WP2.- Retrofitting design planner tool

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Heat4COOL project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 723925

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WP objectives

WP2.- Retrofitting design planner tool

- To develop a reliable design tool that will allow the simulation of the combination of different retrofitting measures (including HVAC, RES and BEMS measures)
- assessing the energy savings of the solutions
- and thus, supporting the retrofitting decision making

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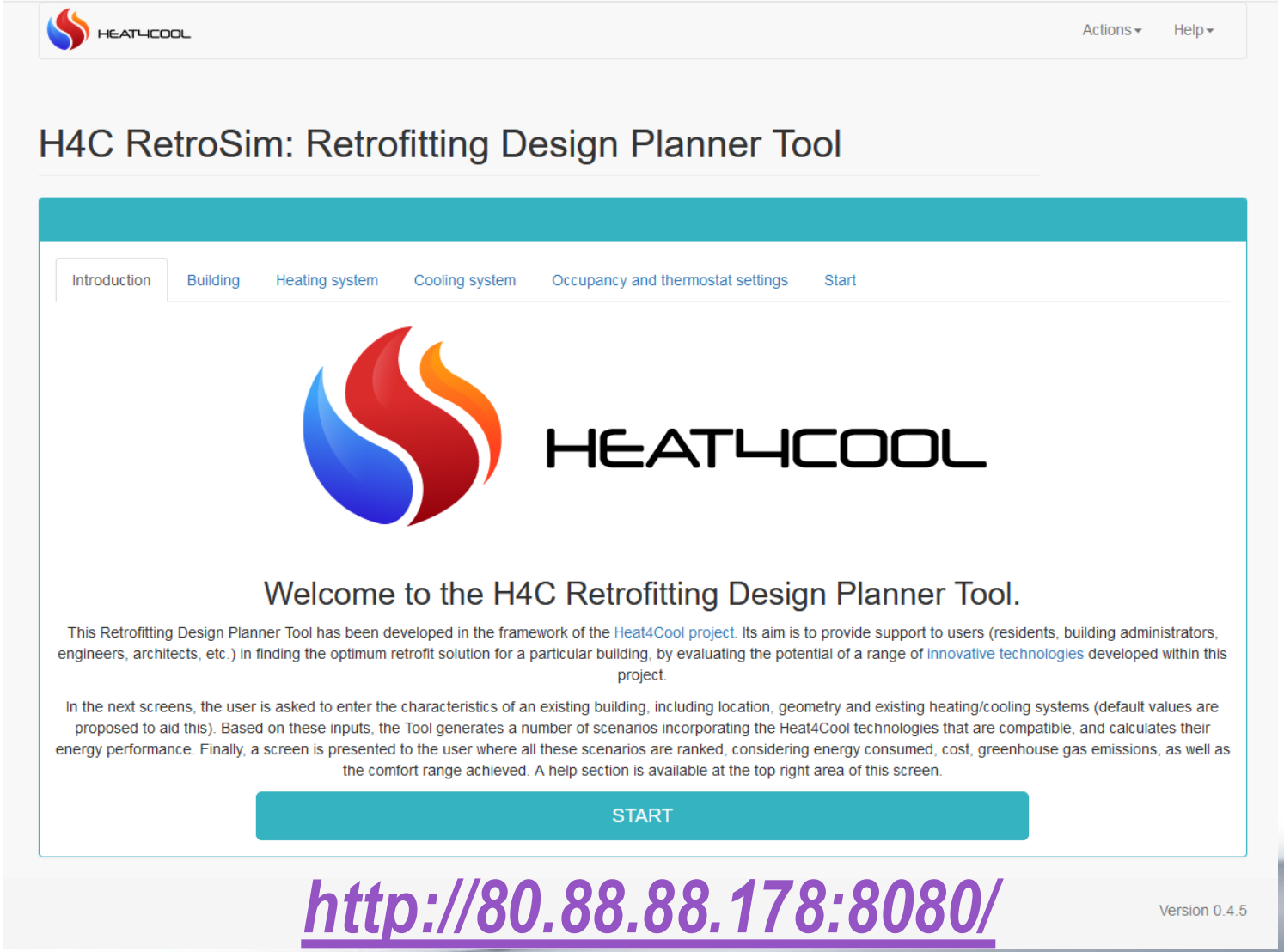
WP final results



http://80.88.88.178:8080/

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Tasks completed

WP2: Retrofitting design planner tool	M1 oct 2016	M7 apr 2017	M8 may 2017	M12 sep 2017	M13 oct 2017	M15 dic 2017	M16 jan 2018	M17 feb 2018	M18 mar 2018	M17 dic 2017	M48 mar 2020	M54 mar 2021
T2.1 Mapping of European building stock												
T2.2 Creation of toolkit dataset												
T2.3 User requirements, technical spec. & architecture design												
T2.4 Creation of optimisation algorithm for solution set												
T2.5 User Interface design and tool integrated development												
Milestones	M1. H4C RD tool requirements				M2. Tool implementation							

T2.1 Mapping of European building stock

T2.2 Creation of the Heat4Cool Retrofitting design tool kit Dataset

T2.3 User requirements, technical specification and architecture design

T2.4 Creation of the optimisation algorithm for the solution set

T2.5 User Interface Design and tool integrated development)

Duration of WP2:

1. Initial planning: 15 months. M1 – M15
2. A 2-month extension for T2.5. January / February 2018 (M17)
3. Continuous updates of the tool as the project evolves and the technologies are developed
4. A final review has required additional effort to properly update the tool and solve identified bugs. Final activities in M48 – M54

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Deliverables & milestones

- D2.1 / D2.2 / D2.3 / D2.4 / D2.5. Submitted and Approved

- MS1 Heat4Cool retrofitting design tool requirements M7

- MS2 Heat4Cool retrofitting design tool implementation M15

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Final Activities during M37-M54

An overall validation and update of the tool has been performed. This means:

- Using pilots' results as reference, the calculation system has been modified and updated.
- Bugs identified during this validation activity as well as in previous periods have been solved. This has affected all the modules composing the tool.
- The final version of the tool has been published.

