*Technical University of Civil Engineering*

*Faculty of Building Services*

# HVAC SYSTEMS FOR A PASSIVE HOUSE – STUDY CASE

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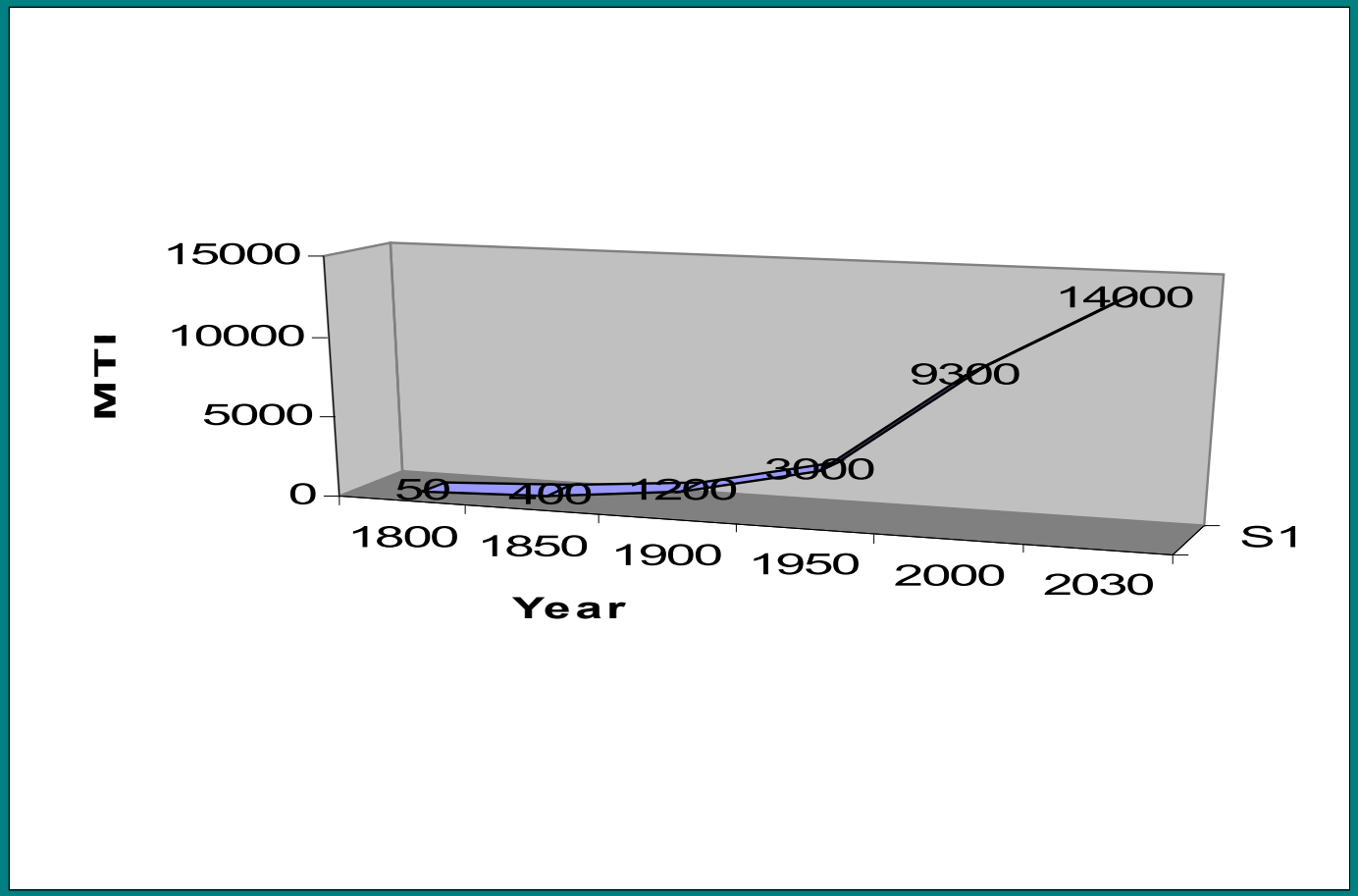
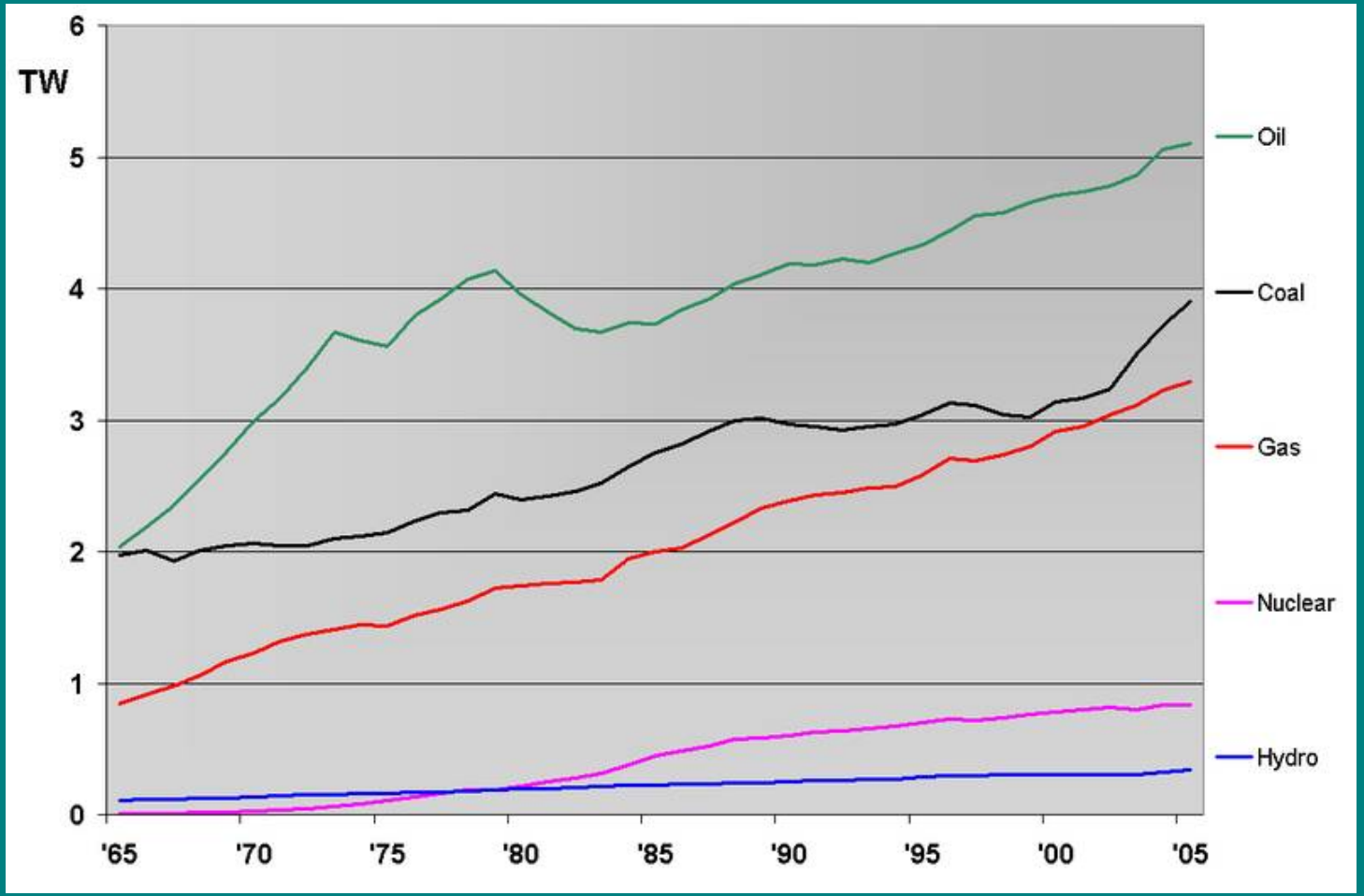
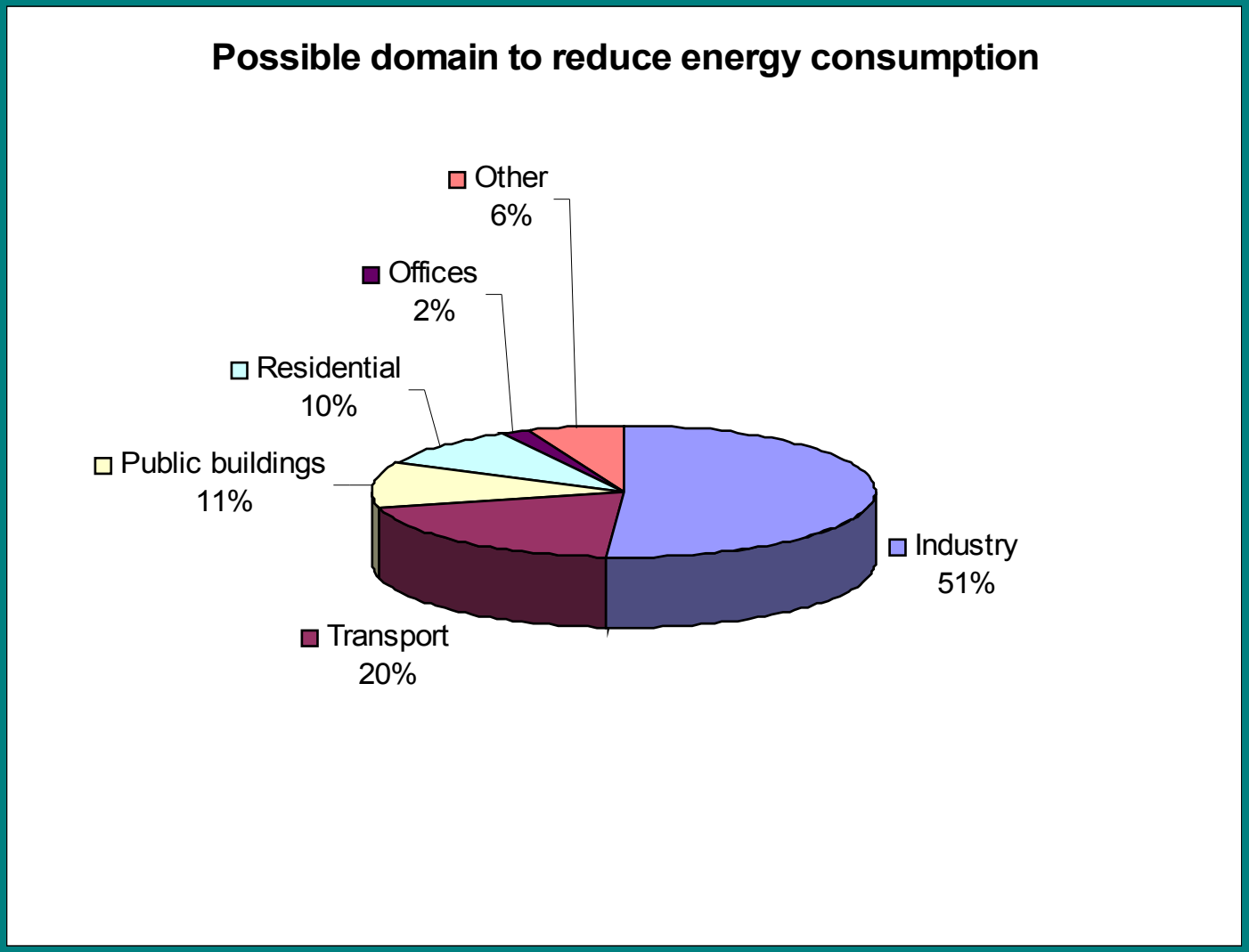
# Energy Consumption (Primary Energy)



