27 September 2022 I 10:00 - 12:00 CET

Ambition requires action:

the sustainable housing revolution with heat pumps

Online seminar

These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements No. 890492 (Superhomes2030); No. 818329 (SunHorizon)

Agenda

- **10:00**-**10:10** Welcome and Introduction by Irene Egea Saiz, EU Project Officer, EHPA

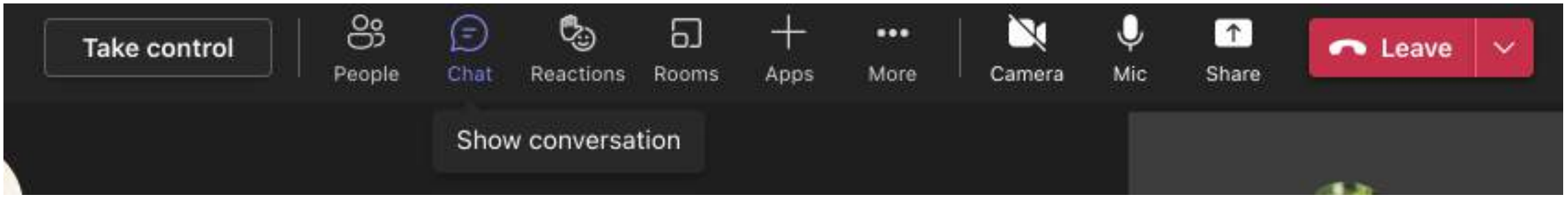
- **10:10**-**10:25** Keynote speech by Thomas Nowak, Secretary General, EHPA

- **10:25**-**11:50** Short presentations and Panel discussion Moderated by Irene Egea Saiz (EHPA) with:

- Nora Ganzinelli, H2020 project Sunhorizon
- Sofia Lettenbichler, EIT Innoenergy
- Robyn O'Mara, H2020 Superhomes2030
- Daniel Carbonell, H2020 TRI-HP

- **11:50**-**12:00** Closing of the event by Irene Egea Saiz (EHPA)

Welcome and meeting logistics: Microsoft Teams Webinar participant features



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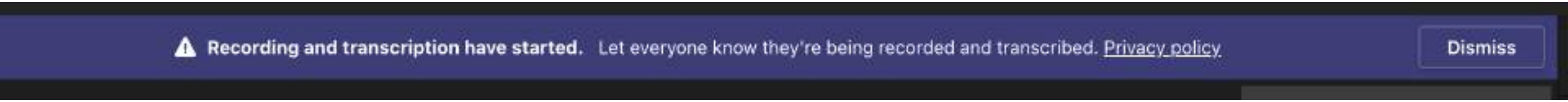


Ambition requires action:
the sustainable housing revolution with heat pumps

Keynote speech - 10:10 - 10:25 CET

Thomas Nowak
Secretary General
EHPA

Ambition requires action: Heat pump solutions for all buildings

Thomas Nowak

Secretary General

European Heat Pump Association

Heat pumps are mature and used everywhere – today
Special benefit, where heating and cooling is needed

White goods & cars

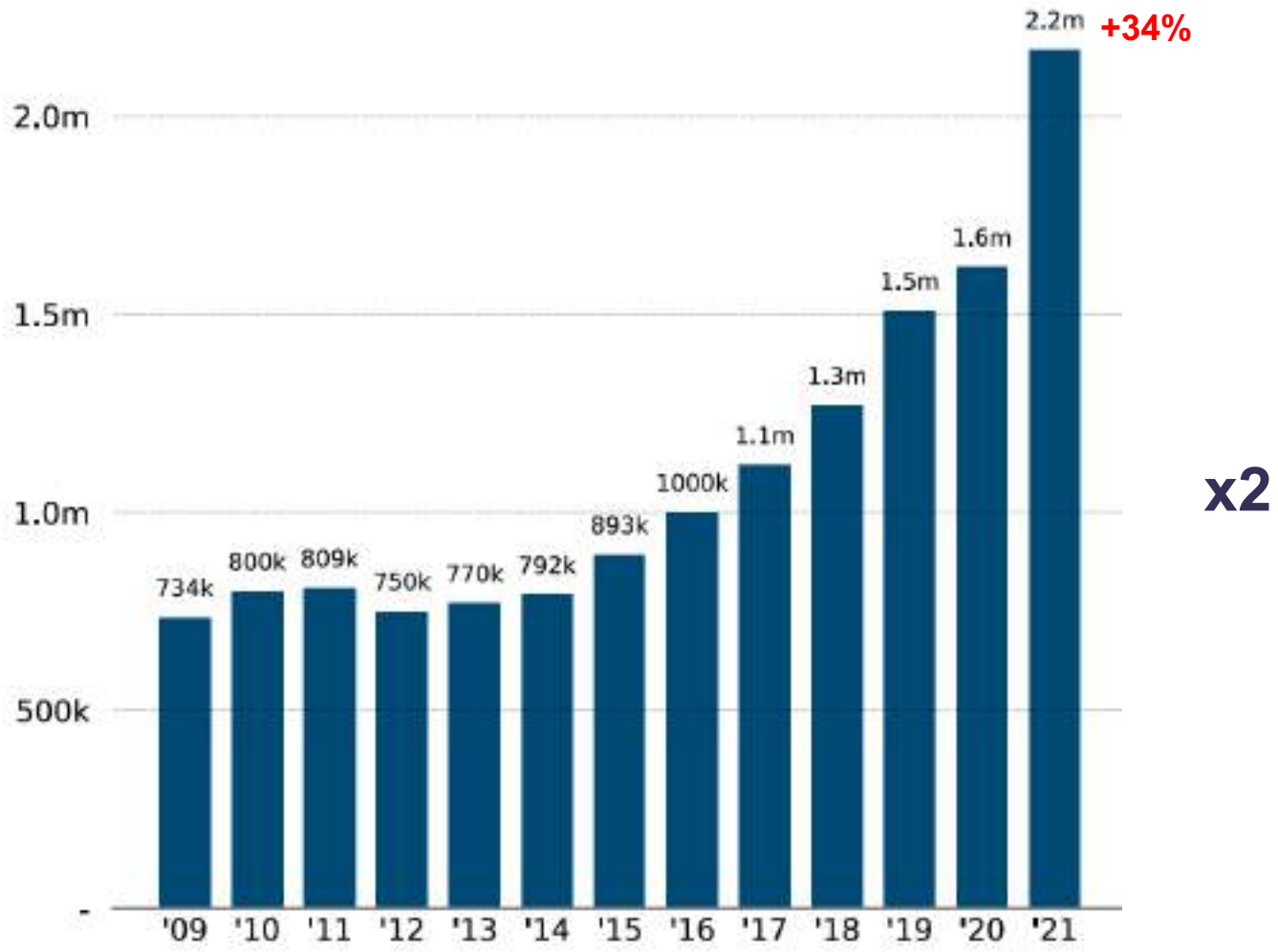
Commercial Applications

Residential Applications

Industrial Applications & District Heating

Big buildings

Heat pump sales in 21 European markets
2021: 2.2 million units | stock: 17 million



x2

?

4,6 m

2025e

Heat pump benefits 2021
Based on 17 million heat pumps installed

Thermal capacity

147 GW

Demand response potential

Up to 3.9 TWh

Useful energy

283 TWh

Renewable energy

179 TWh

Auxiliary energy

If auxiliary energy is **green,** heat pumps provide
100% **green heat**

Fossil final energy savings

229 TWh

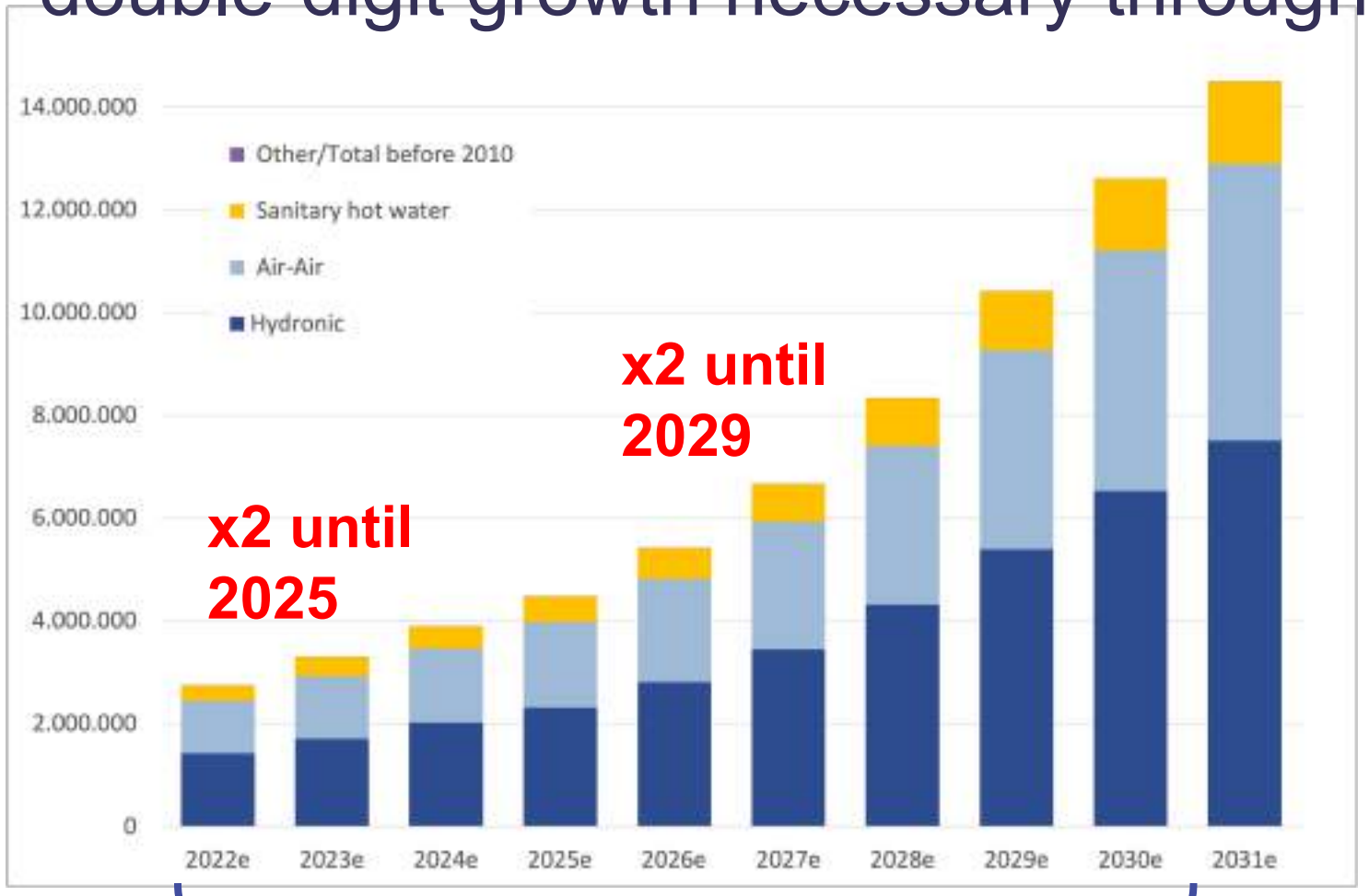
CO_2 savings

45,9 Mt

Clean air

No PM at point of operation

REPowerEU: High ambition for heat pumps double-digit growth necessary throughout this decade



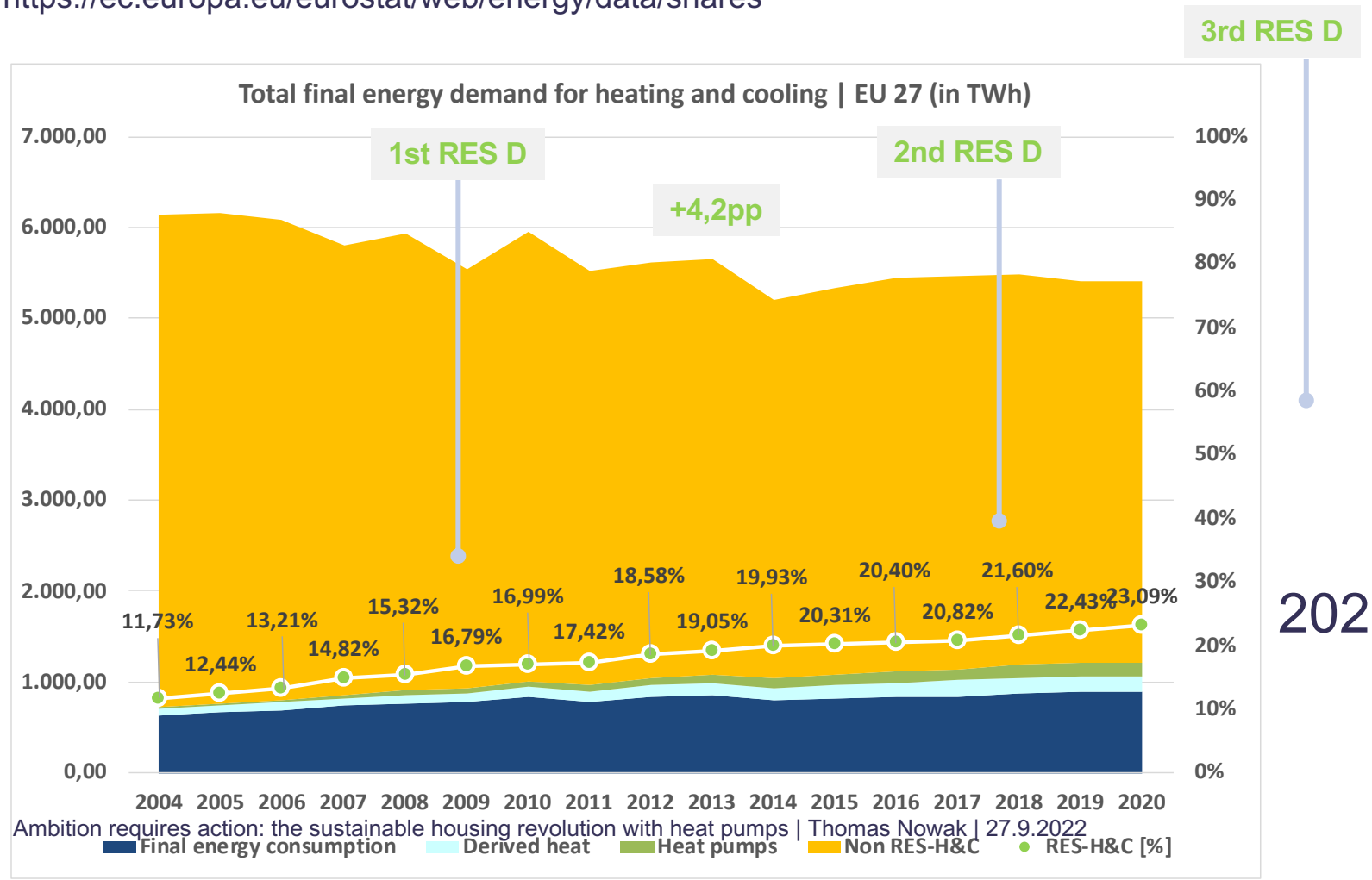
Time horizon of REPowerEU

Air-air HP are also replacin
Fossil gas

Slight advantage for air-water HP

Growth of renewable heating lacks behind EU targets

https://ec.europa.eu/eurostat/web/energy/data/shares



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annual increase of renewable share

2023

Source: Eurostat Shares

Heat pumps work in renovation

EU Project Superhomes in Ireland

- Developped by SEAI, ESB, LIT and TEA
- Independent expert led renovation: Grants, trained contractors, quality control.
- Research, policy, innovation.
- 1-stop shop modelled on Picardie Pass Renovation.
- PDA from European investment bank ELENA.

Co-funded by the Horizon2020 programme of the European Union

A hydrothermal heat pump system – Amsterdam

Decentralized air-to-air HP without outdoor unit – Vancouver

Examples of multi-family building in renovation

Nida Social Housing benefits from Thermia pump - Lithuania

A ground-source heat pump to provide all the heating and hot water via geothermal energy for a complex of 5 houses with 25 family apartments.

