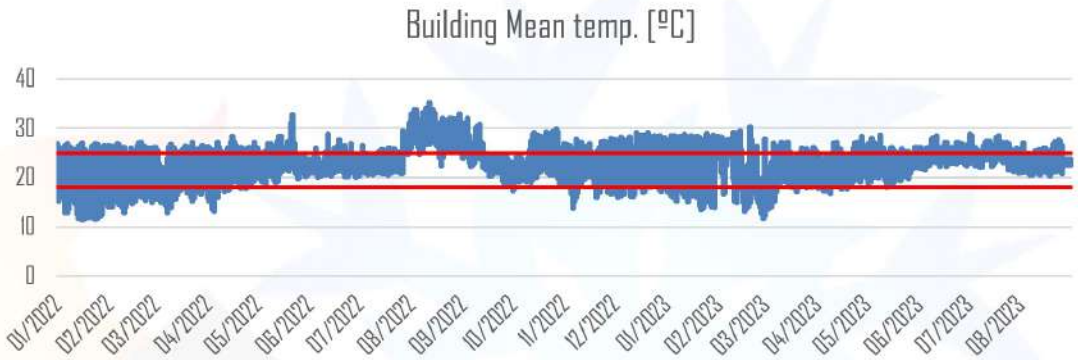
SANT CUGAT Measured data since 2022

Comfort	kWh	Interior Mean temp. [ºC]	Heating comfort [ºC·h]	Cooling comfort [ºC·h]
2022	1	20.8	642.4	83.6
2022	2	22.0	214.2	82.7
2022	3	21.5	232.8	49.8
2022	4	22.9	65.5	100.5
2022	5	23.4	0.0	227.0
2022	6	23.0	27.0	41.4
2022	7	23.7	0.0	234.4
2022	8	28.6	171.0	2698.5
2022	9	23.8	117.0	420.0
2022	10	22.9	2.1	298.2
2022	11	22.1	94.0	136.0
2022	12	23.6	31.1	500.8
2023	1	22.9	165.3	441.6
2023	2	21.7	403.2	389.0
2023	3	21.6	163.7	63.5
2023	4	22.0	422.7	71.1
2023	5	22.9	0.0	85.9
2023	6	24.4	9.0	184.1
2023	7	24.7	67.5	298.5
2023	8	23.4	0.0	117.4



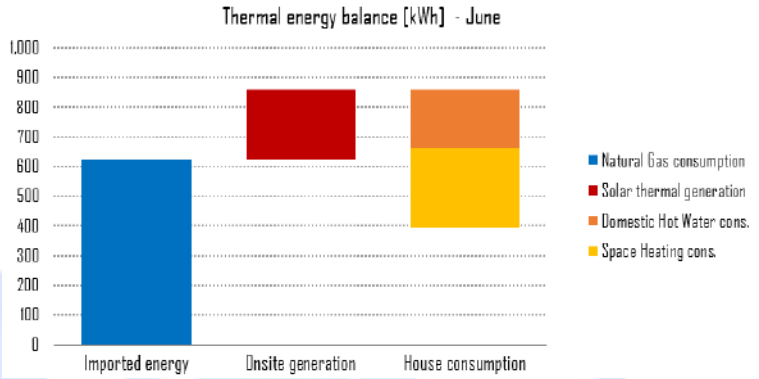
Mean monthly indoor temperature and comfort for the whole buildings
Comfort temperatures based on international standards: 18ºC - 25ºC

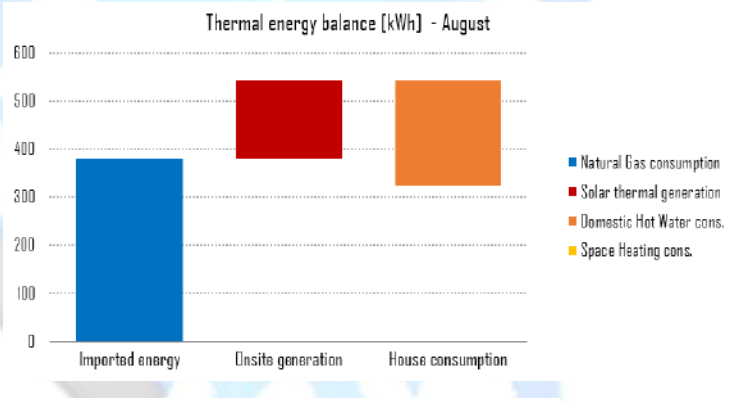
This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

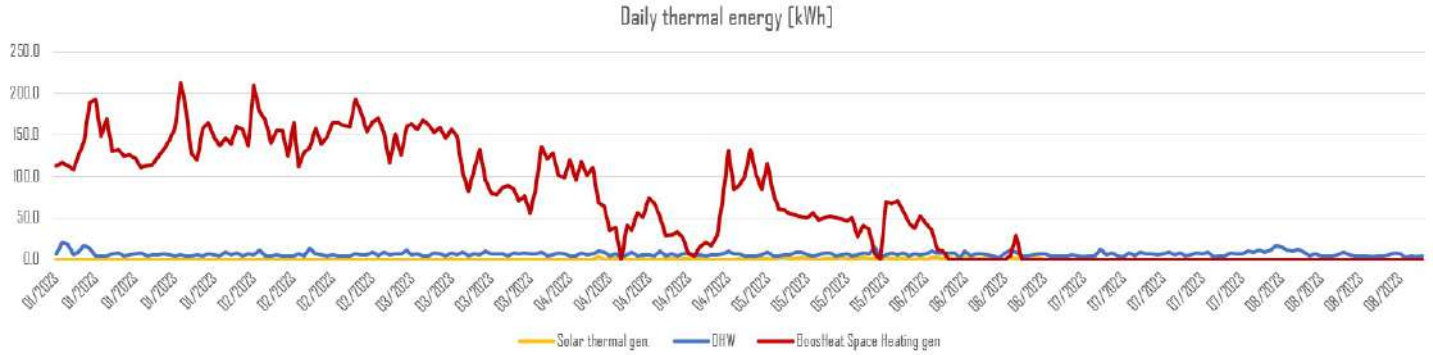
RIGA IMANTA Measured data since 2022

The monitoring started in 2022

Heat	kWh	PVT	Glycol tank	DHW cons.	BH gas cons	SH cons.	BH boiler efficiency
2022	1	0.0	0.0	0.0	0.0	0.0	0%
2022	2	0.0	0.0	231.0	0.0	0.0	0%
2022	3	0.0	0.0	238.0	0.0	0.0	0%
2022	4	0.0	0.0	373.0	0.0	0.0	0%
2022	5	0.0	0.0	229.0	0.0	0.0	0%
2022	6	23.0	60.0	218.0	0.0	0.0	0%
2022	7	28.0	67.0	221.0	0.0	0.0	0%
2022	8	11.0	21.0	238.0	0.0	0.0	0%
2022	9	9.0	11.0	217.0	0.0	0.0	0%
2022	10	0.0	5.0	151.0	0.0	0.0	0%
2022	11	0.0	0.0	166.0	0.0	0.0	0%
2022	12	0.0	0.0	256.0	0.0	0.0	0%
2023	1	0.0	0.0	231.0	4662.9	4343.0	98%
2023	2	0.0	0.0	176.0	4765.9	4371.0	95%
2023	3	1.0	2.0	215.0	3950.4	3688.0	99%
2023	4	13.0	87.0	191.0	1861.2	1642.0	98%
2023	5	31.0	230.0	204.0	2359.0	1896.0	89%
2023	6	33.0	235.0	193.0	622.7	269.0	74%
2023	7	0.0	164.0	201.0	317.8	0.0	63%
2023	8	0.0	163.0	220.0	380.6	0.0	58%







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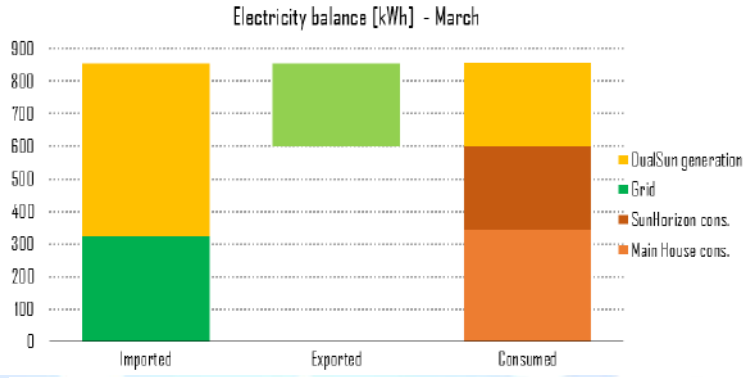
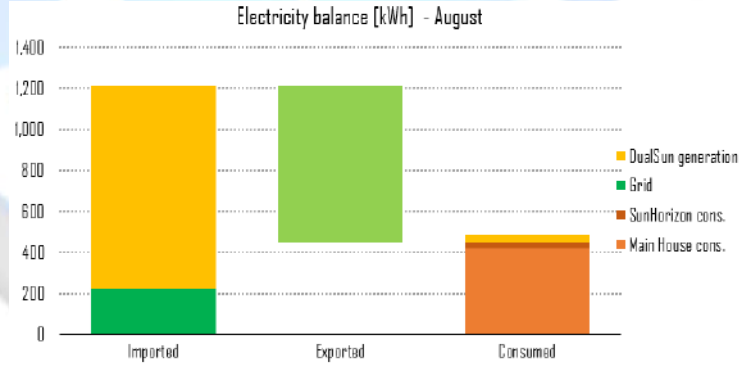
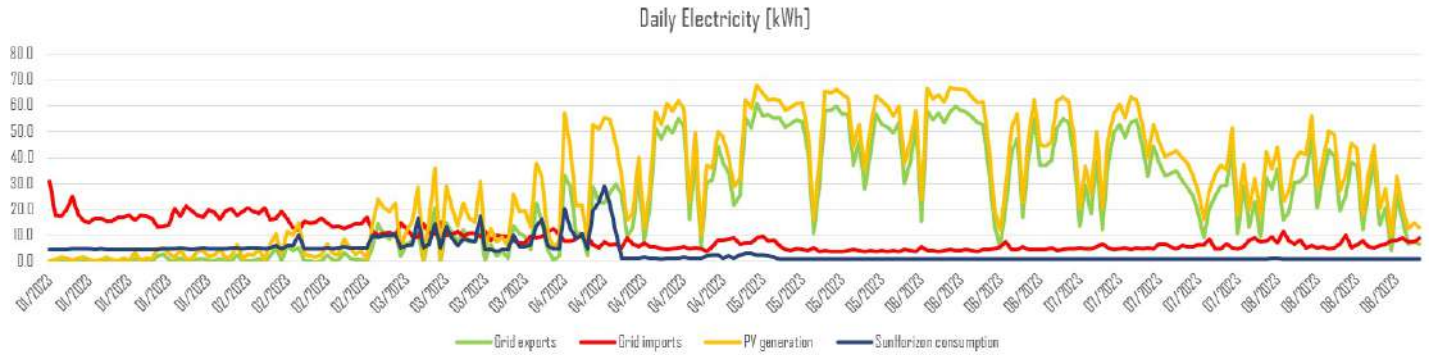
RIGA IMANTA Measured data since 2022

The monitoring started in 2022

Dec.	kWh	Grid exports	Grid imports	Solar Generation	SunHorizon cons.	Self-consumption ratio
2022	1	0.0	350.6	0.0	111.5	0%
2022	2	49.9	461.1	72.5	139.8	31%
2022	3	814.7	317.2	1046.9	191.7	22%
2022	4	753.4	295.0	1269.7	414.7	41%
2022	5	566.6	226.0	1310.9	609.6	57%
2022	6	661.7	161.1	1390.0	534.4	52%
2022	7	737.7	165.8	1383.5	438.7	47%
2022	8	624.8	196.7	1227.6	397.5	49%
2022	9	417.8	379.3	791.0	221.5	47%
2022	10	132.5	564.3	300.8	100.2	56%
2022	11	13.1	617.2	66.9	106.6	80%
2022	12	1.0	759.5	21.3	146.8	95%
2023	1	9.7	552.2	54.1	148.4	82%
2023	2	55.1	446.2	157.6	160.0	65%
2023	3	254.8	324.4	530.3	257.1	52%
2023	4	844.9	197.9	1170.6	192.9	28%
2023	5	1475.5	166.0	1695.3	40.1	13%
2023	6	1305.2	139.0	1543.1	26.6	15%
2023	7	1009.7	172.9	1256.5	29.2	20%
2023	8	757.3	225.0	985.0	30.0	23%







