100% Renewabe Heating and Cooling for a Sustainable Future

Conference & Workshop

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European Technology and Innovation Platform

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#100RHC

Heat4Cool
Smart building retrofitting complemented by solar assisted heat pumps integrated within a self-correcting intelligent building energy management system

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H2020-EU.2.1.5.2. - EEB-03-2016 - Integration of advanced technologies for heating and cooling at building and district level
Grant agreement ID: 723925

Heat4Cool project partners

Heat4Cool consortium

- **6** engineering co.
- **3** manufacturing co.
- **3** academia/research
- **1** industry association

- **Start date:** Oct 2016
- **Duration:** 48 months
- **Status:** ongoing (M36)

Heat4Cool project

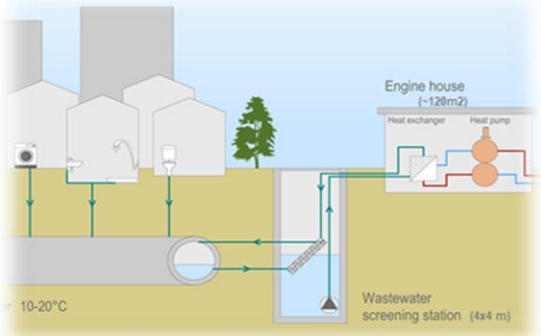
- **Objectives**: develop, integrate and demonstrate easy to install / energy efficient / cost effective **retrofit** Heating & Cooling solutions

► To achieve: 20÷30% energy savings, payback ~ 10 years

Heat4Cool Integration of innovative heating and cooling technologies at building and district level

Building

District



Heat4Cool project activities

Phase 1: Retrofitting design tool

- Mapping of European building stock
- Retrofitting toolkit dataset
- Optimisation algorithm for the solution set
- User interface design

Phase 2: Development

- Solar thermal assisted Adsorption Heat Pump
- Electrical Heat Pump integrated with modular PCM heat storage system
- Wastewater heat recovery with a sewage HX
- Self Correcting Intelligent Building Management System (SCI-BEMs)

Phase 3: Integration & Optimization

- Simulation, modelling and sizing
- Integration
- Debugging
- Optimization
- Scale up at different case studies

Phase 4: Evaluation

- Engineering and Design
- Validation in 3 demonstration pilots at building and 1 at district scale
- Manual, guidelines and training

Tools and systems developed within H4C

1. Building retrofitting **design planner tool**
2. Solar Thermal + VC Heat Pump + **Adsorption Heat Pump**
3. Photovoltaics + VC Heat Pump + **PCM storage**
4. **Wastewater Heat Recovery system** + EHP (district level)
5. Self-Correcting Intelligent Building Energy Management System (**SCI-BEMS**)

Building retrofitting design planner tool

Introduction | Building | Heating system | Cooling system | Occupancy and thermostat settings | Start

Building characteristics

Building or district?
Building

Which type of building would you like to assess?
Whole apartment block

When was it built?
From 1945 to 1969

Where is it located?

Country
Spain

City
Valencia

Building orientation and boundaries

Building size

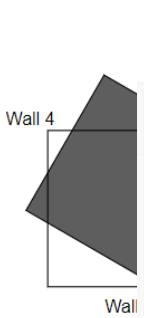
Length (m)
13

Width (m)
15.5

Number of storeys
4

Storey height (m)
3

Orientation angle: deviation from North clockwise (see diagram on the right)
0



Wall 1
Exposed to outside
Percentage of windows: 40%

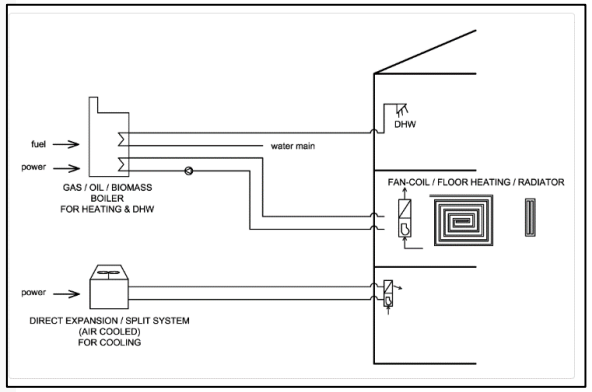
Wall 2
Adjacent to another building
Percentage of windows: 25%

Wall 3
Exposed to outside
Percentage of windows: 26%

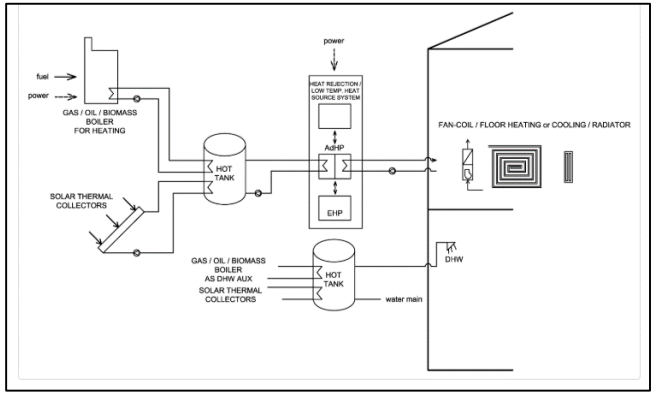
Curre

Sing

Current



AdHP + SC



Simulations KPI overview

Simulation name	Ranking	Non-renewable primary energy (kWh/m2a)	Renewable energy contribution	Greenhouse gas emissions (kgCO2eq/m2a)	Payback period (years)	Techincal and regulatory information	NZEB compliance according to EU 2016/1318
+AdHP+SC	1	35.5	37%	5.5	16	show	No
Current	2	63.3	0%	16.1	0		

