Energy efficient climate control in museum stores

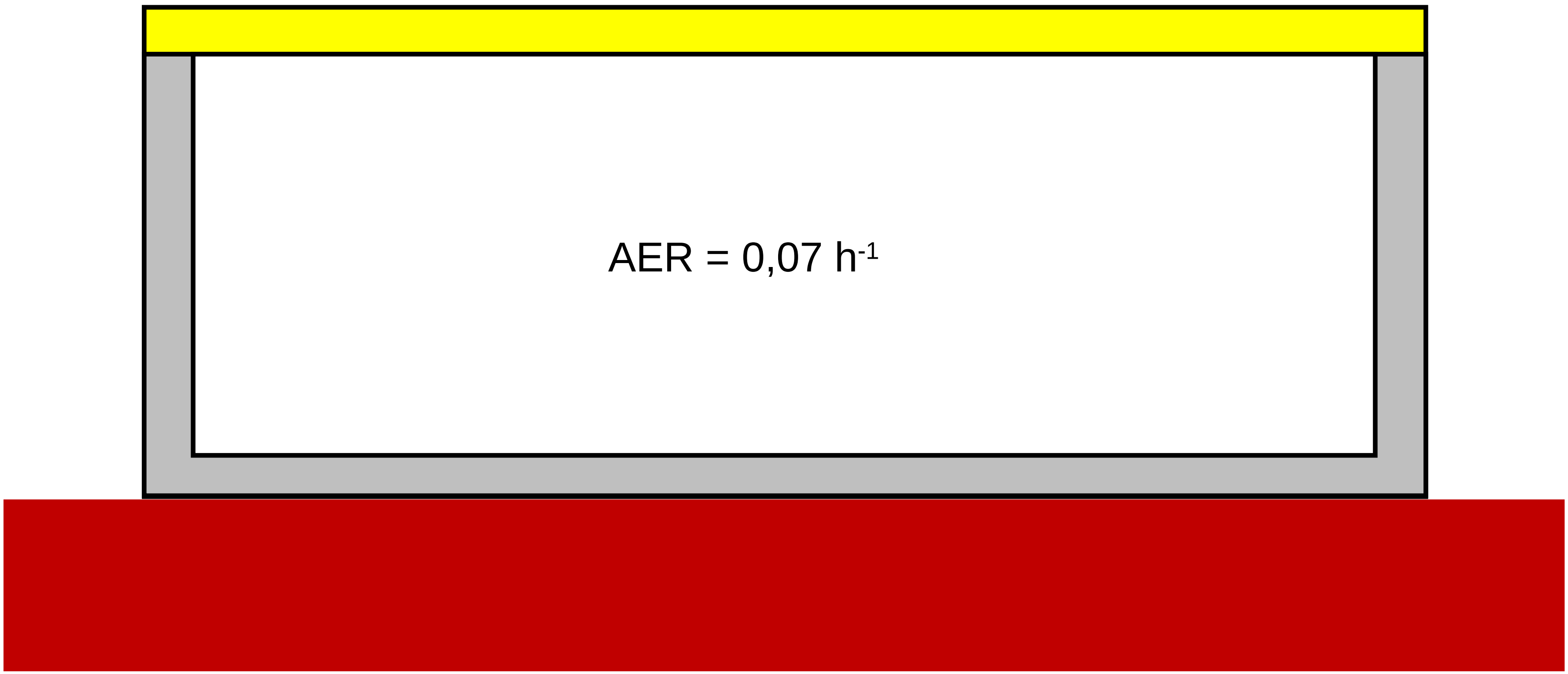
Poul Klenz Larsen

P-hal, Oerholm, NM

Lightweight roof

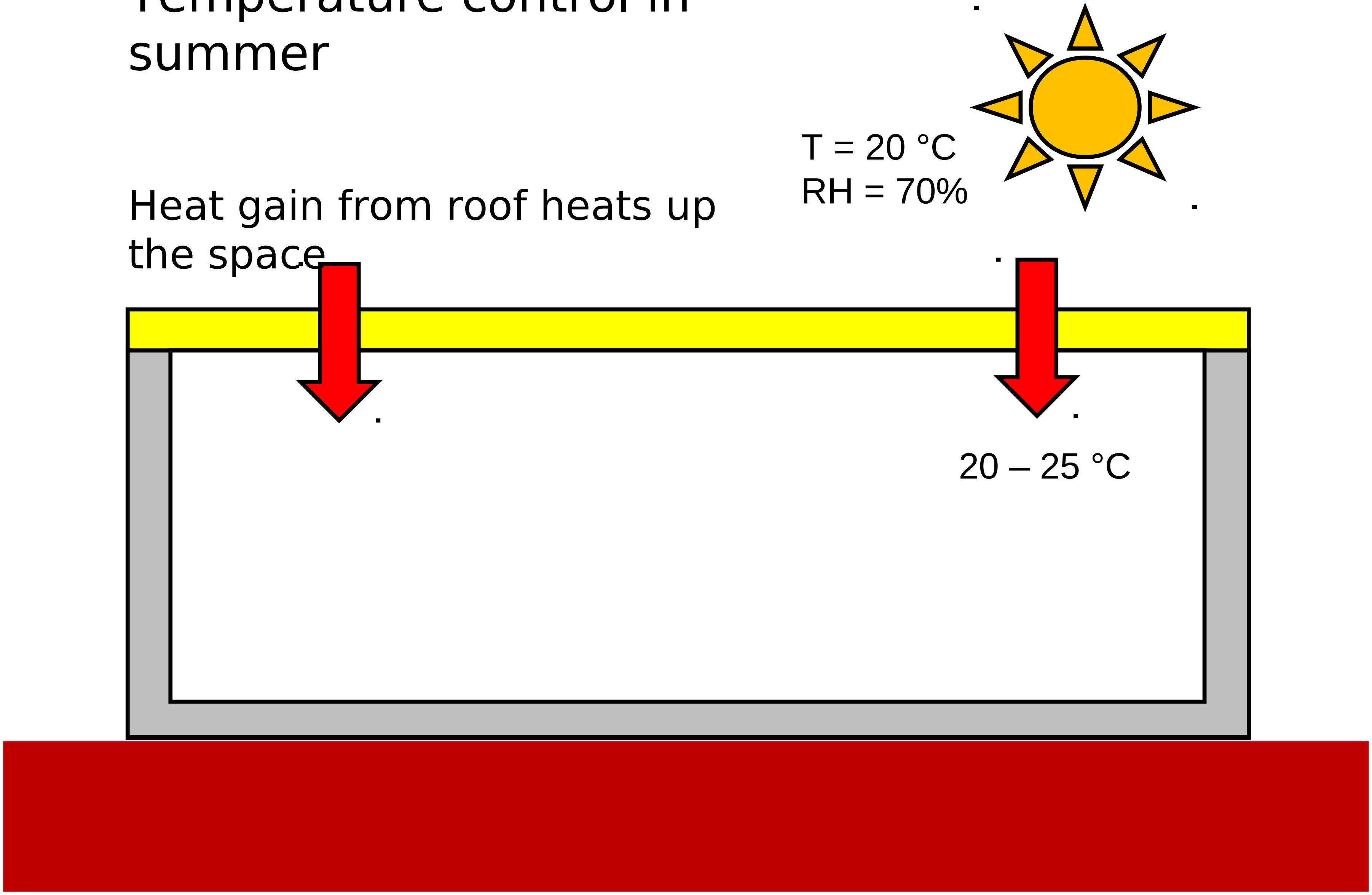
Light weight concrete walls

Concrete floor (no insulation)