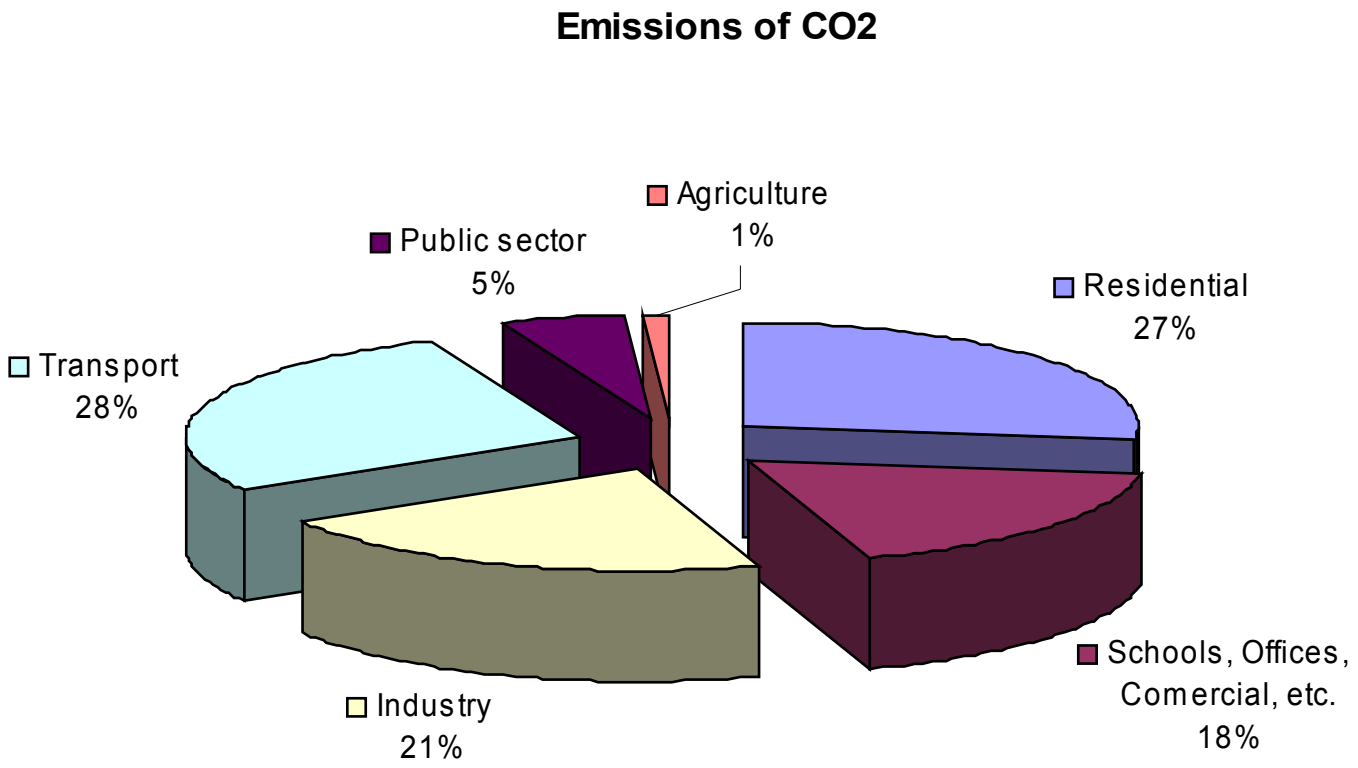
# Energy Production



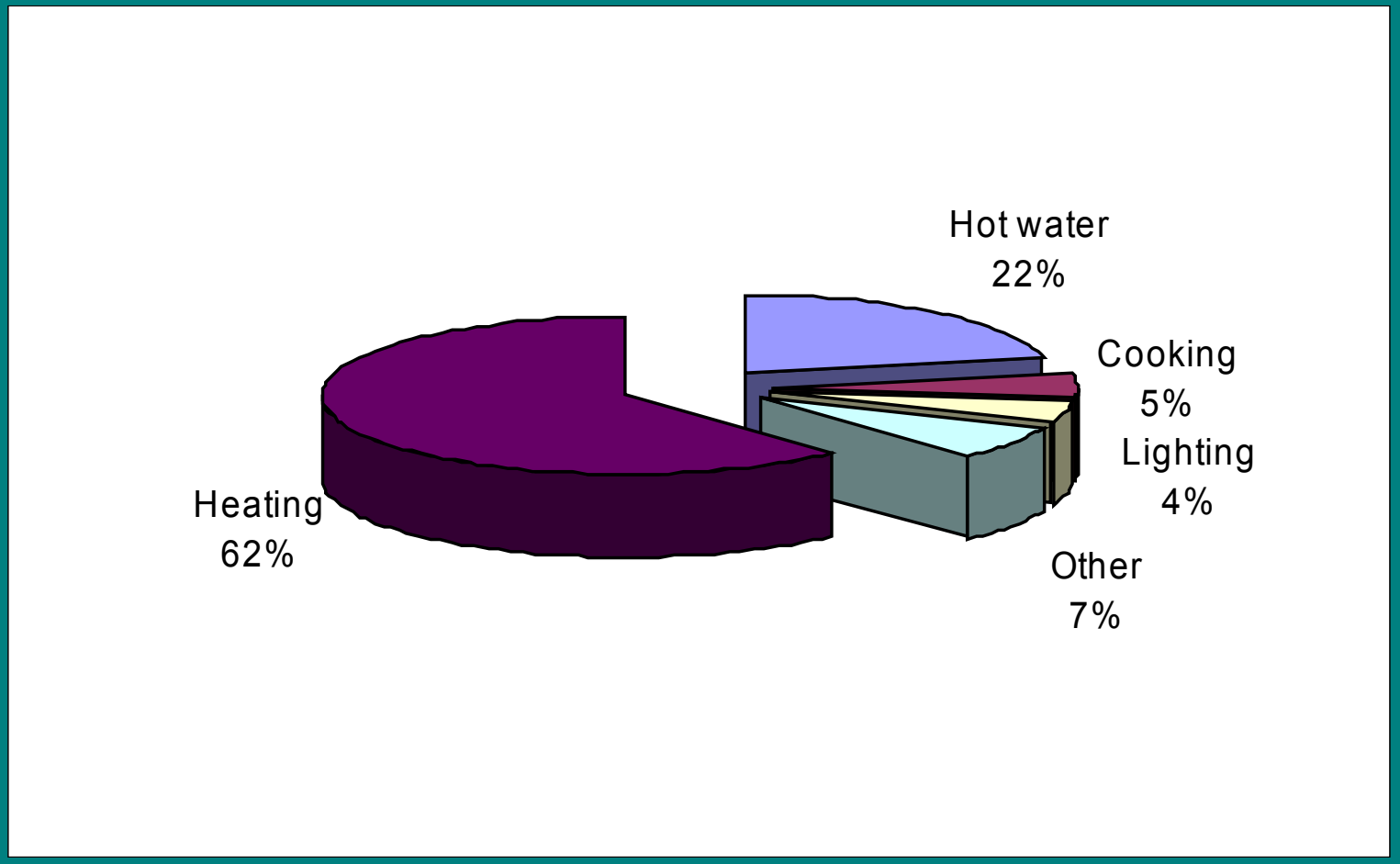
# Domain of Energy Consumption



# Emissions of $CO_2$



# Energy Comsumption in Residential Sector



# Specific coeficient for P.H. (after P.H. Institute – Darmstadt Germany)

- Final Energy
  - » 15 kWh/(m2 year) – heating energy
- Primary Energy
  - » 120 kWh/(m2 year) – total energy (heating, cooling, lighting, cooking, etc.)

# Principles for build up a P.H.

- Volume/surface coefficient (1- single house, 0,65 – single house with a couple of floors, 0,4 block of flats, etc.);
- Orientation;
- Good insolation (limitation of thermal briges);
- Sealed envelope;
- Smart shading.

# Designed P.H.

General data:

- Height: Ground+3 Floors+Attic;
- Ground surface: 500 sq.m;
- Total surface: 2,500 sq.m;
- Total volume: 8,000 c.m.
- Destination: G+3 Flors (open offices), Attic (residential)

# View of the P.H.

## Construction

The external walls have the following structure :

