Preliminary Thermal Modelling Results
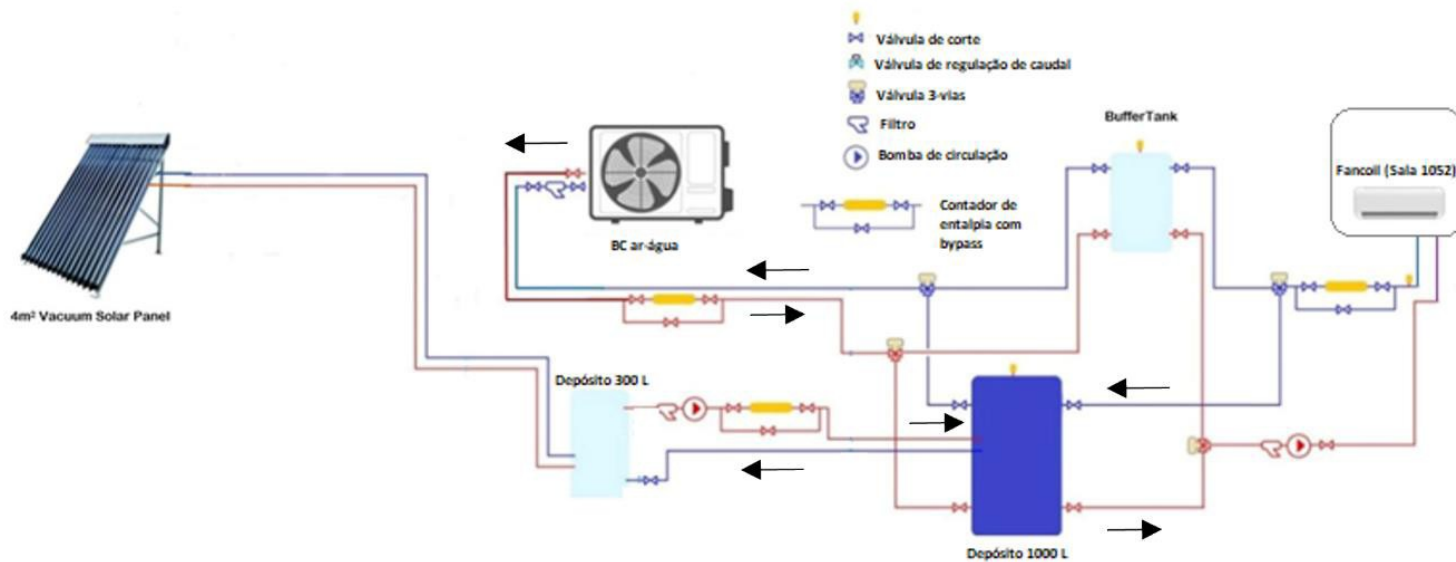
Project SUDOE Improvement

INTERREG IMPROVEMENT AWARENESS RAISING EVENT IN PORTUGAL

LNEG (26 Out 2022)

Jorge Facão

Improvement thermal Portuguese system

Válvula de corte
Válvula de regulação de caudal
Válvula 3-vias
Filtro
Bomba de circulação

BufferTank

Fancoil (Sala 1052)

Contador de entalpia com bypass

BC ar-água

4m² Vacuum Solar Panel

Depósito 300 L

Depósito 1000 L

Motivation / problem

a) Evaluate the results for long-term during heating and cooling seasons;

b) Evaluate several scenarios (time of heat pump operation, variable storage temperature, ...);

c) Determination of the key performance factors of the thermal system, namely: solar fraction, thermal yield, seasonal performance factor, ratio of primary energy from non-renewable energy sources.