Temperature control in summer

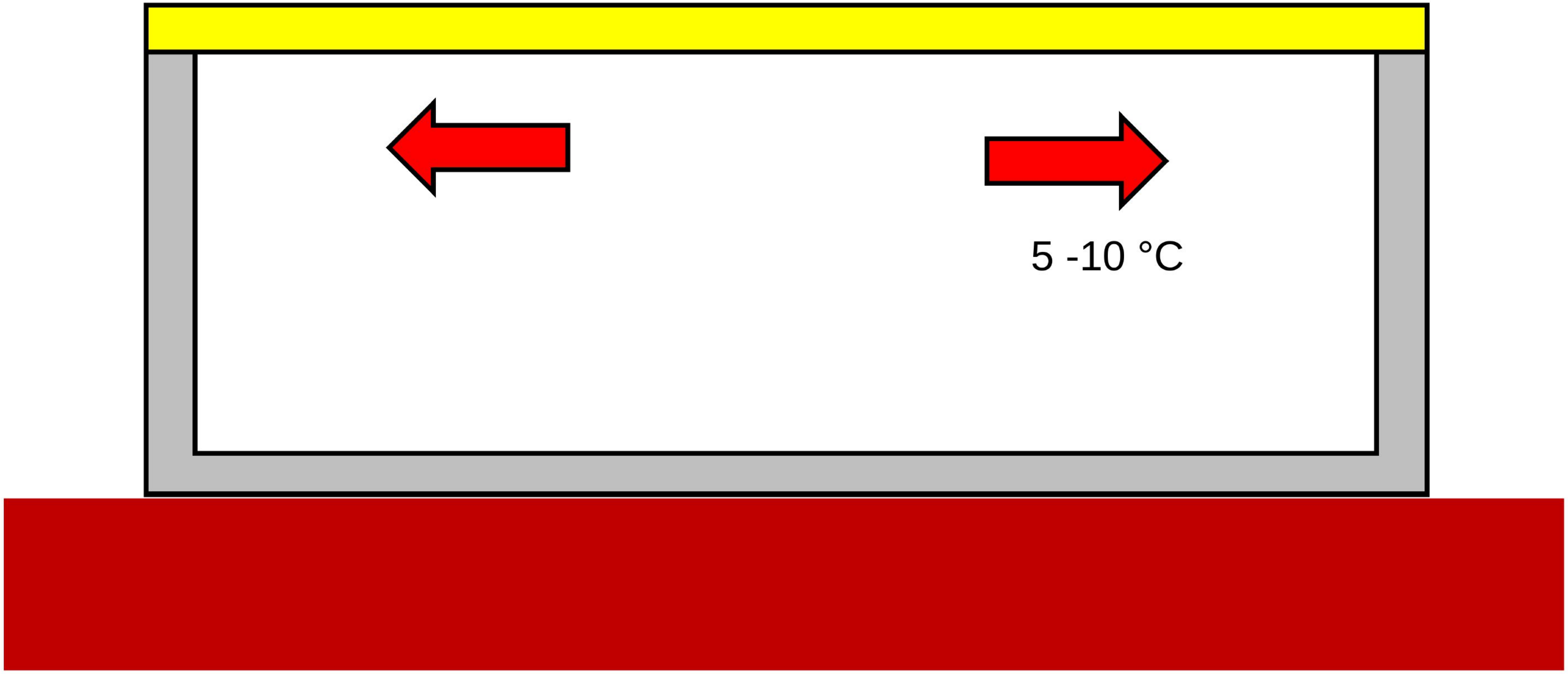
Heat gain from roof heats up the space



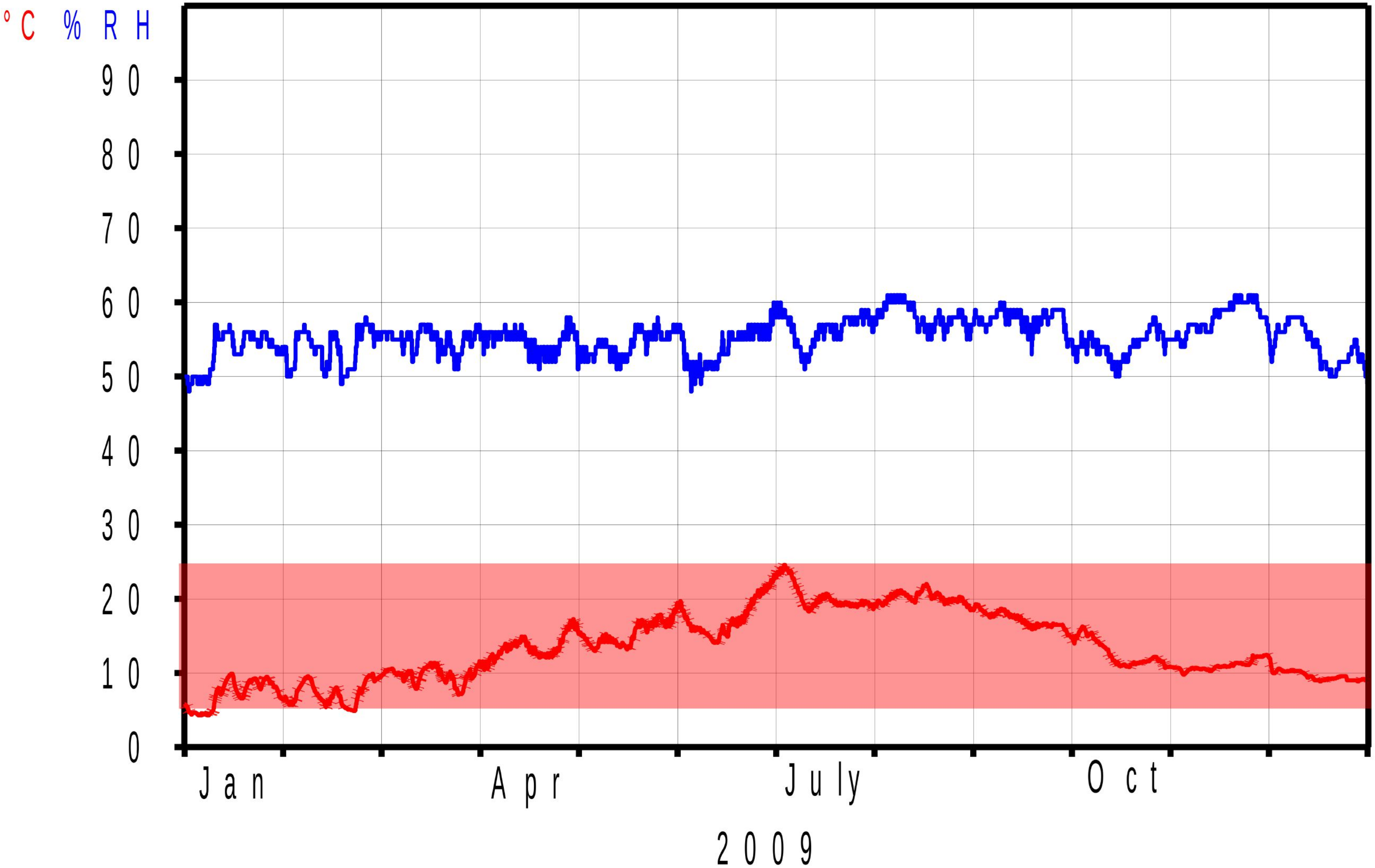
Temperature control in winter

T = 0 °C
RF = 100%

Heating

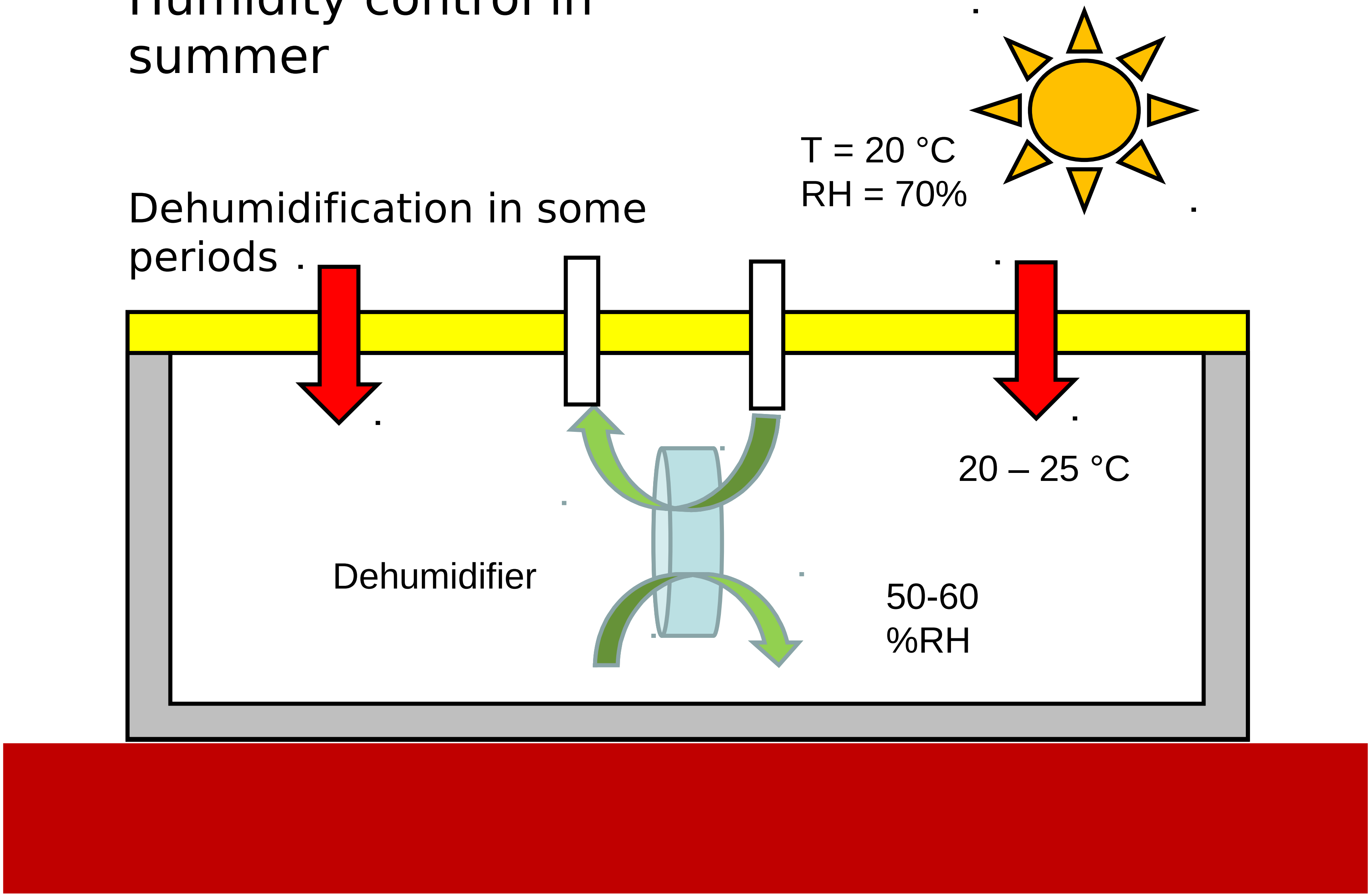


Climate records for the interior over one year.