Technical details of the application

Heating capacity: 38,4 kW
COP: 4,09
Refrigerant: R 407C
Heating source: Boreholes 10 x 100m
Supplied temperature: +40 °C

A house covered in snow in Nida, Lithuania

HP systems in high-rise tower blocks - UK

Picture 1: The towers in Sunderland

Picture 2: The Sunamp UniQ heat battery in place

Picture 3: The Kensa Shoebox HP with the UniQ heat battery in the background

Source: Sunamp

Multi-family building renovation

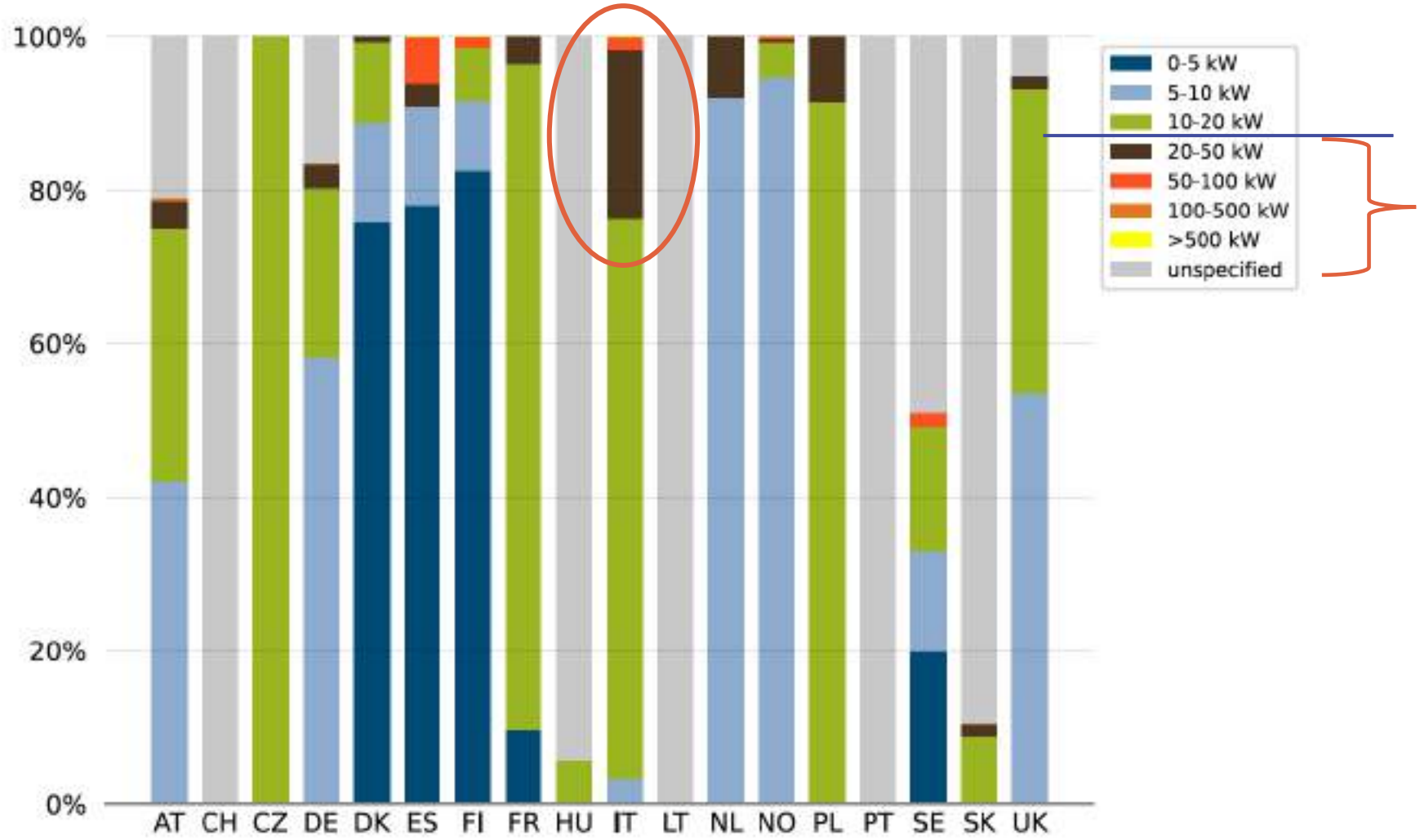
Sustainable modernization project in AT

- 12 flats supplied by mini heat pump
- Heat distribution in the flats with existing radiators
- Domestic hot water tanks with 150l
- Required space in the flat - Important
- Distribution lines of heat pump source through old installations shaft
- Design of a new boiler room in the attic

VAILLANT GROUP

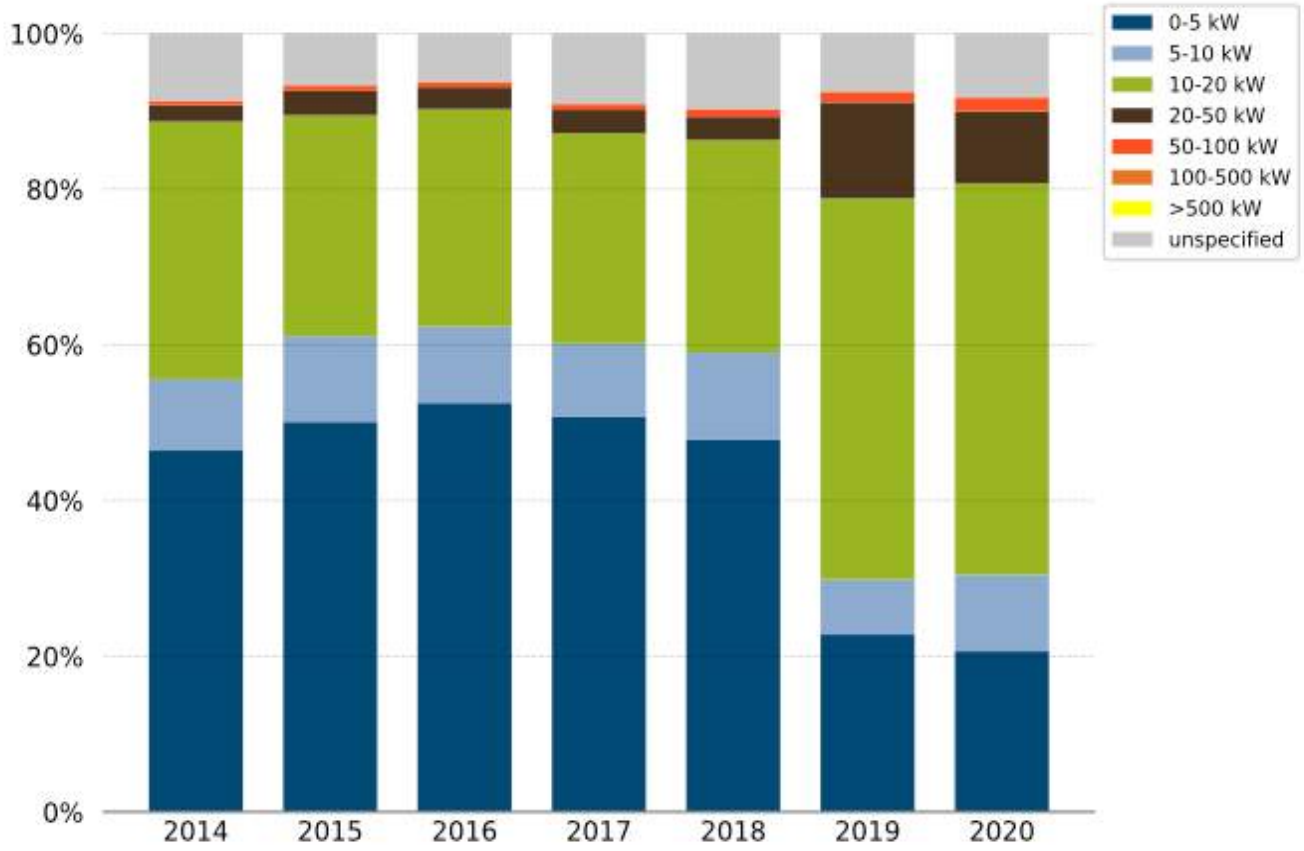
VAILLANT GROUP

Split by country and size | 2020 data



Less than 10% of all HP sold have a capacity of more than 20kW

HP development by capacity – EU



Five points to make it happen

01

Create trust in long term ambition

02

Make clean heating economically most attractive

03

Avoid disruption through legislation

04

Focus on skills for the energy transition

05

Better heat pumps and systems through more R&D and better data

… and plan for the upgrade of electr

One word on electric grids

- There is a lot of good analysis concluding that
  1. More heat pumps means more stable demand
  2. More heat pumps introduces more demand-side flexibility
  3. Value given to flexibility leads to new business models
  4. New business models means new players means more heat pumps
  5. Go back to point #1
- Every planning process that replaces cable/transformer station mus recognize the impact of electrification

The lights will stay on with 50 million heat pumps

In the proposed EU strategy for Energy Systems Integration, the Commission foresees 40% of all residential and 65% of all commercial buildings being heated with electricity by 2050. Electric heat pumps will play a central role in the path towards decarbonising heating and cooling over the next 10 years and beyond.
Electric heat pumps are the most cost-effective solution to substantially reduce CO_2 emissions and energy demand, while improving air-quality, especially in cities. Switching from fossil fuel boilers to electric heat pumps will reduce final energy consumption in buildings by more than 66%, and will reduce the CO_2 emissions generated by heating end-uses at European level by at least 80%, potentially bringing it close to zero. Even if the remaining heat demand was fully supplied by heat pumps, the need for additional electricity would be limited compared to today's demand and generation capacity. Constant energy efficiency improvements in both buildings and equipment will limit any potential increase. Electric heat pumps are three times more efficient than gas boilers and, will therefore be a major contributor to energy efficiency, while at the same time being an important source of renewable heating and cooling with no exhaust emissions.

The large-scale roll-out of electric heat pumps will not jeopardize the security of supply of electricity, not now and not in the future.

The EU electric network is a robust and meshed system. Operators have been working together for decades to ensure a constant and high level of grid stability and have successfully faced similar challenges in dealing with the millions of electric devices which have been deployed in all households across the EU in recent years. The network is already being continuously updated to meet new demand requirements and the reinforcements needed will be within the usual network investment plans. Electricity networks can rely on an already highly interconnected and regulated market, complying with harmonized European rules (Network Codes), which have been further strengthened by the Clean Energy Package.

In addition, smart control functions are increasingly embedded in this equipment. Electric heat pumps are now connected products, making it possible to offer remote monitoring services. Soon it will also be possible to offer remote maintenance. Connectivity also paves the way for controlling heating and cooling installations, with the aim of coupling electric heat pumps with renewable electricity generation and providing flexibility to the electricity system.

The European market for electric heat pumps has been grown solidly and sustainably for several years. It creates direct jobs (manufacturing) and indirect jobs (distribution, installation, maintenance, and repair) from a strong European market as well as from exports. Heat pump technology is today ready to be deployed in most existing buildings, let alone those build new or undergoing energetic renovation. Shifting the building stock and industrial processes to heat pump technologies will not only help Europe to achieve its energy and climate targets, reduce its reliance on imports and increase its energy independence.
Despite the benefits offered by electric heat pumps, the penetration of this technology in Europe is currently only 10% for the building sector.

It will require a strategic approach and a coherent implementation agenda to increase this share to the expected levels. Consequently, regulatory and financial support is required to remove barriers. In this context, the Green Deal, through its Renovation Wave, the system integration strategy and the industrialization strategy, offers a unique opportunity to set out a proper regulatory framework that boosts momentum on electrification of the building sector and industry.

A heat pump accelerator

- Brings all players to the table
- Sounding board for legislation that prioritises heat pump market development to
  - fulfil Europe's energy and climate goals
  - make the continent independent of fossil energy for heating
- Generates heat pump growth in Europe affecting the whole value chain
  - Research and development institutions
  - Component manufacturers
  - Heat pump Manufacturers
  - Planners and Installers
- Direct support to the REPowerEU targets

High ambition needs to be connected to concrete action

‘it needs “all hands on deck to”
accelerate heat pump deployment and eliminate dependency on fossil energy

The European Heat Pump Association aisbl / founded 2000

173

Members

Heat pump manufacturers
Component manufacturers
National associations
Consultants
Research & test institutes

22

countries represented

International cooperation

CECA, IEA, IEA HPC, 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.

Ambition requires action:
the sustainable housing revolution with heat pumps

Short presentations and panel discussion - 10:25 - 11:50 CET

Nora Ganzinelli
Project manager & business developer
Business Development team
Energy & Mobility division
RINA Consulting.

SunHorizon

Ambition requires action: the sustainable housing revolution with heat pumps

28 September 2022

SunHorizon

Sun coupled innovative Heat pumps

Nora Ganzinelli, Project manager, RINA-C

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

About RINA

SunHorizon

RINA

- x5 in 15 years
- 70+ Countries
- 4.000+ Collegues, 90+ Nationalities
- 200+ Offices

RINA C - Energy & Mobility

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

Our vision and objective

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 demosite

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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+BH

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SunHorizon TPs

The demosite 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

BDR THERMEA GROUP

DUALSUN

Storage

ratiotherm

BDR THERMEA GROUP

Needs

Space cooling

Space heating

5 technology packages

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DEMO Sites - Presentations

- **Riga, Latvia**: small residential (2 single houses)

- **Madrid, Spain**: social housing apartment block (9 apartments)

- **Sant Cugat del Vallès, Spain**: tertiary civic center

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DEMO Site – Riga, Latvia

Type of building: **small residential** (two single-family houses, 2012/2013)

	Imanta	Sunisi
Heated space	**235** m^2	**96** m^2
Electricity consumption	~**4.4** MWh/year	~**7.2** MWh/year
Gas consumption	~**39.6** MWh/year **168.5** kWh/m^2	~**21** MWh/year **218.8** kWh/m^2
Pre-SunHorizon	individual **gas boiler** for DHW and space heating through radiators (Imanta, Sunisi) and under-floor heating (only Sunisi)	

Imanta

Sunisi

Demonstration action

TP2: mixed solar-assisted integration of gas-driven thermal compression **heat pump** with boiler (Boostheat) for space heating + DHW; hybrid solar **PV-T panels** (DualSun) to assist BH evaporator and for preheating + electricity production for building appliances coupled with **glycol storage** and **stratified thermal storage** tank (Ratiotherm) + Smart Energy electrical heater for residual PV-T electricity

This Project has received funding from the European Union's Horizon 202 Research and Innovation Programme under Grant Agreement N8I8329

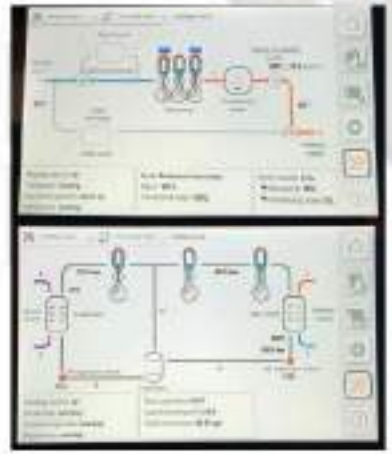
DEMO Site – Riga, Latvia

- **Installation** of TP2 components in Riga, Imanta

RATIO equipment

BH internal and external unit

DS (PVT)