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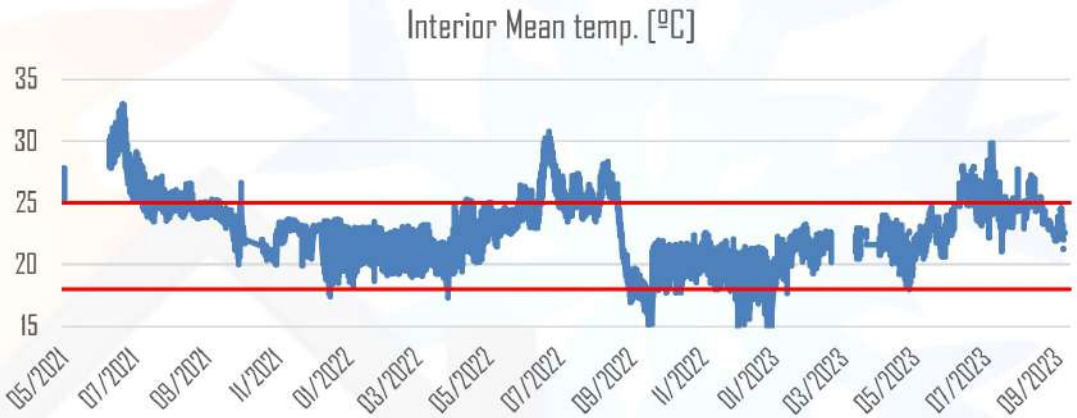
RIGA IMANTA Measured data since 2022

Comfort	Imanta	Interior Mean temp. [ºC]	Heating comfort [ºC·h]	Cooling comfort [ºC·h]
2022	1	21.7	0.0	0.0
2022	2	21.5	0.0	0.0
2022	3	21.3	0.0	0.0
2022	4	21.7	1.2	0.5
2022	5	23.1	0.0	0.0
2022	6	25.1	0.0	487.2
2022	7	26.2	0.0	929.7
2022	8	25.6	0.0	507.3
2022	9	18.7	229.9	0.0
2022	10	20.0	1.9	0.0
2022	11	20.3	0.0	0.0
2022	12	19.4	96.3	0.0
2023	1	20.2	88.2	0.0
2023	2	21.8	0.0	0.0
2023	3	21.8	0.0	0.0
2023	4	21.9	0.0	0.0
2023	5	21.6	0.2	0.0
2023	6	23.9	0.0	112.5
2023	7	25.0	0.0	227.1
2023	8	24.7	0.0	79.1



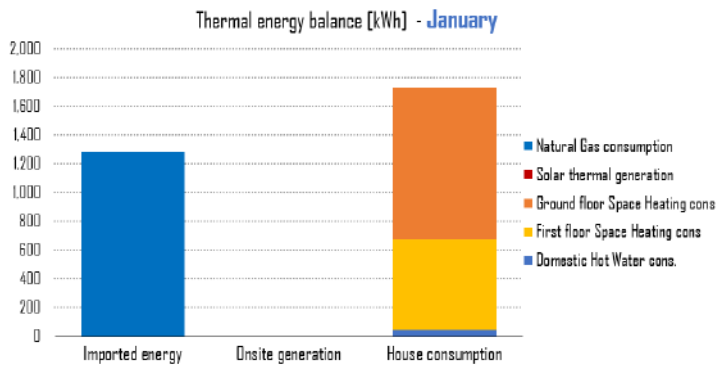
Mean monthly indoor temperature and comfort for the **Office area**
Comfort temperatures based on international standards: 18ºC - 25ºC

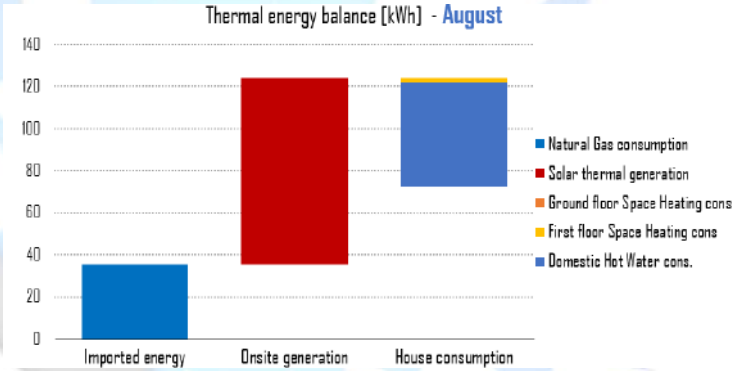
This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

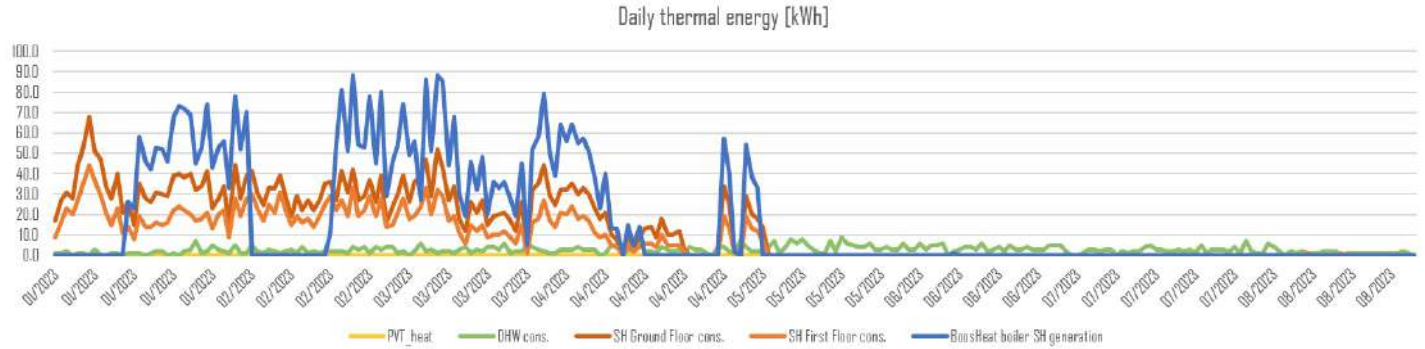
RIGA – Sunisi- Thermal Energy for 2023

The monitoring started in 2022

Heat	kWh	PVT	BH gas cons.	SH generation	SH Ground Floor cons.	SH First Floor cons.	DHW cons.	BH boiler efficiency
2022	1	0.0	0.0	0.0	1331.0	692.0	84.0	0%
2022	2	0.0	0.0	0.0	1102.0	553.0	72.0	0%
2022	3	0.0	0.0	0.0	1026.0	503.0	81.0	0%
2022	4	0.0	0.0	0.0	725.0	278.0	11.0	0%
2022	5	0.0	318.5	83.0	242.0	84.0	0.0	26%
2022	6	19.0	307.7	0.0	4.0	0.0	0.0	0%
2022	7	135.0	99.9	0.0	2.0	0.0	0.0	0%
2022	8	185.0	131.3	0.0	3.0	0.0	0.0	0%
2022	9	62.0	344.2	77.0	82.0	30.0	0.0	22%
2022	10	10.0	1186.2	698.0	499.0	165.0	13.0	59%
2022	11	0.0	1770.0	1233.0	802.0	477.0	39.0	70%
2022	12	0.0	1481.9	1112.0	1204.0	765.0	40.0	75%
2023	1	0.0	1281.9	952.0	1058.0	625.0	45.0	74%
2023	2	0.0	1100.0	828.0	873.0	626.0	64.0	75%
2023	3	0.0	1999.5	1432.0	844.0	512.0	81.0	72%
2023	4	0.0	892.7	565.0	418.0	231.0	83.0	63%
2023	5	0.0	737.0	167.0	108.0	65.0	127.0	23%
2023	6	35.0	349.5	1.0	0.0	0.0	111.0	0%
2023	7	100.0	318.4	0.0	0.0	0.0	72.0	0%
2023	8	89.0	35.2	0.0	0.0	2.0	50.0	0%







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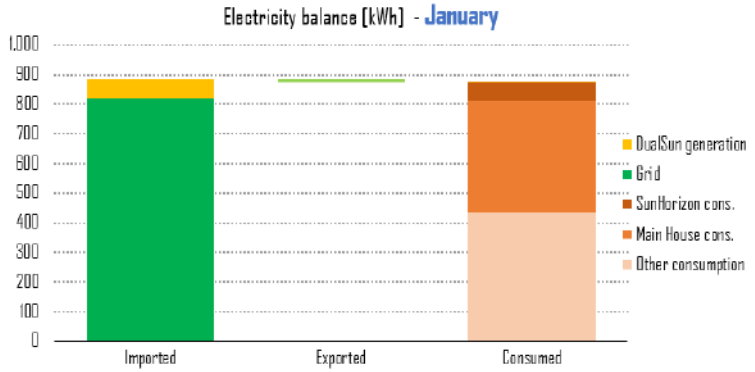
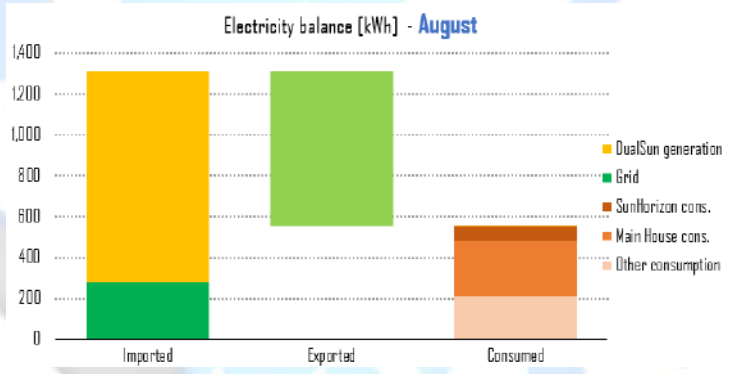
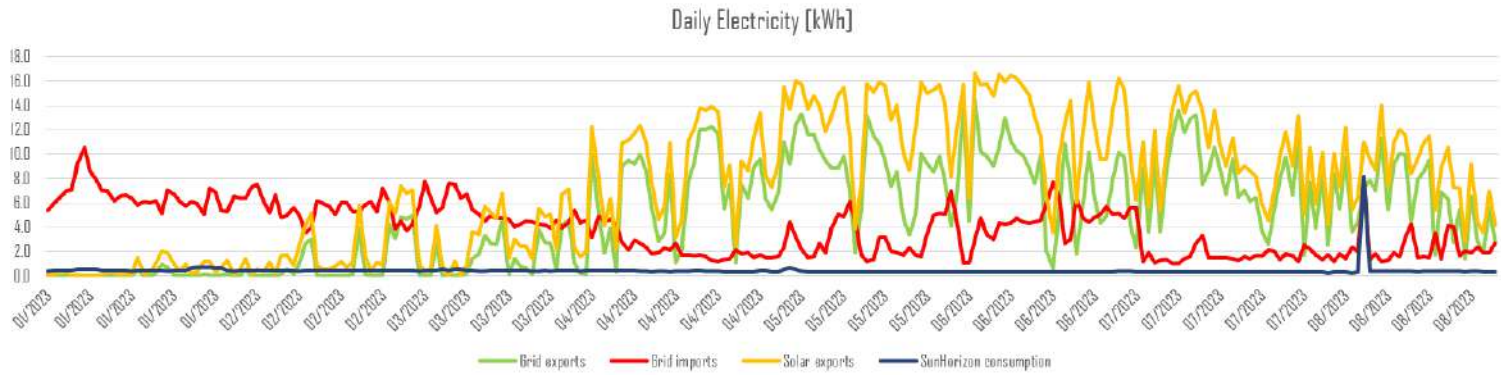
RIGA – Sunisi- Electricity for 2023