Humidity control in summer

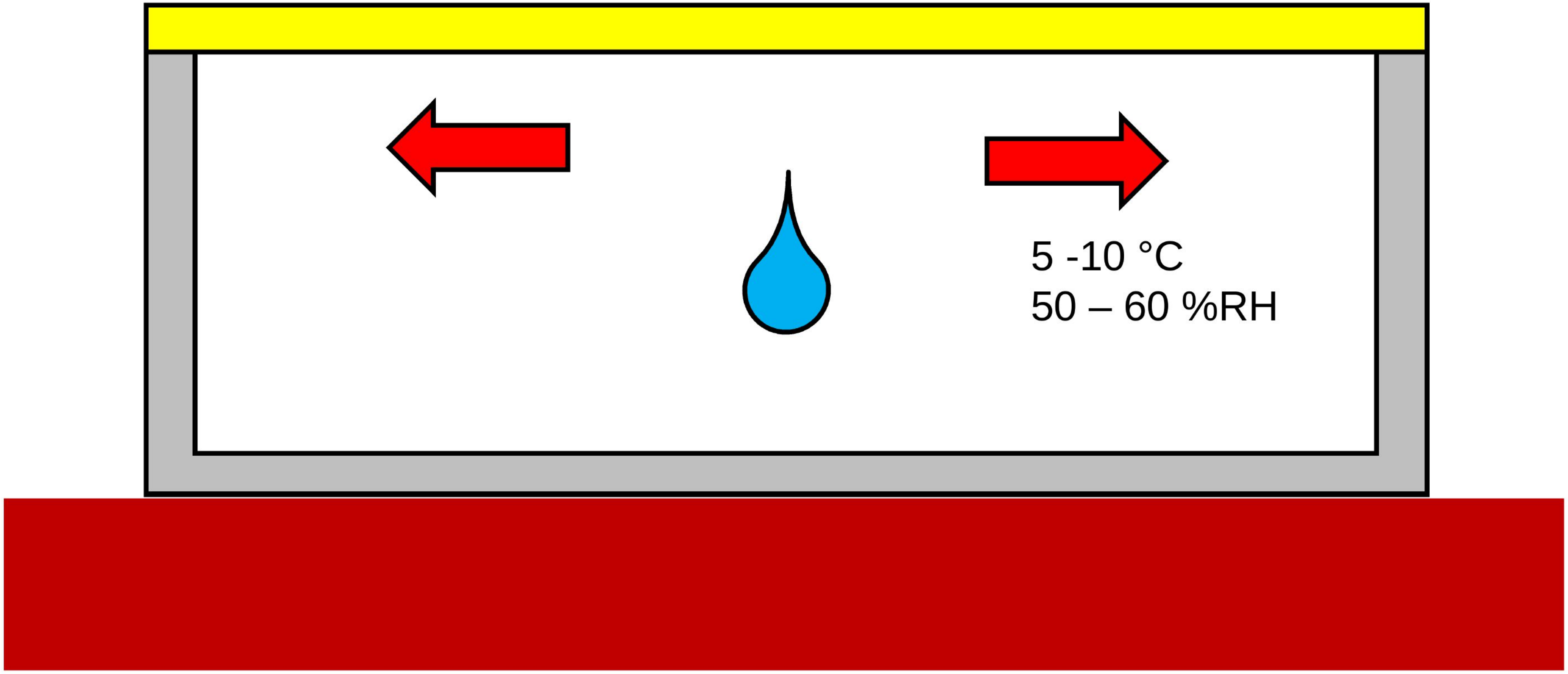
Dehumidification in some periods



Humidity control in winter

T = 0 °C
RF = 100%

Humidification in some periods



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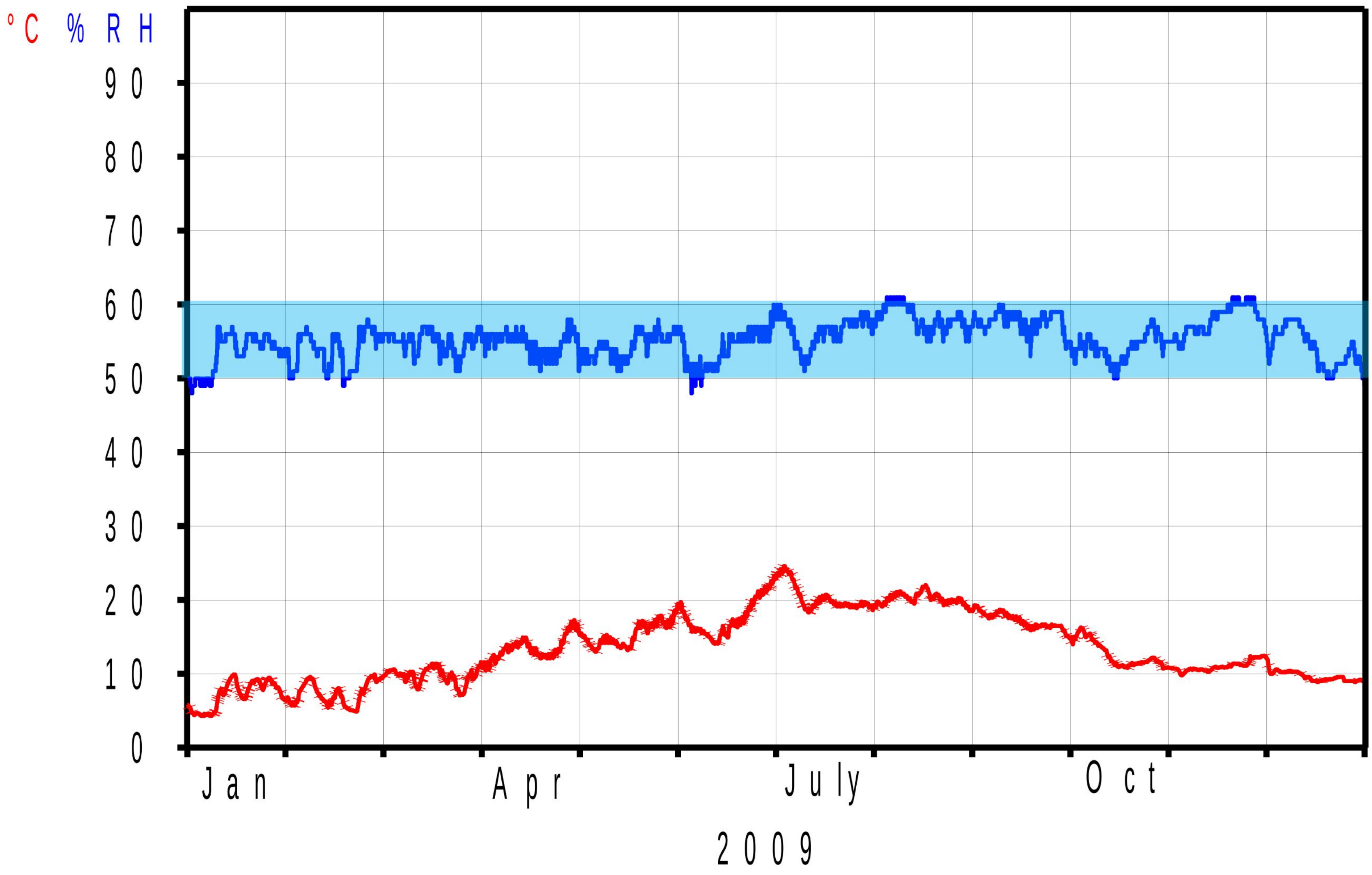
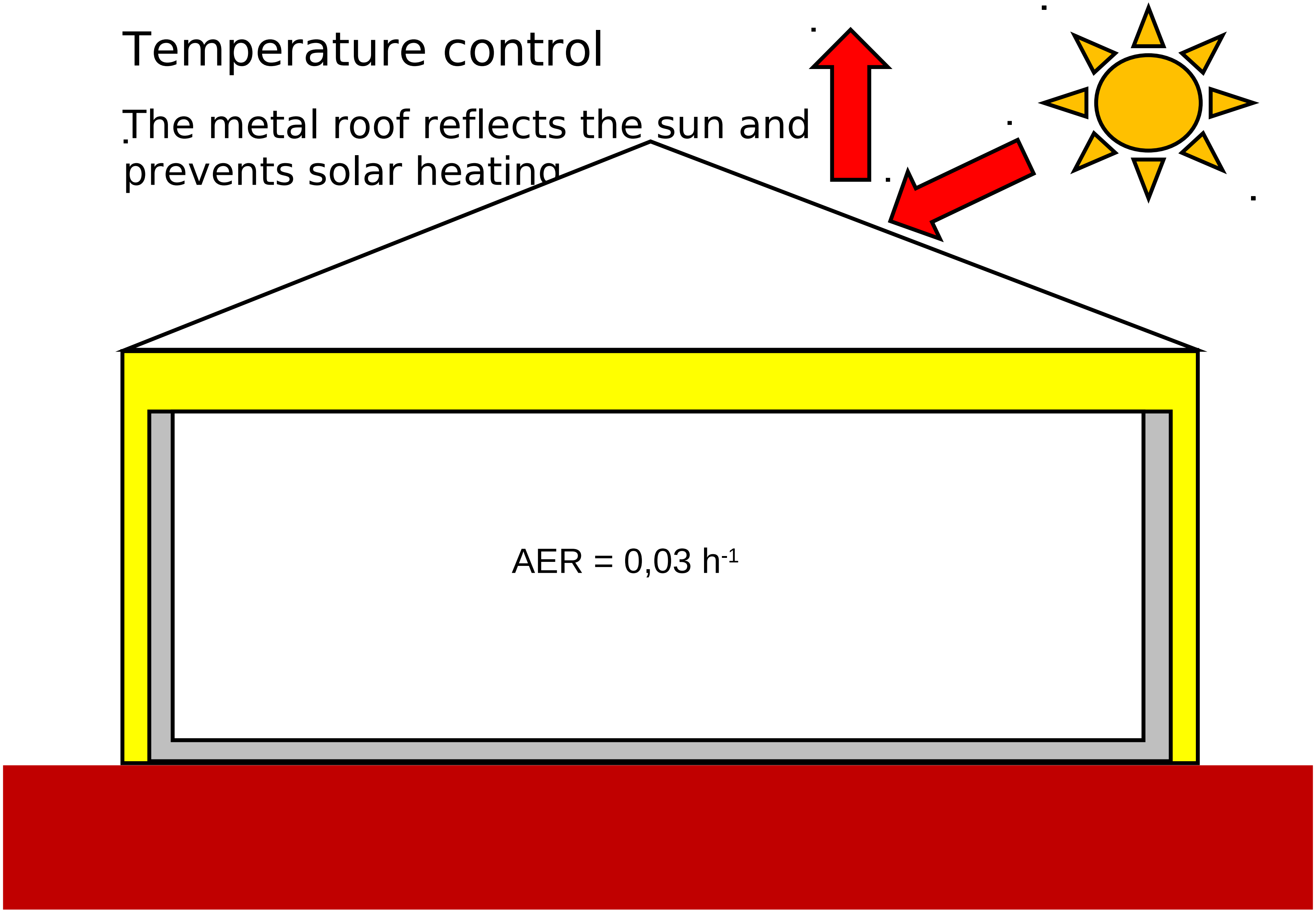