Heat4Cool pilot sites

1. Sofia (BG)

PV + EHP + PCM

3 floors
4 apartments
350 m^2

PV 12 kWp
EHP 10 kWt
PCM 36 kWh

2. Valencia (ES)

ST + TDC + EHP

4 floors
12 apartments
588 m^2

ST 50 m^2
TDC 15 kWc
EHP 45 kWc

3. Chorzow (PL)

PV + EHP + PCM

4 floors
12 apartments
1330 m^2

PV 15 kWp
EHP 30 kWt
PCM 96 kWh

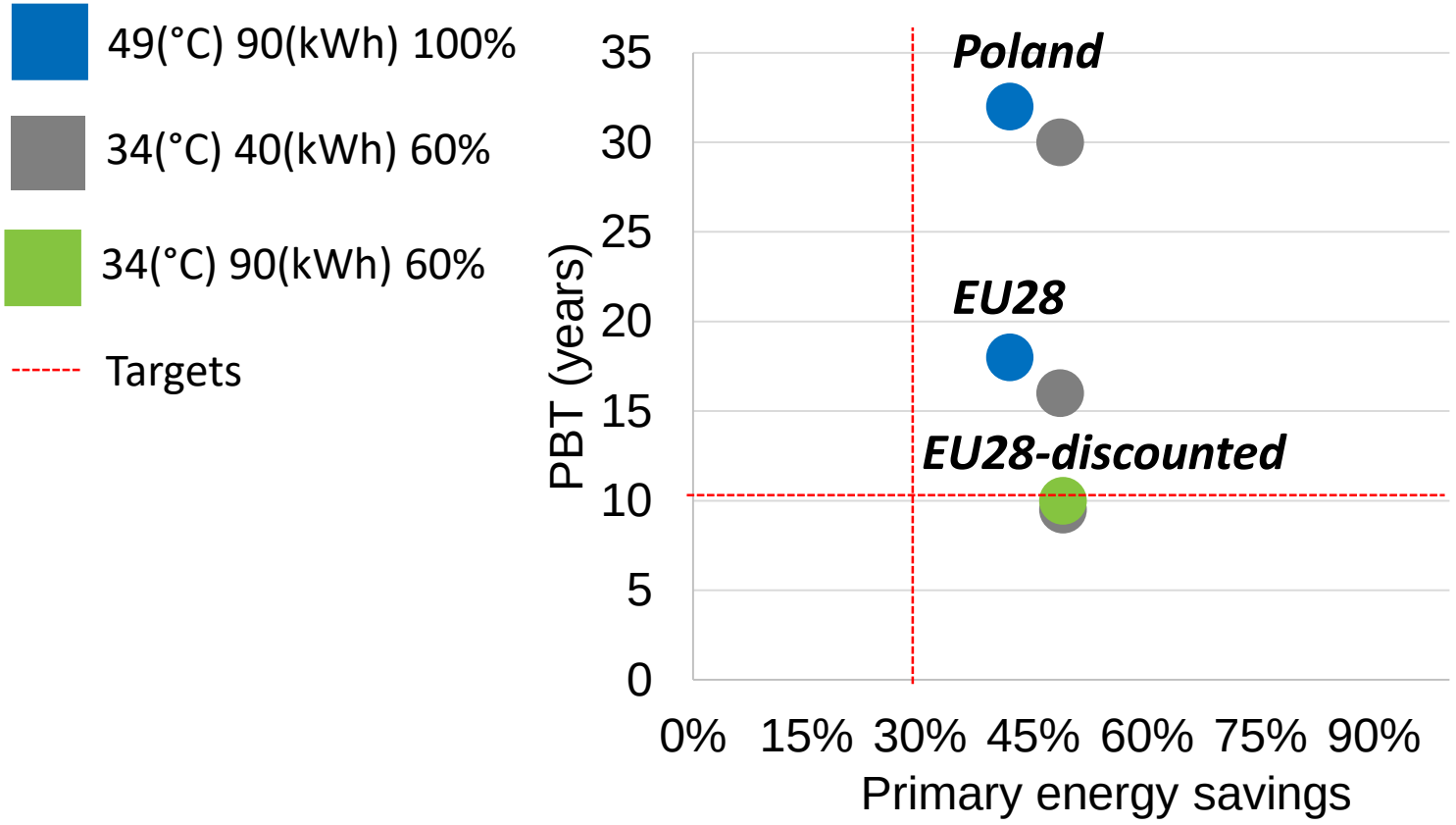
4. Budapest (HU)

WW + EHP

3 Buildings
1330 m^2 ,1900 m^2,
8000 m^2

WW & HP 1 MWt

Techno-economic assessment of Polish site = PV + EHP + PCM



Poland Economic analysis done using Polish parameters
low cost of energy:
Gas: 0.04 (€/kWh)
Electricity: 0.15 (€/kWh)

EU28 Economic analysis done using European average parameters
higher cost of energy
Gas: 0.07 (€/kWh) +75%
Electricity: 0.23 (€/kWh) + 53%

EU28-discounted

20% discount on
the investment cost and
existing boiler efficiency = 75%

Remarks

- Heat4Cool proposes efficient and cost-effective renewable based solutions with a degree of flexibility.
- 20÷30% energy savings and about 10 years payback are expected based on our simulations
- Modelling and simulation have been key in identifying the best configuration and control strategy in each pilot.
- Fast simulation tools like H4C RetroSim and integrated solutions easy to install, monitor and control will be key for replicability

Thank you!
Questions?

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