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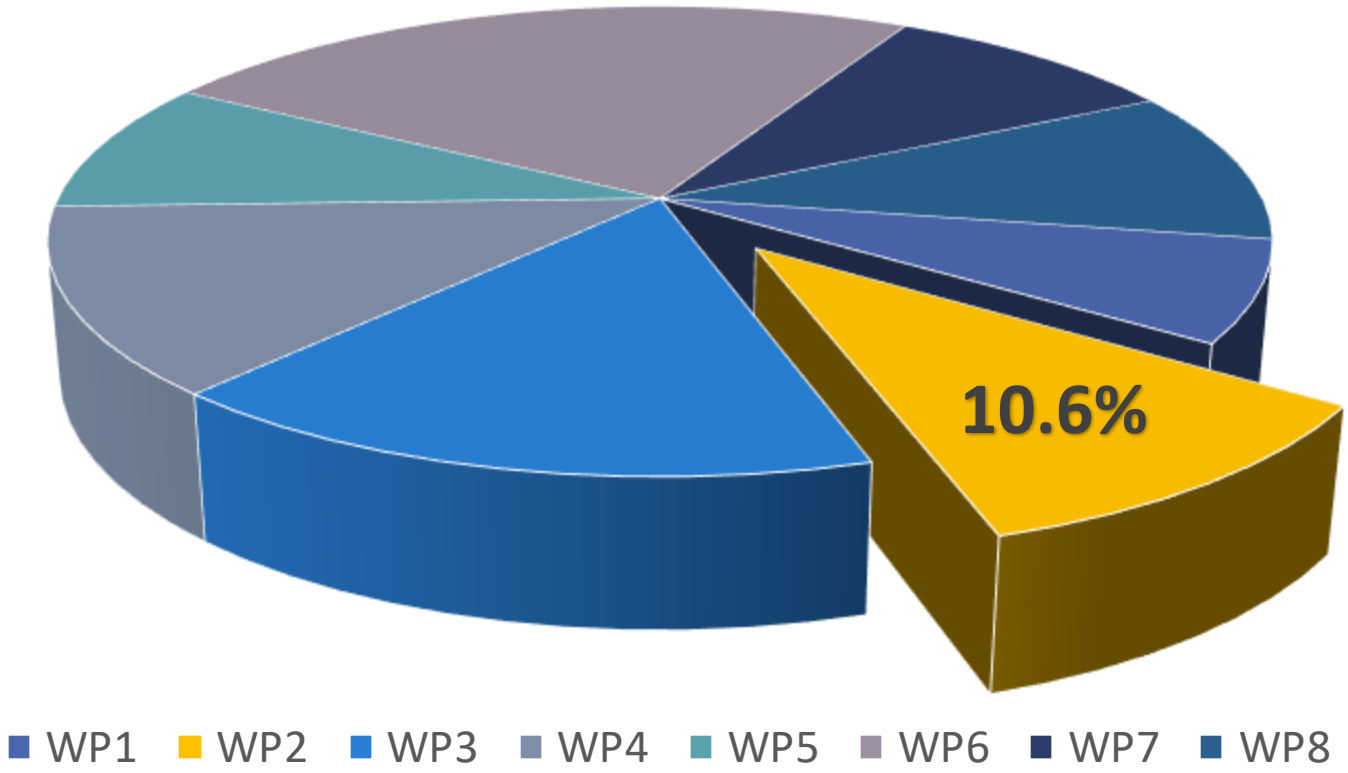
Planned use of PMs



Associated Key Exploitable Result (KER):

Retrofitting design planner tool

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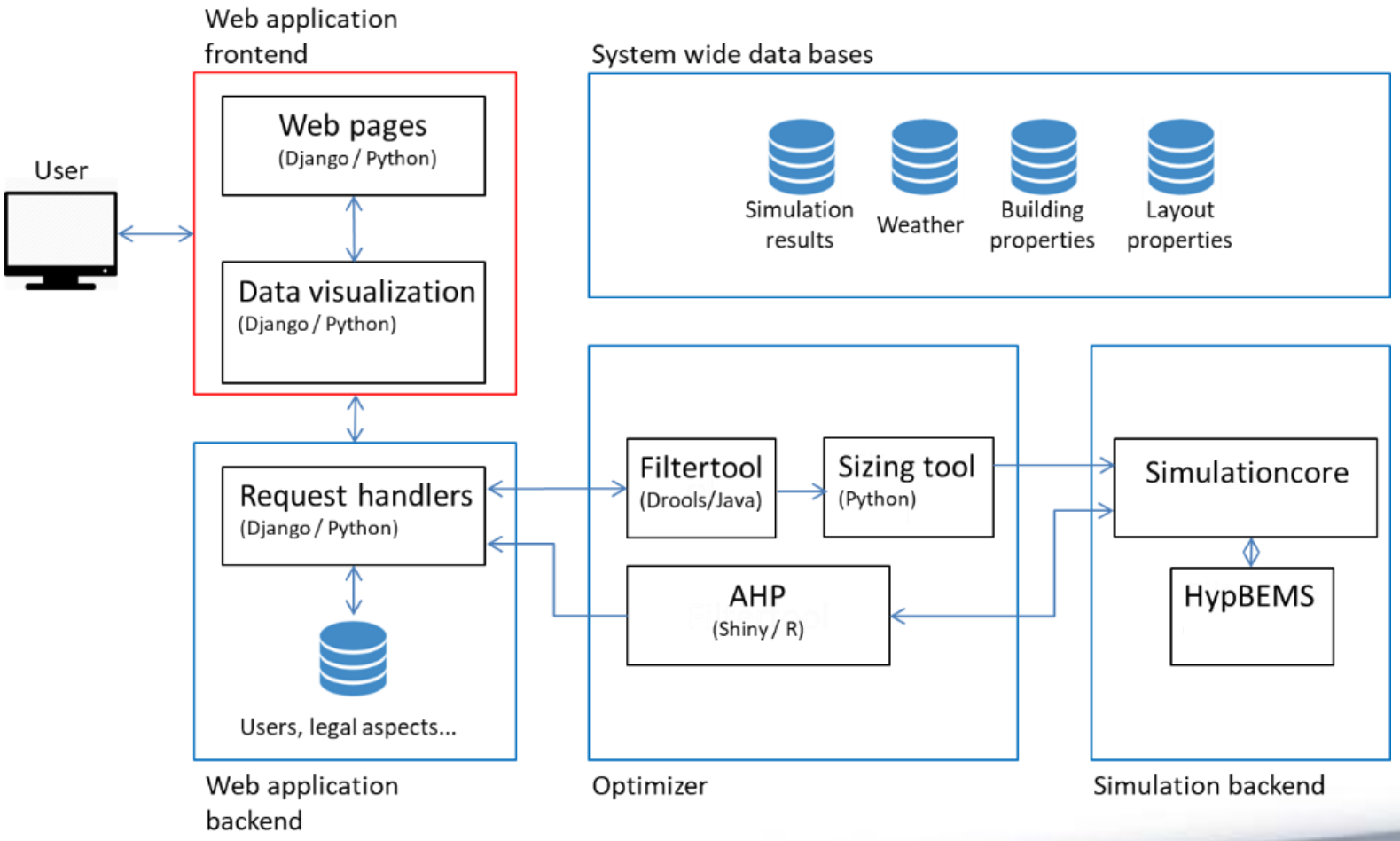
WP final results