The monitoring started in 2022

Dec.	kWh	House imports	Grid exports	Grid imports	Solar generation	SunHorizon cons.	Self-consumption ratio
2022	1	121.5	0.0	169.7	0.0	8.6	0%
2022	2	232.6	-7.8	464.0	166.7	43.1	105%
2022	3	386.3	711.4	316.6	990.0	31.1	28%
2022	4	337.1	761.4	267.9	1146.8	265.0	34%
2022	5	352.1	604.6	619.7	1333.1	496.6	55%
2022	6	383.1	549.8	464.0	1380.2	414.5	60%
2022	7	385.3	822.9	368.6	1345.4	110.3	39%
2022	8	334.6	950.5	273.0	1251.5	32.3	24%
2022	9	317.0	662.8	237.6	844.0	38.2	21%
2022	10	304.3	262.2	334.6	393.2	72.2	33%
2022	11	270.8	21.4	377.3	61.8	59.1	65%
2022	12	324.8	0.8	551.0	12.9	59.1	94%
2023	1	378.8	11.4	818.5	65.4	62.2	83%
2023	2	296.7	79.0	638.5	188.0	50.9	58%
2023	3	382.4	227.0	630.5	423.7	55.1	46%
2023	4	308.9	812.5	289.5	1074.8	46.3	24%
2023	5	308.2	1074.8	356.3	1608.5	40.5	33%
2023	6	211.9	964.4	541.4	1530.7	35.5	37%
2023	7	277.7	951.5	234.9	1251.3	35.2	24%
2023	8	268.4	756.8	278.9	1031.6	71.9	27%







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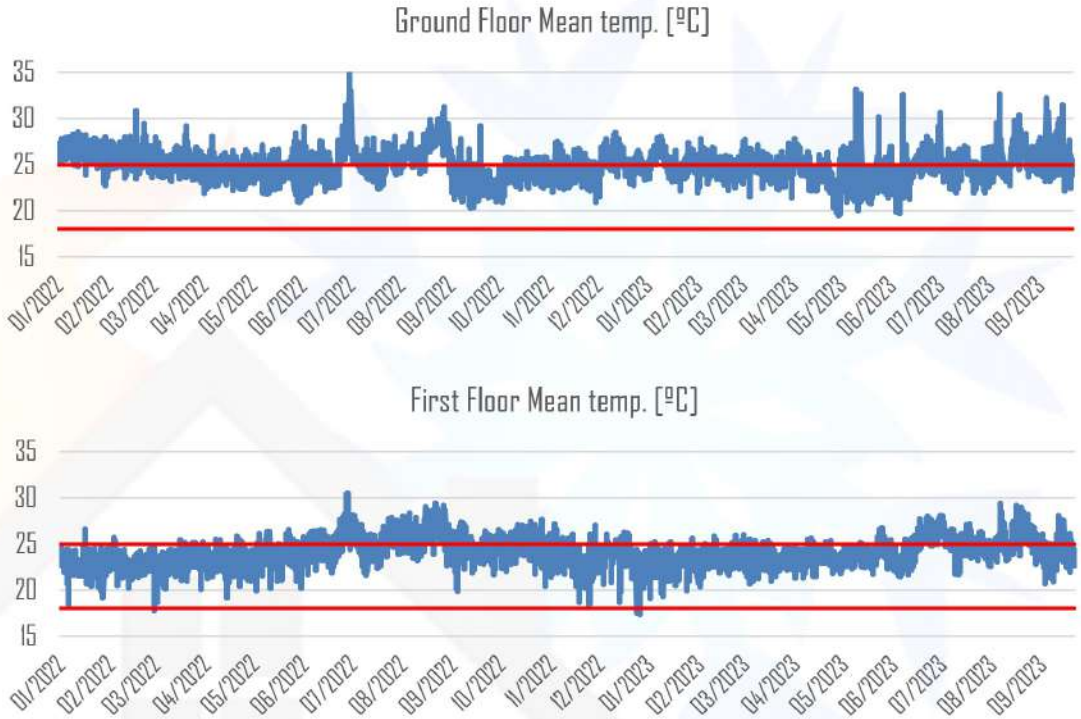
RIGA SUNISI Measured data since 2022

Comfort	Sunisi	Interior Mean temp. [ºC]	Heating comfort [ºC·h]	Cooling comfort [ºC·h]
2022	1	24.1	0.0	6.4
2022	2	23.9	0.0	1.4
2022	3	24.0	0.0	9.5
2022	4	25.4	0.0	528.2
2022	5	25.4	0.0	388.9
2022	6	26.2	0.0	870.6
2022	7	23.8	0.0	7.5
2022	8	24.8	0.0	63.1
2022	9	24.0	0.0	19.0
2022	10	24.6	0.0	129.0
2022	11	24.1	0.0	14.3
2022	12	24.2	0.0	14.0
2023	1	24.1	0.0	8.1
2023	2	24.1	0.0	1.4
2023	3	23.6	0.0	5.7
2023	4	23.7	0.0	63.0
2023	5	24.5	0.0	48.6
2023	6	25.9	0.0	452.6
2023	7	24.9	0.0	203.0
2023	8	25.6	0.0	533.1



Mean monthly indoor temperature and comfort for the ground floor and first floor
Comfort temperatures based on international standards: 18ºC - 25ºC

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

Thank you so much for your attention!

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

David Chèze
CEA

SUNHORIZON: Sun Coupled innovative heat pumps - Final conference

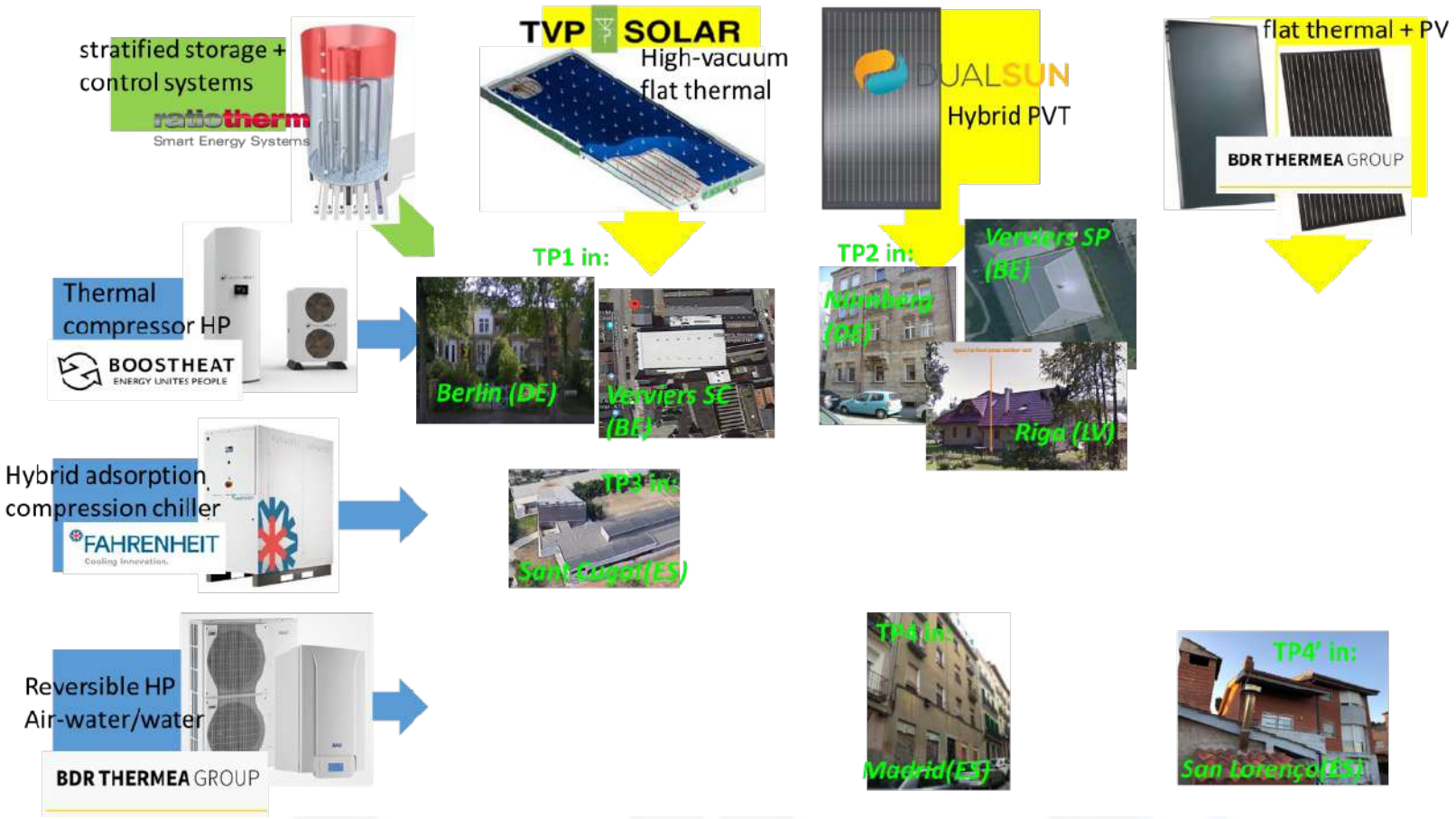
This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Beneficiary Name: CEA
Speaker: D. Chèze
Final conference

Sun Horizon Conference Coupling solar technologies with heat pumps in building

Demonstration at TRL7, Work Package 6

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329



Outlook of the demonstration in 2018, at project's startup

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- Overall learning from the demo cancelled experience : Discussion about original 8 demos foreseen:
  - 3 still alive (TP2revised heating , TP3 heating/cooling, TP4 multifamily building heating/cooling, previously presented) , 4 up to engineering phase, 1 up to installation phase
  - Reasons: administrative and technical difficulties can't be overcome within project's timeframe and budget: flood disaster destroyed building, project integrating in separate renovation workplan, work seasonality for solar panels installation, after covid and ukranian war: costs increase , installers availability, components availability, Boostheat withdrawal, depreciation rules for HP in Berlin,
  - Major difficulties during the project caused delayed monitoring results to optimize the installations' performance
  - Multiple subsystems manufacturers involved either without engineering company to manage the detailed interactions of subsystems (both in engineering and operational phase) , especially the controls, or without proper budget

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- Overall technical learning from outlook :
  - of original TP1 , TP2, TP4 single family Demo cancelled :
    - Expected simulated performance (TP1, TP2, TP3, TP4) from Eurosun 2020 presentation and Experimental test results in INES, remind from ISES SWC 2021 presentation, Bottlenecks:
      - TP2: outdoor air unit backup to secure the demo in the eventuality of low efficiency when low solar resource, increased complexity of the hydraulics and caused installation and control issues
      - TP2, TP4: Solar thermal from PVT in series with HP evaporator : complexity (buffer, tempering valve and control) if unmodified HP => real performance < theoretical performance
  - Of TP3 : complex interactions issues between thermal storage, control, absorption chiller, existing H/C plant; solar field size suits solar heating demand but exceed solar cooling demand
  - Technical Challenge : separate partners for each subsystem => partners communication challenge
- Conclusion SOL thermal and HP in buildings
  - HP driven solar integration :

  + solar heat integration schematics

  + existing H/C generator circuit and control integration schematics as optional features ?
  - Standard designs and controls rules for more reliable installation and operation: reducing CAPEX and OPEX

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D6.7 public report :

- Publication end of November 2023,
- Review of demonstration activities, lessons learnt and savings assessment from latest performance monitoring period,
- https://sunhorizon-project.eu/project-public-reports/

Thank you for your attention : david.cheze@cea.fr

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

Dimitrios Ntimos
Project Manager, IES Ltd.