Resolution

a) Development of a numerical model of the building and thermal using TRNSYS simulation software;

b) Experimental validation of the developed numerical model;

c) Extrapolation of the results obtained for long-term calculations and for heating and cooling seasons;

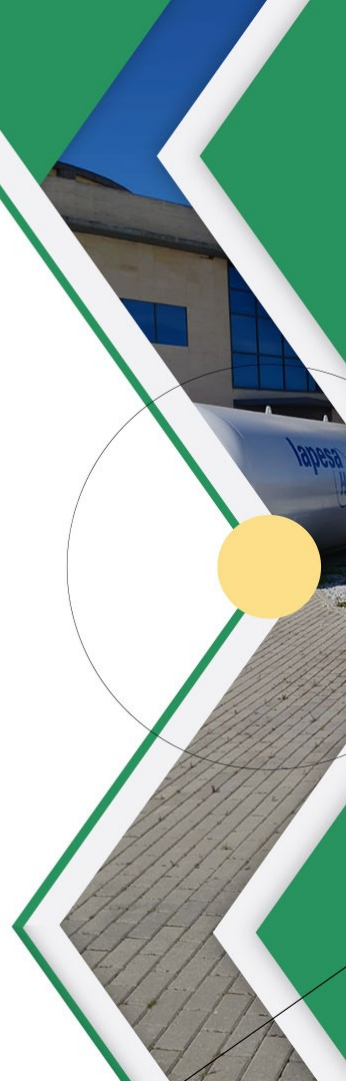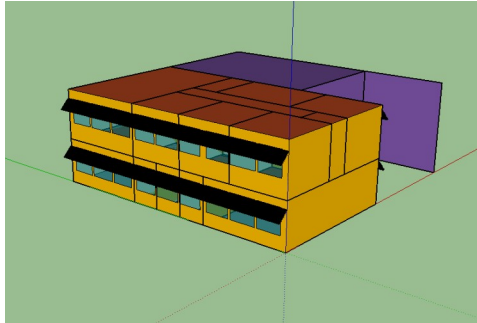d) Simulation of several scenarios (time of heat pump operation, variable storage temperature, ...).

Model of the building

$$C_z \frac{dT_z}{dt} = f_{af}\rho_{af}C_{af}(T_{af} - T_z) + Q_{cond}(t) + q(t) + Q_s(t) + Q_{ra}(t)$$

Ventilation, conduction through elements $\theta_{ar-sol} = \theta_e + \frac{\alpha I}{h_{se}}$, internal thermal loads, solar loads through glazing and air infiltration.
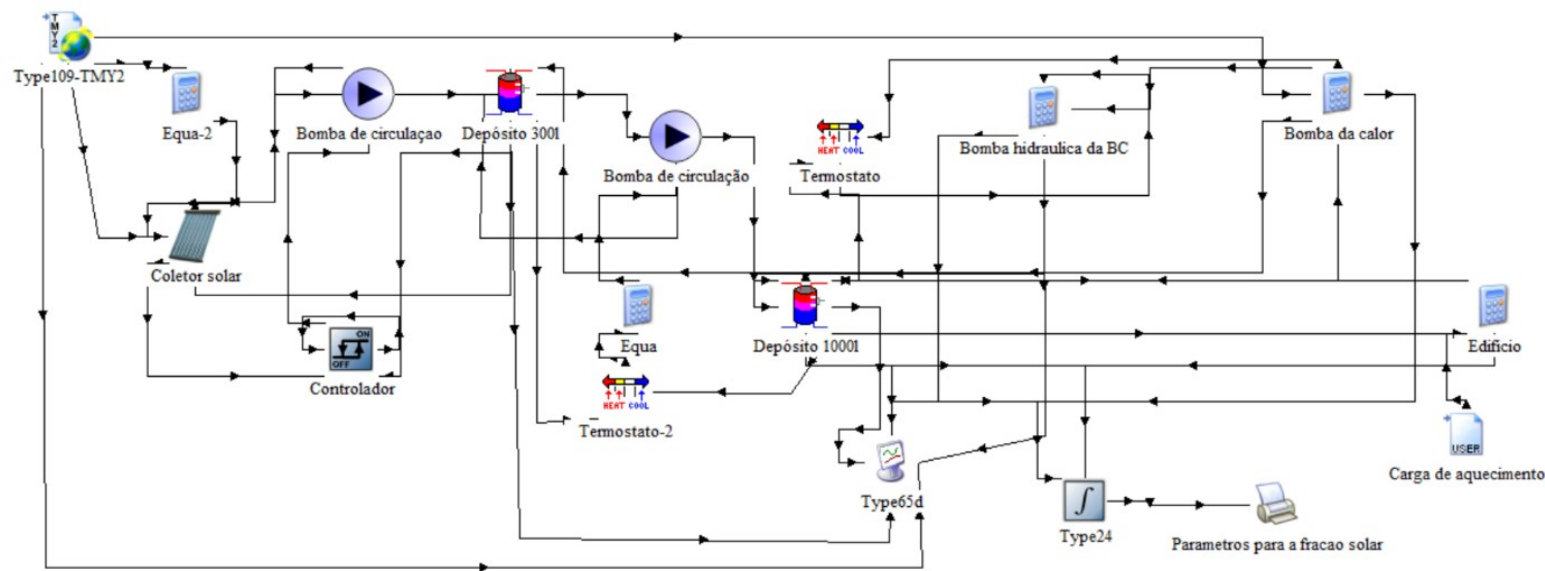
Next step