New store for the Museum of cultural history in Ribe

Temperature control

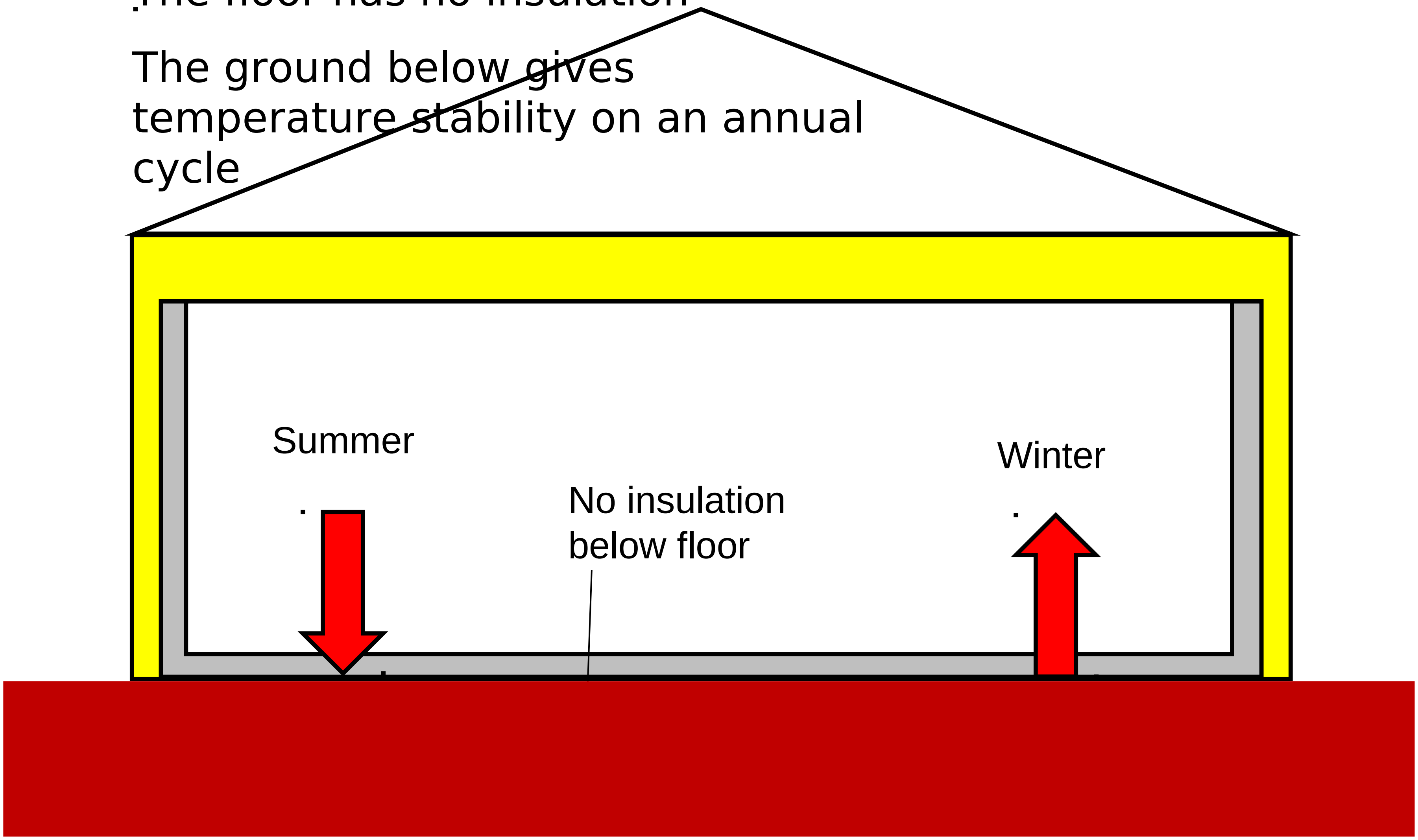
The metal roof reflects the sun and prevents solar heating