SUNHORIZON: Sun Coupled innovative heat pumps - Final conference

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Smart User Interface and the role of self learning

IES INTEGRATED ENVIRONMENTAL SOLUTIONS

Speaker: Dimitris Ntimos
27/09/2023

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Our Role in the project to lead activities related to:

Developing an **integrated smart control and surveillance system** based on intelligent algorithms to incorporate advanced capabilities:

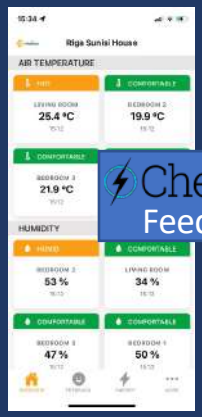
i. prediction,
ii. self-learning
iii. end-user feedback

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Platform Overview

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

SUNHORIZON PLATFORM OVERVIEW



CheckWatt Feedback App

Energy-IEQ data

Occupant feedback

Auto-upload measured data

ISC

Monitoring Platform

KPI/PI/CONTROL

CARTIF

Controller/ Maintenance

Air Temperature/ Energy Demand Predictions

Schneider Electric

PV

SOLAR

STORAGE

METERS

Measured/ Prediction Data

Next day simulation

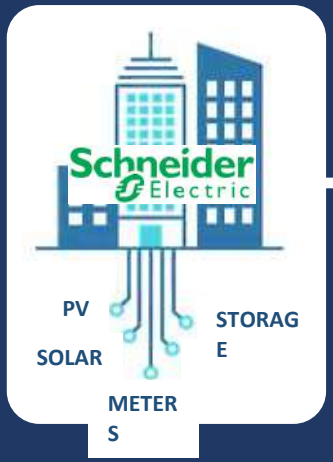
Air Temperature/ Demand Predictions

INPUTS	SELF-LEARNING	VE MODEL	OUTPUTS
Weather Occupancy Plug Loads Lighting Gain IEQ	Comfort Occupancy IEQ	VE	Energy IEQ Loads

Calibration: Daily check if the model is calibrated

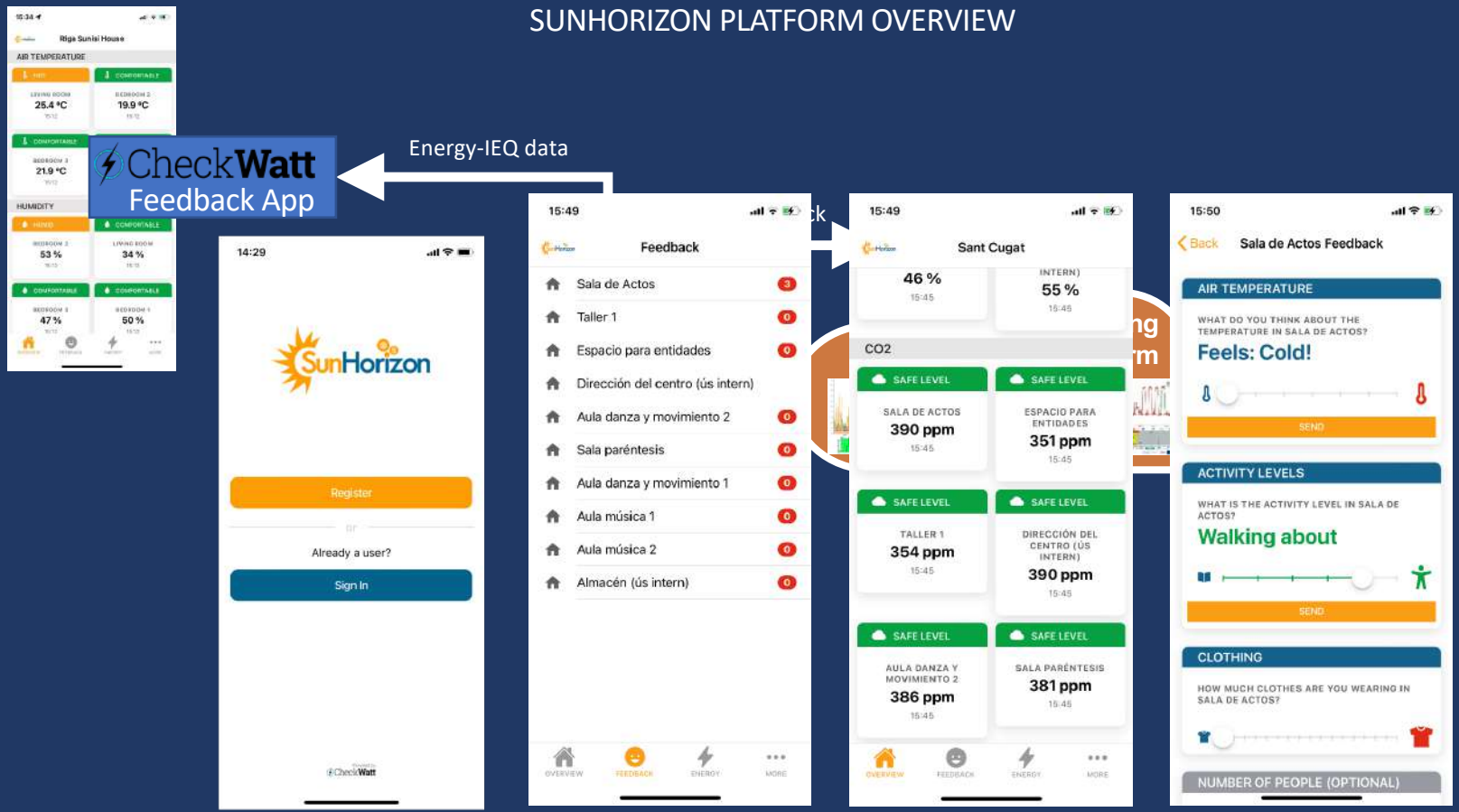
Next day simulation: Runs once a day

4 demo sites
1021 variables
10 minute frequency

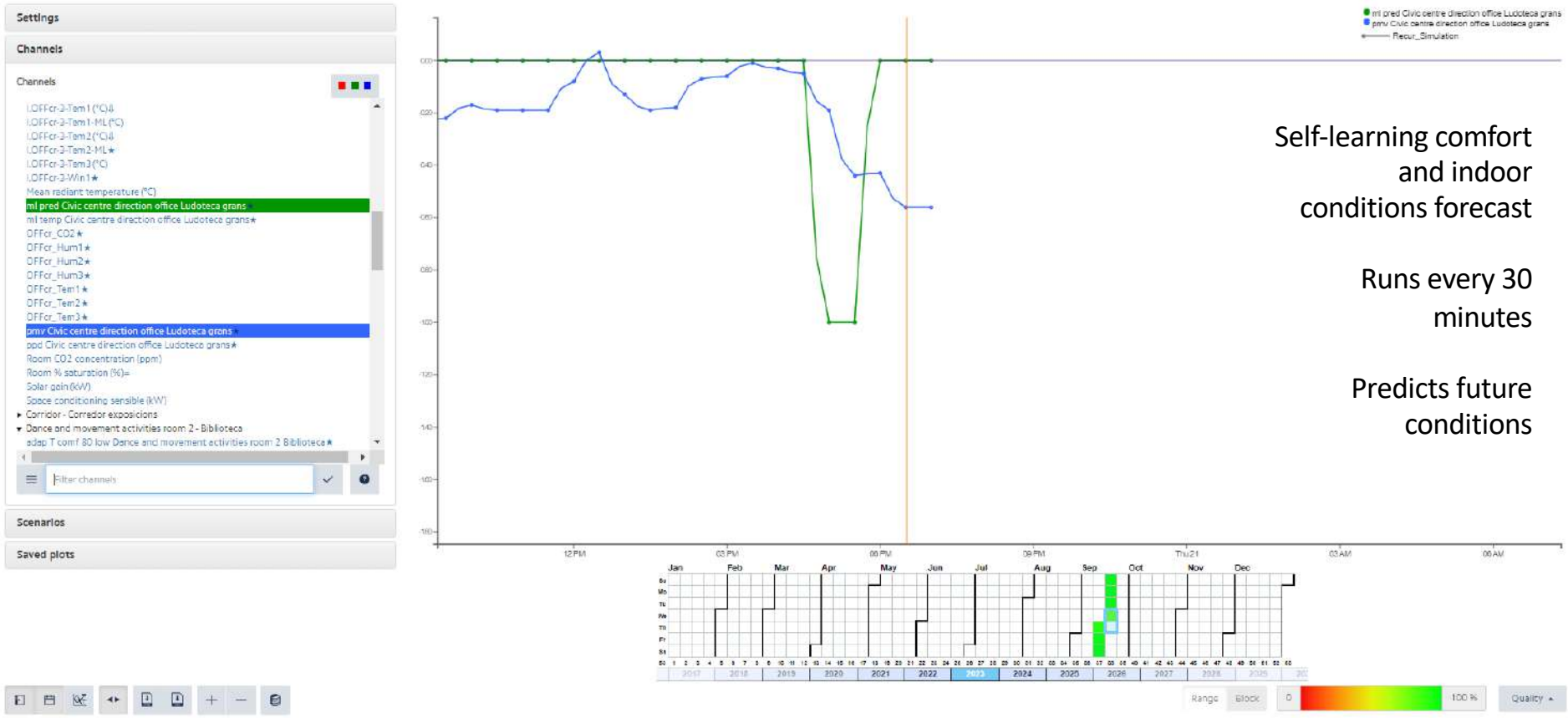


Display historical data
Display insights
Set up alerts/alarms
Calculate KPIs
Push real data to simulation
Display simulated data
Check model calibration status
Self-learning predictions
Weather forecasts
Import/export data (API)

SUNHORIZON PLATFORM OVERVIEW



SELF-LEARNING AND PHYSICS SIMULATIONS



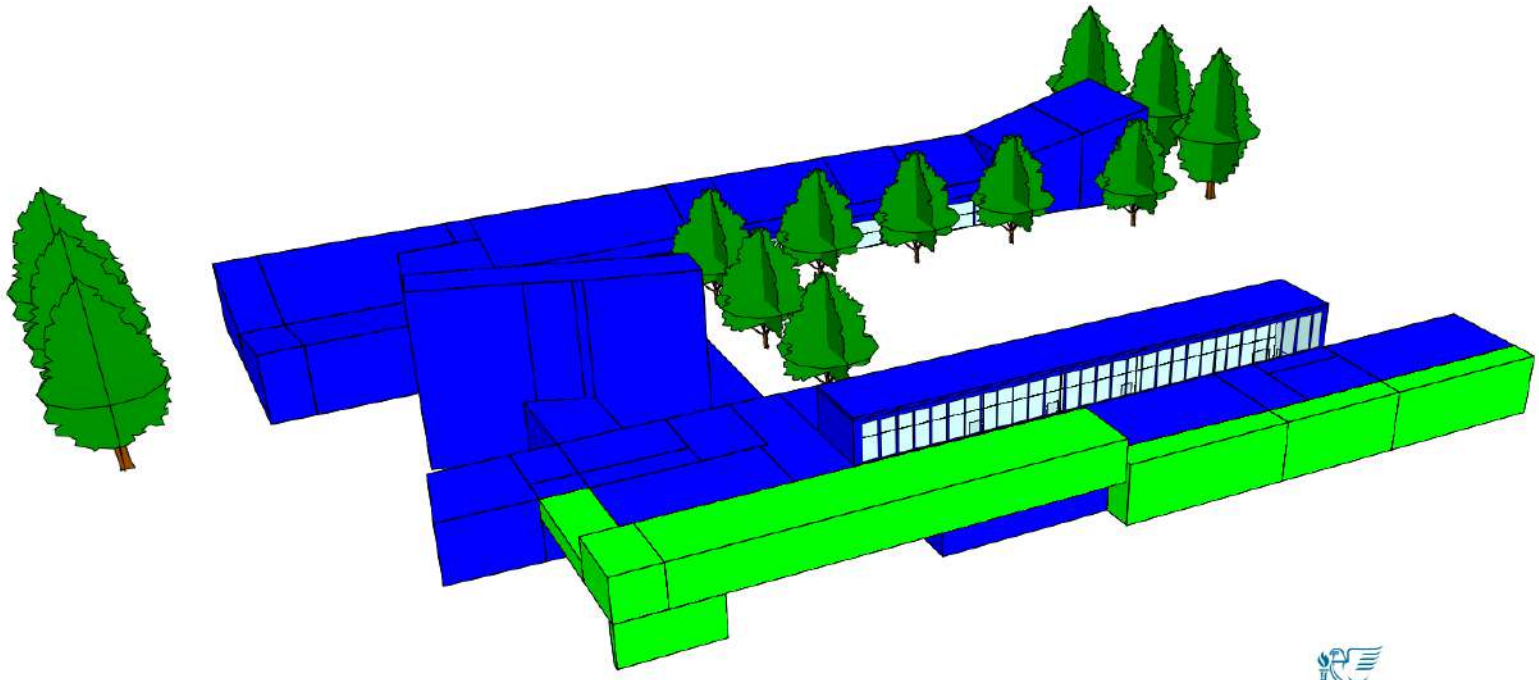
Self-learning comfort and indoor conditions forecast