- external coating :

$\delta = 0.015$ m; $\lambda = 0.93$ W/m.K;

- thermal insulation layer made of expanded polystyrene :

$\delta = 0.20$ m; $\lambda = 0.04$ W/m.K;

- neopor layer :

$\delta = 0.063$ m; $\lambda = 0.027$ W/m.K;

- concrete steel layer :

$\delta = 0.20$ m; $\lambda = 1.74$ W/m.K;

- neopor layer :

$\delta = 0.063$ m; $\lambda = 0.027$ W/m.K;

- thermal insulation layer made of mineral cotton :

$\delta = 0.05$ m; $\lambda = 0.04$ W/m.K;

- Rigips layer : $\delta = 0.012$ m; $\lambda = 0.50$ W/m.K;

The windows : double thermopan window ;

The roof of the house that is wood fireproofed rigid frame, with cellulose insulation of de 40 cm total thickness, with Lindab profiled plate.

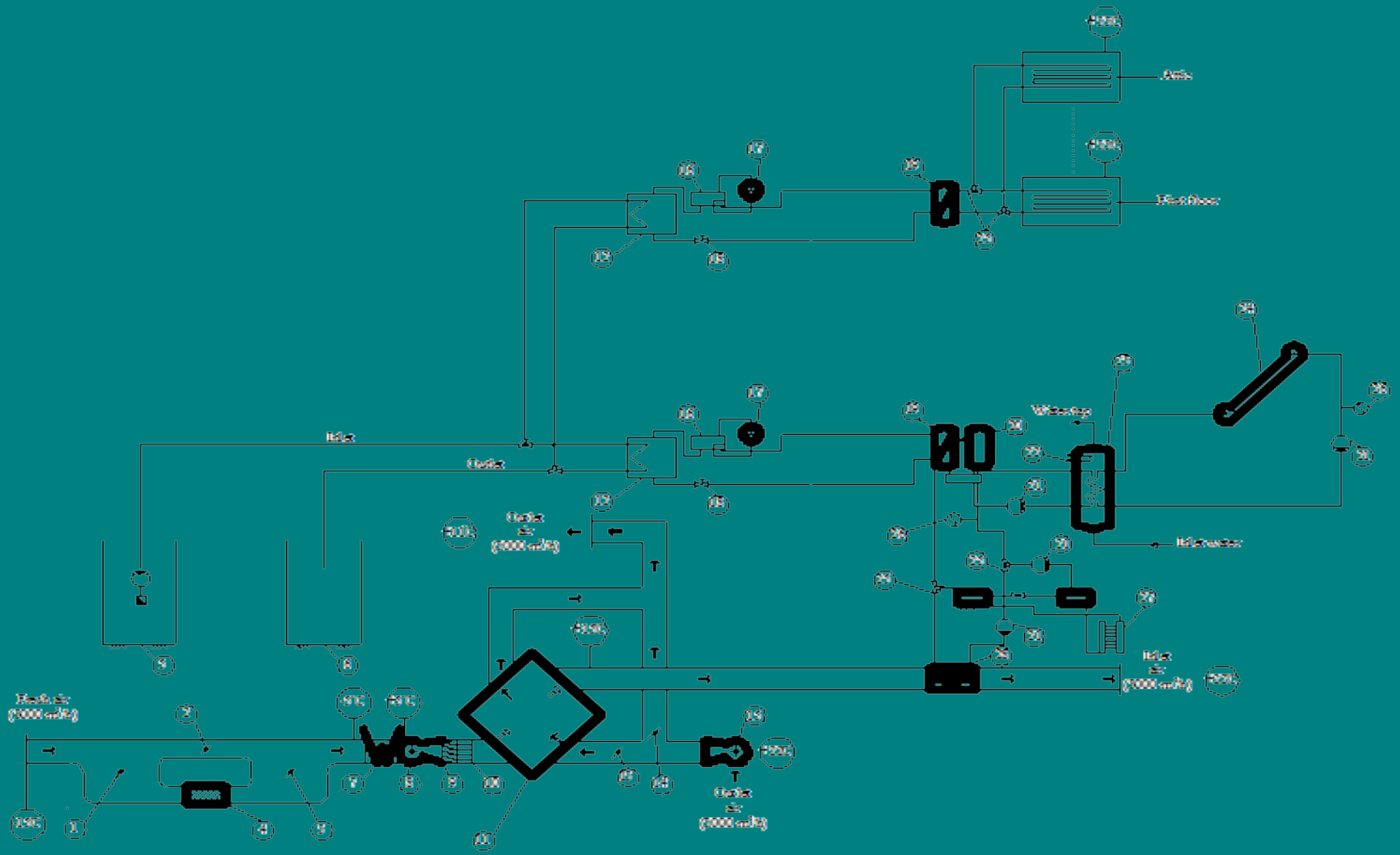
## Utilitys

| SUMMER | | | | |
|---|---|---|---|---|
| Te [°C] | 25 | 30 | 35 | 40 |
| $Q_{Totalcool}$ [W] | - 415 | 1284 | 3040 | 4766 |
| WINTER | | | | |
| Te [°C] | -15 | -10 | -5 | 0 |
| $Q_{Total\ heat}$ [W] | 12818 | 11065 | 9311 | 7557 |