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DEMO Site – Riga, Latvia

- **Installation** of TP2 components in Riga, Sunisi

Shed built for SunHorizon technology hosting

Gas boiler

RATIO equipment

BH internal unit

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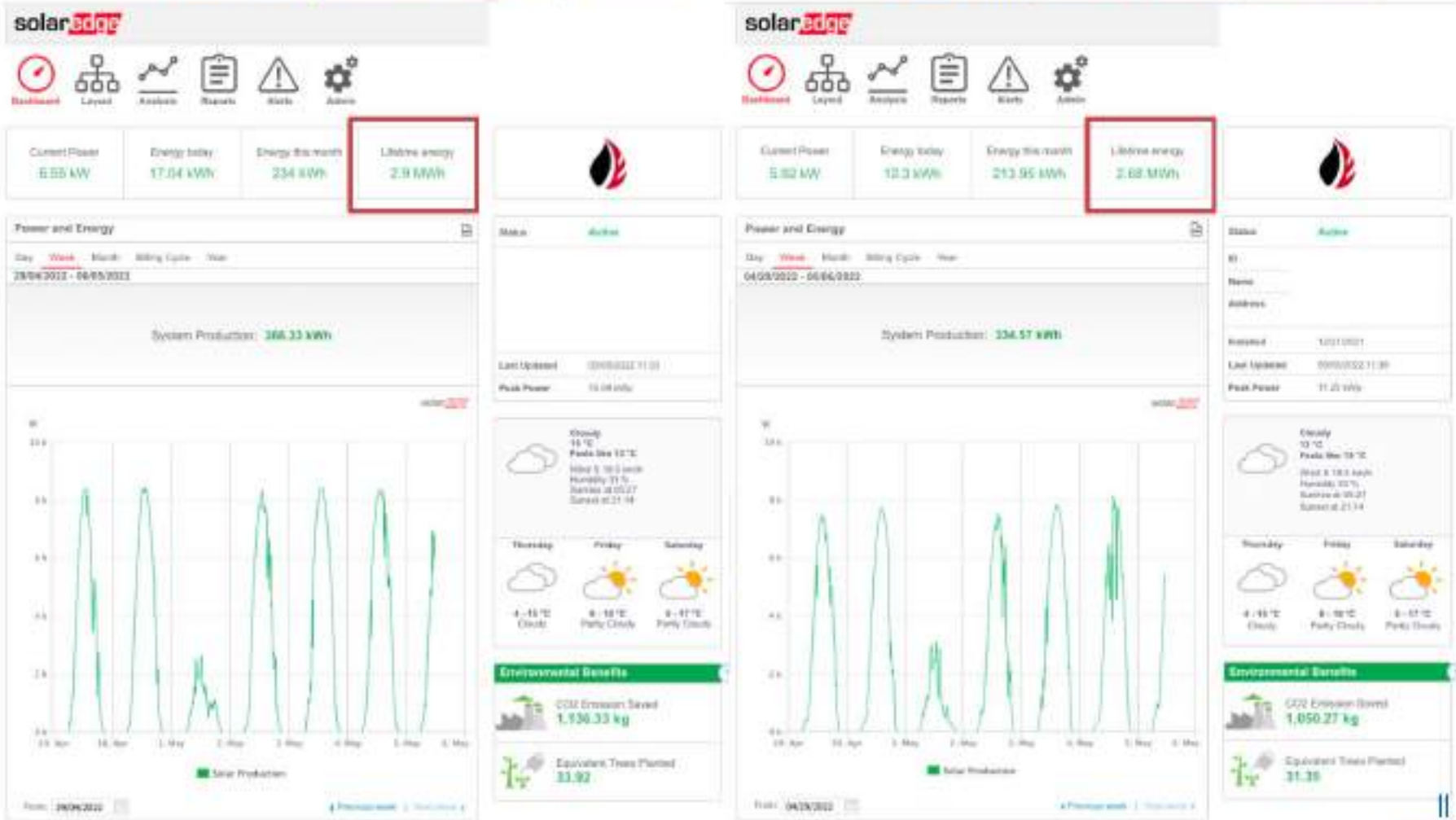
DEMO Sites – Riga, Latvia

PV production from solar panels (1 Jan – 4 May 2022)

Imanta: **2.90** MWh produced (10.24 kWp installed)

Sunisi: **2.68** MWh produced (9.6 kWp installed)



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DEMO Site – Madrid, Spain

Type of building: **Large residential Social housing** apartment block, envelope under retrofit, 10 flats with a ground floor + 4 floors (1072 m2) near the town center of Madrid. Solar energy potential: 62 m2.

Heated space	**1.072 m2**
Yearly thermal demand estimation	~ **13 MWh** DHW, **18 MWh** electricity, **60 MWh** space heating, **4 MWh** cooling.
Pre-SunHorizon	Existing individual appliances per flat: gas boiler supply DHW and space heating through radiator circuit and air/air split for cooling.

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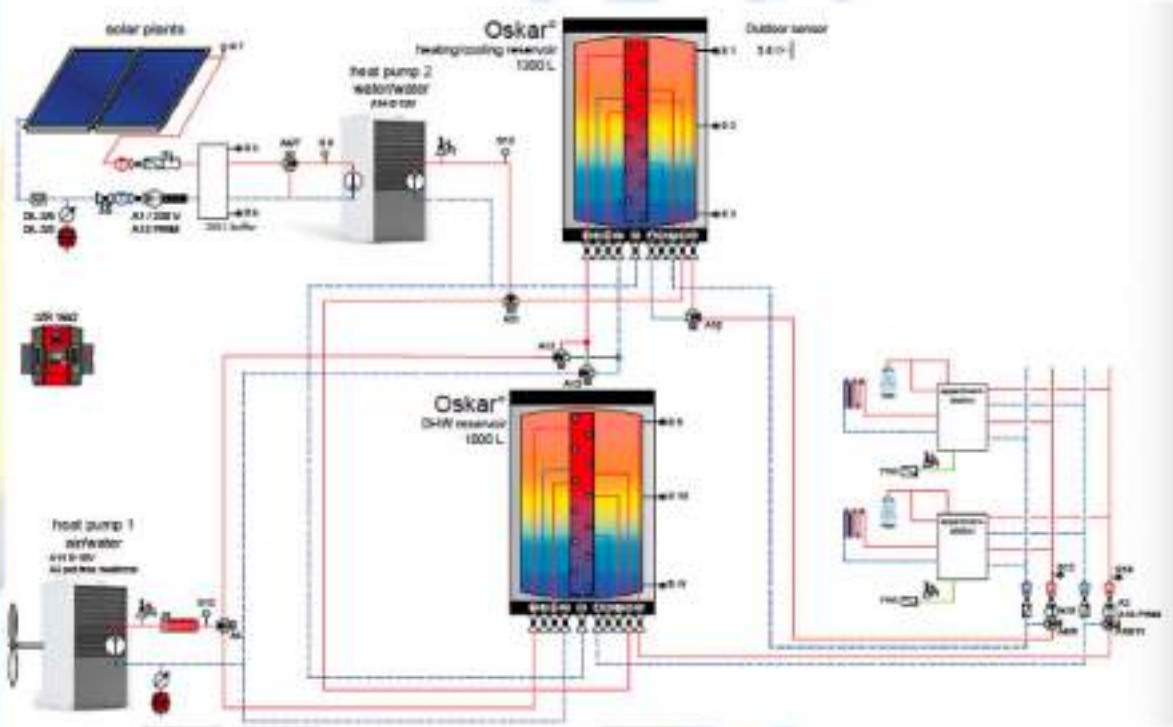
DEMO Site – Madrid, Spain

Demonstration action:
TP4, Parallel integration:

- reversible HP (BDR) for space heating + cooling + DHW;
- Thermal output from solar hybrid PV-T (DUALSUN) to cover heat demand and to assist BDR evaporator;
- PV-T (DUALSUN) electricity production to cover building appliances electricity consumption.



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DEMO Site - Madrid, Spain - Passive Renovation

- **ENVELOPE**: External Insulation 8 - 10 cm. U value = 0,262 W/m2K
- **ROOF**: Integration of insulation layer: 80 mm de Extrude Polystyrene, total thickness: 52 cm; Uvalue= 0, 26 W/m2K
- **WINDOWS**: Substitution of windows: Aluminum TBB Double Glazed with Low Emission layer + Solar Control 4+4-16-6; Uvalue = 1,00 W/m2K
- **LIFT**: Change location of the lift to improve the accesibility

Façade before

Façade after

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

DEMO Site – Madrid, Spain

Overview of the process of renovation:

SUNHORIZON Building refurbishment and construction works consists of 2 phases:

- **1st PHASE:**

Dwelling refurbishment, improvement of insulation, etc. + Pre-installation SH: Interior installation and exterior distribution system (interior heat exchangers, fan coils, interior and exterior distribution pipes and conducts, ventilation, etc.).

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DEMO Site - Madrid, Spain - SUNHORIZON Renovation

PHASE 1:





Phase I of the renovation works at Madrid demosite

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

DEMO Site – Madrid, Spain - SUNHORIZON Renovation

PHASE 2: SunHorizon equipment connection to the pre-installation (Hydraulics, Electrics and Controls) and commissioning.

First Shipment containing the 1000L and 1300L arrived Second Half July.

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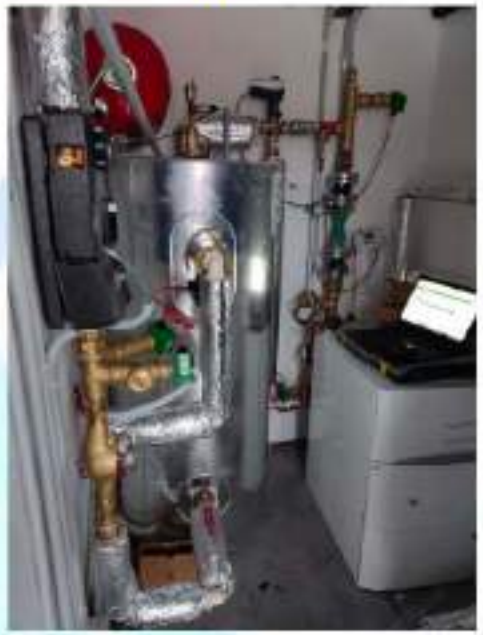
DEMO Site - Madrid, Spain - SUNHORIZON Renovation



50 m^2 (~ 10 kWe) DS panels (PVT)

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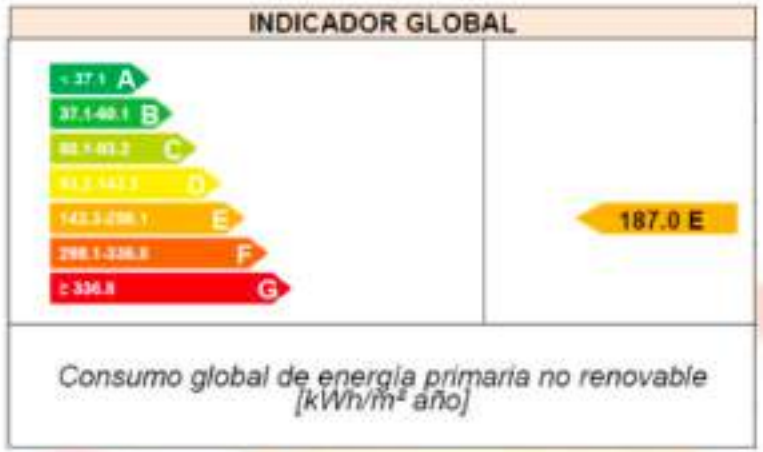
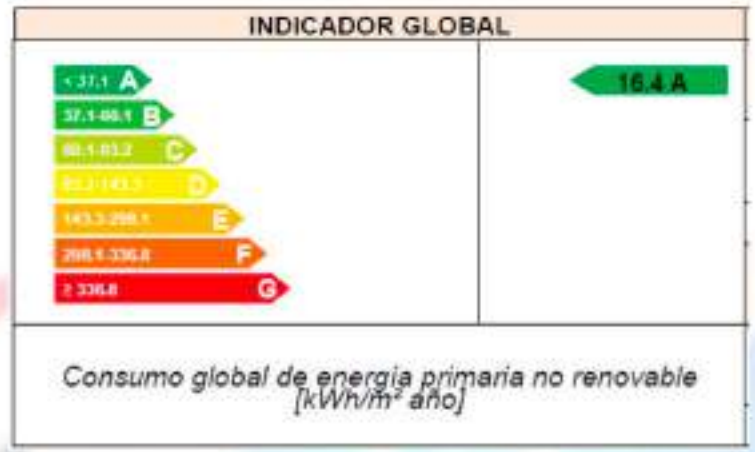
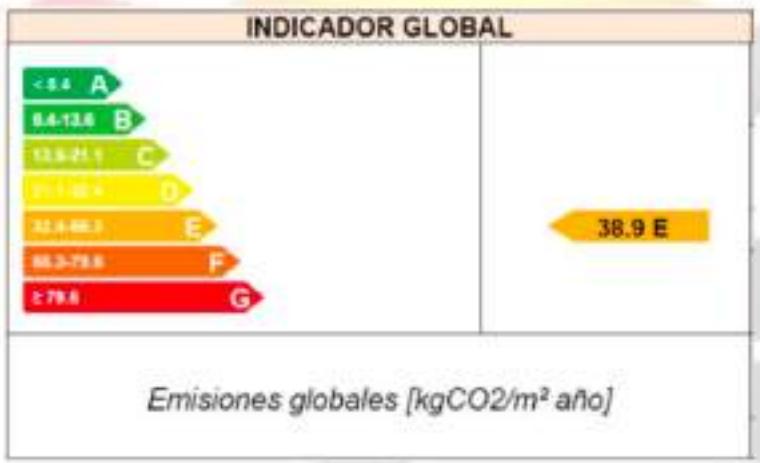
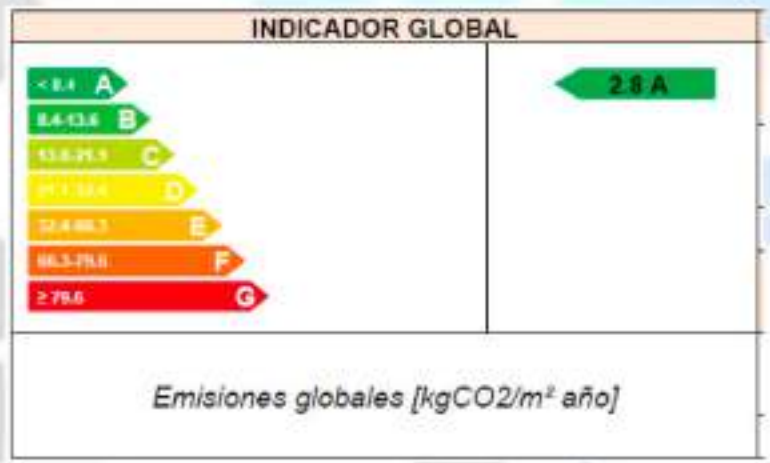
DEMO Site - Madrid, Spain - Energy Efficiency Impact









GHG savings of 71%

Non Renewable Primary energy savings of 87%

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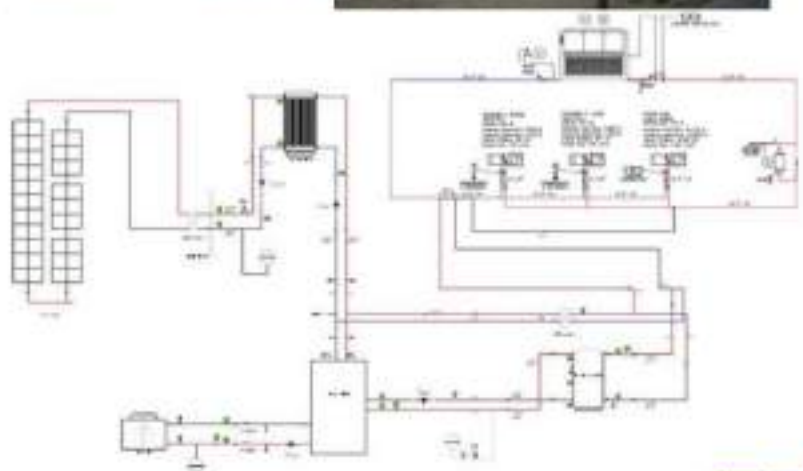
DEMO Site – Sant Cugat del Vallès, Spain

Type of building: **Tertiary civic center** (Surface: 2.440,25 m2 in 1 floor)

Heated space	**1.200 m2**
Electricity consumption	~**200** MWh/year
Pre-SunHorizon	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). 2 x split air conditioner: 2.1 kW (cooling capacity) – 3 (heating capacity)

Demonstration action

TP3. Solar-driven HP: Solar thermal (TVP) drives the thermal compressor of FAHR chiller with increased efficiency to provide 40kW(+60 kW) cooling capacity with existing 93 kW chiller on the existing cooling distribution.