Runs every 30 minutes

Predicts future conditions

SELF-LEARNING AND PHYSICS SIMULATIONS

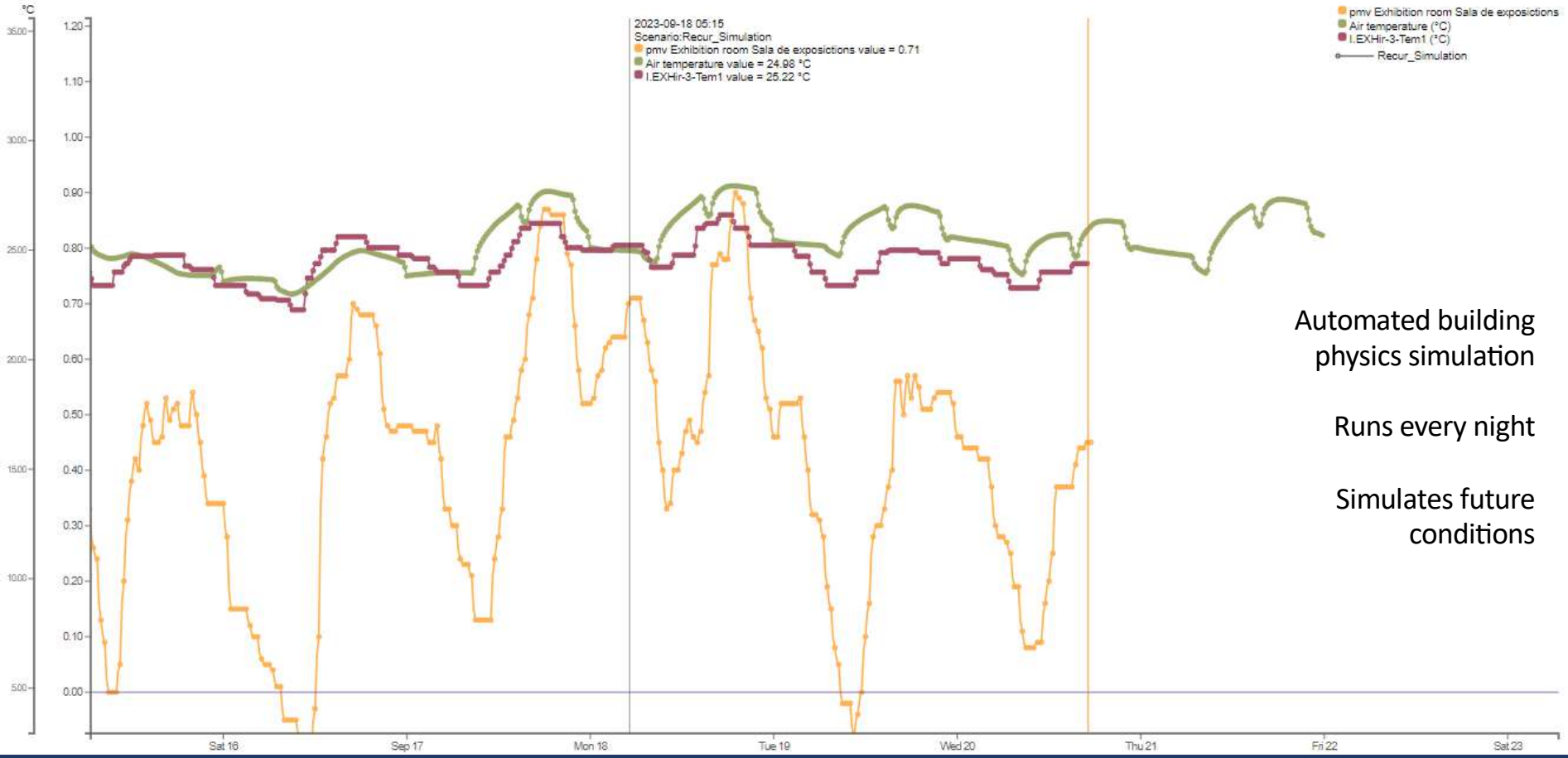
Sant Cugat Demo site - Calibrated physics based 3D energy model



Screenshot: IES VE software

Calibrated according to CIBSE TM63 Guidelines

SELF-LEARNING AND PHYSICS SIMULATIONS

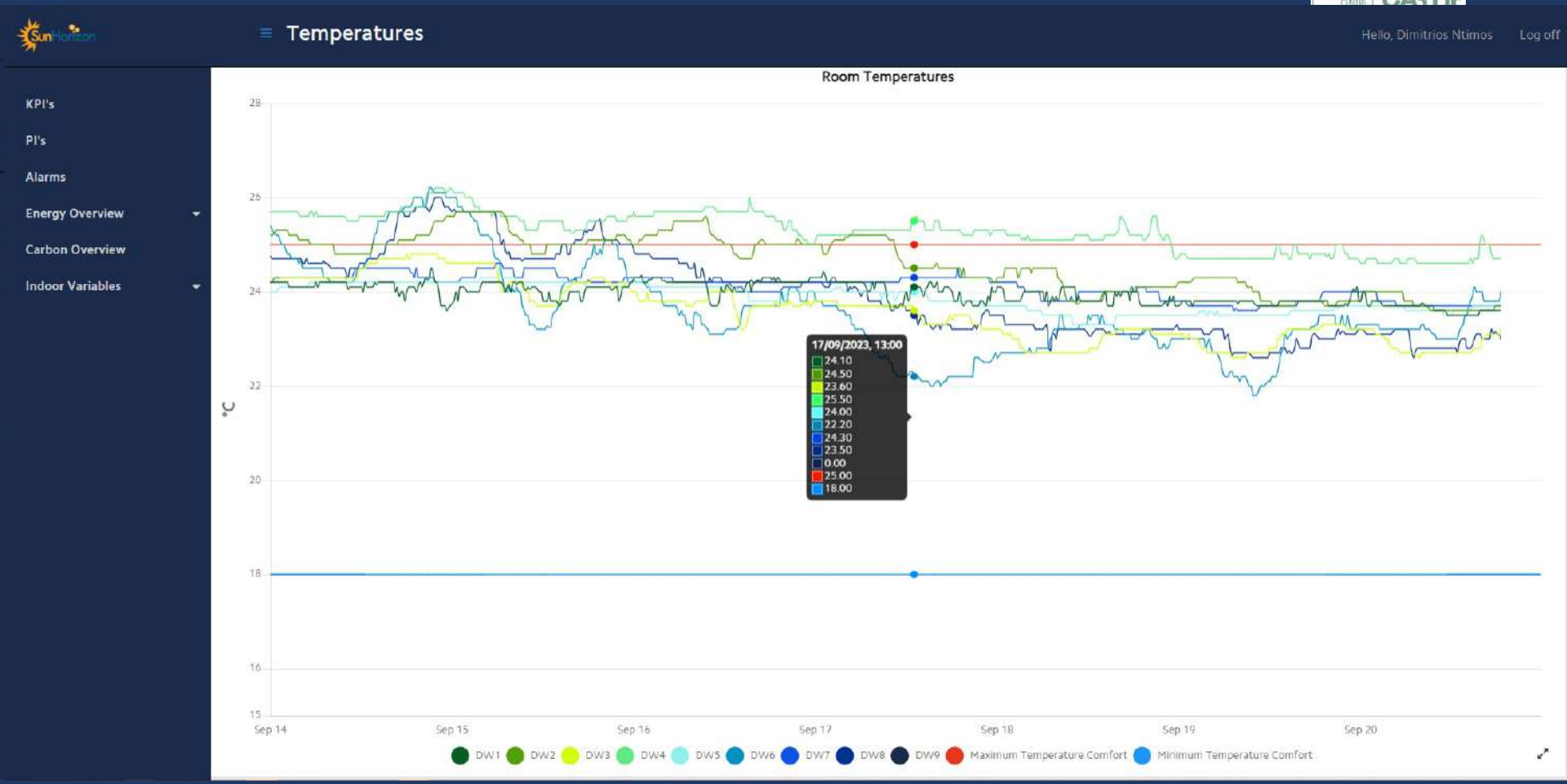


Automated building physics simulation

Runs every night

Simulates future conditions

SUNHORIZON PLATFORM OVERVIEW

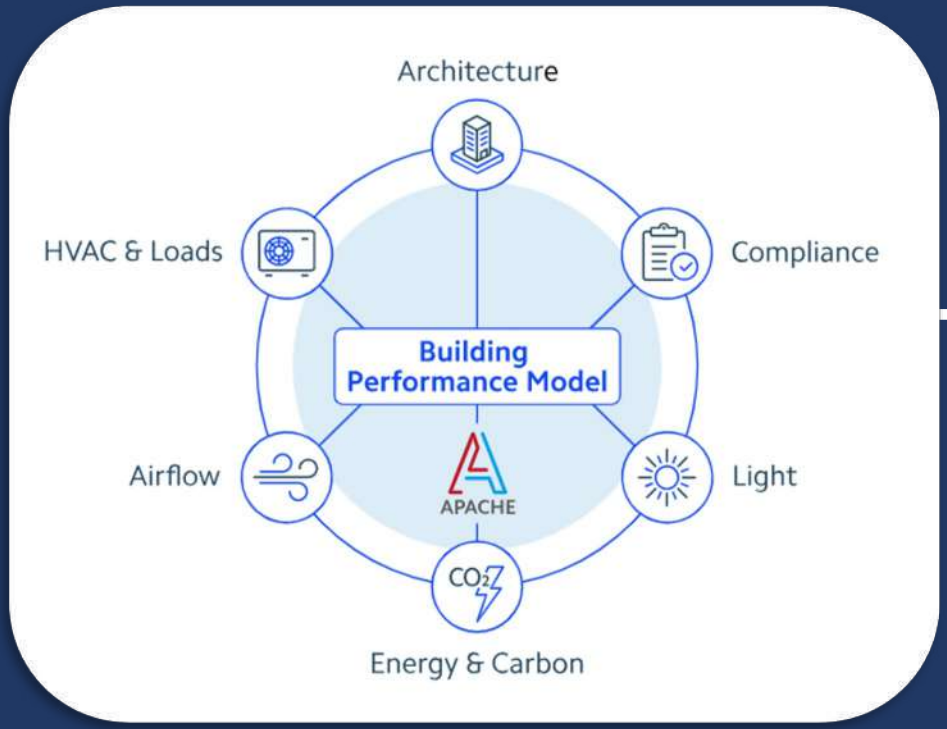


Biggest IES achievement in SunHorizon

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Biggest IES achievement in SunHorizon

BEFORE SUNHORIZON:
-APACHE building physics simulation engine sits at the heart of the VE desktop software
-Desktop analysis only by a modelling expert



iesve.com/software/apache

AFTER SUNHORIZON:
APACHE simulation engine is **decoupled** from VE and operates autonomously both in desktop and on the cloud

AFTER SUNHORIZON: APACHE model can be programmed to run on the cloud using latest sensor data

check calibration status

Feed in Controller with data in real time

Challenges and Lessons Learnt

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Challenges and Lessons Learnt

Main Challenges:

Connectivity and Synchronisation Issues

Data Incompatibility

Security and Privacy Concerns

Error Handling

Collaboration

Key Lessons Learnt:

Early Planning

Continuous Data Validation

User Feedback and Iterative Improvement

www.iesve.com

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N818329

Thank you, any questions?

dimitrios.ntimos@iesve.com

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Sílvia Jané
Veolia

SUNHORIZON: Sun Coupled innovative heat pumps - Final conference

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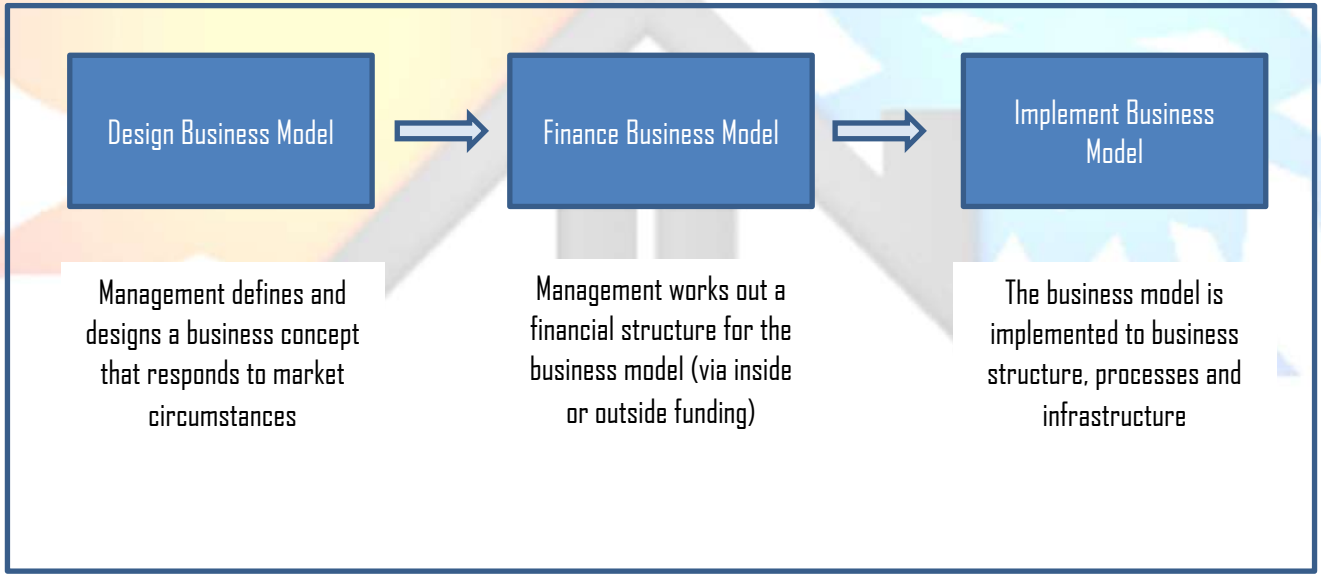
Maximising the potential of SunHorizon: An exploitation strategy

Sílvia Jané
Veolia Serveis Catalunya, S.A.U.