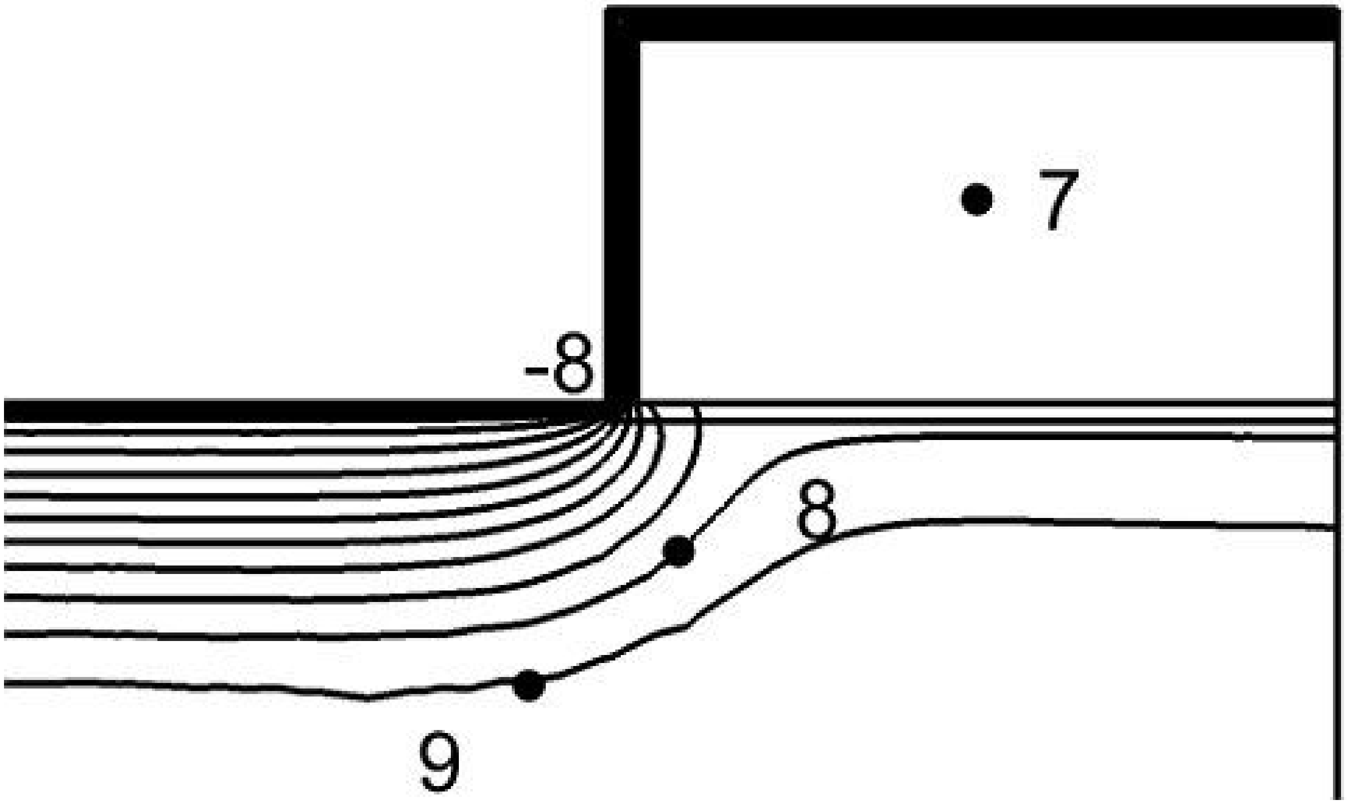
Temperature control

The floor has no insulation

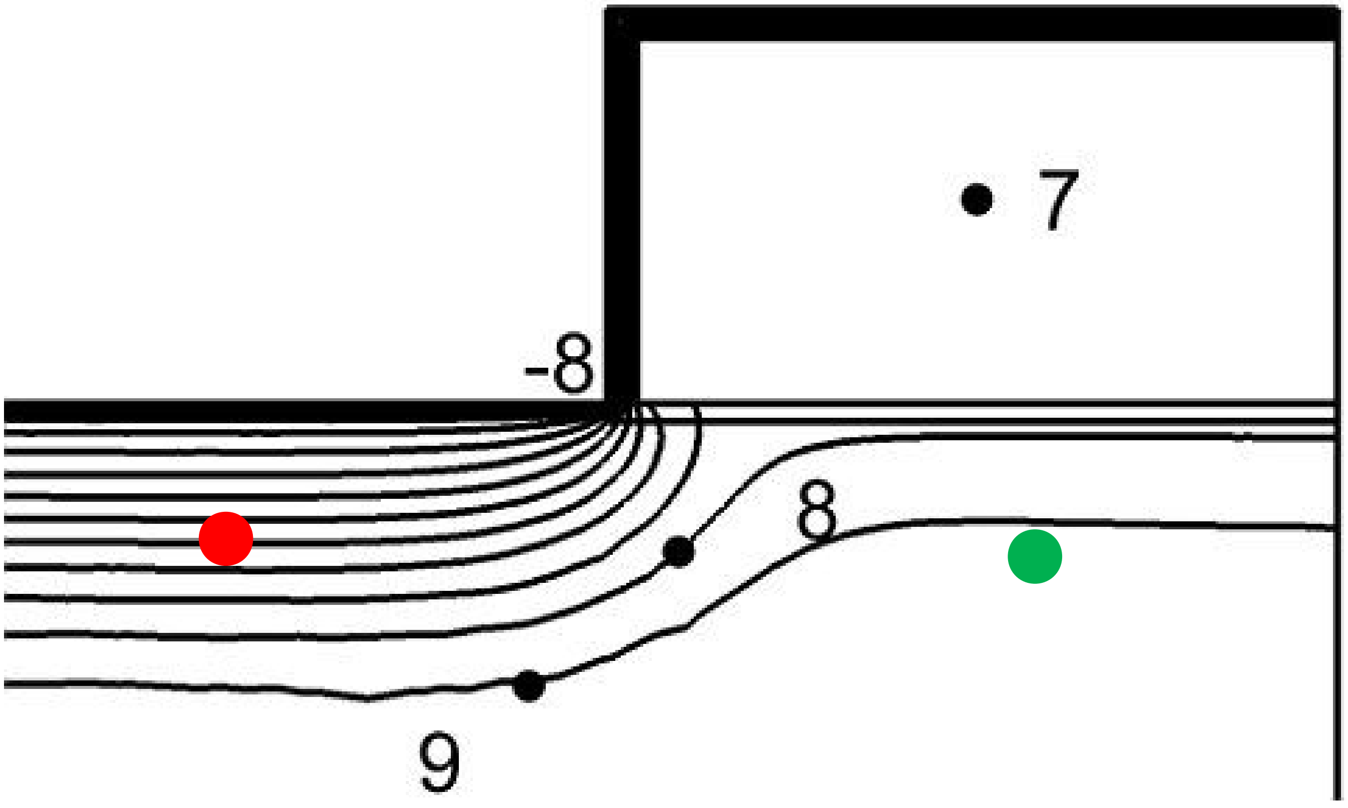
The ground below gives temperature stability on an annual cycle