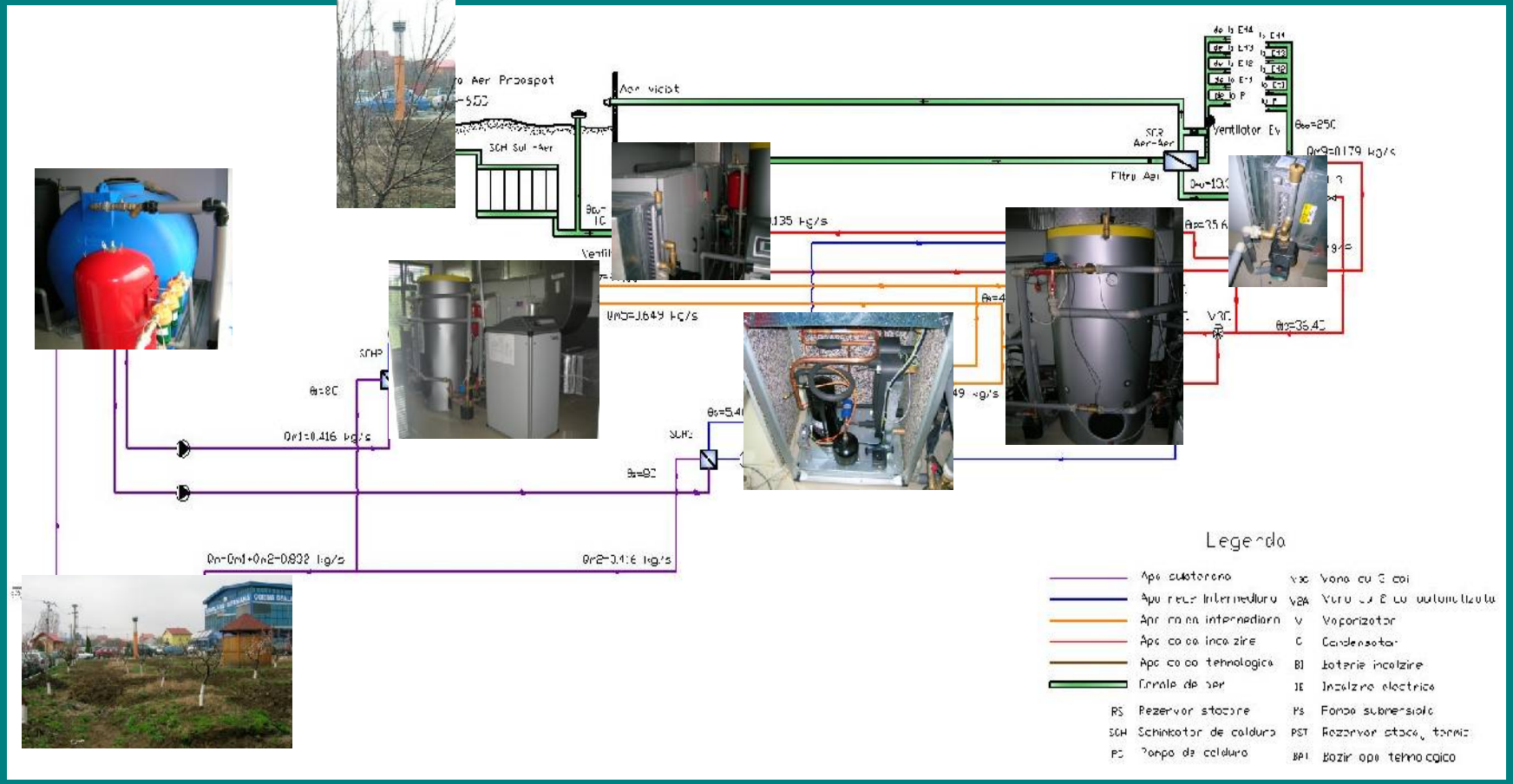
# The specific consumptions

- Specific consumption for heating: $q_{heat}$ = 9.56 kWh/m2.year;
- Specific consumption for preparing hot water: $q_{hw}$ = 11.86 kWh/m2.year;
- Specific consumption for lighting: $q_{lighting}$ = 9.40 kWh/m2.year;
- Specific consumption for air-conditioning: q_ ac= 9.23 kWh/m2.year;
- Total specific consumption resulted: q_ total = 40.06 kWh/m2.year.