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Primary concepts: what is a business model?

"A business model is a conceptual tool containing a set of objects, concepts and their relationship with the objective to express the business logic of a specific firm. Therefore, we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences" – Osterwalder, Pigneur & Tucci (2005)



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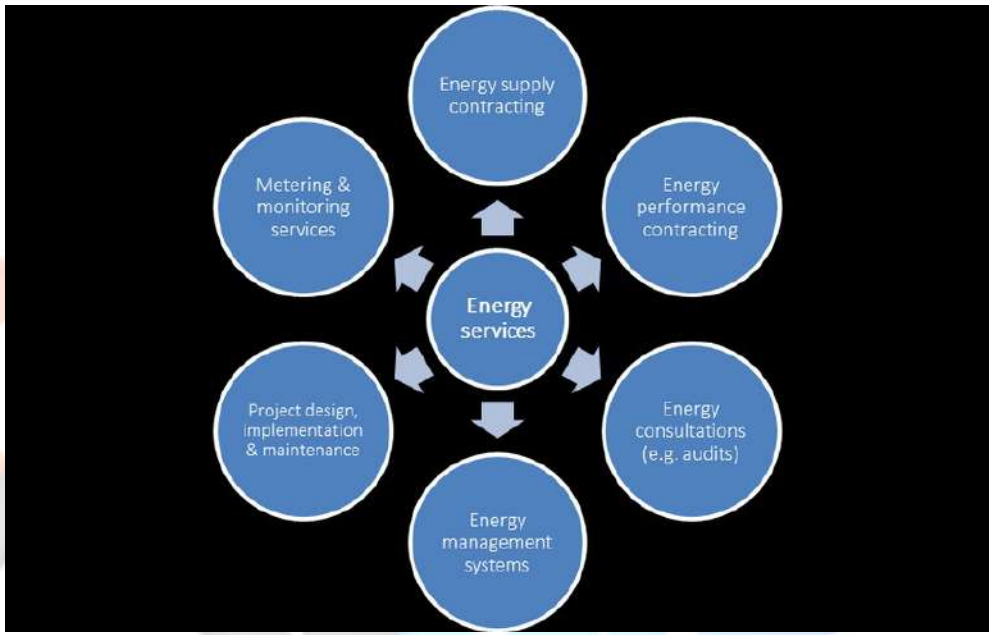
Introduction: what is an energy service? What is an ESCO?

- An **energy service** is **the physical benefit, utility or good derived from a combination of energy with energy-efficient technology or with action, which may include the operations, maintenance and control necessary to deliver the service**, which is delivered on the basis of a contract and in normal circumstances has proven to result in verifiable and measurable or estimable energy efficiency improvement or primary energy savings.



- An **Energy Services Company (ESCO) is a natural or legal person (usually in the form of a firm/company) who delivers energy services or other energy efficiency improvement measures in a final customer's facility or premises**. The remuneration of ESCOs is directly tied to the energy savings achieved. ESCOs can finance, or assist in arranging financing for the operation of an energy system by providing a savings guarantee.

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In what terms do ESCOs offer energy services?

The main service contract arrangements might include different services, depending on each client's facilities, needs and perspectives:

- **Provision 1 (P1) – Energy management**: perform all energy management tasks (supplying guarantees in terms of quality, quantity, safety and lowering purchase costs) via contractual arrangement;
- **Provision 2 (P2) – Maintenance**: perform different types of maintenance that must be applied in order to guarantee the correct and optimal operation conditions of all equipment/devices deployed;
- **Provision 3 (P3) – Full Warranty repair:** provide a full reparation service of all failures that may occur during the operation of the installation, so that the ESCO assumes all technical and substitutional risks of all equipment/devices deployed;
- **Provision 4 (P4) – Improvement works and installation renewal**: provide a regular innovation and improvement analysis so that the client is offered different energy efficiency improvements on a specific installation/equipment via self-financing or third-party financing.

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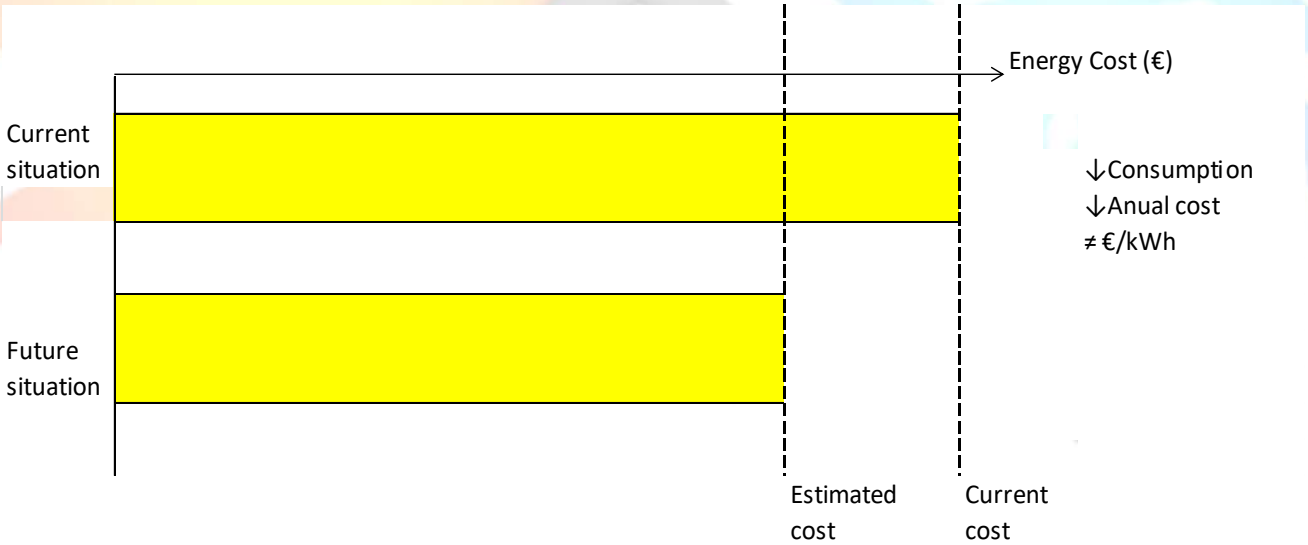
In what terms do ESCOs offer energy services?

When referring to **Energy management services provision (P1)**, different types of contracts are considered:

- **Energy Supply Contracting (ESC)**: a contractual arrangement where the focus is the reduction of supply costs rather than demand-side efficiency gains, with energy efficiency measures being typically limited to the energy supply and conversion side. The focus of ESCs is the supply of useful energy, usually in the form of heat, steam or electricity;



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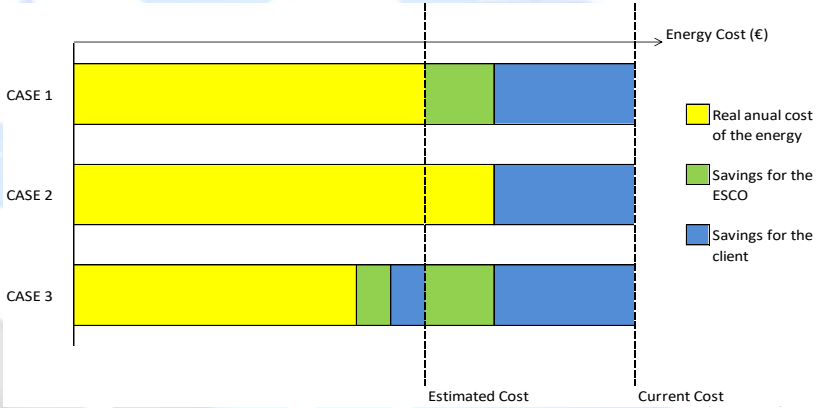
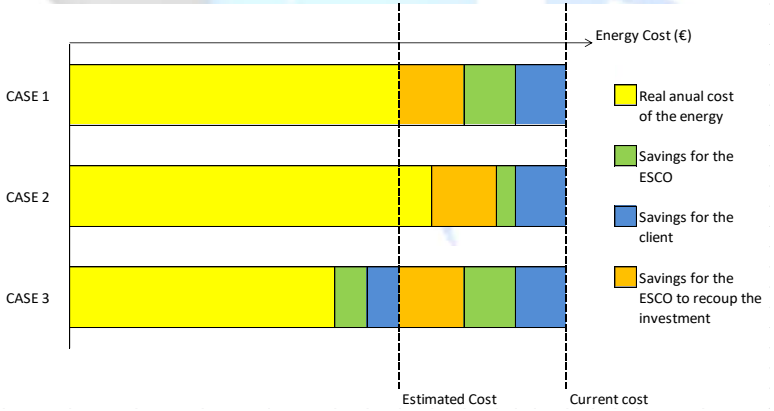
In what terms do ESCOs offer energy services?

- **Energy Performance Contracting (EPC)**: a contractual arrangement where investments (work, supply or service) are paid for in relation to a contractually agreed level of energy efficiency improvement or other agreed energy performance criterion, such as energy and/or economic savings;

  - **Guaranteed Savings Contract (EPC – GSC)**: the ESCO guarantees at least the minimum savings that will be obtained with the implementation of energy efficiency and/or energy conservation measures (EEM/ECMs).



  - **Shared Savings Contract (EPC – SSC)**: the savings obtained with the implementation of EEM/ECMs are shared between the client and the ESCO.



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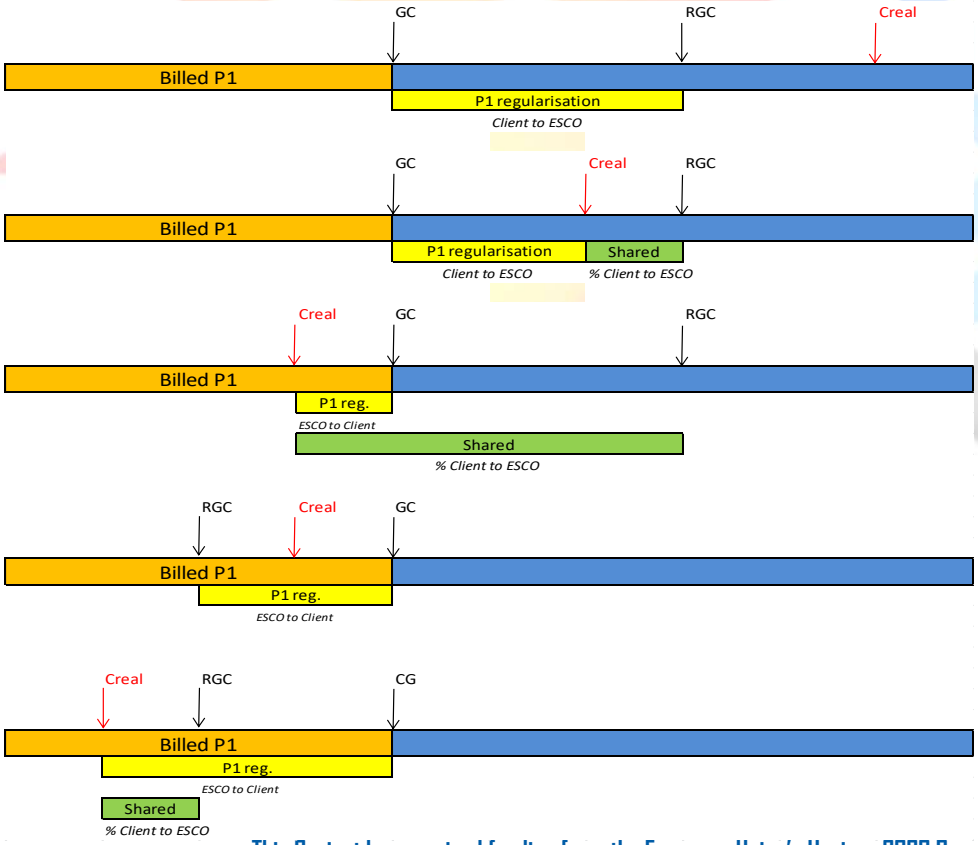
In what terms do ESCOs offer energy services?