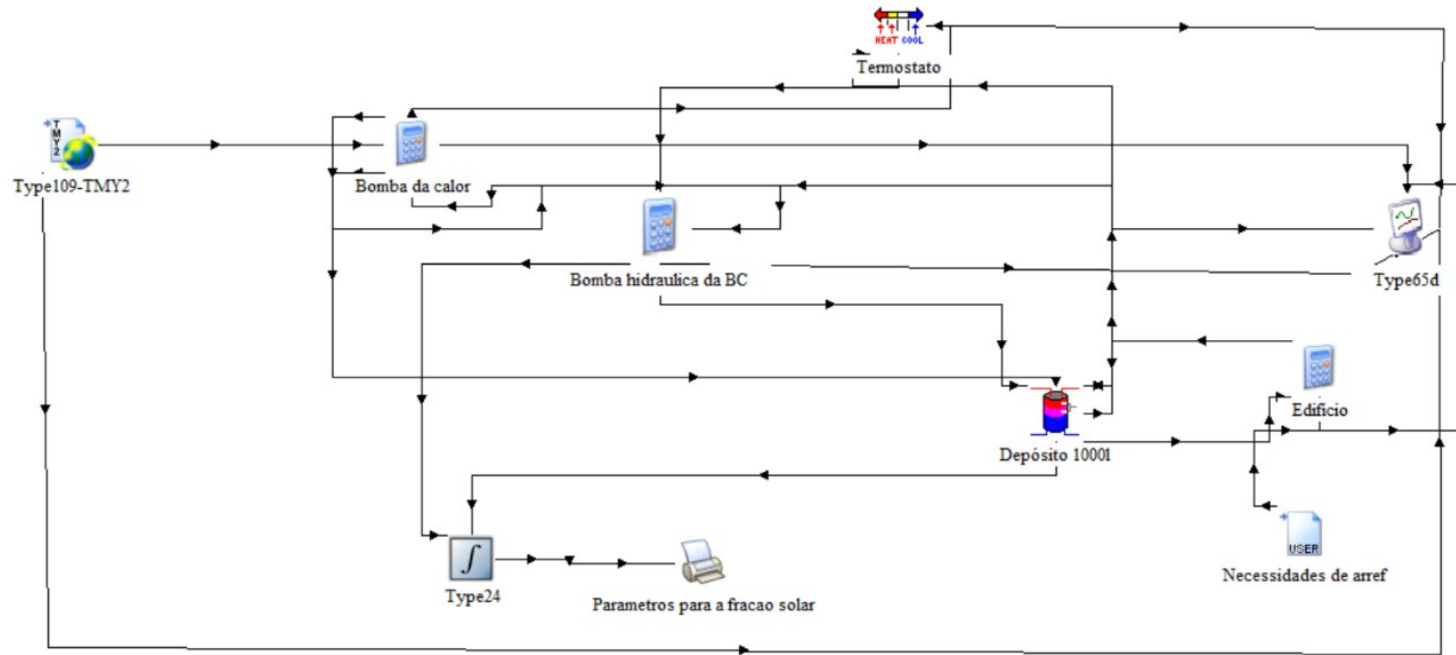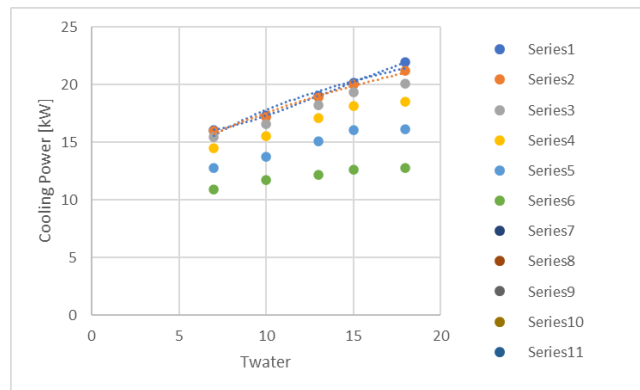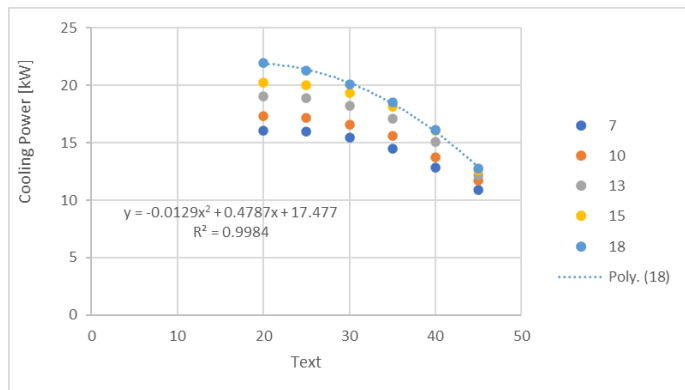