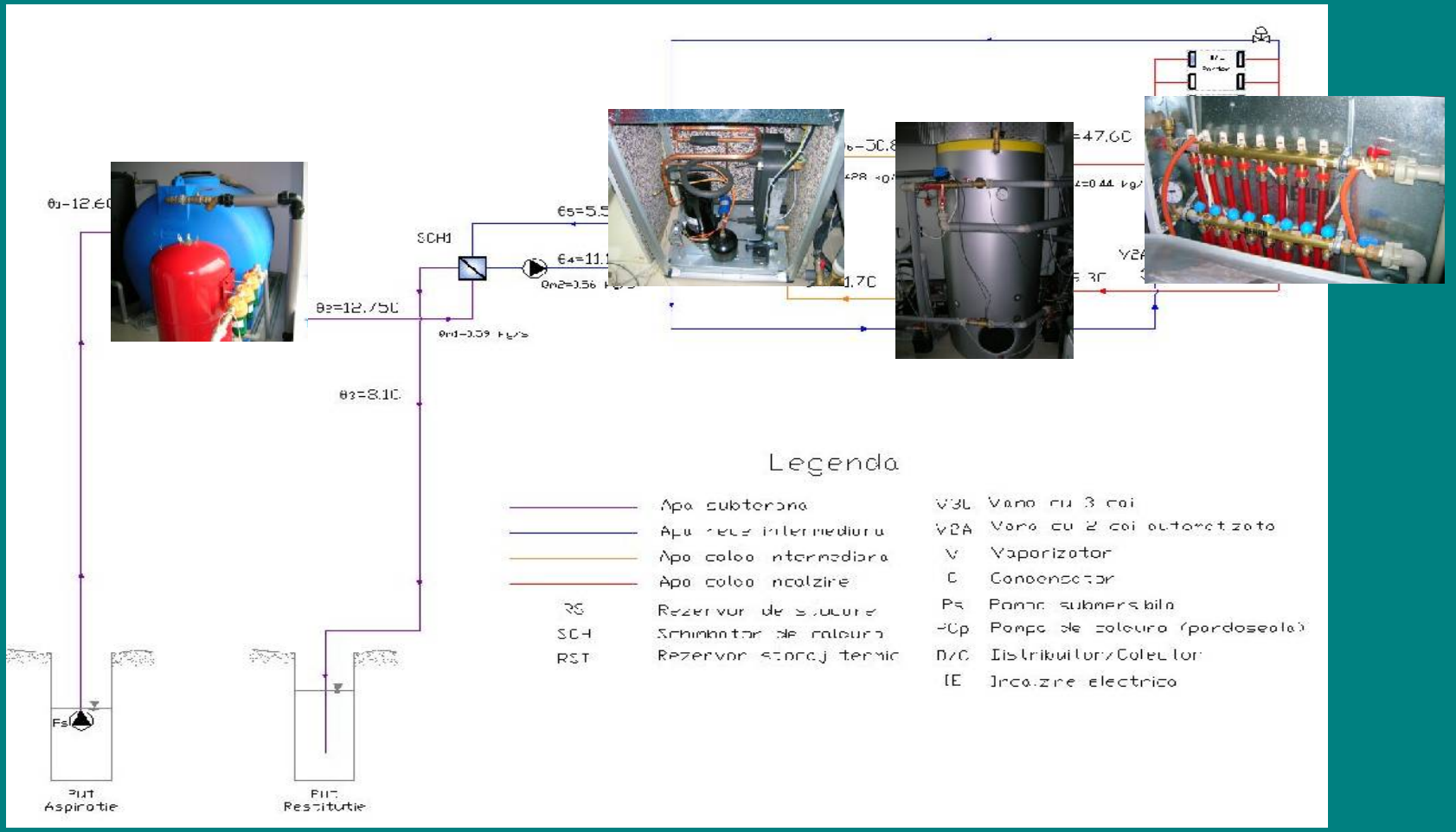
# Heating/Cooling air system



# Heating or Cooling plant using the mechanic ventilation system



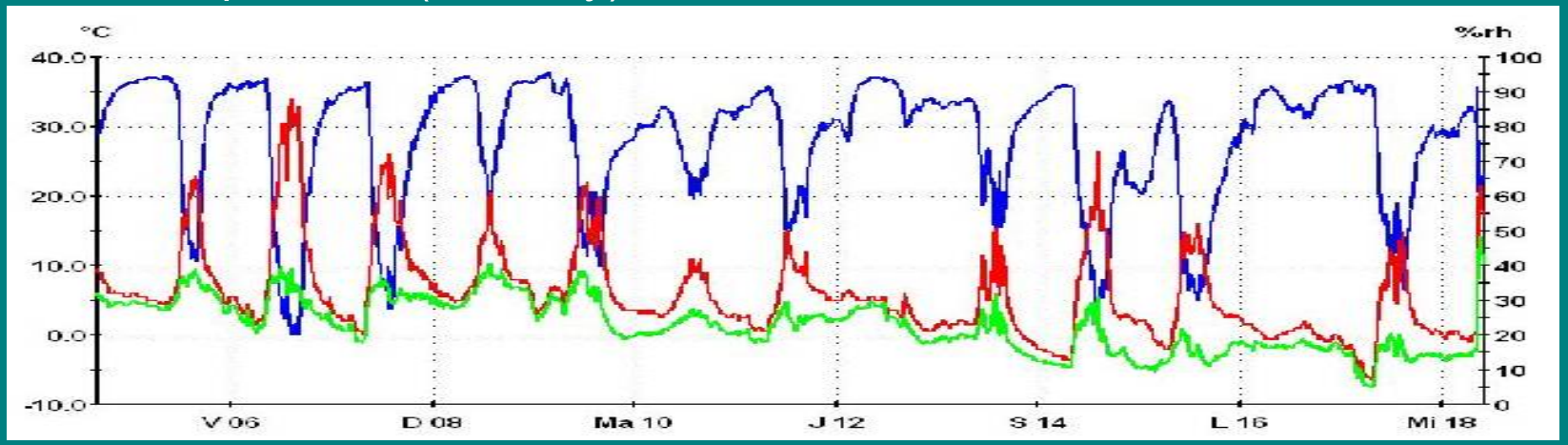
# Heating or Cooling plant using the radiant floor



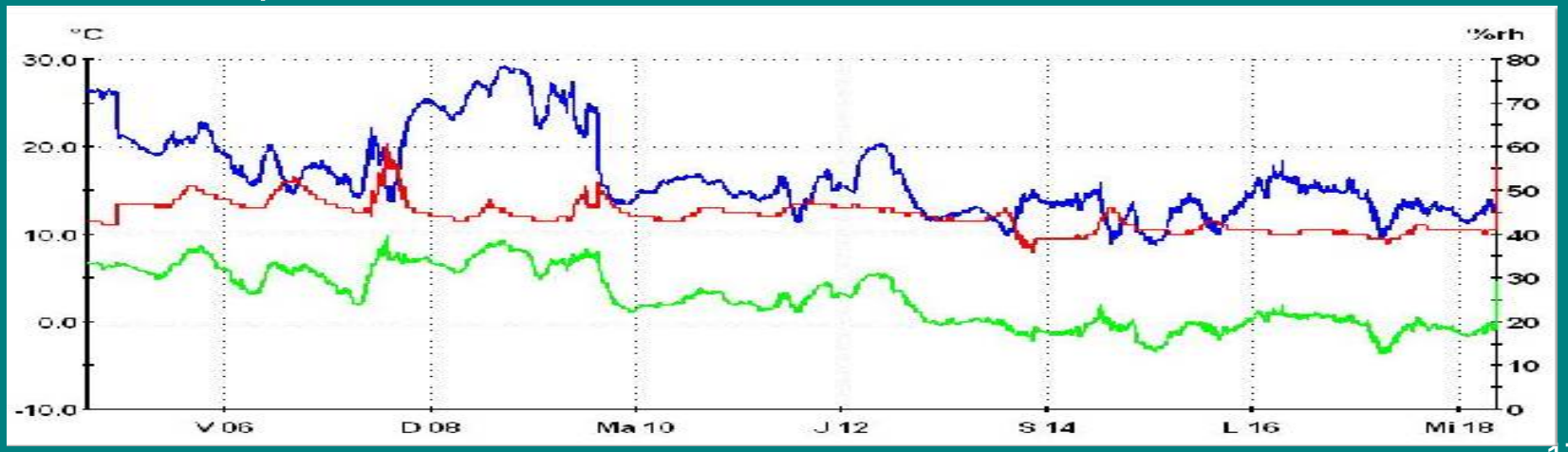
# Conclusions

# Temperature variation in the ground heat exchanger

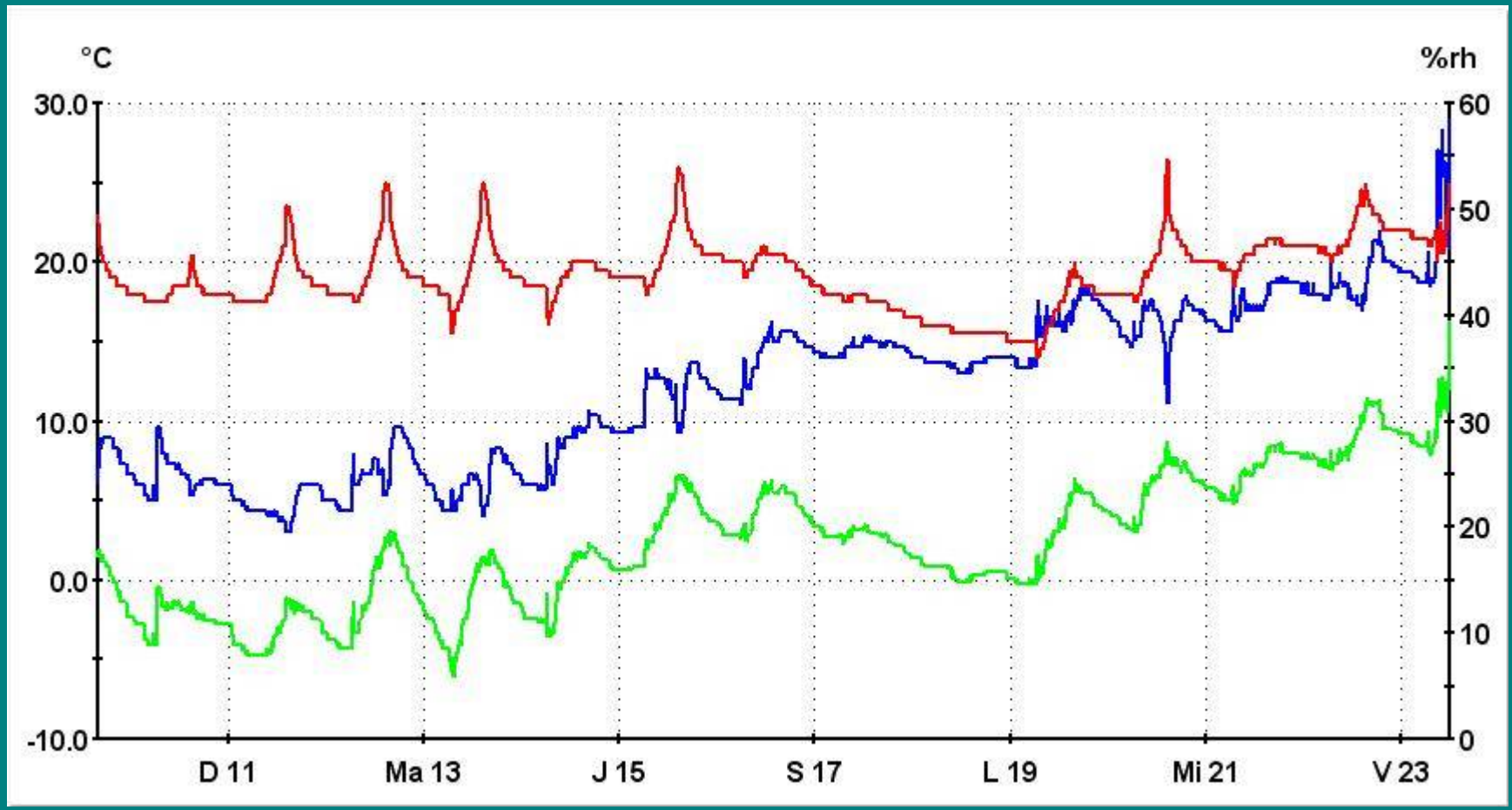
- Inlet temperature (february)