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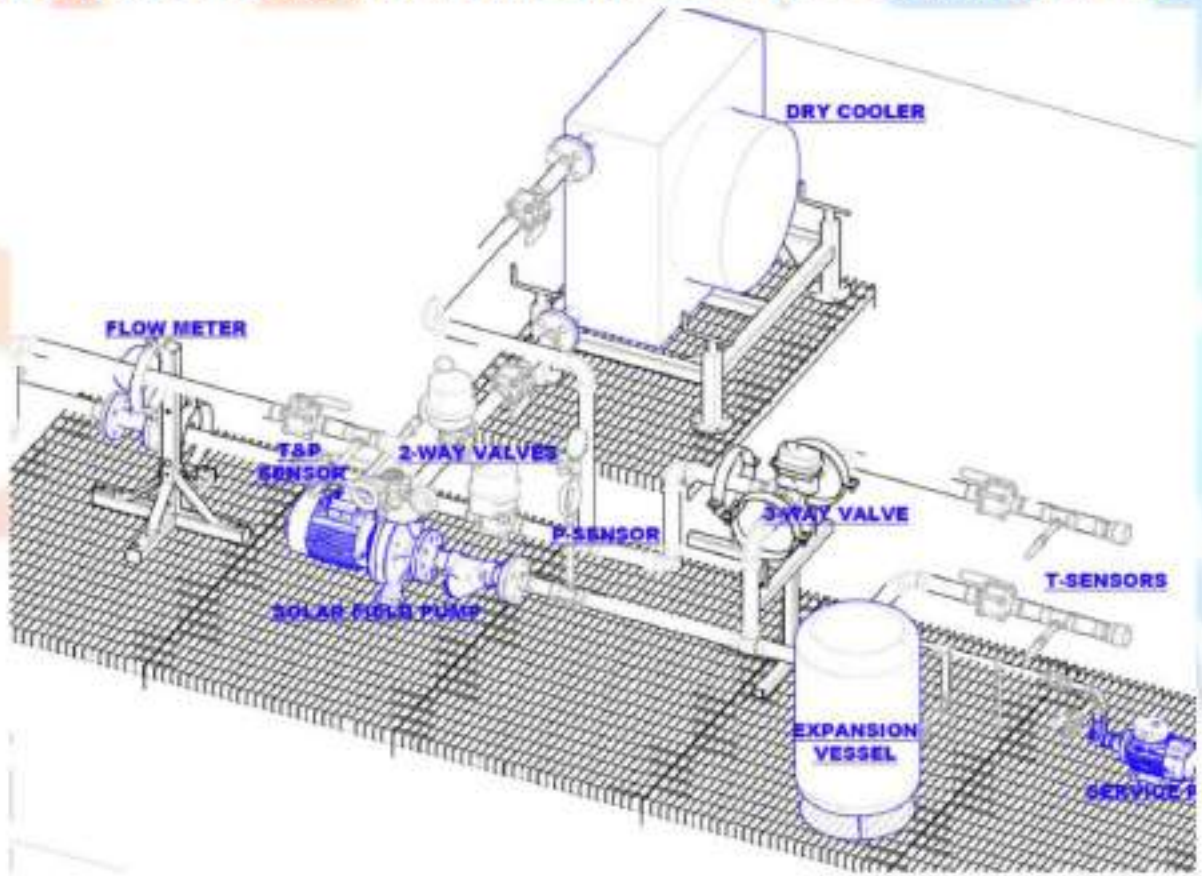
DEMO Site – Sant Cugat del Vallès, Spain

Installation of TP3 components in Sant Cugat del Vallès. Main components:

- **SOLAR FIELD (TVP)**: 98 panels, 192 m2, 125 kW.
- **Heat pumps (FAH)**: Sorption unit 40 kW, compression unit 60 kW. Temp: 80-95ºC (IN), 70-85ºC (OUT)



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DEMO Site – Sant Cugat del Vallès, Spain

- **Installation** of TP3 components in Sant Cugat del Vallès

TVP high vacuum panels system (125 kWth)

TVP system

Pump and expansion vessels of the FAHR system

FAHRENHEIT re-cooler system

RATIOTHERM hot water storage system (10.000 l)

FAHRENHEIT hot water storage

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DEMO Site – Sant Cugat del Vallès, Spain

Centre Cultural Mirasol (Sant Cugat pilot):

Opening hours: from Monday to Sunday 8am to 2.30pm and 4pm to 10pm

Following influx of users:

- 405 users in the mornings from Monday to Friday
- 330 users in the afternoons from Monday to Friday
- 170 users on weekends
- **905 users per week**
- **3620 users per month**

Total number of courses and activities offered per week:

- 55 courses and workshops on culture (music, painting, cooking, dance, yoga, etc)
- 3 daily professional training courses and ICT tools.
- 1 public school training classroom
- 1 theater and dance hall
- Daily workshops of permanent based cultural entities
- Daily space for the elderly day center and services (hairdressing, physiotherapy, etc)

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DEMO Site - Sant Cugat del Vallès, Spain

SunHorizon App

The App allows users to view real-time information about their building's indoor climate and energy consumption (temperature, humidity and CO_2 concentration) through the installation of sensors in 10 rooms of the building.

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

Replicability potential

Riga, Latvia	Madrid, Spain	Sant Cugat del Vallès, Spain
- Small residential (single houses 30% in Latvia) with natural gas connection (48% of dwellings in Latvia)	- Residential and tertiary	- Medium scale tertiary buildings and residential
- New and renovated buildings	- New and renovated buildings	- New and renovated buildings
All climates	- Sunny climates	- Sunny climates

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

SunHorizon

Thank you!

Nora Ganzinelli, RINA Consulting
nora.ganzinelli@rina.org

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

Ambition requires action:
the sustainable housing revolution with heat pumps

Short presentations and panel discussion - 10:25 - 11:50 CET

Sofia Lettenbichler
European Public Affairs Officer
EIT InnoEnergy

eit InnoEnergy

Co-funded by the European Union

Image courtesy of Theo van Rensen, TBB Photo Contest

Co-funded by the European Union

Ambition requires action: the sustainable housing revolution with heat pumps

EIT InnoEnergy: Sustainable Cities and Buildings, Energy Efficiency

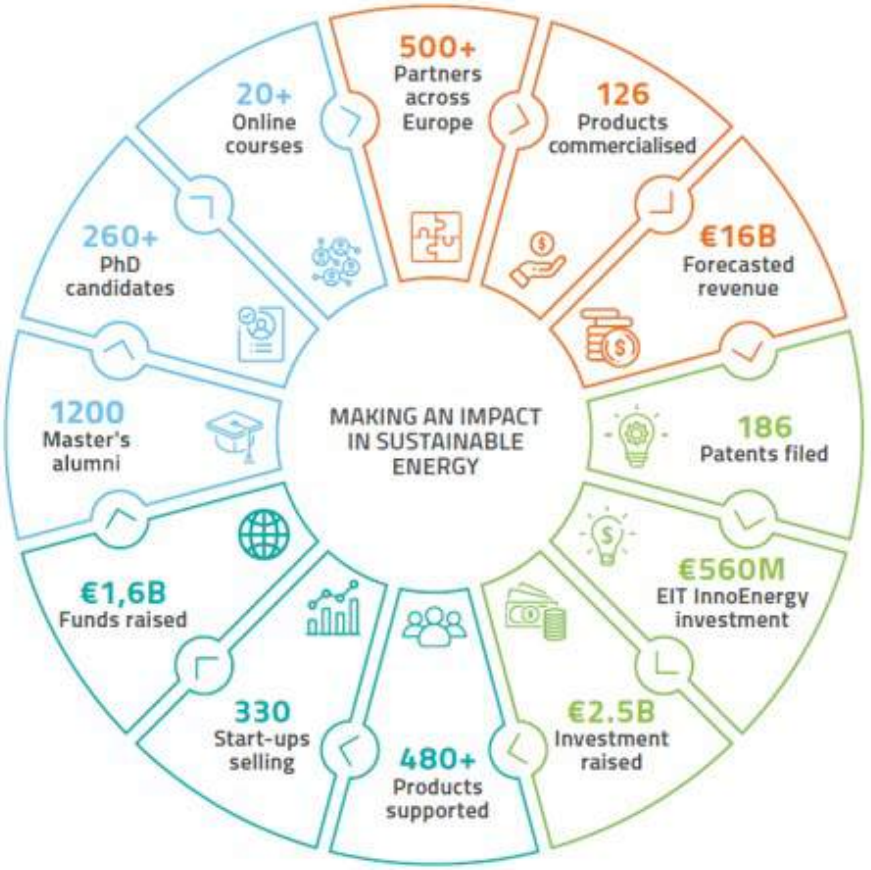
Sofia Lettenbichler, September 2022

Reducing Risk and Time-to-Market for Sustainable Energy Innovation

A European Public-Private Partnership

Public Goals with Private Means
→ #1 Most Active Investor in Energy
"2020 Annual Global League Tables" Pitchbook

Pan-European Footprint



Our Activities

Education: Master Programmes and Professional Learning

Incubation & Acceleration: Investing in Early-Stage Start-Ups and Scale-Ups

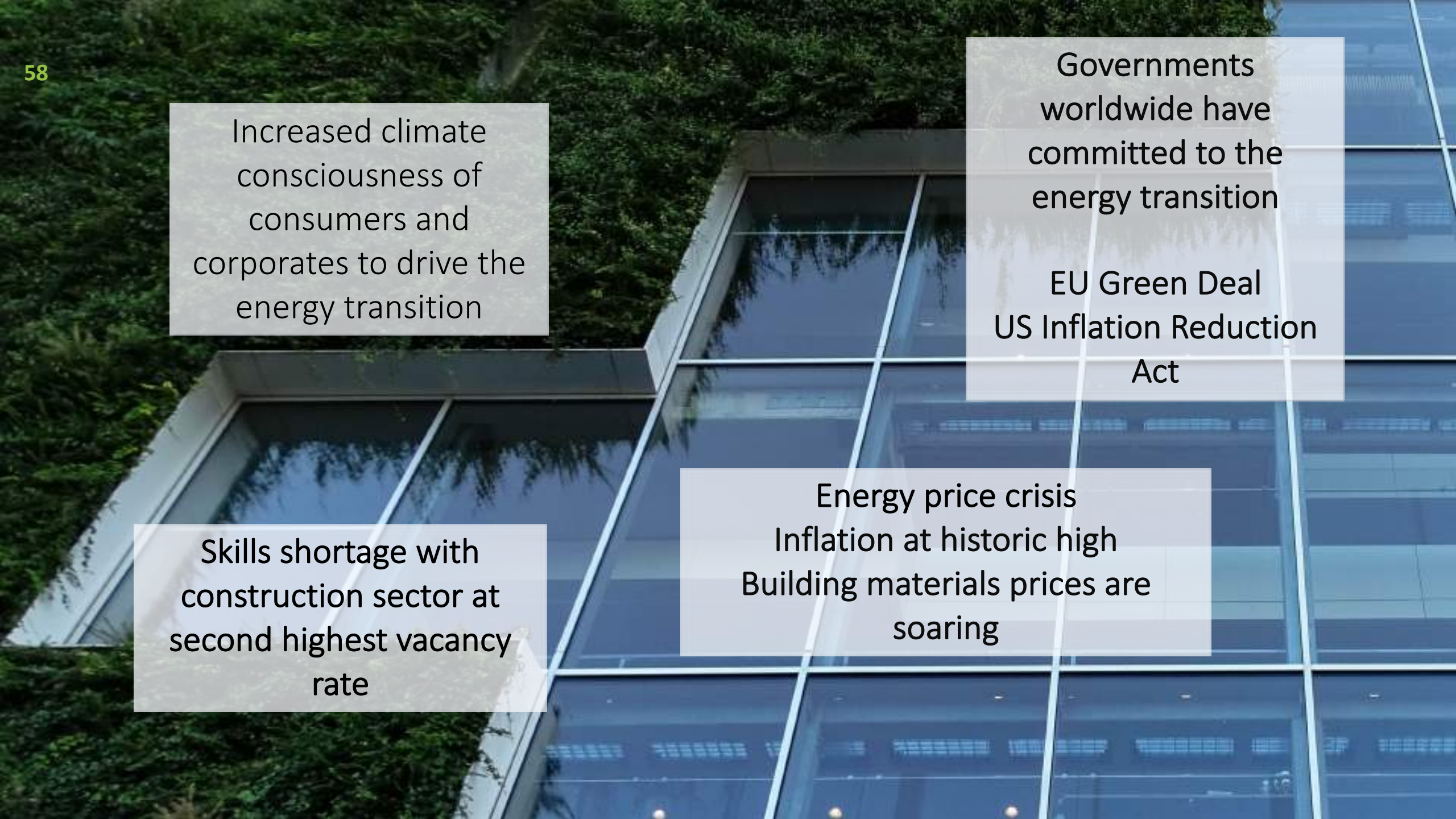
Innovation: Investing in Product Development

Industrial Value-Chains: European Battery Alliance, European Green Hydrogen Acceleration Centre, European Solar Initiative

Sustainable Cities and Buildings, Energy Efficiency

- Context -


9%
of EU GDP
18 million
direct jobs
36%
EU energy use
37%
CO2 emissions



Increased climate consciousness of consumers and corporates to drive the energy transition

Governments worldwide have committed to the energy transition

EU Green Deal
US Inflation Reduction Act

Energy price crisis
Inflation at historic high
Building materials prices are soaring

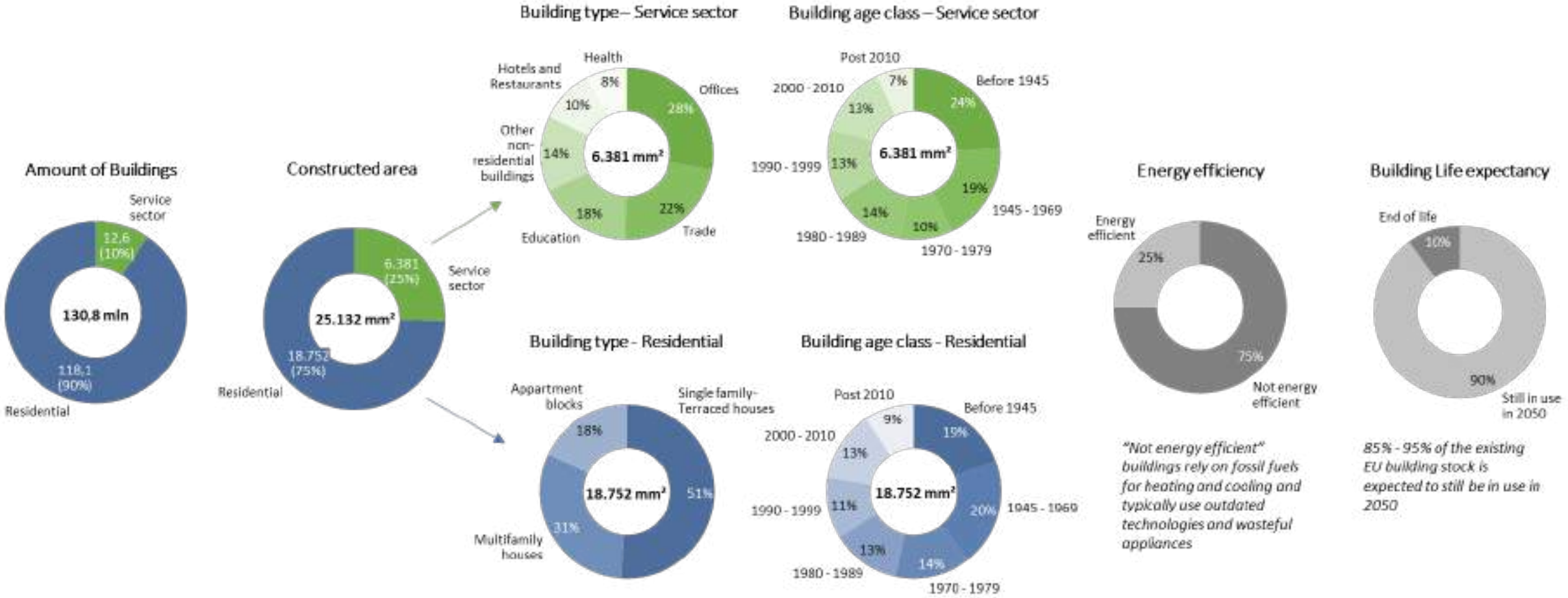
Skills shortage with construction sector at second highest vacancy rate