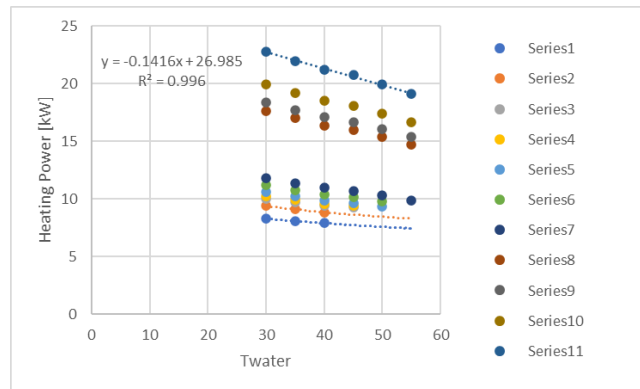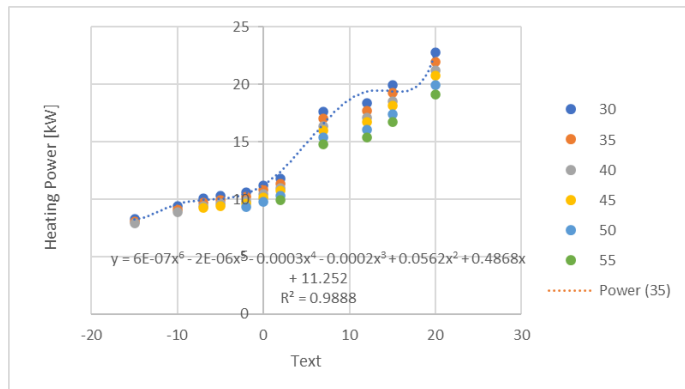Simulate the building with multizone TRNSYS Type 56