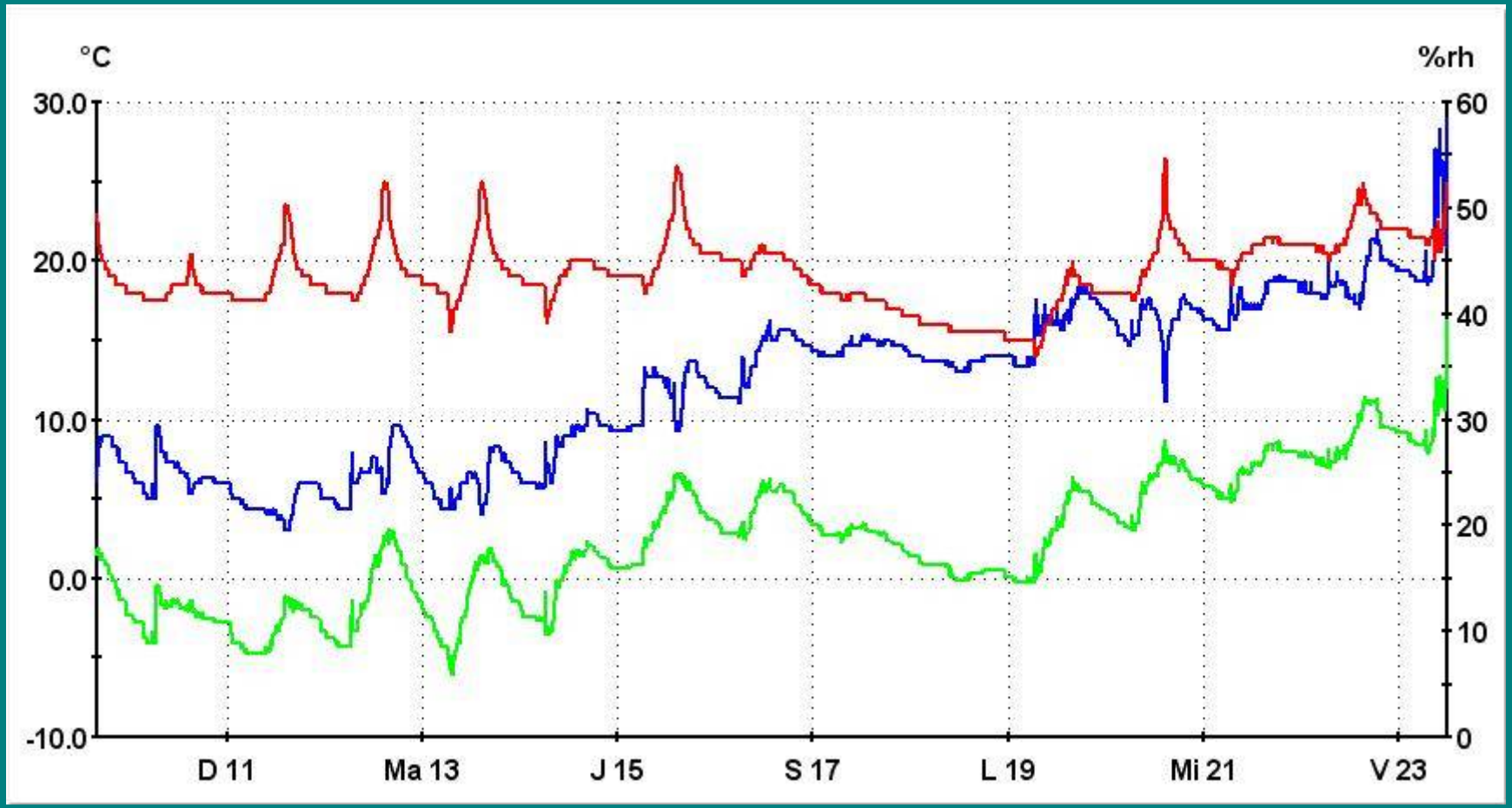

- Outlet temperature



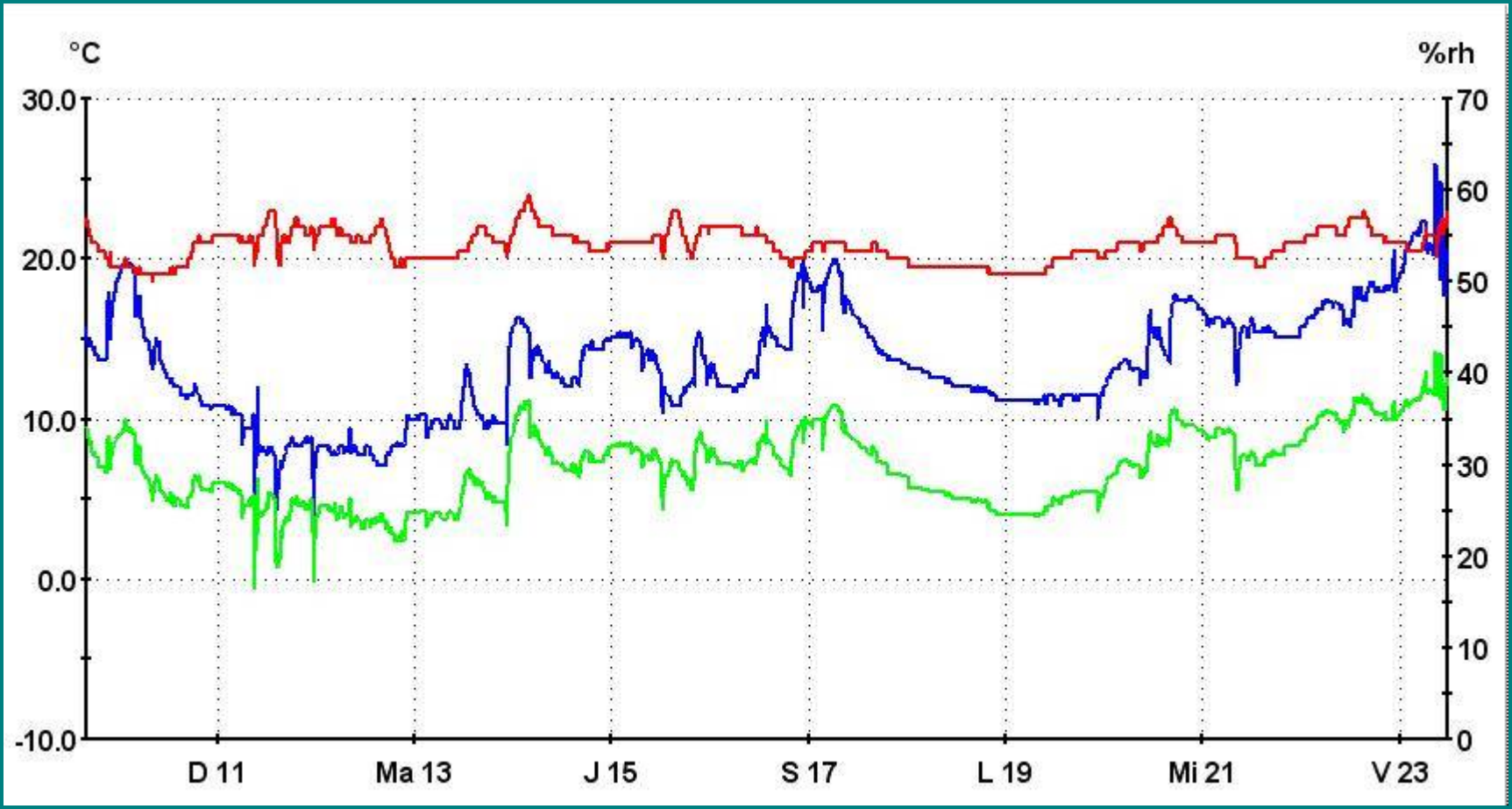
# Floor heating (ground / open office)