Sustainable Cities and Buildings, Energy Efficiency

- Background and Market Insights -

Co-funded by the European Union

Today, 75% of EU buildings are energy in-efficient. Yet ~90% of these buildings are expected to be still in use, in 2050



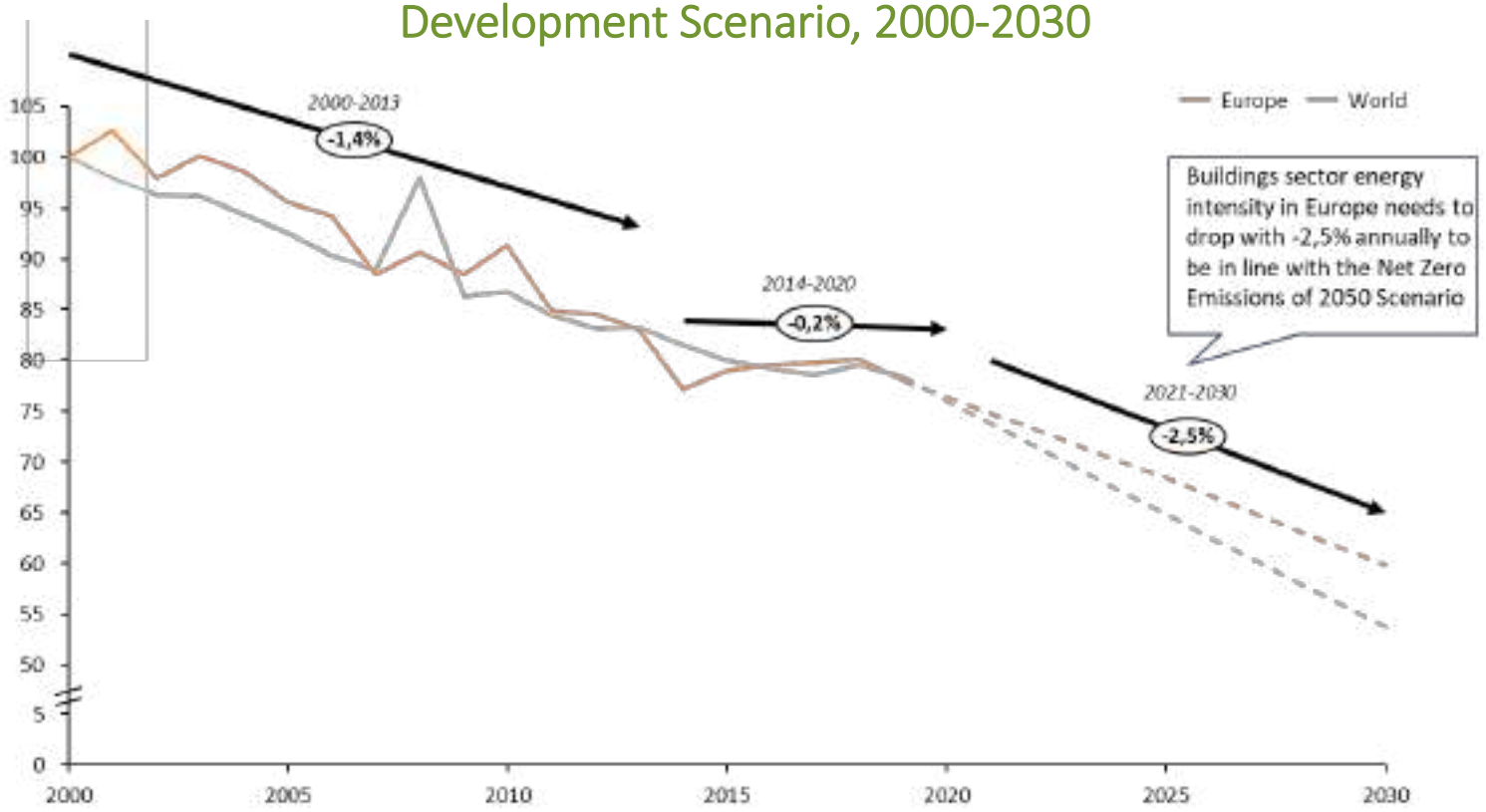
"Not energy efficient" buildings rely on fossil fuels for heating and cooling and typically use outdated technologies and wasteful appliances

85% - 95% of the existing EU building stock is expected to still be in use in 2050

Source: RICS EU building stock analyses
Note: 1 mm² = 1 square megameter, which equals 1 trillion square meters

The EU building sector energy intensity has been decreasing over the past 20 years but slowed down over the last 5 years. Increased pace needed to reach Paris agreement targets

Buildings sector energy intensity in Europe in the Sustainable Development Scenario, 2000-2030



- Productivity of the European buildings & constructions sector is improving at a lower rate than other industries. Key reasons:
  - Less spending on R&D
  - Low venture capital investments
  - Fragmentation resulted in limited innovation and limited technology integration capabilities

Source: IEA, Shadow Ventures

Note: energy intensity is a measure of the energy inefficiency of the buildings sector. It is calculated as units of energy per building surface.

There are various barriers from both building owners and value chain actors perspective as a result of which renovation rates have remained low

Barriers from building owners perspective

Technology
- Uncertainty of performance and performance gap (i.e. the difference between intended and actual performance)
- Lack of technological, product and system developments

Knowledge-information gap
- Difficulties of proving non-energy benefits of renovation
- low awareness (genuine disconnect climate change and energy efficiency property)
- Reliable information and support

Market inefficiencies
- Split incentives and conflicting interests
- Duration, hassle and complexity of energy efficiency renovation projects

Financial
- High upfront costs
- Lack of access to capital
- Uncaptured value (energy efficiency improvements do not always translate into increased rent or property valuation)
- Low confidence in energy bill savings

Barriers from value chain actors perspective

Knowledge-information gap
- Lack of skilled personnel and training
- Low quality auditing

EU renovation market structure
- Fragmented value chain: difficulties in coordination and communication
- Insufficient resources and competences to tender for public procurements
- Reluctant leaseholders, not willing to contribute to change, thereby limiting economy of scale
- Gaining permission: collective agreement amongst groups of apartment owners
- Supply chain constraints: limitations in scale, costs and routine
- Bureaucracy: financing models for energy efficiency renovation projects have long lead times for approval

Regulatory
- Lack of continuity in regulations
- Limited consistent grant schemes and governmental programs

Cities and districts will become more sustainable and greener, through focus on smart and sustainable infrastructure and design, green planning of public spaces and adoption of circular models and local production

- Sustainable cities
- 15 minute city
- Sustainable and green infrastructure
- Circular economy, local production
- **Low carbon construction**
- **Renovation**
- **Sustainable buildings**
- **Alternative building techniques**

Source: Deloitte: Urban future with a purpose, 2021; various

Sustainable Cities and Buildings
Energy Efficiency

- EIT InnoEnergy's Footprint -

Main segments "Sustainable Cities and Buildings"

	A. Sustainable Cities	B. Construction & Renovation	C. Distributed clean energy systems	D. Sustainable buildings
Objectives	• Optimising the flow of energy, people, and data in a high density populated area • Enabling accessible, affordable and livable cities	• Reducing the impact on the environment and increase the construction/renovation rate. • Enabling affordable, livable, nearly zero energy sustainable buildings	On-site generation & self-consumption	• Maximising energy efficiency of buildings and the sustainability level, without sacrificing comfort or IAQ
Examples	▪ DC Brain ▪ Gradis ▪ Ecovat ▪ Heat Ventors ▪ CWJ ▪ Energy Floors ▪ Glowee ▪ Bin-e ▪ Recircula ▪ Sadako ▪ Trigger Systems ▪ Hardt Hyperloop ▪ Zeleros Hyperloop	▪ WoonDuurzaam ▪ EOS ▪ ESC – EvoHaus ▪ Dom' innov ▪ Wohnwagon ▪ SunAirBalcony	▪ Sylfen ▪ HPS ▪ FerroAmp ▪ ESC-EvoHaus ▪ Samster ▪ SunRoof ▪ SunRidge ▪ SoLarge ▪ SunAirBalcony ▪ Windmyroof ▪ Pionierkraft ▪ AMPNet ▪ ART HP ▪ AlpinovX ▪ Ecovat	▪ Watch-e ▪ BetterSpace ▪ Vilisto ▪ CEO ▪ Ecotropy ▪ Busto ▪ OGGA ▪ Ngenic ▪ ThermoSmart ▪ GreenRunning ▪ Sepin ▪ E2NSX ▪ Enappgy ▪ Bee2Energy ▪ Energiot ▪ Duschkraft ▪ Heaboo ▪ KlugIT ▪ IonSeed ▪ Sit&Heat

Main segments Energy Efficiency for Industry: Monitoring & Analytics and Energy-Efficient Equipment

Monitoring & Analytics

Sensors

Objective: getting a clear view on where energy consumption takes place

Tools: sensor and monitoring equipment

EIT InnoEnergy Portfolio companies:

- **Sensorfact**
- **OneWatt**
- **GreenRunning**

Software

Objective: where it is not immediately obvious from monitoring, use data analytics to optimise energy consumption and maintenance irt production requirements

Tools: Specialized software, AI, Big Data, machine learning

EIT InnoEnergy Portfolio companies:

- **Energiency**
- **Sensorfact**
- **OmegaLambdaTec**

Energy-Efficient Equipment and Electrification

Objective: replacing or complementing existing industrial equipment with more energy efficient equipment to reduce energy consumption and/or enable decarbonisation

Tools: heat pumps, energy storage, EE components

EIT InnoEnergy Portfolio companies:

- **ECOP:** high temperature heat pump
- **AlpinovX**: Efficient cooling / heat pump
- **EcoTechCeram:** high temperature heat storage
- **HeatVentors:** moderate temperature heat storage
- **HeatPower:** supercharged steam turbine
- **Cascade Drives**: Linear drives to electrify linear motion in heavy machines
- **Simplex Motion**: half weight-double torque servomotors

Industrial, energy efficient heat pump at 100 – 150 C

The Need

Process heat has a significant cost due to legislation and soaring gas prices. Few sustainable solutions are available in the 100-200°C range. There is an urgent need for heat pumps that remain efficient up to 150°C, are cost-effective, reliable and do not use fluorinated greenhouse gases (F-gases).

The Solution

Ecop introduced a new heat pump that is cost-effective and energy efficient. The same appliance has a broad area of application, from -20 °C to 150 °C. It requires no lubrication and all parts are low maintenance, standard and industrial. The Ecop rotation heat pump can be used simultaneously in one machine to generate heat and cold. No F-gases or flammable refrigerants are used.

Rotation Heat Pump for industrial applications and DHC systems

www.ecop.at

Pilot phase, starting sales

Co-funded by the European Union

High temperature heat storage

The Need

The main challenge is the reduction of capital expenses (capex) (€/kWh th installed) for a thermal energy storage technical solution for heat intensive industries.

The Solution

A new concept for waste heat recovery for temperatures of between 200 and 1.000°C, with low capital and operating expenses, based on the implementation of ceramic materials inside a container named Eco-Stock. Well adapted to small and medium industries, it comprises of a 20 foot, 30 tonne container with a capacity from 1 to 3 MWh th per cycle. Cycles run from 30 min to 8 hours. Temperature from ambient to 1000°C. Thermal
loss from just 5 to 8% per day.

Value Proposition

- Constant outlet temperature
- Efficiency > 92% per cycle
- Low-cost energy (from 5€/MWh th)
- Mobile

Eco-Tech Ceram

ETC

www.ecotechceram.com

Pilot phase

Co-funded by the European Union

Easy to install, reduces energy consumption and improves IAQ

The Need

Building energy management systems (BEMS) have significant limitations. The cost to install, maintain and utilise them is high. Furthermore, continuous energy optimization is not included.

The Solution

The Cloud Energy Optimizer (CEO) is a cloud-based add-on to building energy management systems (BEMS), which, based on the weather forecast, predicts the energy needs of the building (zones). Easy to install, it leads to energy savings of 10% to 50%, cost reductions, as well as improved indoor comfort.

Value Proposition

- Enhanced indoor comfort.
- Extends the lifespan of technical installations.
- Instant and significant energy and cost reduction by 10% to 40%.
- Use of the most sustainable and/or cheapest energy available.
- No adaptations required for heating, ventilation, and air conditioning (HVAC) system or building.

Cloud Energy Optimizer

cloud ENERGY optimizer

www.cloudenergyoptimizer.com

Consolidated sales

Co-funded by the European Union

A discrete, roof-mounted small wind turbine for large buildings

The Need

Energy price and regulations are pushing building owners to install renewable energy production. Solar panels take roofspace and weigh too much for many commercial and logistics buildings.

The Solution

The WindBox is a new solution to generate clean electricity on buildings. It is a 1.5 kW wind turbine, horizontal axis, weighing 130kg, designed to be installed on the buildings' acroterion. In this position, the turbine can benefit from higher winds that follow the building's façade, freeing space on the roof for other applications. The turbine is silent and does not vibrate, enabling its installation on any type of building.

Value Proposition

- Able to produce clean power on commercial and logistics buildings with roofs too fragile for solar panels.
- Can complete an existing solar panels installation and bring energy generation at night.
- Electricity produced through the Windbox has a lower carbon intensity than solar panels.

WindBox

WIND my ROOF

www.windmyroof.com

Starting sales

Co-funded by the European Union

70% energy autarkic house with self-generation and self-consumption of energy via PV / heat pumps

The Need

Efficient, low-demand and near-autarkic houses are unaffordable for low and mid income groups, and also require high investment costs to build.

The Solution

Evohaus is a turn-key operator that constructs or renovates homes, operating in areas through the creation of local Energy Supply Cooperatives (ESC). The evohaus model integrates smart building design, insulation, renewable technologies, energy management, and supply contracts in a complete end-to-end package for sustainable living.

Value Proposition

- Interactive and user feedback-based information system.
- Cost effective energy storage solution
- New buildings with best "economic" passive measures.
- Self-generation and self-consumption of energy via PV / heat pumps.
- Active participation of inhabitants.
- Lower total energy cost and increased independency: at 70% energy autarky.

Co-funded by the European Union

“One-stop-shop” for building refurbishments

Product Description

The Need

Most families in Spain cannot afford the integral rehabilitation of their homes, an essential requirement in order to reduce polluting emissions. Furthermore, there is no culture of rehabilitation, it is not acknowledged or valued. Immobility prevails and there is general mistrust of grants.

The Solution

The EOS energy refurbishment model focuses on the customer. A single interlocutor accompanies owners throughout the process managing all issues. The specific requirements of each individual project are studied to guarantee that rehabilitation costs are offset by benefits. New energy fees are charged under a spending ceiling in a unique contract, which pays back a large part of the investment, maintenance and amortisation of the financed project.

Value Proposition

- EOS guarantees 100% financing and advance payment of the investment rehabilitation costs: building permits, professional fees, rates, grants, taxes and works. Customers only pay when the work is completed.
- Energy savings are guaranteed by the implemented energy measures. This pays back a large part of the investment under a spending ceiling included in the contract.
- A single interlocutor manages the entire project.
- Full warranty and maintenance of all installations.