Schematic of the heating model developed in TRNSYS
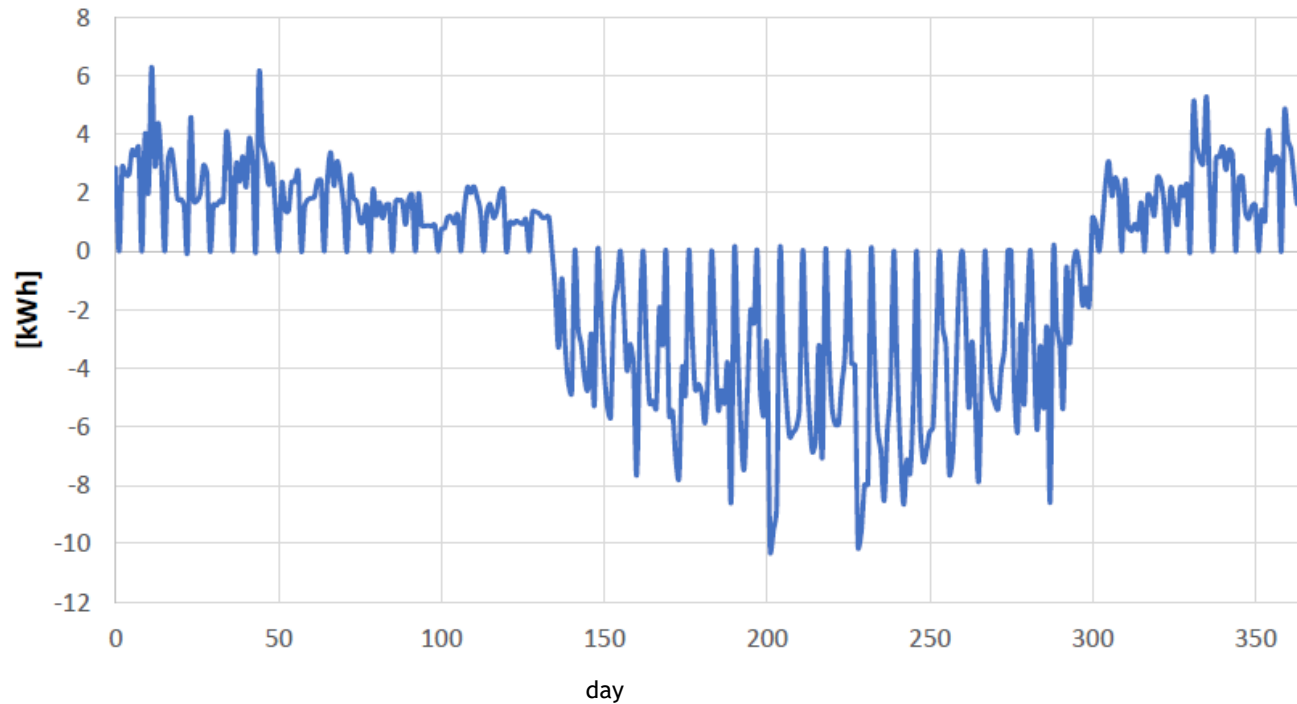
Schematic of the cooling model developed in TRNSYS