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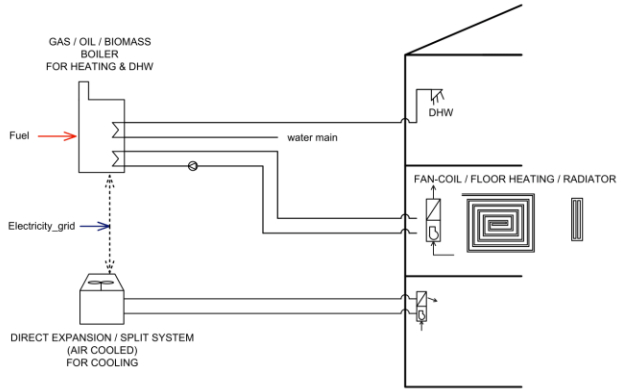

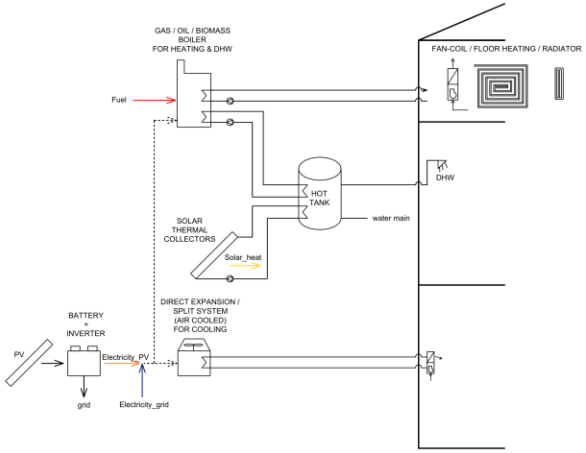

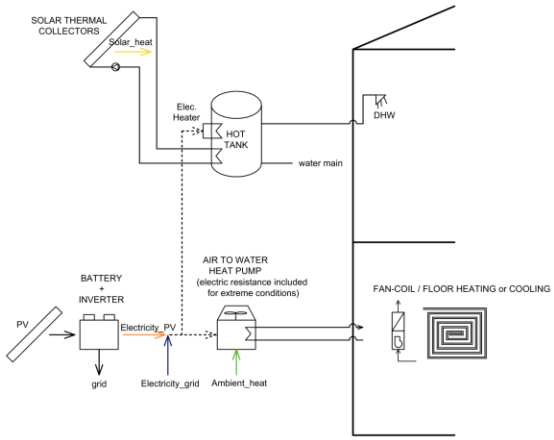

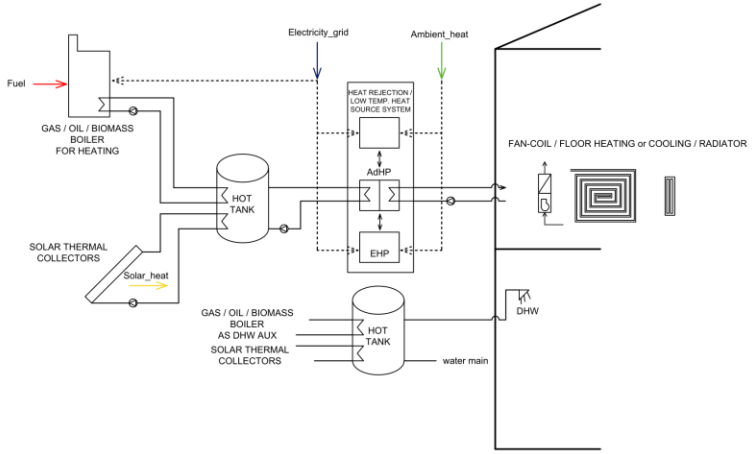

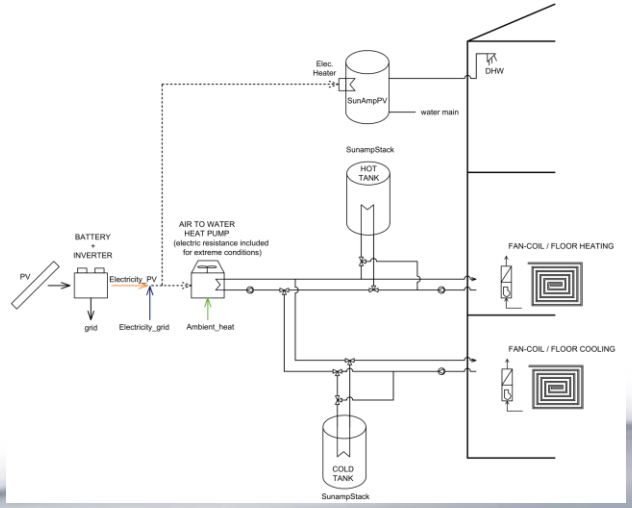

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WP final results

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

Building characteristics

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

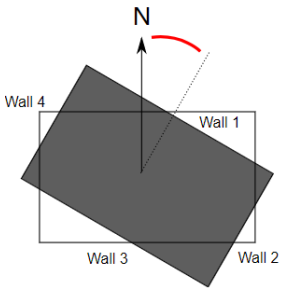
Length (m)
13

Width (m)
15.5

Number of storeys
4

Storey height (m)
3

Orientation angle: deviation from North clockwise (see diagram on the right)
350



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%

Wall 4
Adjacent to another building

Percentage of windows: 25%

Roof/ceiling
Exposed to outside

Floor slab
Adjacent to another conditioned

Which percentage of the roof surface is available for solar plants?
30

Orientation of solar collectors/panels (deviation from South)
114

Inclination of solar collectors/panels (from horizontal)
24

How much area is available for new technical equipment (m^2)?
5

Thermal insulation of the building envelope (W/m^2K)