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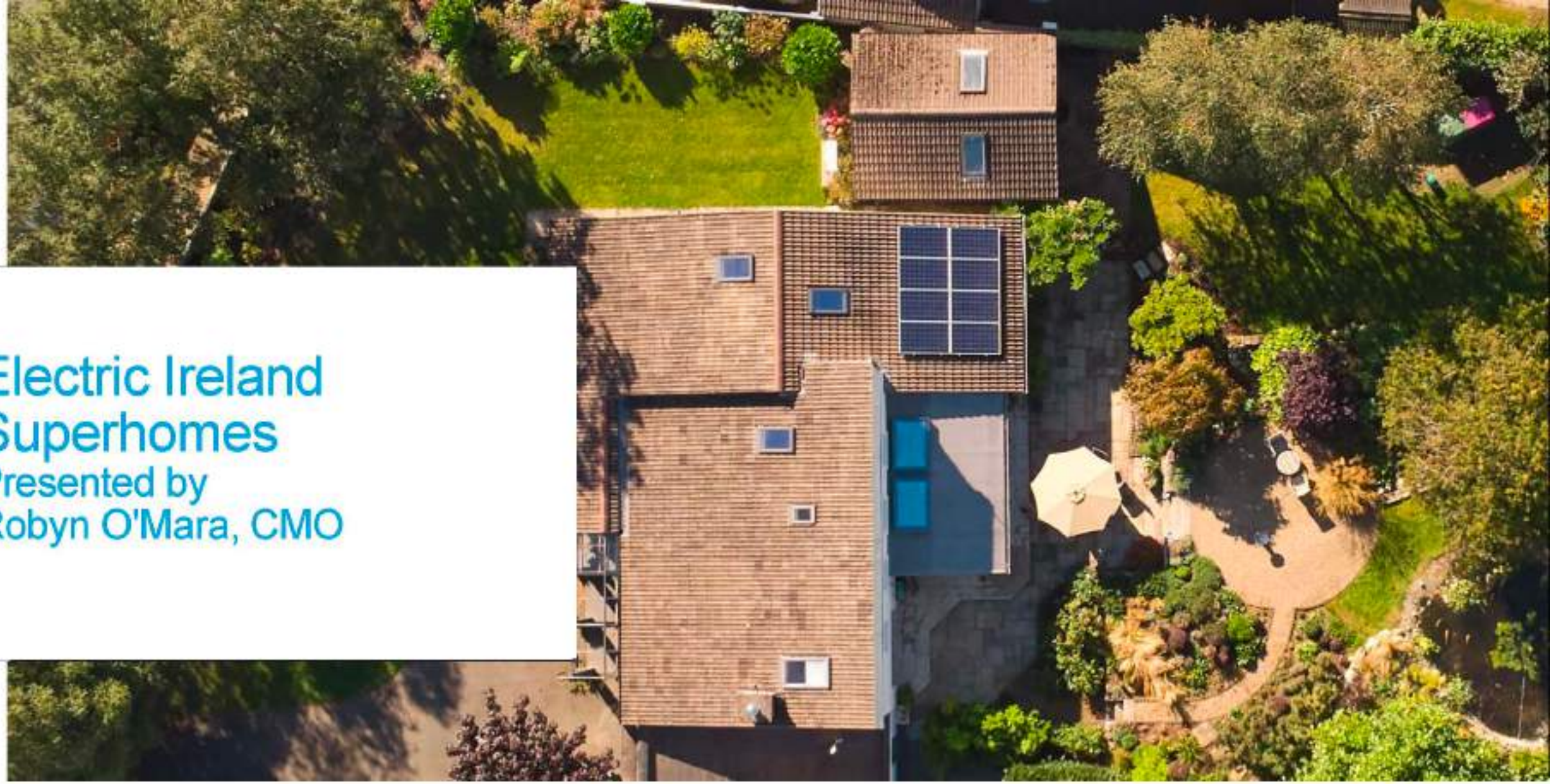
Ambition requires action:
the sustainable housing revolution with heat pumps

Short presentations and panel discussion - 10:25 - 11:50 CET

Robyn O'Mara
Chief Marketing Officer
Electric Ireland Superhomes

electric Ireland Superhomes



Electric Ireland Superhomes

Presented by
Robyn O'Mara, CMO

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

ehpa european heat pump association

electric Ireland Superhomes

A bit about us…

Our Mission: **We Empower our Customers to Achieve Warmer, Healthier Low-Carbon Homes**

Our Ambition

Operations

- Central office to regional hubs
- Recruitment to >200 FTE
- IT Digital systems, marketing, sales, HR, regulatory, finance and Stakeholders

Contractors

- Development and partnerships
- Skills development and apprenticeships

Consumer

- Marketing, awareness, consideration and reputation
- Grants
- Finance

Ambition requires action: the sustainable housing revolution with heat pumps, September 2022

ehpa european heat pump association

electric ireland Superhomes

One Stop Shop Model

Awareness & Marketing

Engage: Retrofit awareness raising

Knowledge Transfer

Homeowners experience

Design & Tender

Design to meet B2 and HLI standard using cost optimal retrofit model

Advocacy

EDUCATE: Showcase best in practice

ENGAGE: Open door events

ENGAGE: Show process works

Consideration & Sales

Trusted retrofit advisor

The quick measures to undertake

Which trades and contractors to use

Quality control

Quality control and certainty

Good contractor access

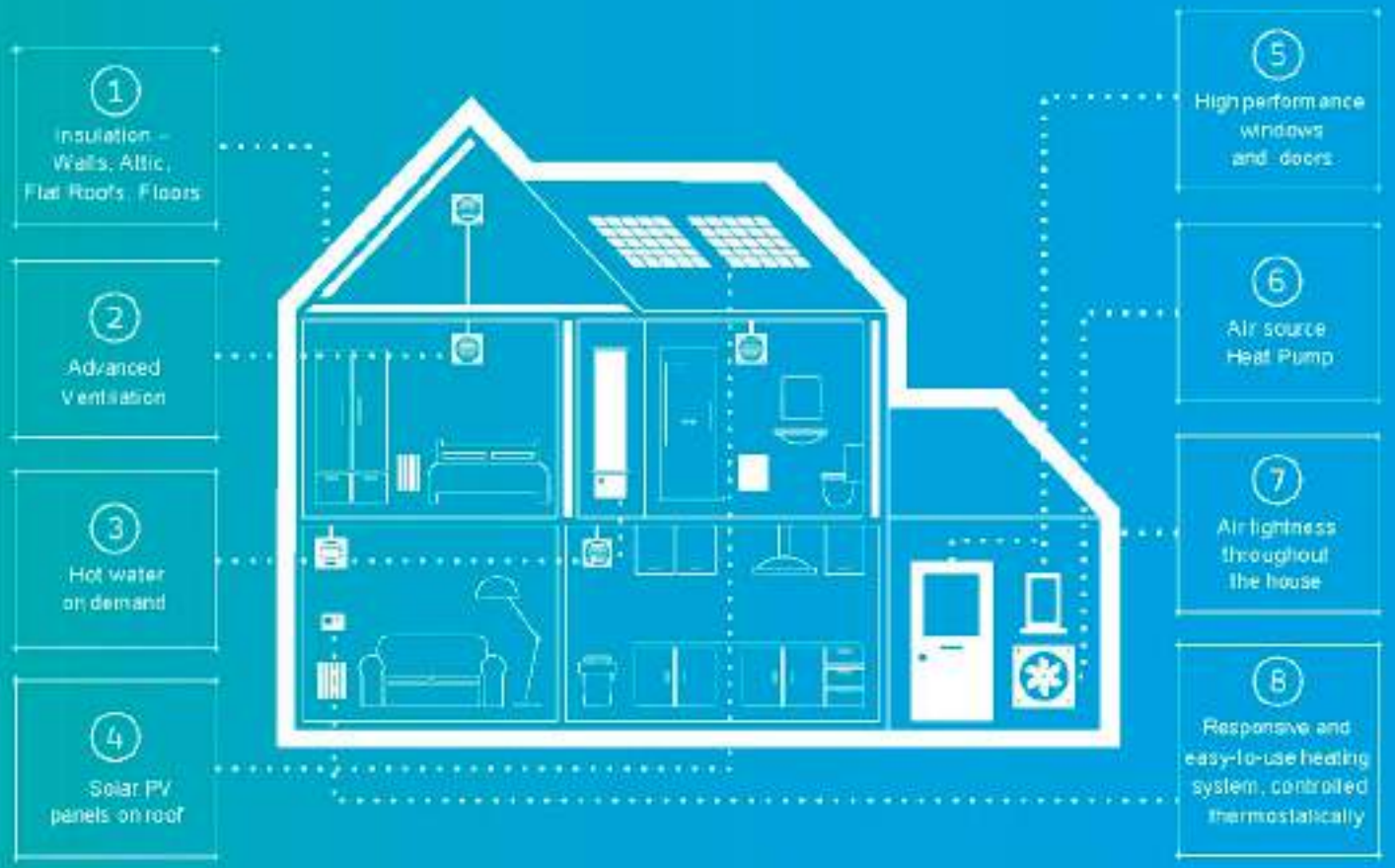
Feedback to contractor

Paper Work Grants

Finance

What is a Superhome?

A Superhome combines a range of the most energy efficient measures to achieve a B2 BER rating or better, creating a warm, comfortable and draught free home, free of fossil fuel heating.



Ambition requires action: the sustainable housing revolution with heat pumps, September 2022

ehpa european heat pump association

electric ireland Superhomes

Retrofit Measures

Insulation

Airtightness

Ventilation

Heat Pump

Solar PV (optional)

Integrated Home Renovation Service – Horizon 2020 Programme

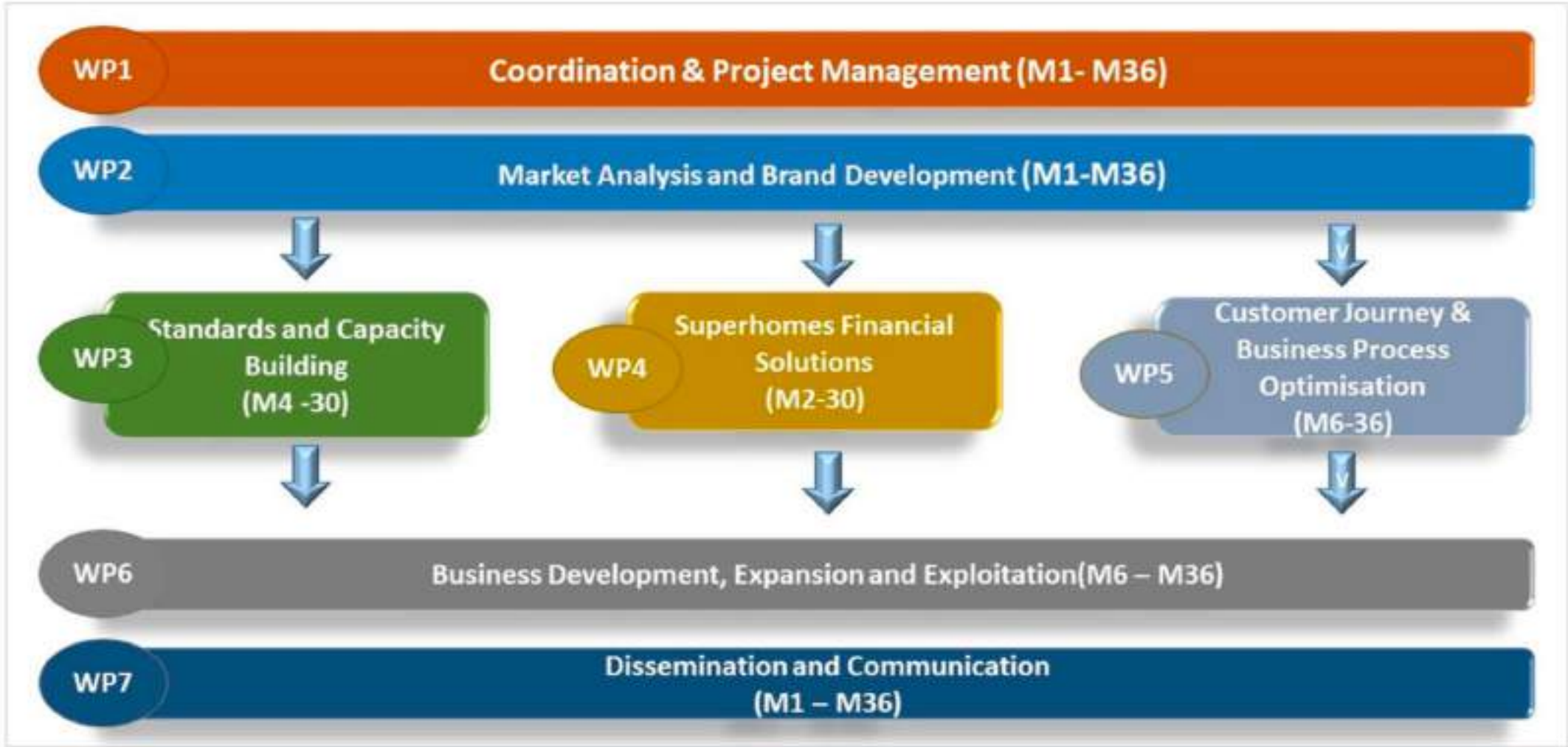
Superhomes2030

- June 2020 -2023 (Funding c.€1m)
- Aim : Scale Superhomes to 500 homes pa (€25m)
- Develop :
  - 4 Regional Superhomes One-Stop-Shops
  - >60% population coverage
  - Contractor Development & Training (80 contractors)
  - Consumer Finance Solutions
  - Technical standards, tools, analysis & design systems and solutions
  - Knowledge Hub
  - Deep Retrofit Community of Practice (CoP)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 892492 (Superhomes2030)

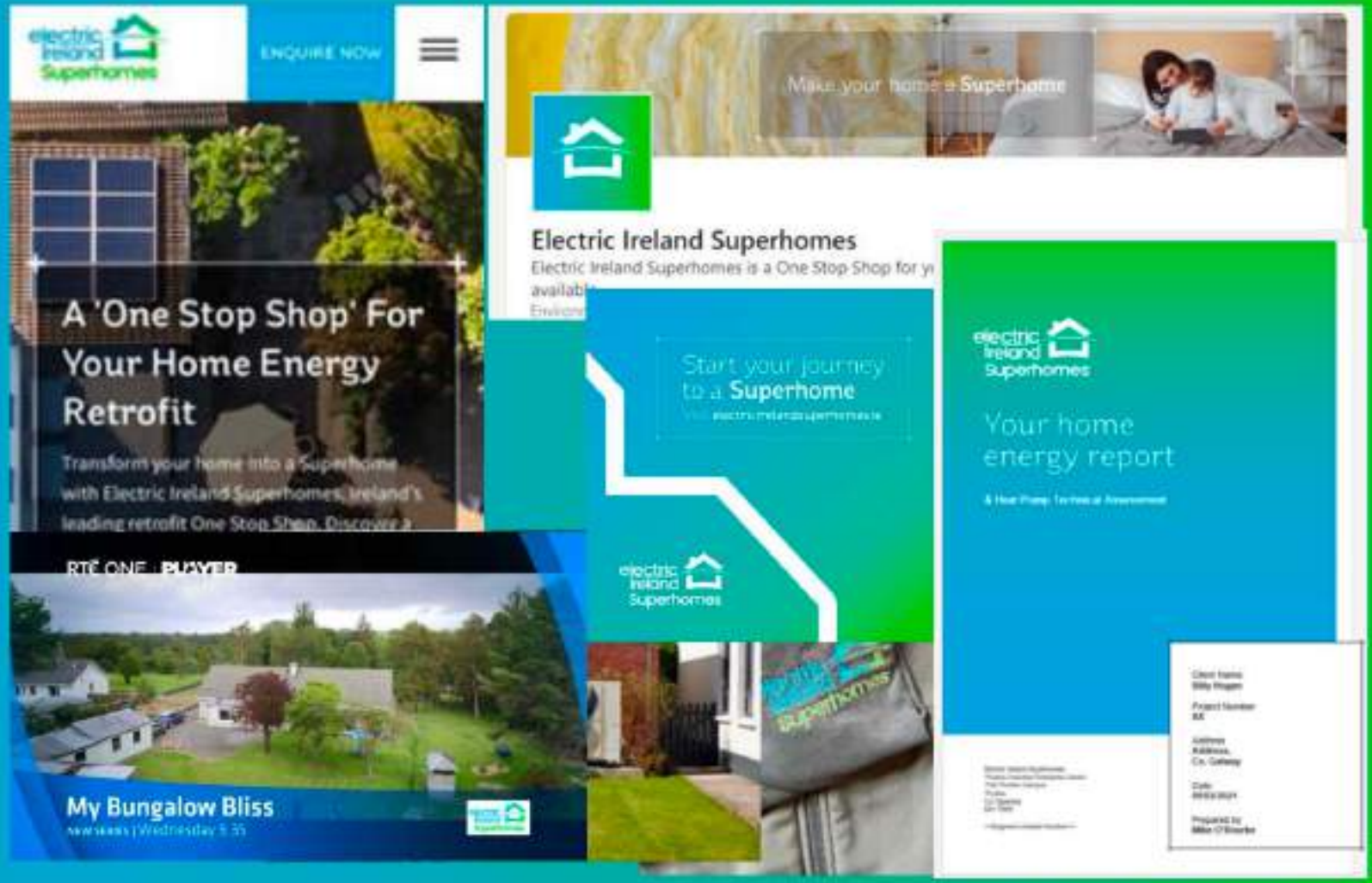
TIPPERARY energy AGENCY LIT ehpa european heat pump association SustainabilityWorks ESB Energy for generations electric Ireland Superhomes

Work Programmes



WP 2
"Market & Brand"

- New website & online application process
- Active Social Media
- Clear customer communications
- Consumer trade Shows
- PR - Radio & Print
- Advertising Campaign Q1
- Sponsorship national TV
- Amplify Government Communications



WP 5 - Operational & Quality System

Customer-Centric Approach

- Robust Systems
- Continuous Improvement

Learnings

Home Owners

- Quality
- Independent decision-making support
- Products/solutions selected best for the building and budget
- End to end service
- Minimise paper-work
- Finance

Contractors

- Building network of reputable, knowledgeable contractors takes effort
- Need pipeline of work - stop/start programs don't work
- Skilled resources are scarce
- Cashflow, Paperwork, Materials costs, Alternative work, Resources, Occupied houses

Ireland : Public Policy supportive but Challenges….