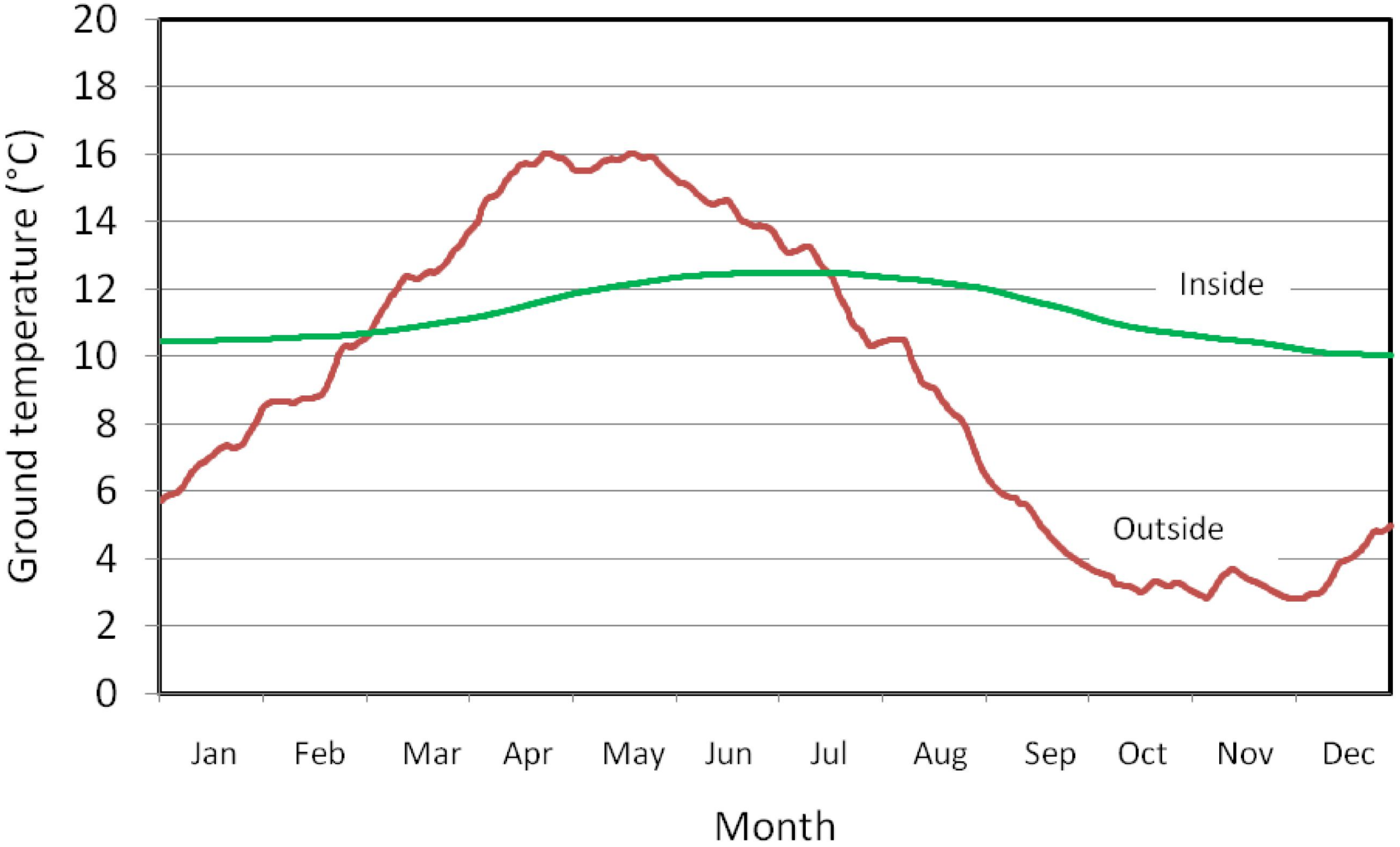
Temperature gradient in February



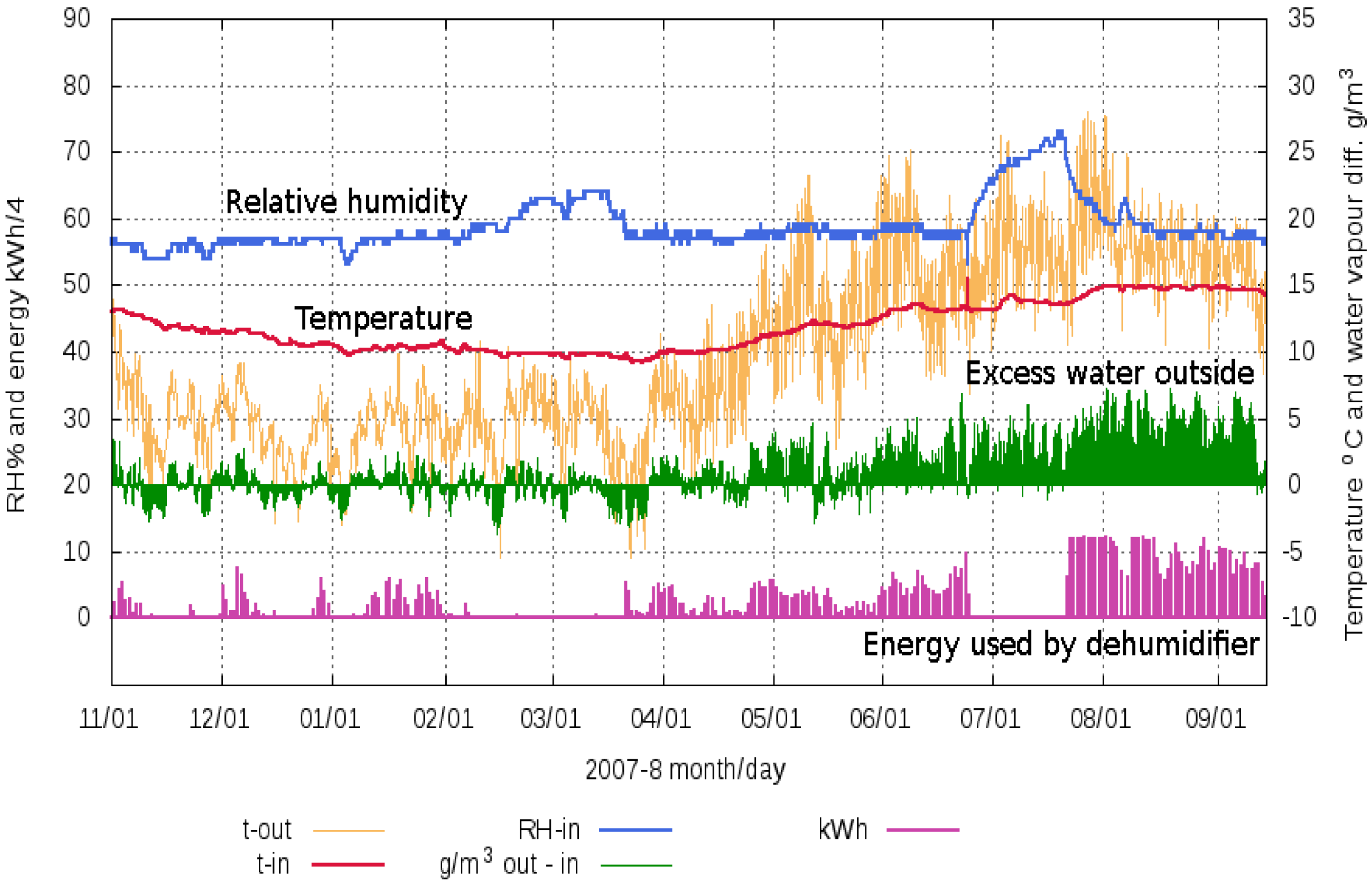