U-value of walls
0.47

U-value of the roof
0.273

U-value of the ground floor
0.448

U-value of windows
2.89

Thermal bridges heat loss
Medium

Thermal bridges heat loss (W/m^2K)
0.1

Ventilation system with heat recovery
No

Unintended air leakage
Medium

Thermal capacity of external walls
Mediumweight

Thermal capacity of internal walls and slabs
Mediumweight

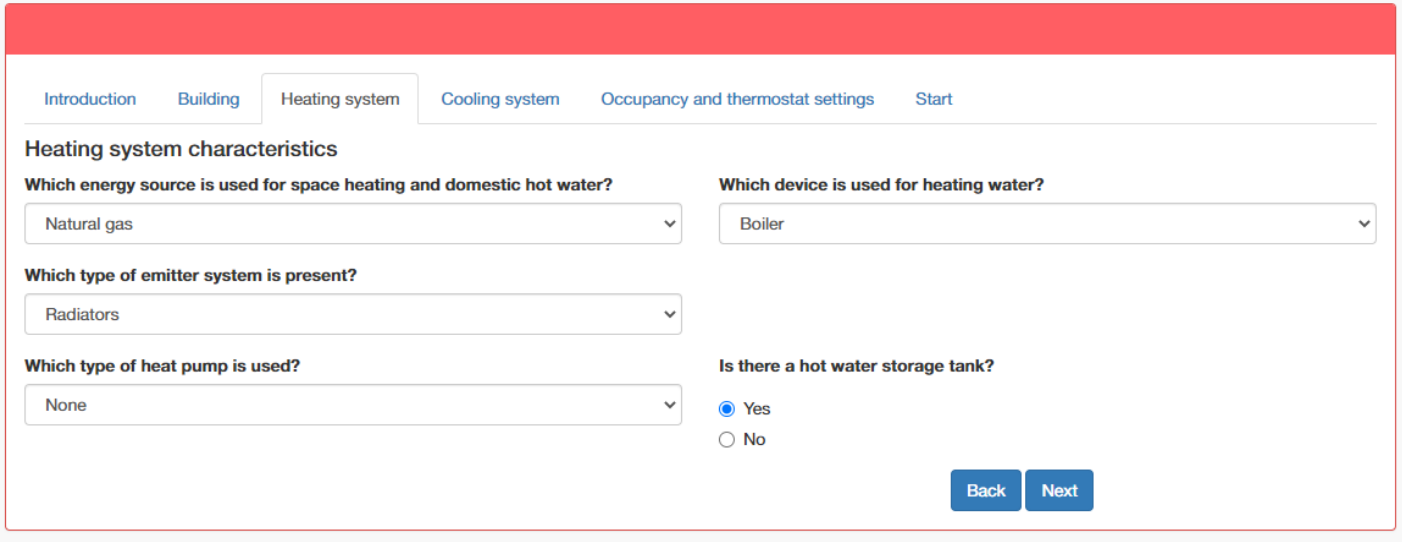
Thermal capacity of external walls (J/m^2K)
65000

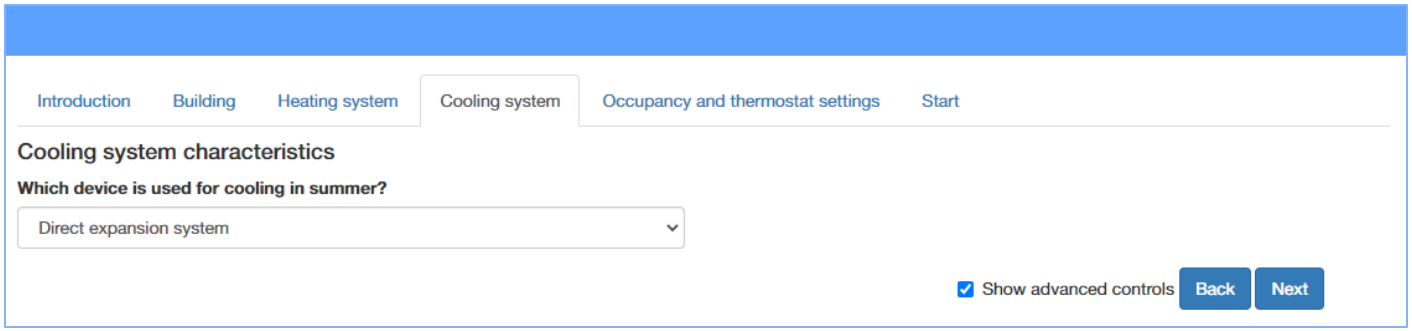
Thermal capacity of internal walls and slabs (J/m^2K)
65000

Building Characteristics

- Building geometry
- Envelope characteristics
- Available space for systems and RES installation

WP final results





Heating and cooling system

Based on the existing heating and cooling systems, the «Current» layout is identified (layout 1, 2 or 3) and the filter tool defines the alternatives scenarios