- Government Grants (Feb 2022)
  - Levels
  - Multi-annual scheme (no closing dates)
  - Funding certainty (€8Bn to 2030)
- Delivery at scale - industrialization
- Consumer : Costs are high (€60k +) – need education & loan guarantee scheme
- Capacity constraints – surveyors and contractors
- Automation & Digital
- Construction costs, supply chain issues and cost of living
- But….good progress

National Development Plan 2021-2030

ehpa european heat pump association

electric ireland Superhomes

Thank You

Ambition requires action:
the sustainable housing revolution with heat pumps

Short presentations and panel discussion - 10:25 - 11:50 CET

Daniel Carbonell
Team Leader - Thermal systems & modelling,
SPF- OST

SPF INSTITUT FÜR SOLARTECHNIK

OST

TRI-HP PROJECT | Trigeneration systems based on heat pumps with natural refrigerants and multiple renewable sources

OST
Ostschweizer
Fachhochschule

TRI-HP PROJECT

Trigeneration systems based on heat pumps with natural refrigerants and multiple renewable sources

Dr. Daniel Carbonell

SPF Institute for Solar Technology
Eastern Switzerland University of Applied Sciences (OST)

SPF INSTITUT FÜR SOLARTECHNIK

TRI-HP PROJECT

Trigeneration systems based on heat pumps with natural refrigerants and multiple renewable sources

- Horizon H2020 research program
- Research and Innovation Action
- From TRL 3 to TRL 5
- Total EU contribution 5 M€
- Duration 2019 - 2023

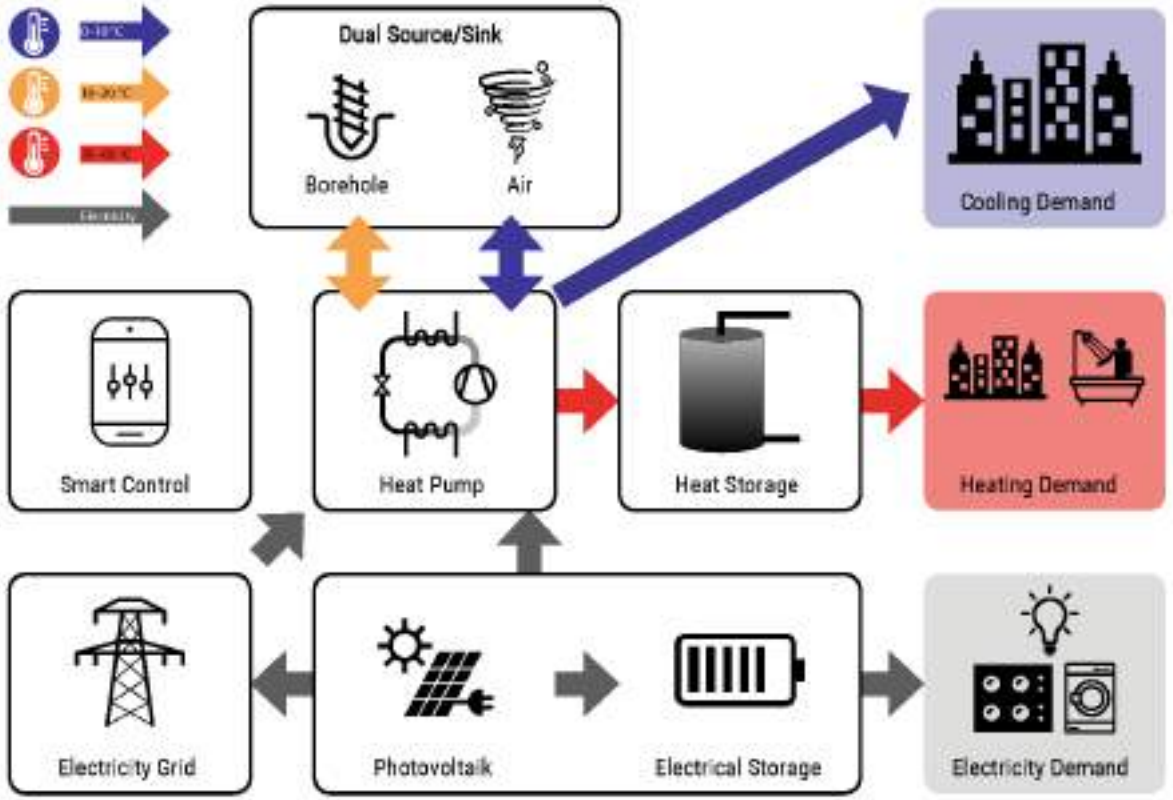
TRI-generation systems

- Based on electrically driven **natural refrigerant heat pumps (HPs)** coupled with PV to provide **heating**, **cooling** and **electricity** to multi-family residential **buildings**
- Targets:
  - **80 % renewable on-site share** with net-zero energy concept (20 % exchanged with the grid)
  - **Cost reduction by 10 – 15 %** compared to current HP technologies with same energetic efficiency
  - **75 % GHG emissions reductions** respect to gas boiler and air chillers with grid purchased electricity

www.tri-hp.eu

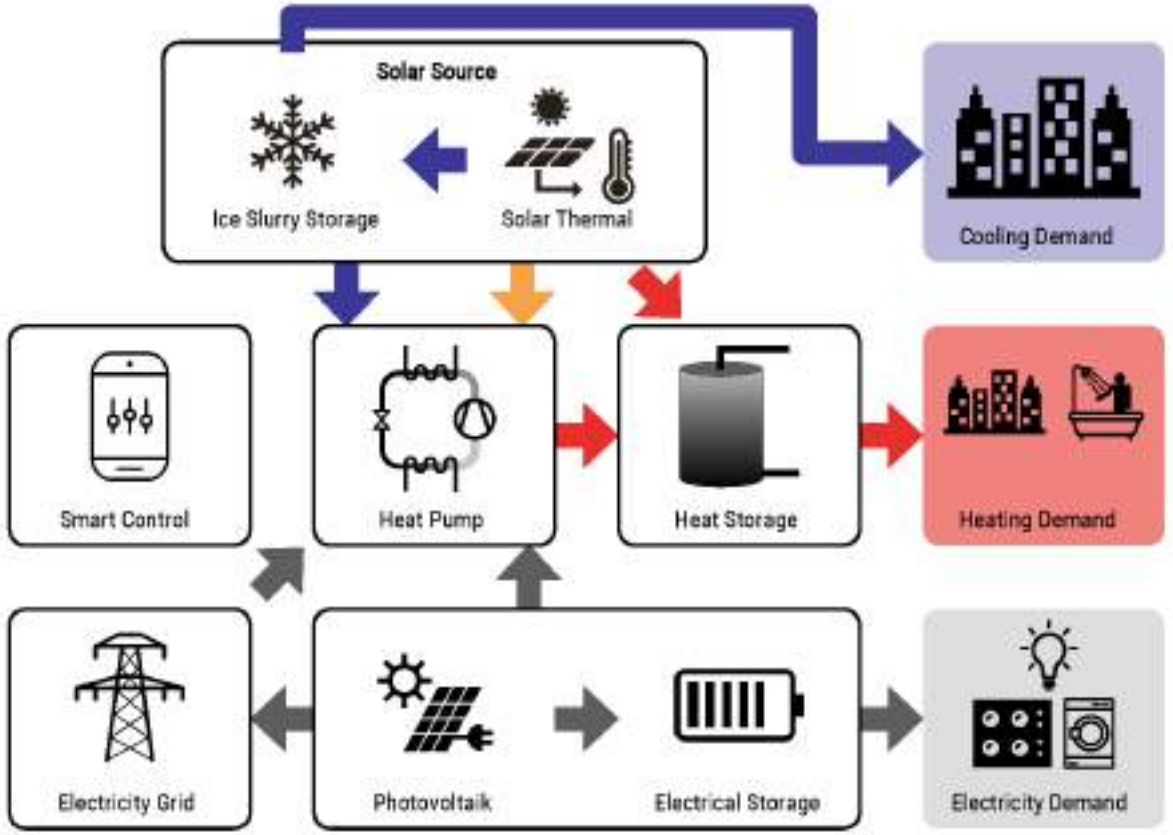
Dual source/sink system

- Source: ground and air
- Heating and cooling with reversible HP



Solar-ice slurry system

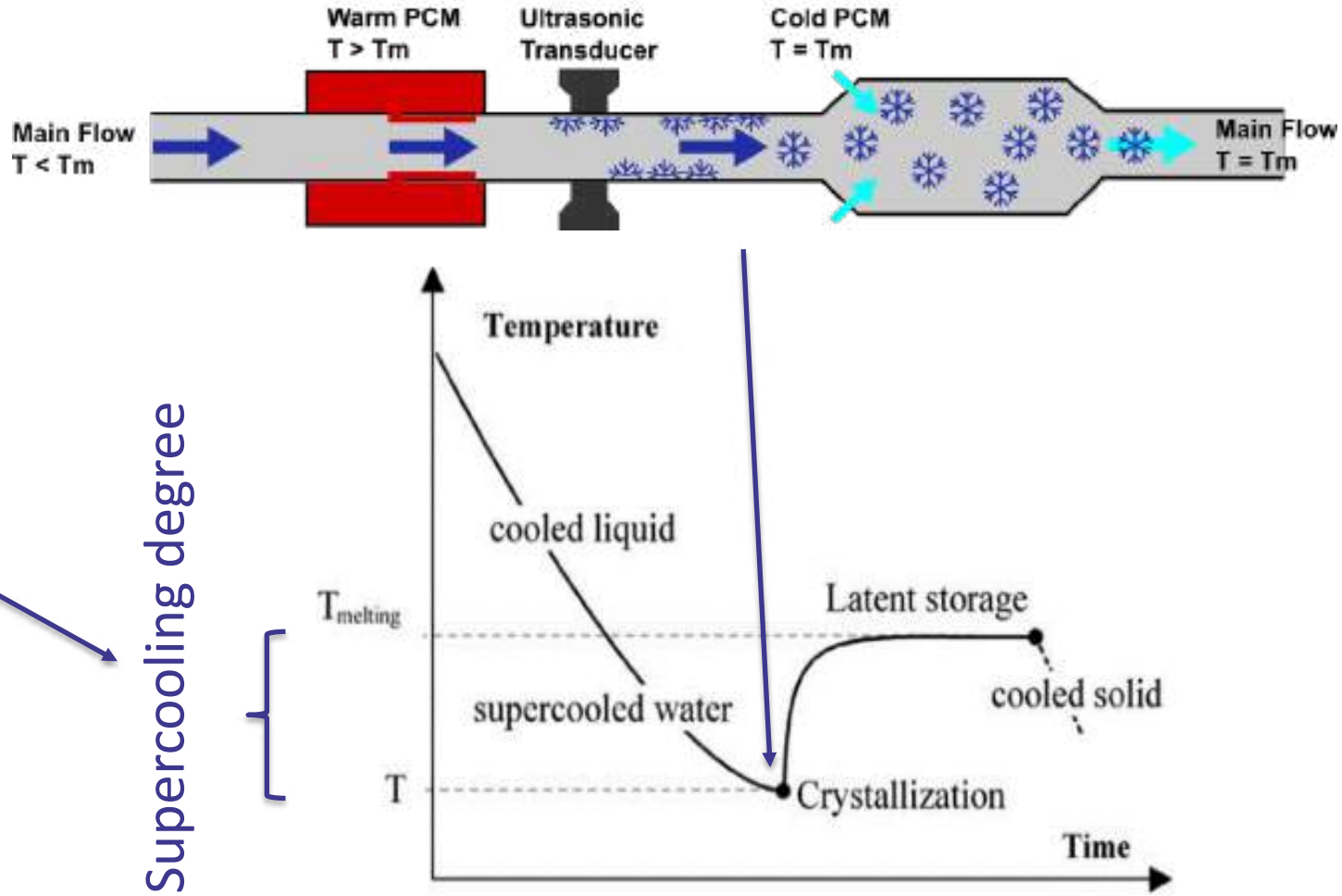
- Source: solar with ice slurry as intermediate storage medium
- Heating with cooling as add-on feature



Supercooling ice slurry with controlled nucleation

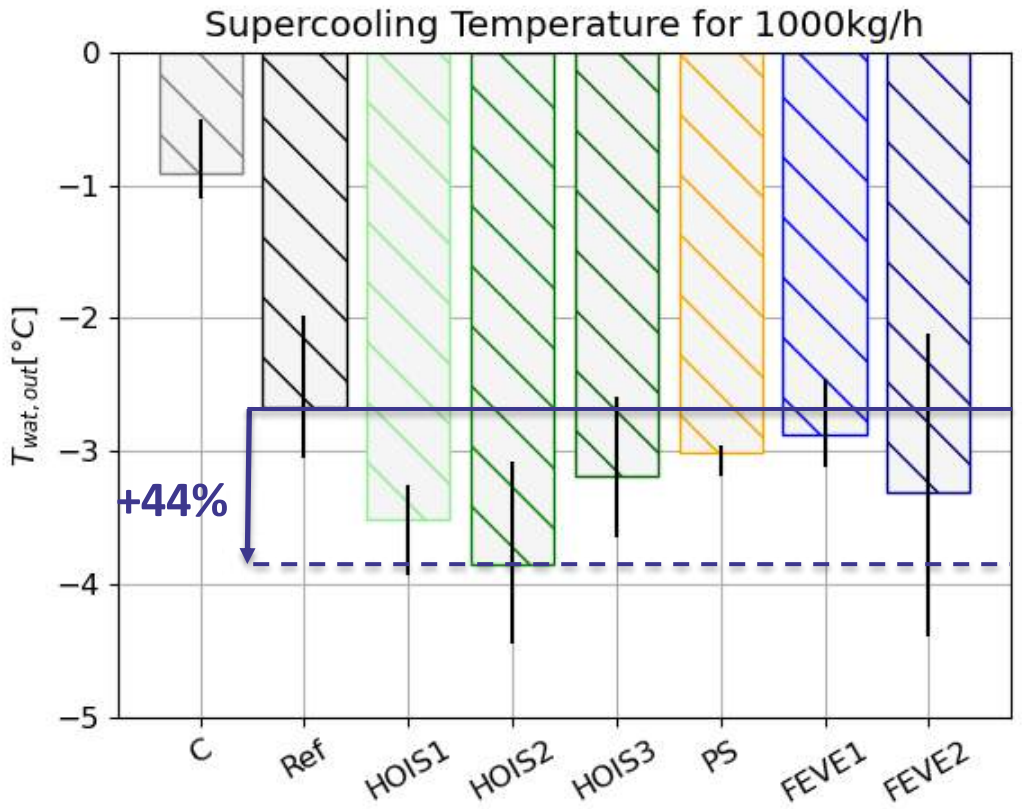
Controlled supercooling via icephobic coatings