Measured temperatures inside and outside



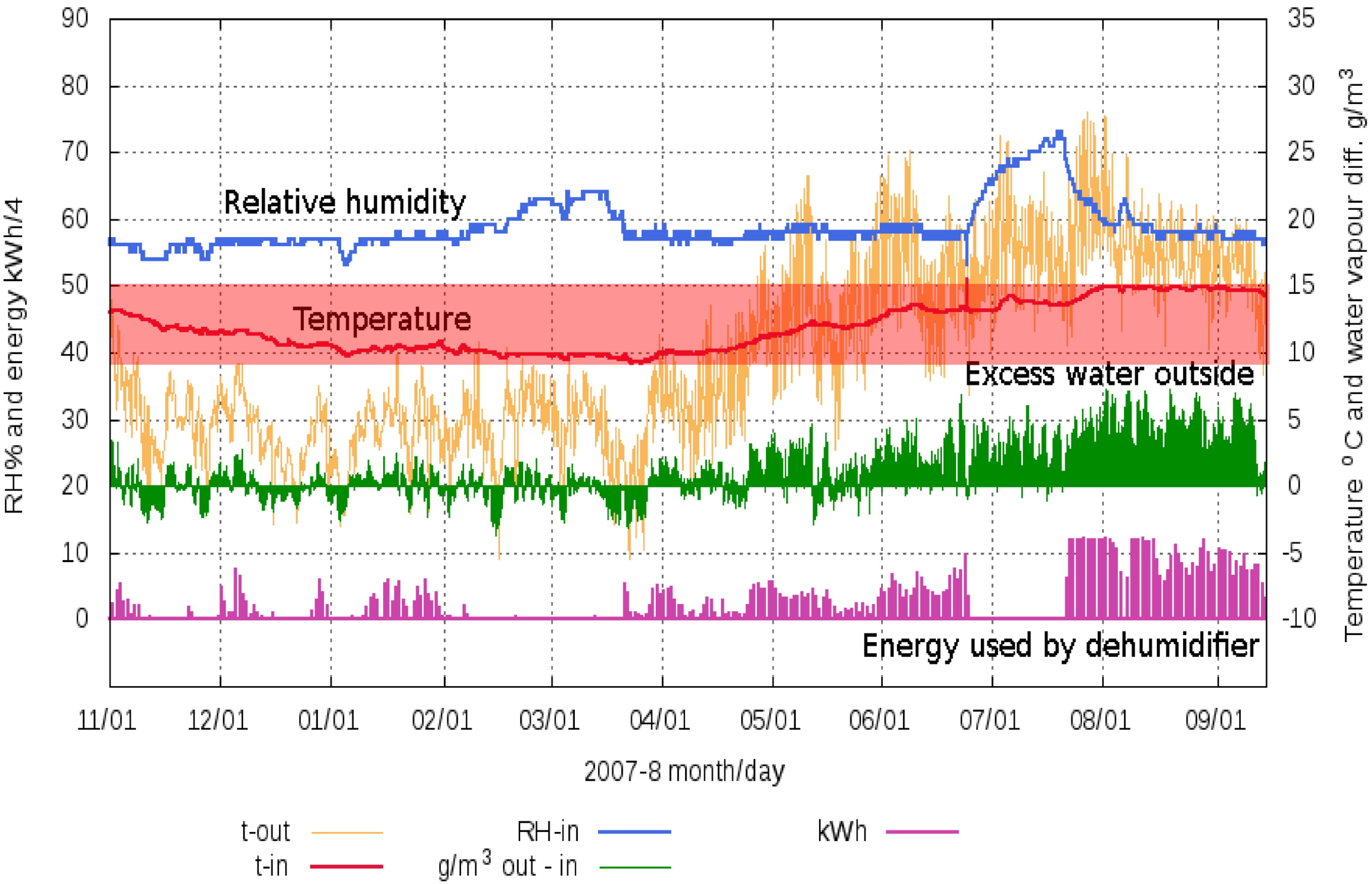
Ground temperature measured 2 m below surface