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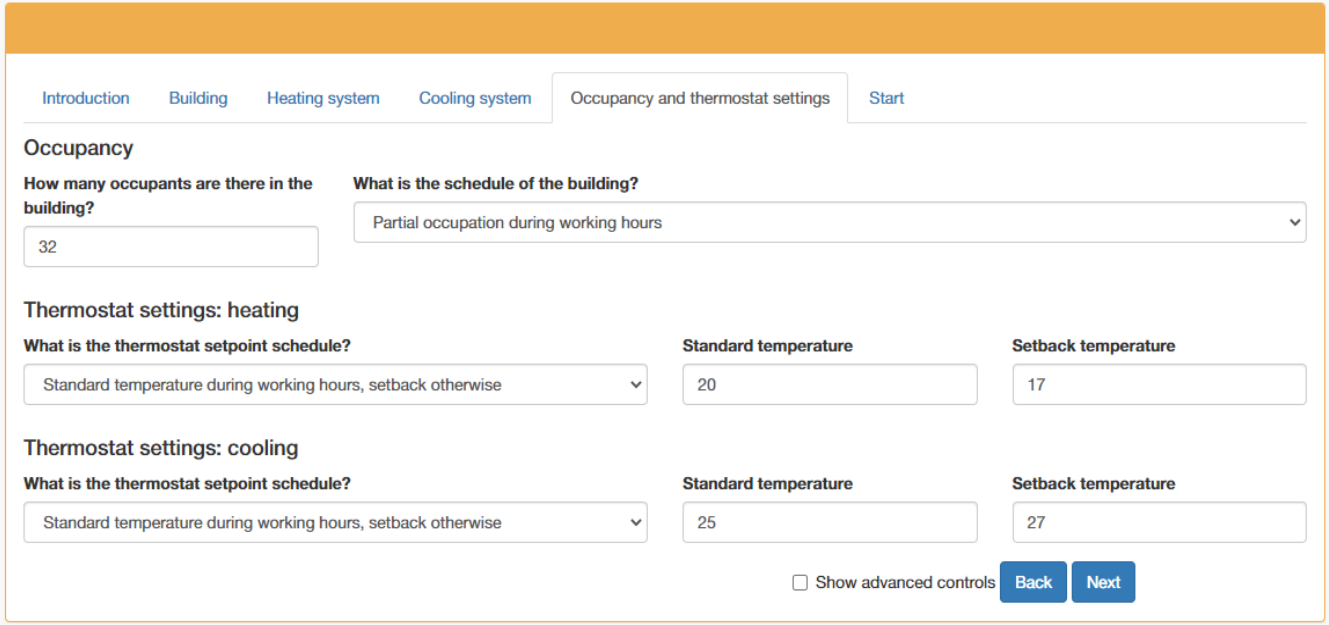
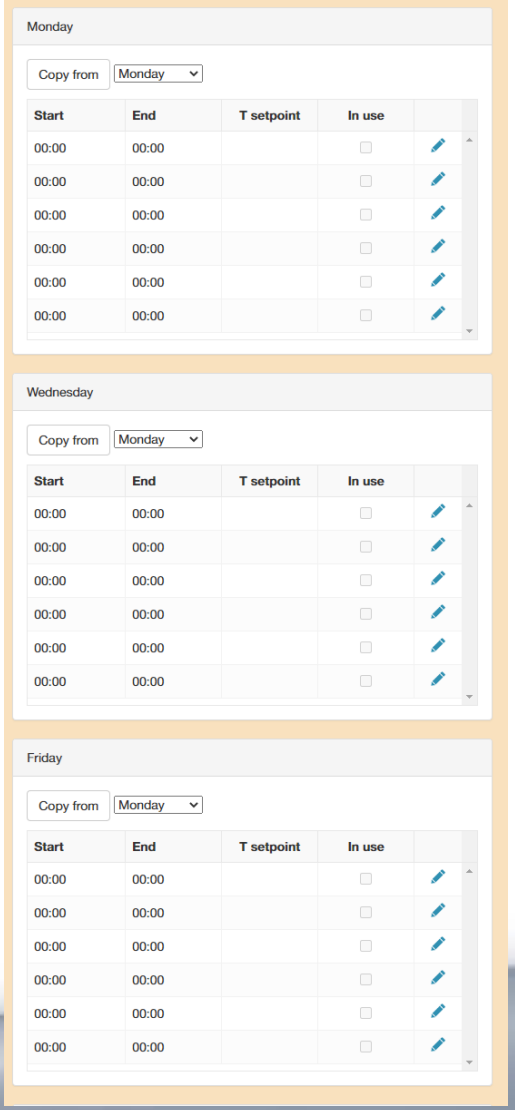
WP final results

Occupancy and thermostat settings

Occupancy and thermostat profiles can be chosen among predefined schedules or customized using the advanced options weekly schedules.





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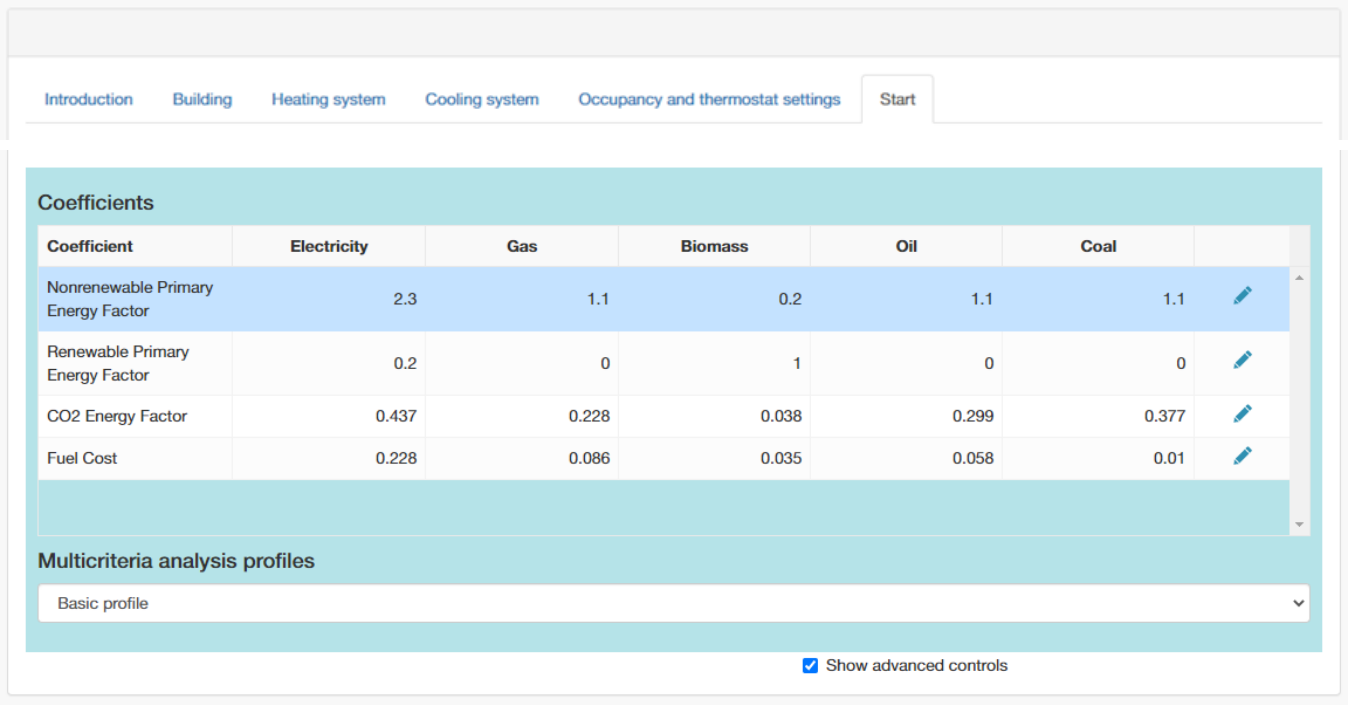
WP final results



Coefficients and multicriteria profiles

- Reference coefficients are pre-loaded for each country, based on national documentation and international standard EN ISO 52000
- The user can customize the coefficients and the multicriteria profile to simulate different scenarios in the Analytical Hierarchy Process (AHP)