- **Forfeit Contracting (EPC)**: a contractual arrangement where there is an agreed amount of energy (Guaranteed Consumption - GC) and the price per year is fixed with some technical parameters such as degree-days, occupancy profile, etc. This price is reviewed annually according to the variation of these parameters (Revised Guaranteed Consumption – RGC) with a formula that is established at the beginning of the contract.



- **Real Consumption > Revised Guaranteed Consumption**: the ESCO assumes the extra cost.
- **Real Consumption < Revised Guaranteed Consumption**: the savings are shared between the client and the ESCO in a stated percentage.
- **Revised Guaranteed Consumption < Guaranteed Consumption**: the ESCO returns the difference to the client.

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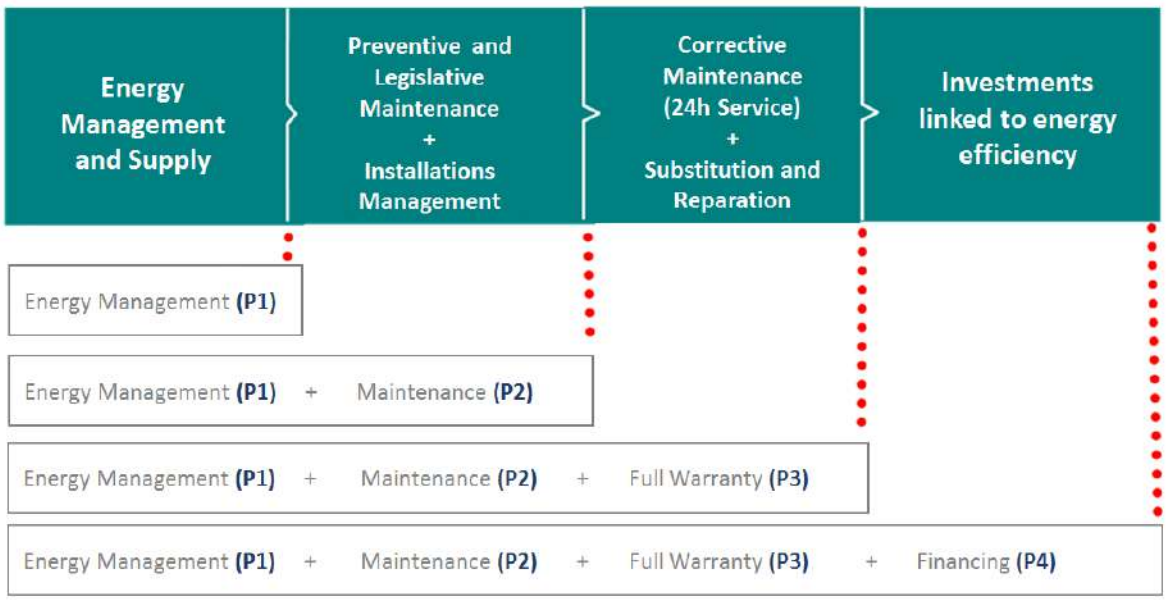
ESCO contracting terms: a brief summary

As stated before, the main service contract arrangements/terms might include different services, depending on each client's facilities, needs and perspectives. The proposed Energy Savings and Maintenance Contracting model can offer different provisions:



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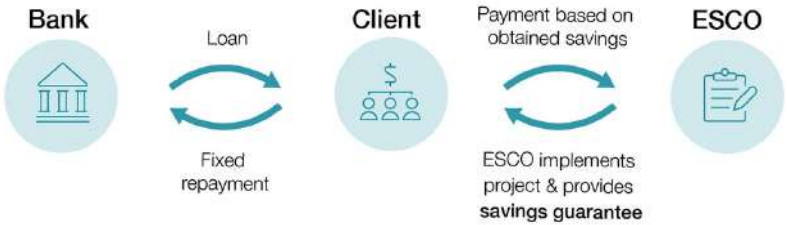
Financing options to provide energy services

Regarding the financing of ESCO contracted services, the most typical options for each kind of contract is as follows:

- **Energy Performance Contract – Guaranteed Savings Model (EPC – GSC)**:



- **Energy Performance Contract – Shared Savings Model (EPC – GSC)**:

- **Super ESCO Model:**

- Depending on the customer's preference and access to capital, the customer, the ESCO, or a combination of both is responsible for securing the financial aspects of the project;
- A direct loan agreement with a third-party lender is an option for both parties.

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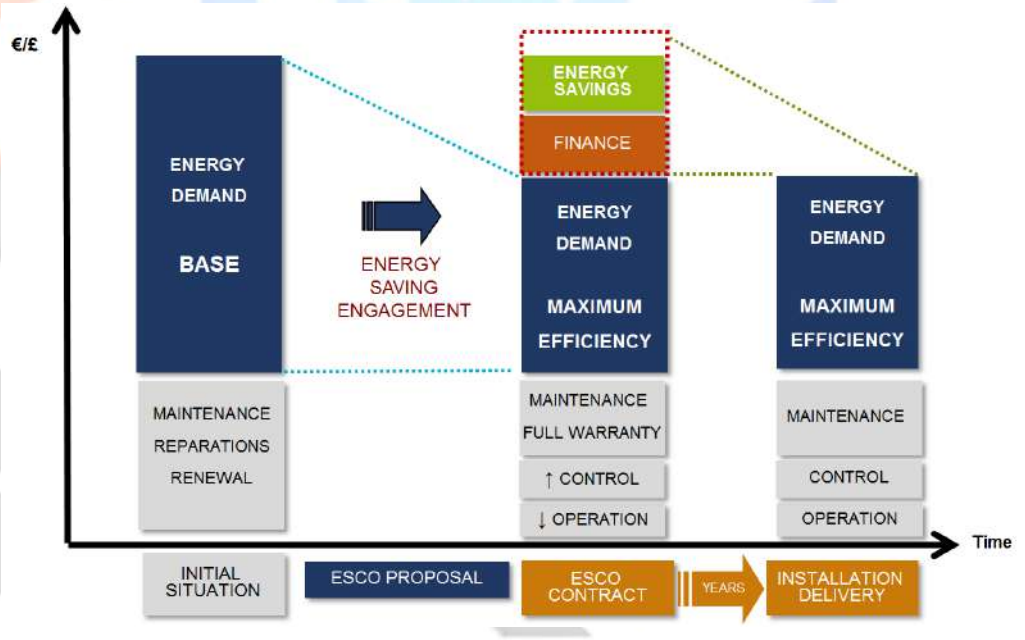
ESCO business model benefits

Externalizing energy services through an ESCO (exploitation plan of a customer's energy infrastructure) provides many well known benefits:

- ✓ Energy savings, cost savings and GHG emissions' reduction (usually CO_2);
- ✓ Transparency on energy and operational costs;
- ✓ Minimization of technical operational risk (ESCO takes that risk);
- ✓ Normative and legal compliance of all activities performed;
- ✓ Energy assets optimization, with a comprehensive maintenance plan;
- ✓ Development of a corporate image of commitment with sustainability and energy efficiency;
- ✓ Enhancement and guarantee of the installation's financing options.



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Mélanie Auvray
EHPA

SUNHORIZON: Sun Coupled innovative heat pumps - Final conference

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The EU Heat Pump Accelator to speed up the heat transition

Five steps to a fast heat pump roll-out

Mélanie Auvray, Brussel, 27 September 2023

About EHPA

Founded in **2000**

193 Members representing the entire value chain

- Heat pump and component manufacturers
- National associations
- Test labs
- Utilities and Consultancies
- Research institutes and Universities

28 Countries

International cooperation

CECA, IEA, IEA HPT, IRENA, HPCJ

Vision: In a fully decarbonised Europe, heat-pump technologies are the number one heating and cooling solution, being a core enabler for a renewable, sustainable and smart energy system.

The heat pump decade

at transition

Source:
Leonid Faerberg,
kyivindependant.com

ehpa

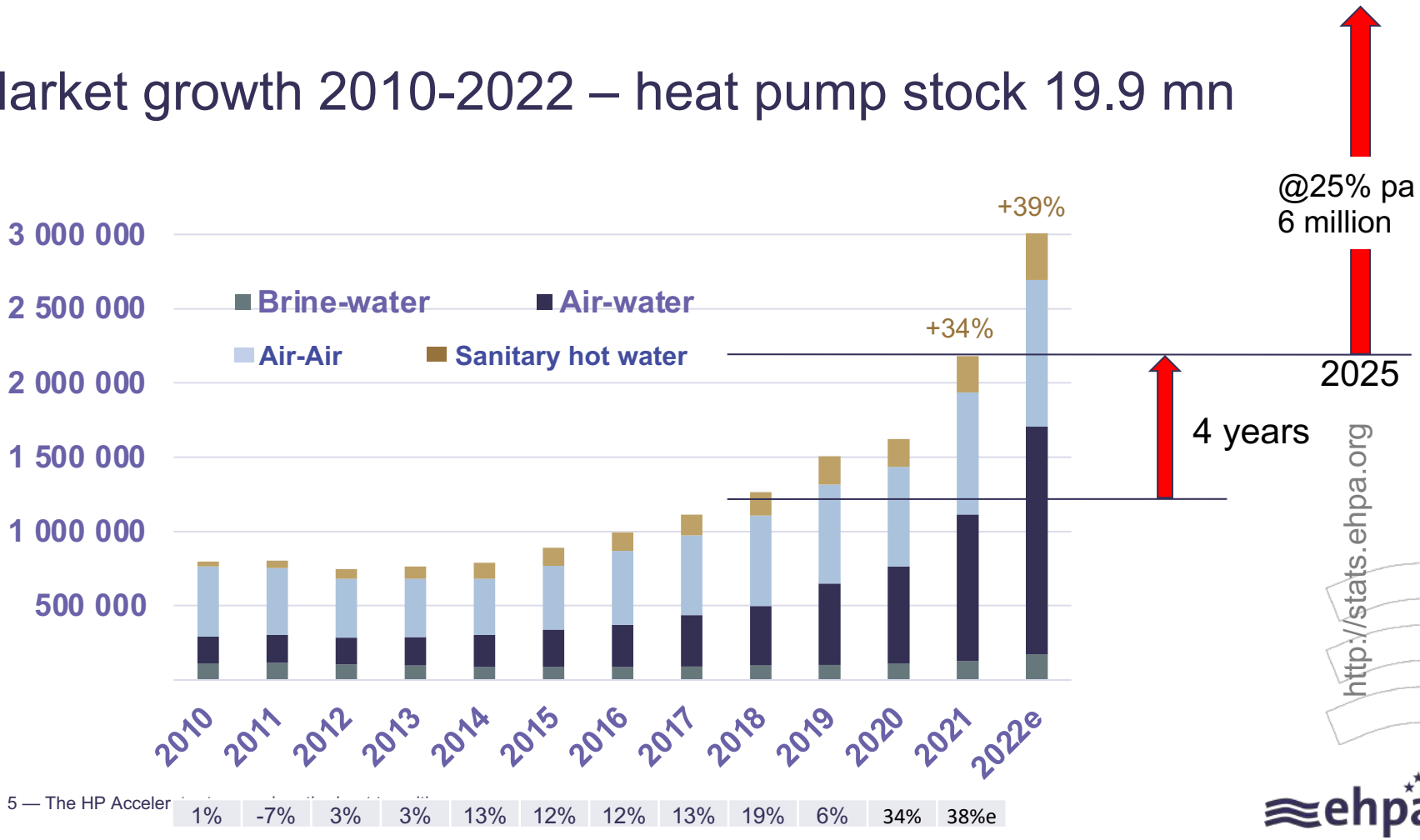
1.8 billion heat pumps **to be installed in worldwide** by 2050 (IEA)