Heat pump model

Top-left chart: Heating Power [kW] vs Text, with series 30, 35, 40, 45, 50, 55 and Power (35) trendline.
$$y = 6E\text{-}07x^6 - 2E\text{-}06x^5 - 0.0003x^4 - 0.0002x^3 + 0.0562x^2 + 0.4868x + 11.252$$
$$R^2 = 0.9888$$

Top-right chart: Heating Power [kW] vs Twater, Series1–Series11.
$$y = -0.1416x + 26.985$$
$$R^2 = 0.996$$

Bottom-left chart: Cooling Power [kW] vs Text, with series 7, 10, 13, 15, 18 and Poly. (18) trendline.
$$y = -0.0129x^2 + 0.4787x + 17.477$$
$$R^2 = 0.9984$$

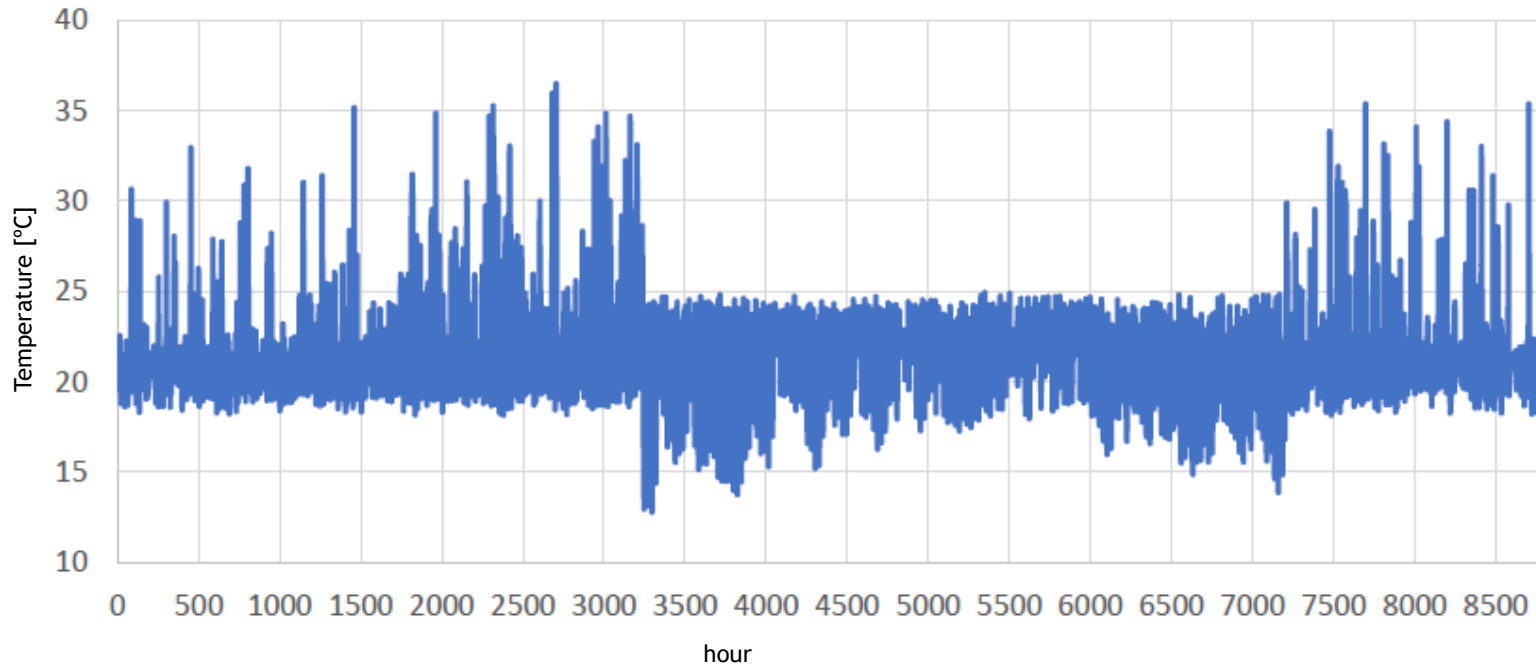Bottom-right chart: Cooling Power [kW] vs Twater, Series1–Series11.

Preliminary results

Thermal load of the room

Preliminary results

Simulated room temperature with climatization

Preliminary results – simulated thermal performance indicators

$$= \frac{}{ + _{h}} = 4,8\,\%$$

$= 2,6$

$= 4,0$

Future work

a) Implementation of the building model in TRNSYS through Type 56;

b) Validation of the results with experimental data;

c) Update the thermal performance results;

d) Extrapolate the analysis considering other scenarios.

THANK YOU!
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