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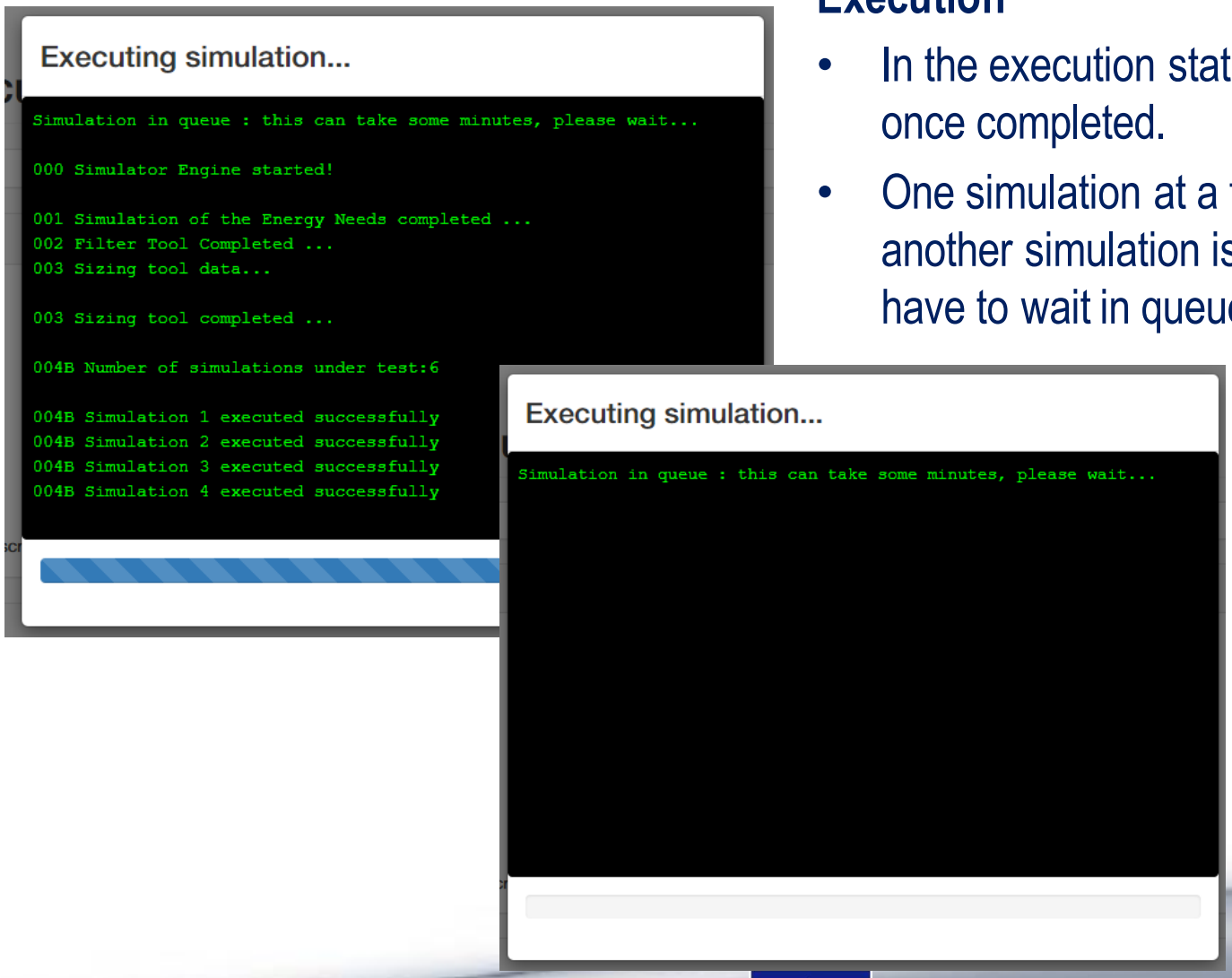
WP final results



Execution

- In the execution status, the steps are listed once completed.
- One simulation at a time can be run. If another simulation is already running, you have to wait in queue.

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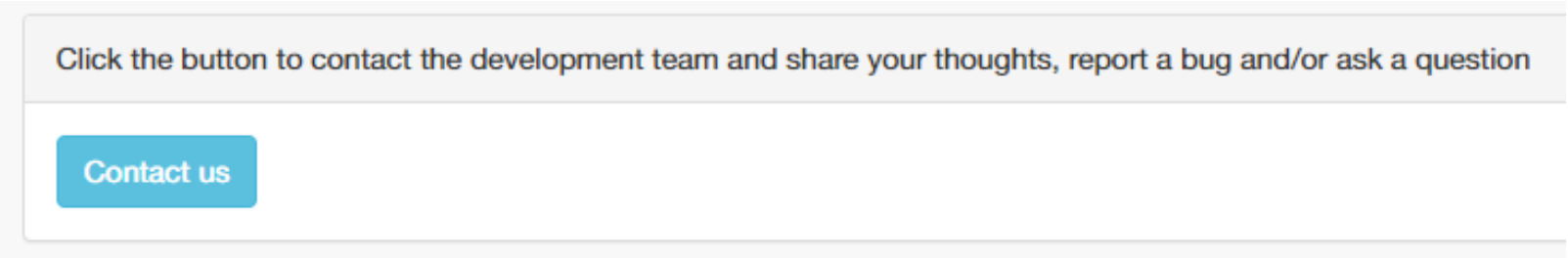
WP final results

Support



- Continuous support by the development team
- The user can contact us to share thoughts and observations, report a bug, ask questions

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WP final results

KPI overview

- The layout are ranked by the AHP on the basis of:
  - Primary energy
  - Greenhouse gas emissions
  - Comfort deviation

Simulations KPI overview

Simulation name	Layout	Ranking	Non-renewable primary energy (kWh/m2/y)	Renewable energy contribution	Greenhouse gas emissions (kgCO2eq/m2/y)	Electricity fed to the grid (kWh/y)	Average Comfort devation (°C)	Techincal and regulatory informatio
+AdHP+EHP+SC	4	1	19.2	90%	3.7	0.00	-1.01	show
+AdHP+EHP+SC+BEMS	4	2	19.0	90%	3.7	0.00	-1.01	show
Current	2	3	59.3	1%	12.1	0.00	-1.14	
+BEMS	2	4	59.1	1%	12.1	0.00	-1.14	show
+EHP+PV+PCM+BEMS	5	5	67.8	70%	12.9	11252.66	-0.99	show