60 Million additional hydronic heat pumps **to be sold** in Europe by 2030*

extrapolation includes air-air HP

3 Million heat pumps **sold** in Europe 2022

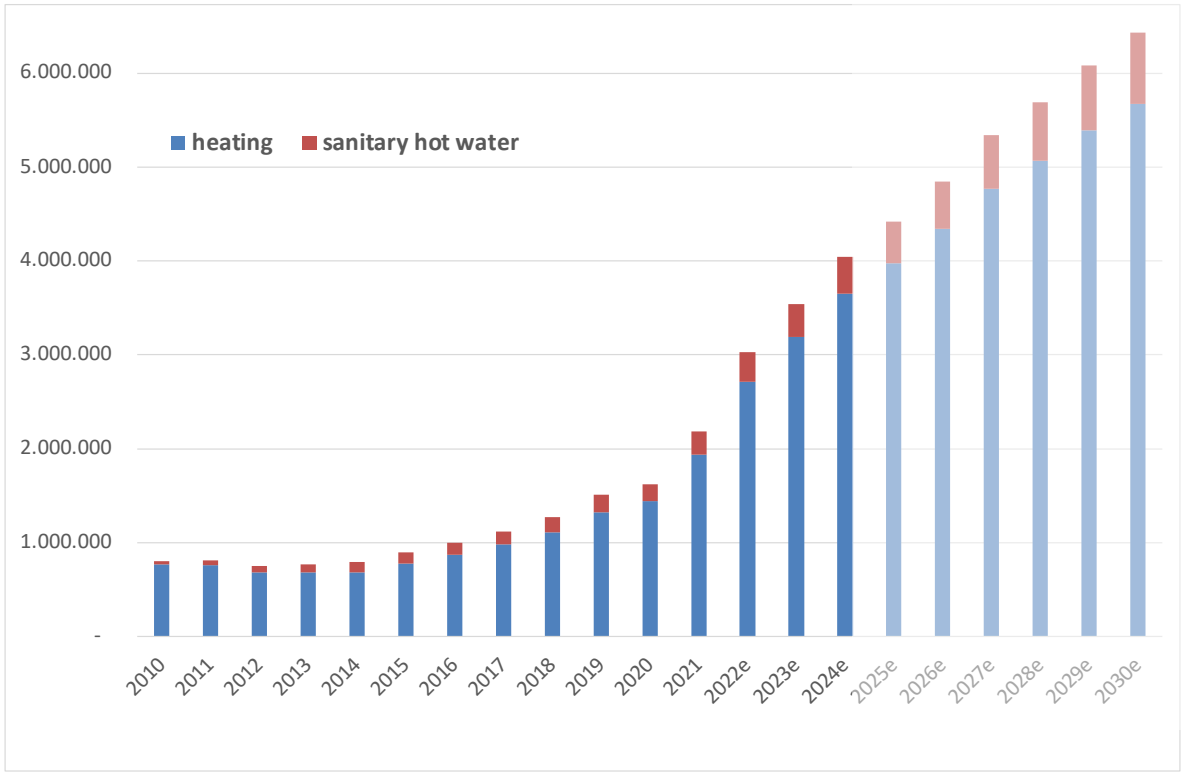
Market growth 2010-2022 – heat pump stock 19.9 mn



5 — The HP Acceler

ehpa

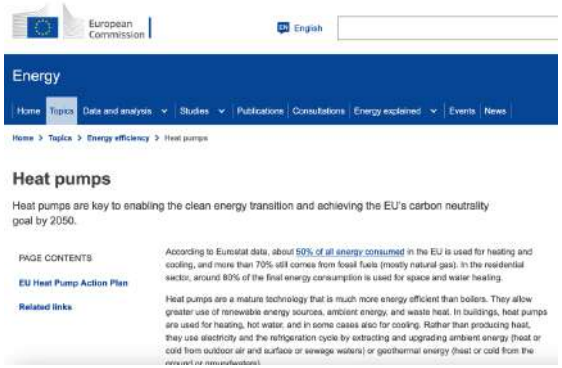
Sales forecast BAU to 2030: additional 43 million units
>70% in annual sales



ehpa

High ambition needs action: Heat Pump Accelerator

From mid 2022: EHPA stresses: "**We need a heat pump accelerator**"

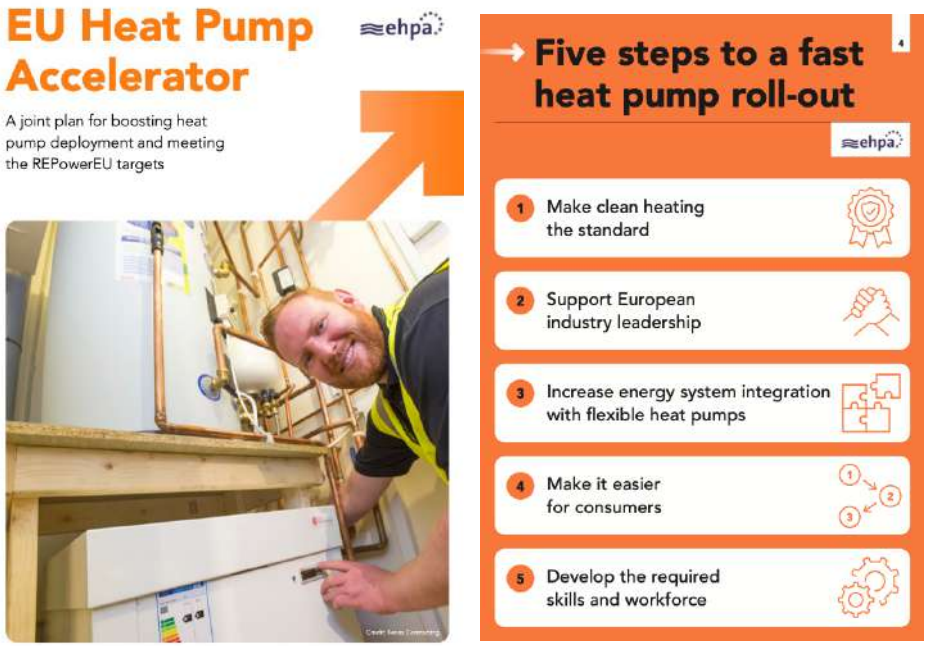


Q1 2023 EC endorses and announces Heat Pump Action Plan + dedicated webpage

June 2023: EHPA launches Heat Pump Accelerator

Q4 2023: Adoption of EC Heat Pump Action Plan

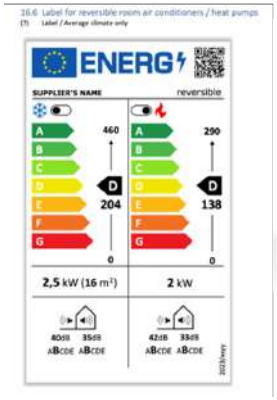
Heat Pump Accelerator to reach 60 million heat pumps by 2030



e HP Accelerator to speed up the heat transition

1. Make clean heating the standard

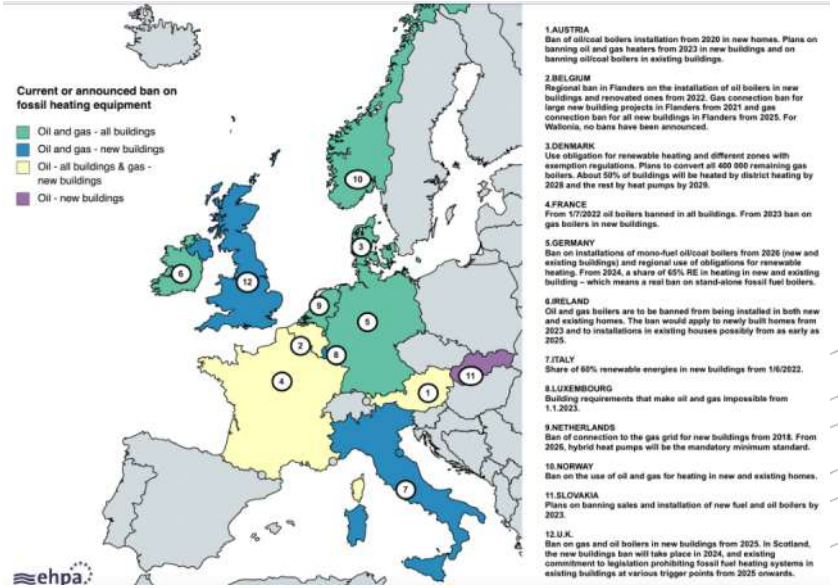
EU level



Ecodesign

Energy Performance of Buildings

National level



ehpa

2. Support European industry leadership

Source: Daikin

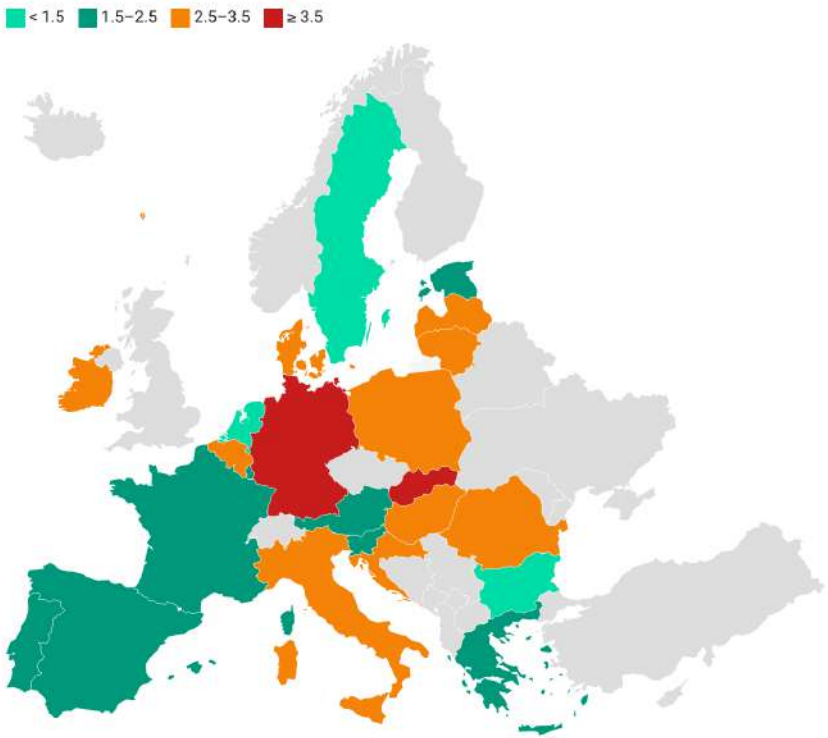
10 — The HP Accelerator to speed up the heat transition

Industry is preparing for growth

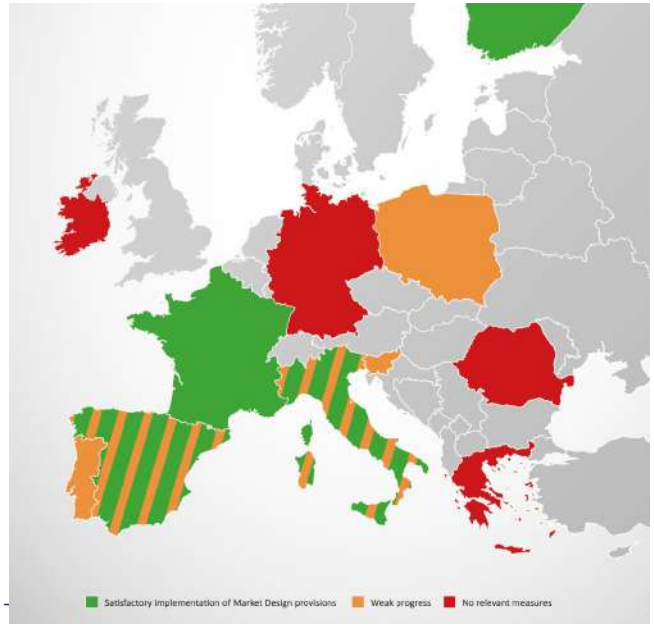
As of today, more than 5 billion € of investment announced until 2025

Based on press releases by Daikin, Viessmann, Stiebel-Eltron, Bosch, Panasonic, Vaillant, Hoval, Ziehl-Abegg, Alfa-Laval, Grundfoss, Wilo, Kensa, Ariston, Clivet/Midea, etc.

3. Make it easier for consumers: importance of the electricity to gas price ratio



4. Increase energy system integration with flexible heat pumps



Demand side flexibility update:

“Barely any progress to ensure access to price signals for end-users ” *

Giving a value to flexibility is essential to make heat pumps attractive to end users and aggregators

* Source: The implementation of the Electricity Market Design 2022 to drive demand side flexibility. Smarten 2022

ehpa

5. Develop the required skills and workforce

Source: skvp.se: Swedish heat pump school competition winner

Thank you!

Mélanie Auvray
melanie.auvray@ehpa.org

@helloheatpumps

European Heat Pump Association

www.ehpa.org

ehpa

27/09/2023 I 9h30 - 12h00

SUNHORIZON: Suncoupled innovative heat pumps

Final conference

Brussels Marriott Hotel Grand Place

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