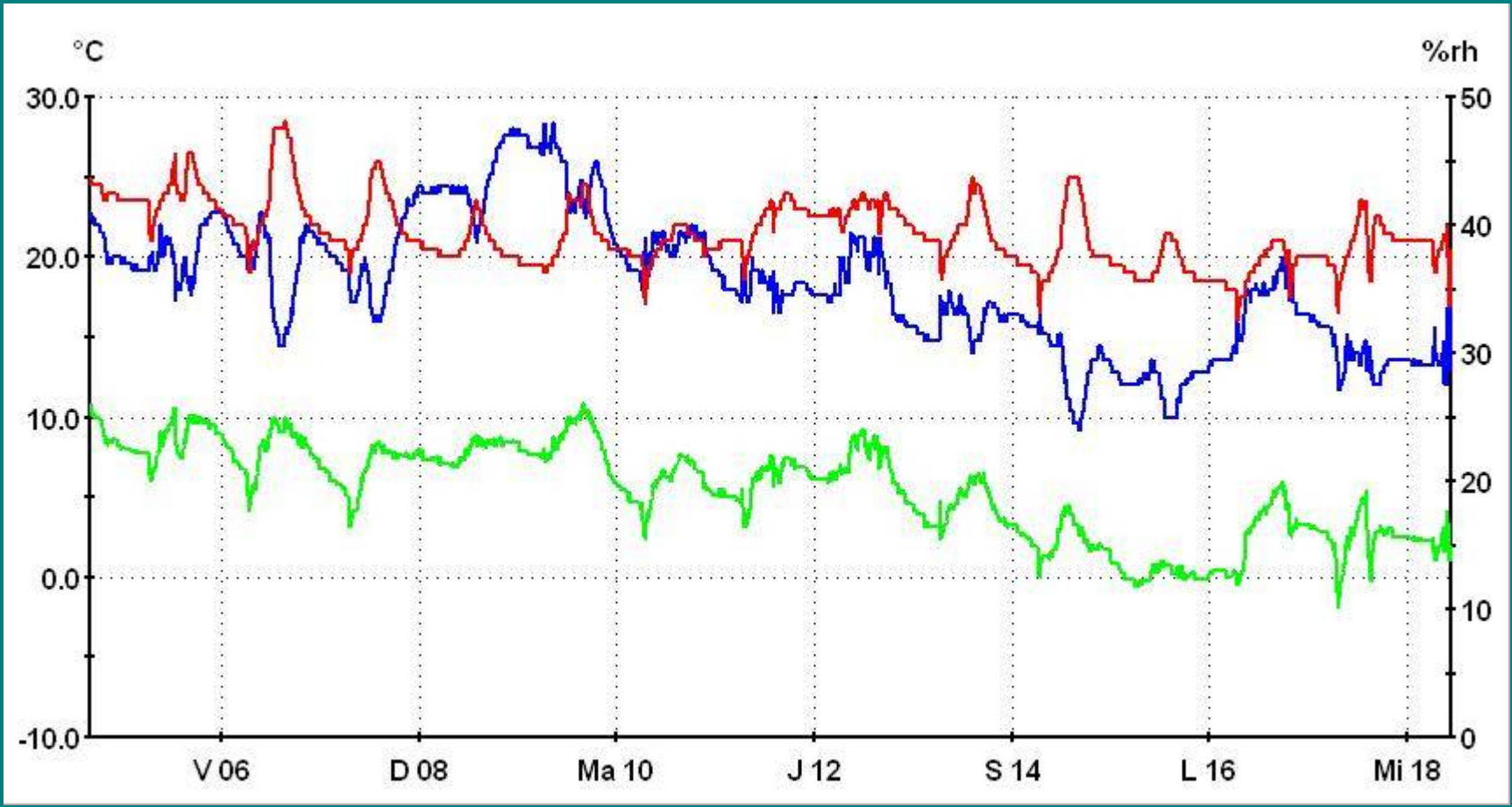
# Floor heating (first floor / open office)



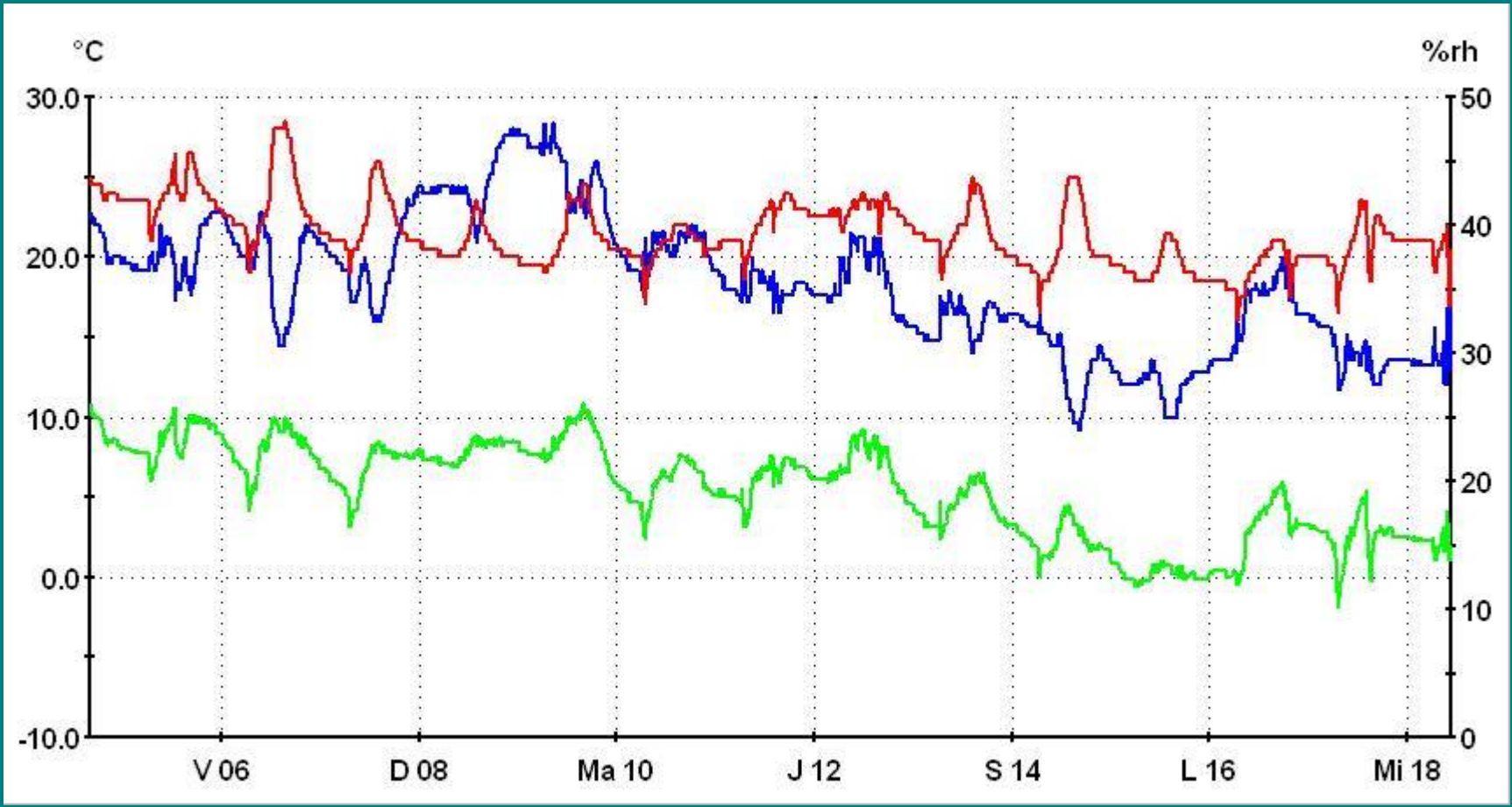
# Floor heating (residential)