Hover a table row to read a brief description of the components

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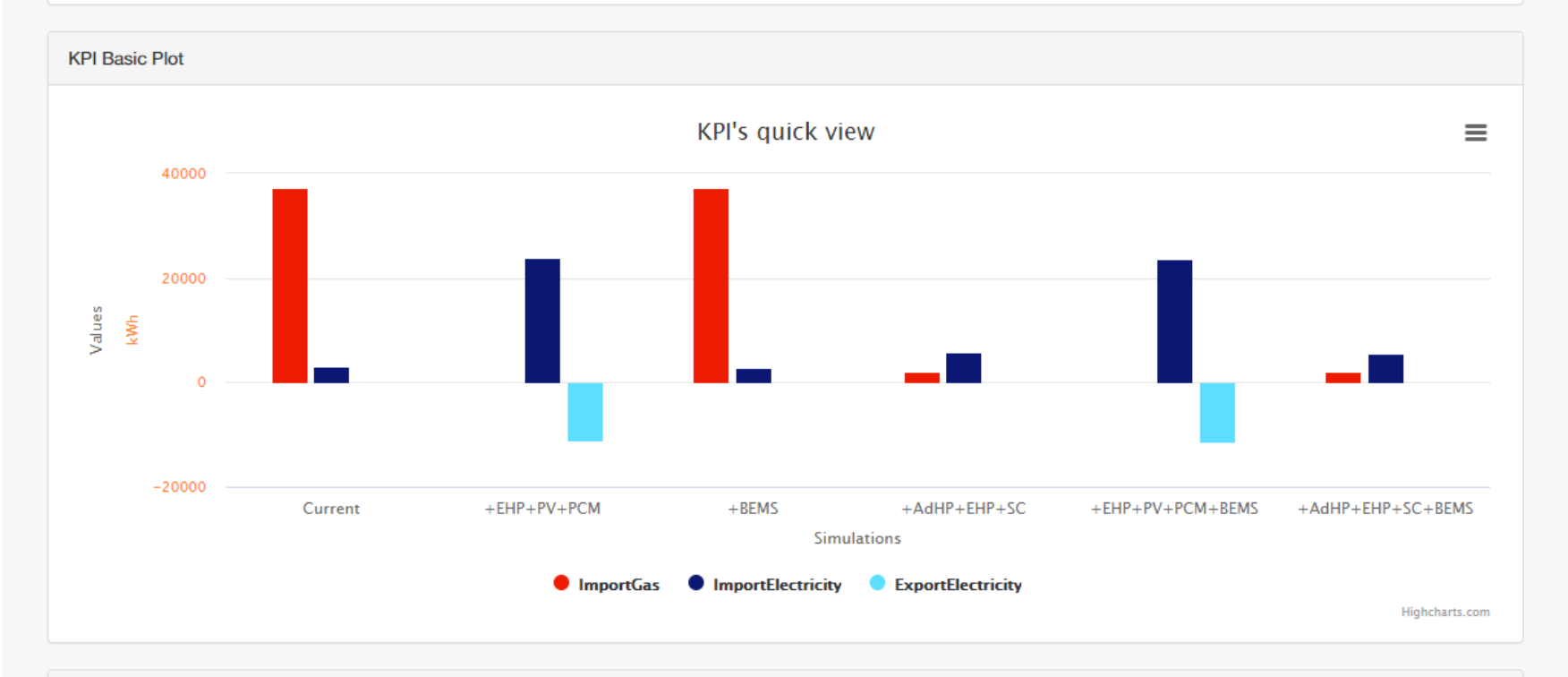
WP final results

Fuel and electricity import and export are plotted and compared for each layout



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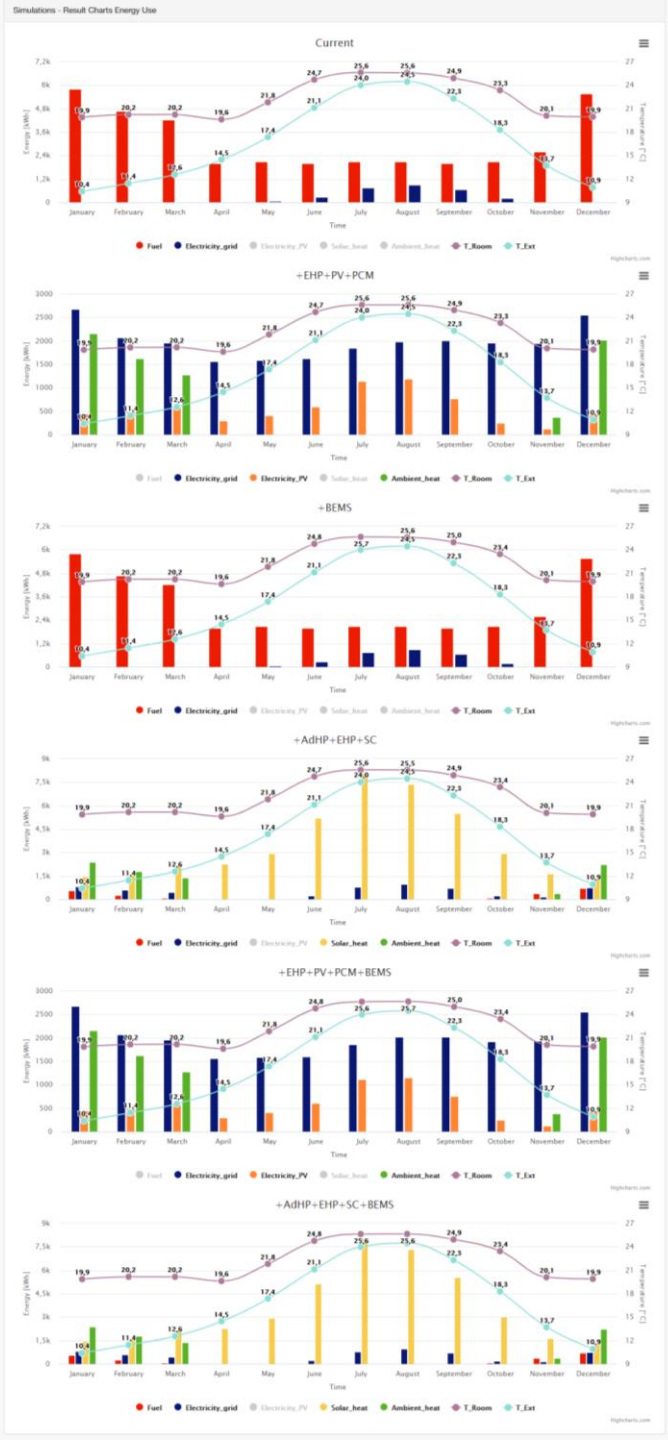
WP final results

Simulations Results

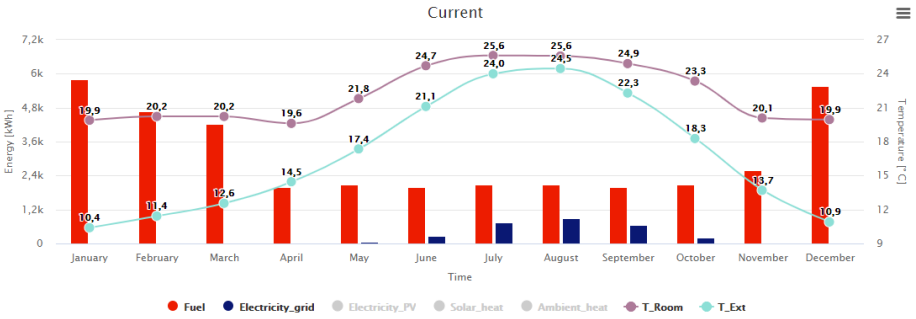
The monthly values of energy use are shown for each layout:

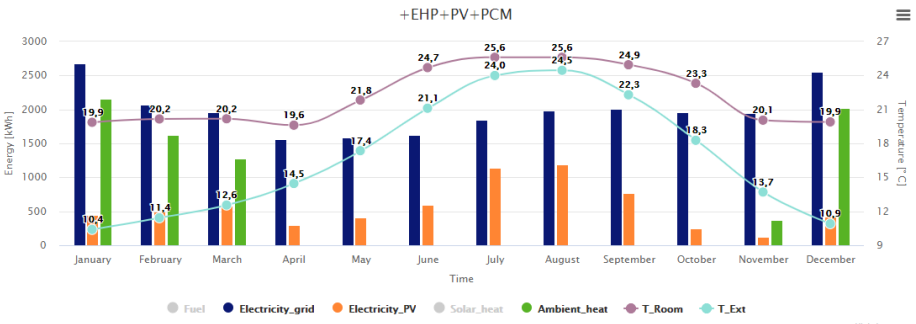
- Fuel consumption (Gas, Oil, Biomass, Coal)
- Electricity imported from grid
- Electricity produced by PV and directly consumed
- Thermal energy produced by solar thermal collectors)
- Ambient heat

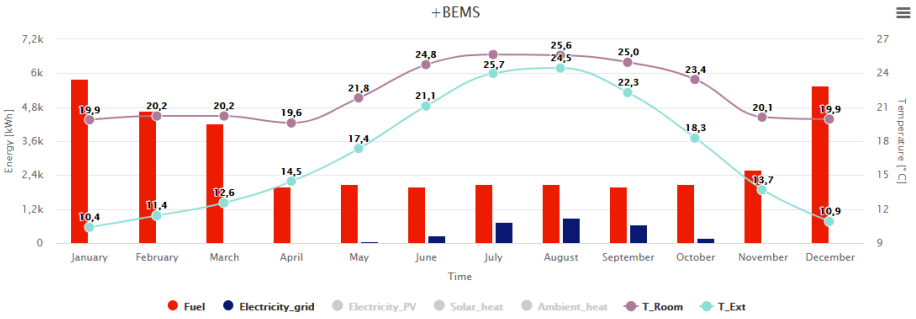


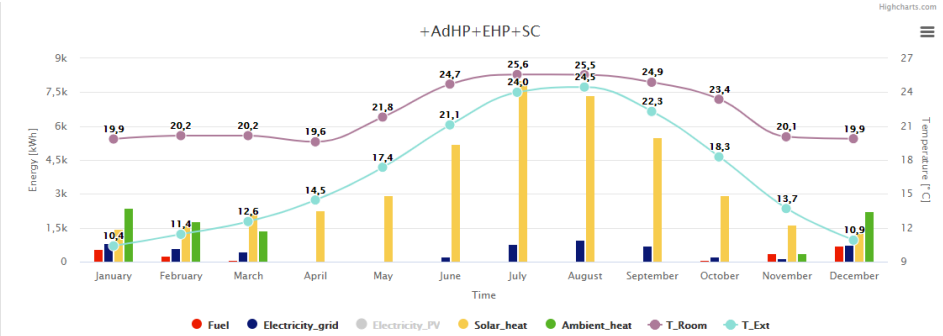
WP final results

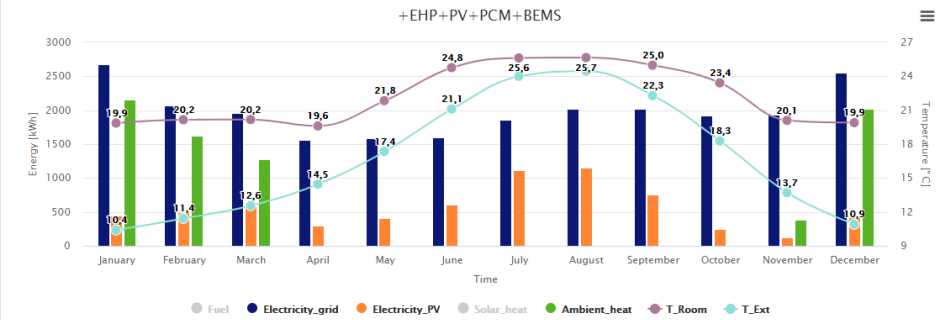
Simulations Results

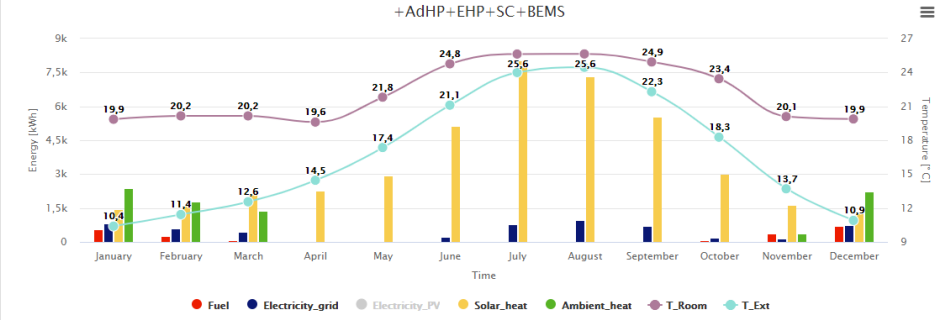












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Issues encountered / lessons learnt

- The results of the tool for simulating relevant scenarios are validated and are useful for the intended use of the tool.
- The validation of the tool was not foreseen. The valuable results during the development of the project but, mainly, at the end, are necessary to provide feedback to the tool. As a consequence, additional dedication was required.
- The design of the tool based on modules has benefits: Gives flexibility as well as a good opportunity to share the development between different involved partners. However, this approach supposed an additional complexity when the modules needed to be integrated in the final version of the tool.

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Conclusions

- **As a result of WP2, the H4C RetroSim tool has been developed and is available online**

- Main features of the tool are:
  - Quick assessment
  - Different alternatives are considered depending on the case
  - Innovative H4C solutions are simulated
  - The tool has a high degree of flexibility to configure scenarios
  - Specific modules developed for: Filtering, sizing, simulating, controlling and ranking of alternatives

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Thank you

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