Controlled nucleation via crystallizer



Relevant results: Hx innovation - Performance of icephobic surfaces

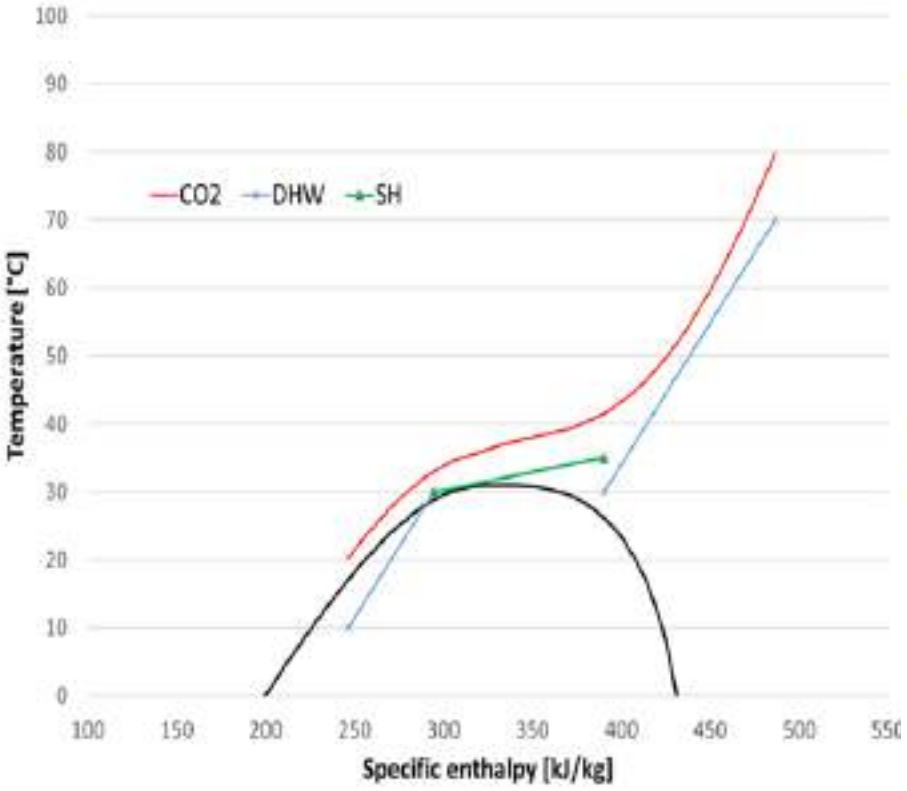
Supercooling Degree

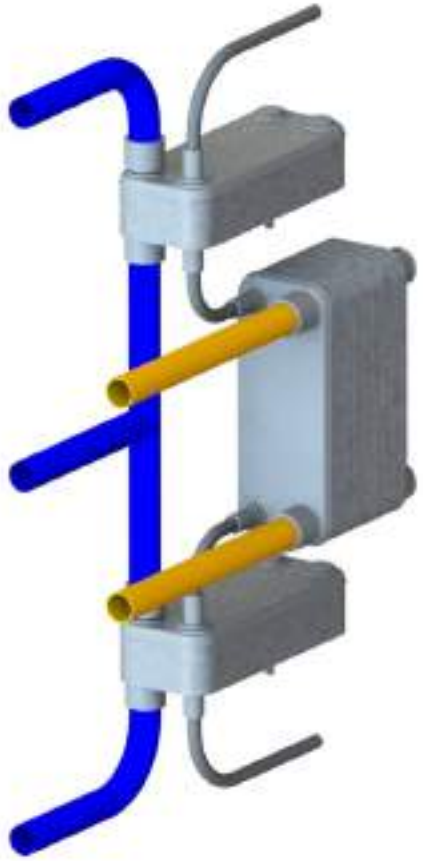


- **Up to 44 % improvement of icephobic coatings respect to untreated heat exchanger**
- Heat exchangers were operated at half of its nominal mass flow rate due to laboratory set-up cooling limitations
  - supercooling is reduced when using nominal mass flow rates.
- **Results published** in “Development of supercoolers for ice slurry generators using icephobic coatings”
  - **https://doi.org/10.1016/j.ijrefrig.2022.07.011**

Hybrid Organic-Inorganic Silane sol-gel (HOIS), PolySiloxane (PS), FluoroEthylene Vinyl Ether (FEVE)

Relevant results: Hx innovation - Tri-partite gas cooler





- Approximation of water temperatures to the temperature profile of CO_2
- Very high thermal output
- Exclusively use of plate copper-brazed heat exchangers
- extremely compactly
- Simultaneous heating of heating and domestic hot water

Results published: “Heat transfer and pressure drop of supercritical CO2 in brazed plate heat exchangers of the tri-partite gas cooler” **https://doi.org/10.1016/j.ijheatmasstransfer.2021.121641**

Relevant results: Natural refrigerant heat pump - CO2

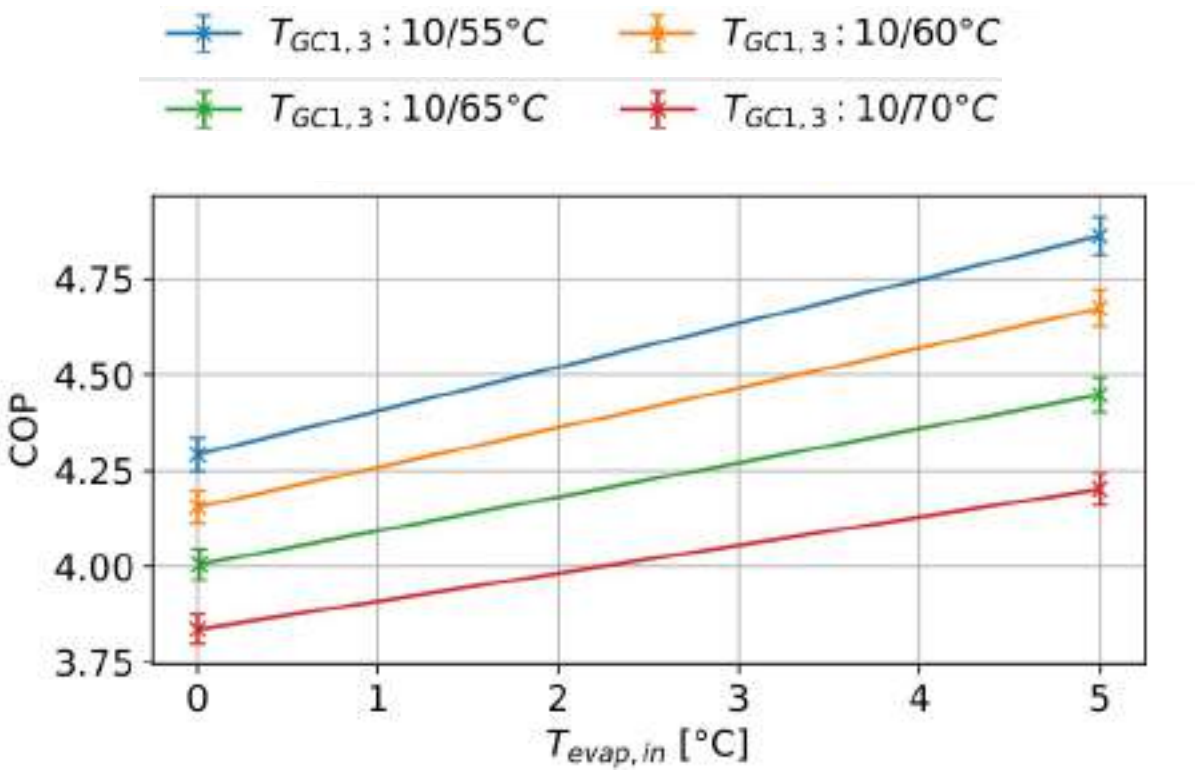
- Refrigerant R-744 (CO2)
- Power controlled, flooded evaporation, ejector tech
- Tri-partite gas cooler for simultaneous DHW and SH
- Supercooler as evaporator

Application:

- Residential buildings with high DHW share
  - for mild/cold climates
- Solar - Ice slurry system
- Some free cooling is available

Relevant results: Natural refrigerant heat pump - CO2

- Example of parallel mode : DHW and SH (30/35 °C)
- Power controlled, flooded evaporation, ejector technology



- Results at Tevap,in 0 °C supercooled water by 2 K with COP= 4 at 65 °C for DHW and 35 °C SH
- A propane slurry heat pump was also tested sucessfully
- **Results published for propane slurry heat pump**: *"Residential heat pump for indoor installation operating with R-290 and ice-slurry heat-source"* **http://dx.doi.org/10.18462/iir.gl2022.0039**

Relevant results: Natural refrigerant heat pump - dual source/sink

- Refrigerant R-290 (Propane)
- Power controlled, reversible
- **Innovative dual source/sink heat exchanger**
  - Use of brine and air
- High efficiency in heating and cooling mode

Application:

- Residential buildings with heating and cooling needs
- For mild/warm climates

- **Results published**: *"Dual source heat exchangers as evaporator/condenser in a R90 heat pump: Design and experimental validation"*, **http://dx.doi.org/10.18462/iir.gl2022.0011**

" Design and experimental validation of a R290 dual-source heat pump", **http://dx.doi.org/10.18462/iir.gl2022.0168**

Relevant results: Advanced Energy Management System (AEMS)

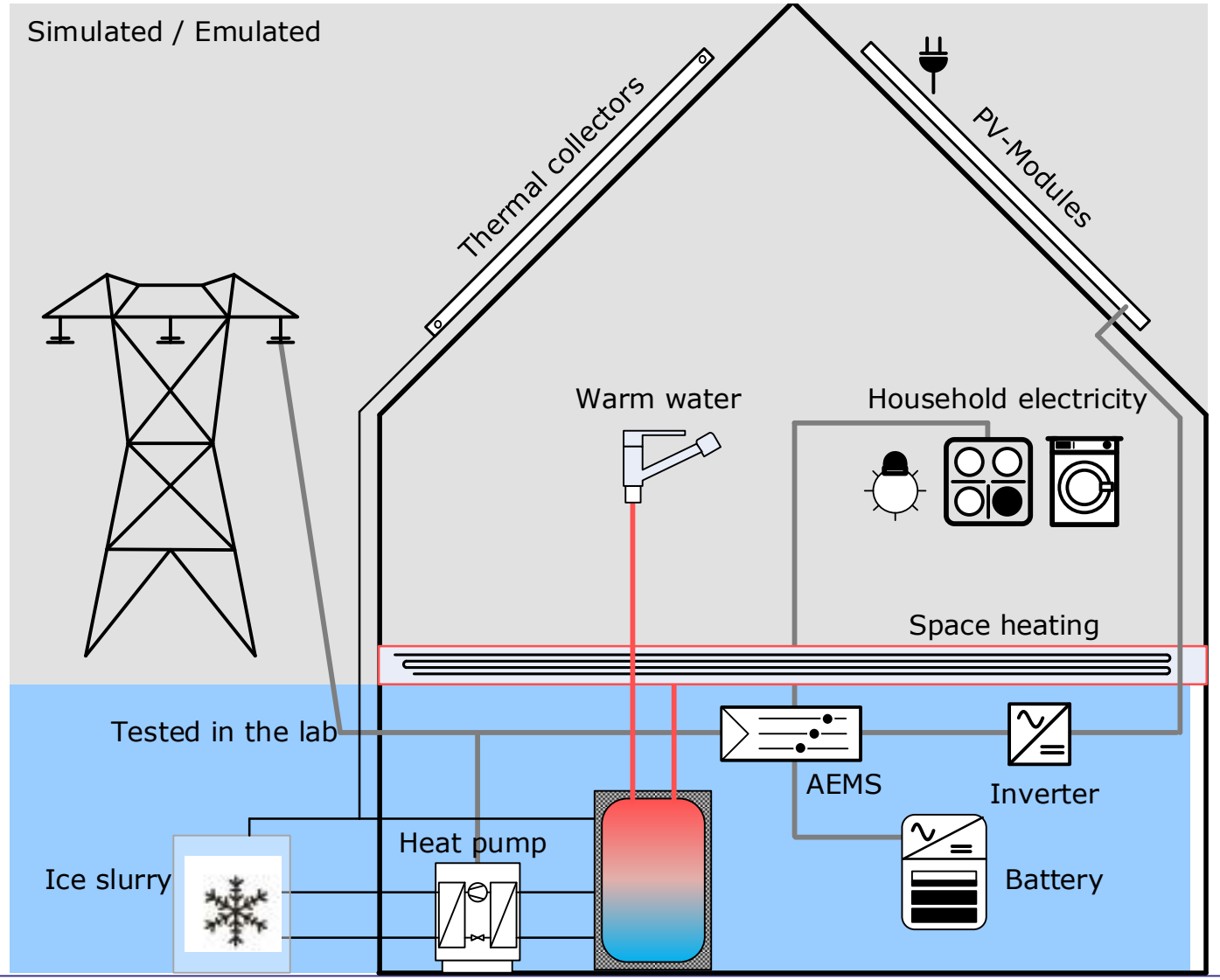
- Development of an optimal energy management algorithm to minimize the energy cost by up to 15 % and increase the share of renewables up to 80%
- Validation and assessment of the potential benefits of the AEMS by means of simulation and experiments covering different scenarios and conditions.
- The AEMS algorithm relies on models of the heat pumps and HVAC systems to determine their optimal operation over a 24 hours horizon in the future, using weather and occupancy forecasts for this purpose
- **Results published:**

"*Co-simulation studies of optimal control for natural refrigerant heat pumps*",
https://doi.org/10.34641/clima.2022.432

"*A review of the fault behaviour of heat pumps and measurements, detection and diagnosis methods including virtual sensors*",
https://doi.org/10.1016/j.jobe.2021.102254

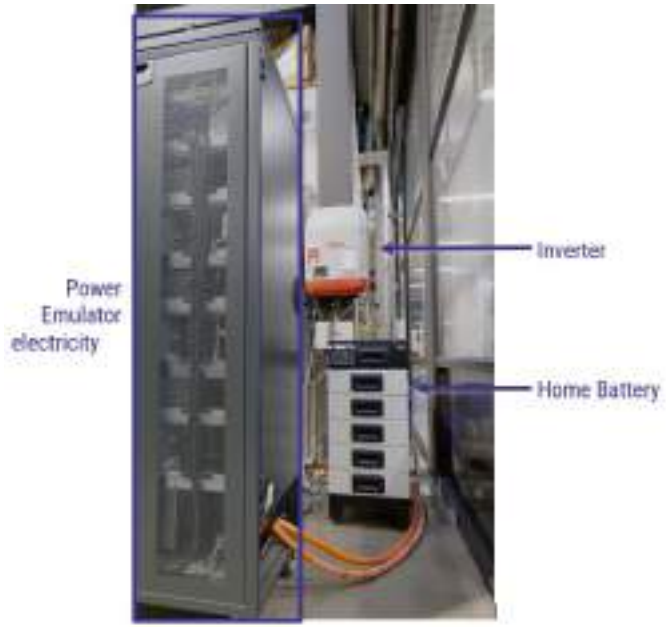
Hardware in the loop dynamic system test

- Concise Cycle test of 6 days representing all year
- Brings the TRL to 5
- Grey part is simulated/emulated
  - Demands, weather, solar thermal and PV
- Blue part is installed in the lab and tested as a whole
- **Results published**: "Concise cycle test methods to evaluate heating/cooling systems with multiple renewable sources", **https://doi.org/10.34641/clima.2022.390**



Current test on the hardware in the loop dynamic system test

- **System includes**: battery, DHW and SH storages, CO2 heat pump, hydraulics, autonomous control
- **Emulation** of ice slurry tank, PV, solar thermal, DHE and SH demands



Technology Acceptance

- Understanding and improving stakeholder's acceptance
- Analyse and identify the interest and needs of key stakeholders
- Methods
  - Qualitative **interviews** with stakeholders (DE, CH, ES, NO)
  - Regional **stakeholders workshops** (**DE**, CH, ES, NO)

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- **Published Results** : "*Enhancing stakeholders' acceptance of trigeneration heating and cooling systems: Recommendations from the TRI-HP stakeholder process*" **https:// doi:10.5281/zenodo.5500482.** "*Social acceptance of innovative renewable heating and cooling systems: Barriers, hindrances, drivers and incentives*"**, https://doi.org/10.5281/zenodo.5500469**

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TRI-HP PROJECT | Trigeneration systems based on heat pumps with natural refrigerants and multiple renewable sources

Ambition requires action:
the sustainable housing revolution with heat pumps

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27 September 2022 I 10:00 - 12:00 CET

Ambition requires action:

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Online seminar

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