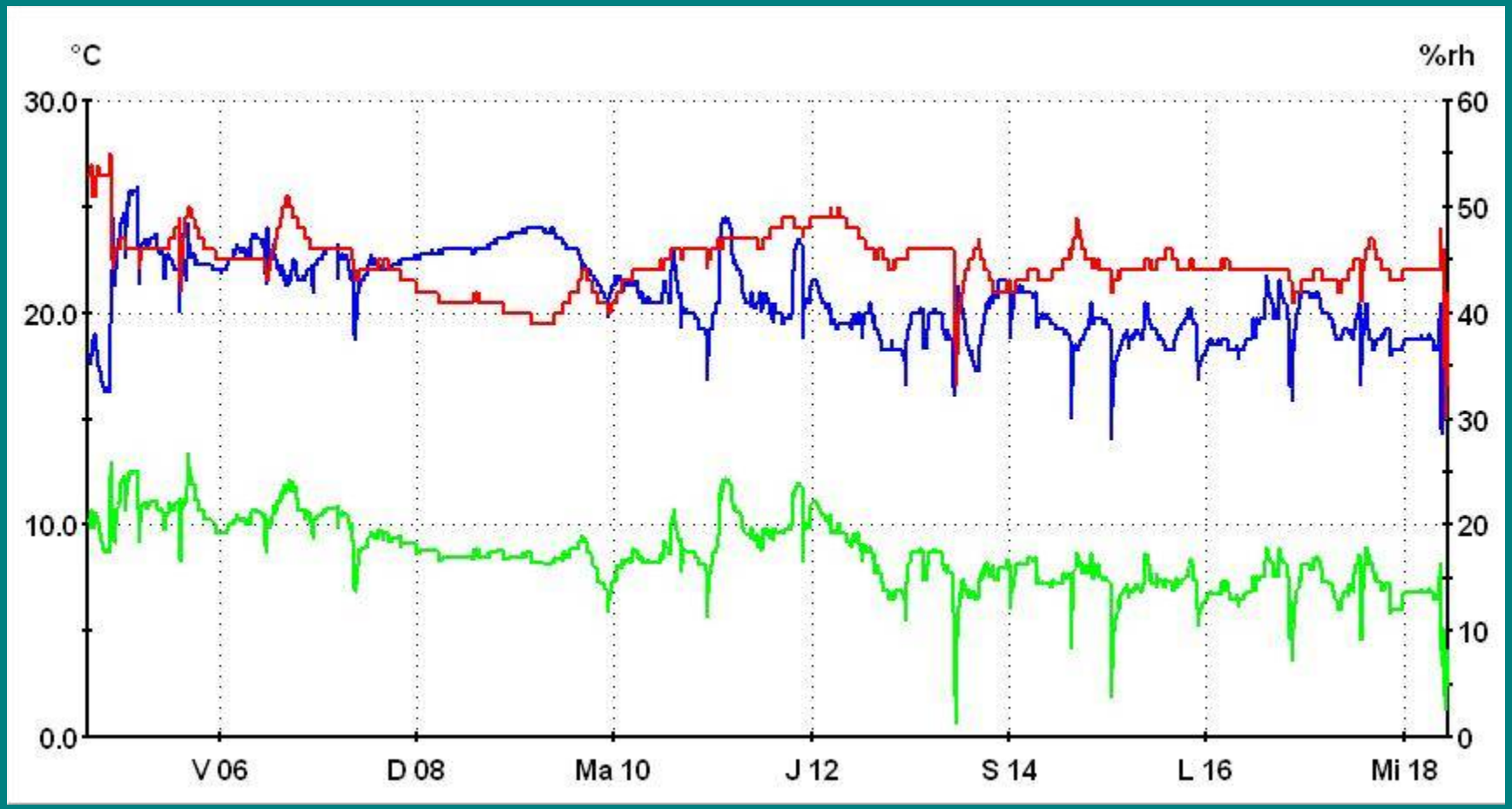
# Air + Floor Heating (Ground / open office)



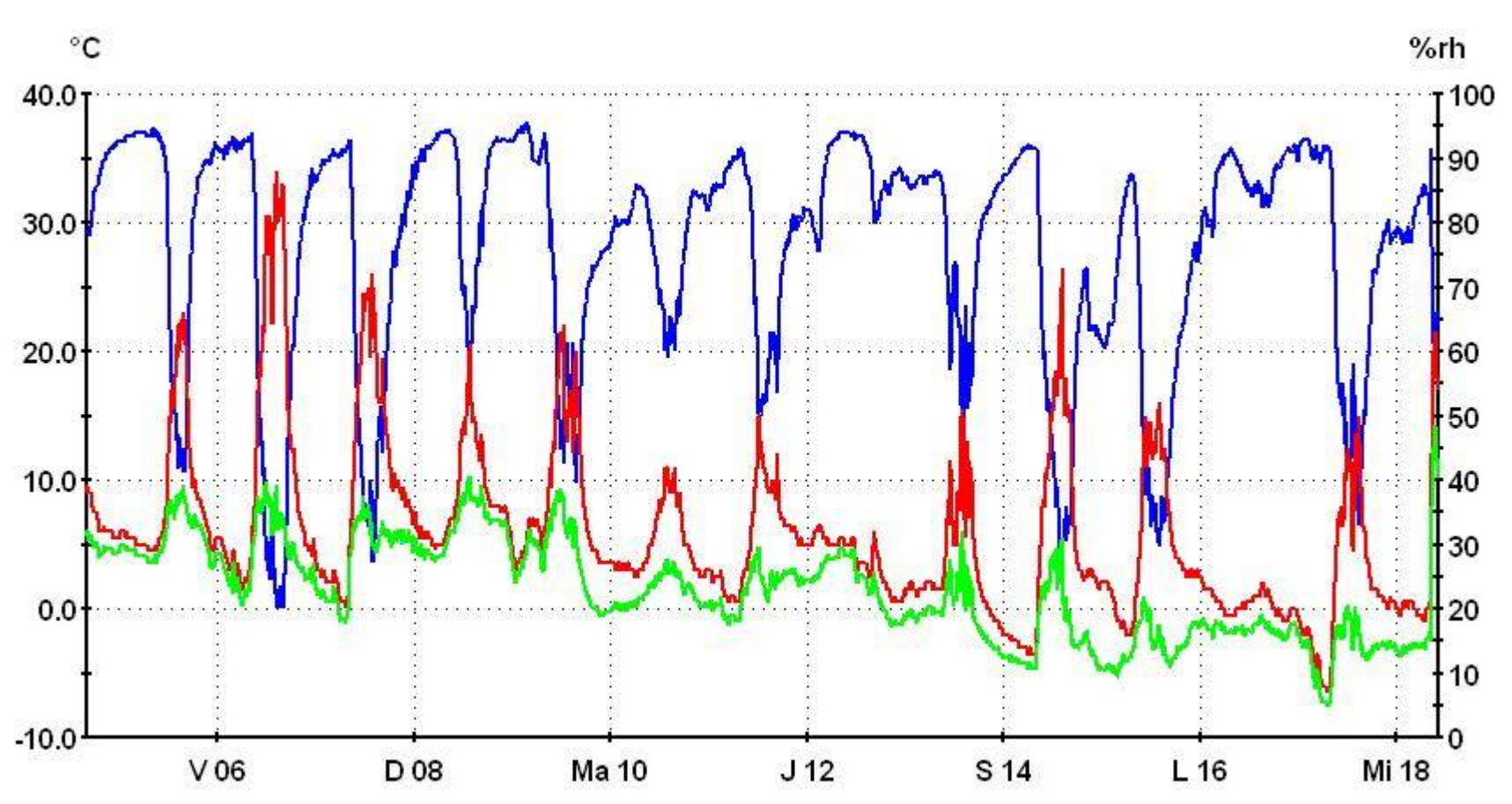
# Air + Floor Heating (first floor / open office)



# Air + Floor heating (residential)



# Outside temperature



# Thank you for your attention!