The climate records for one year in the Ribe store



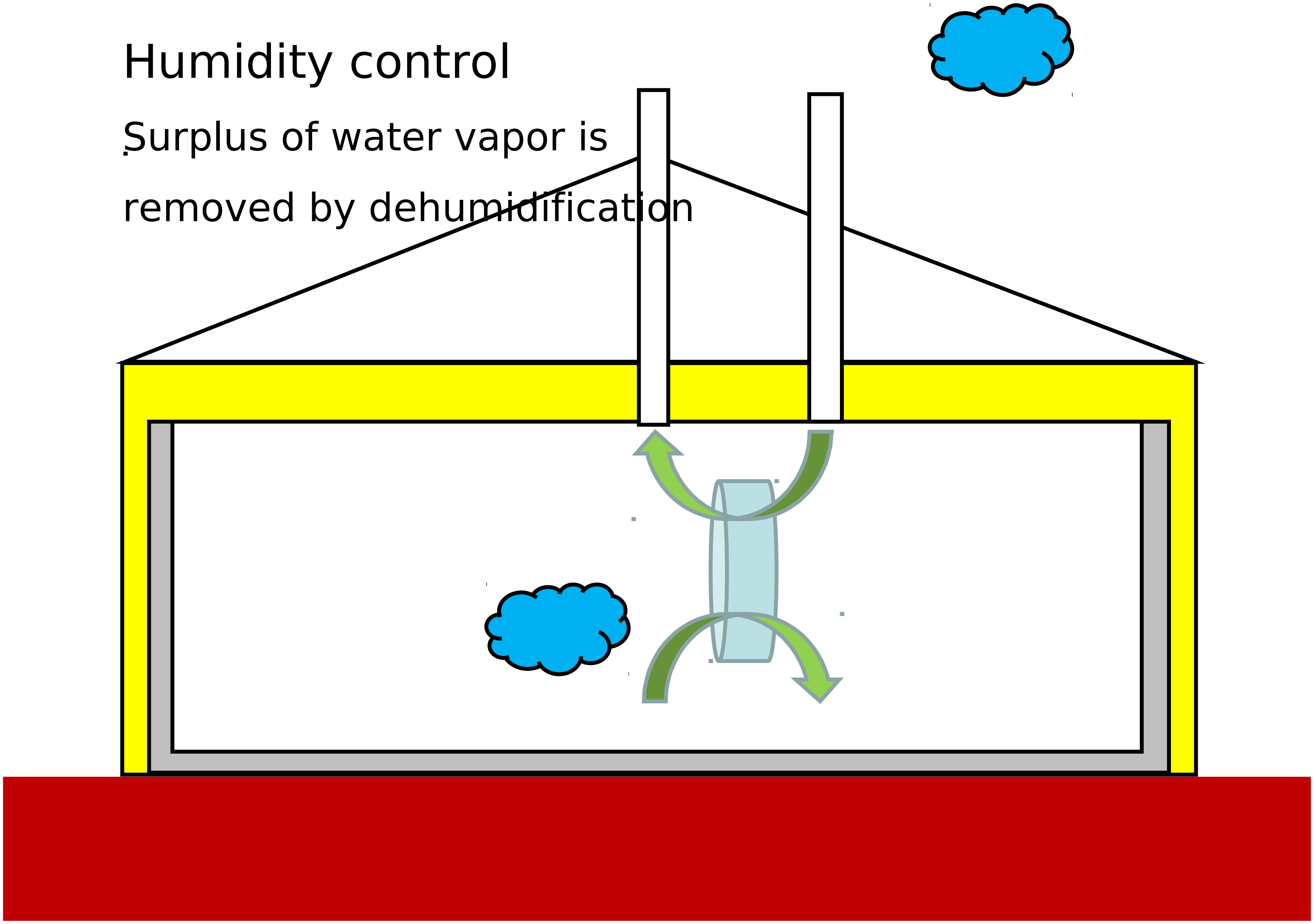
The temperature is 8 – 16 °C



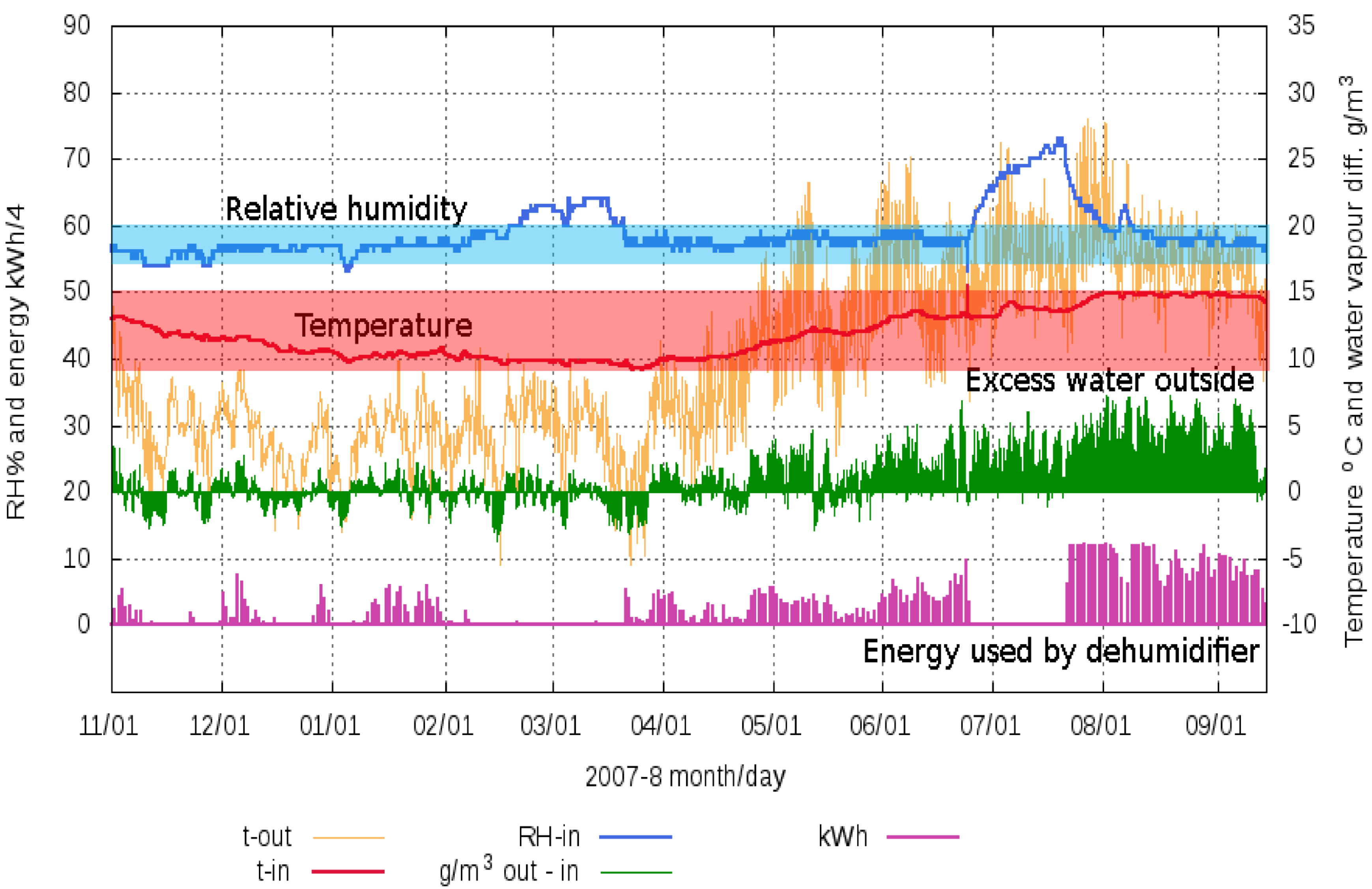
Humidity control

Surplus of water vapor is

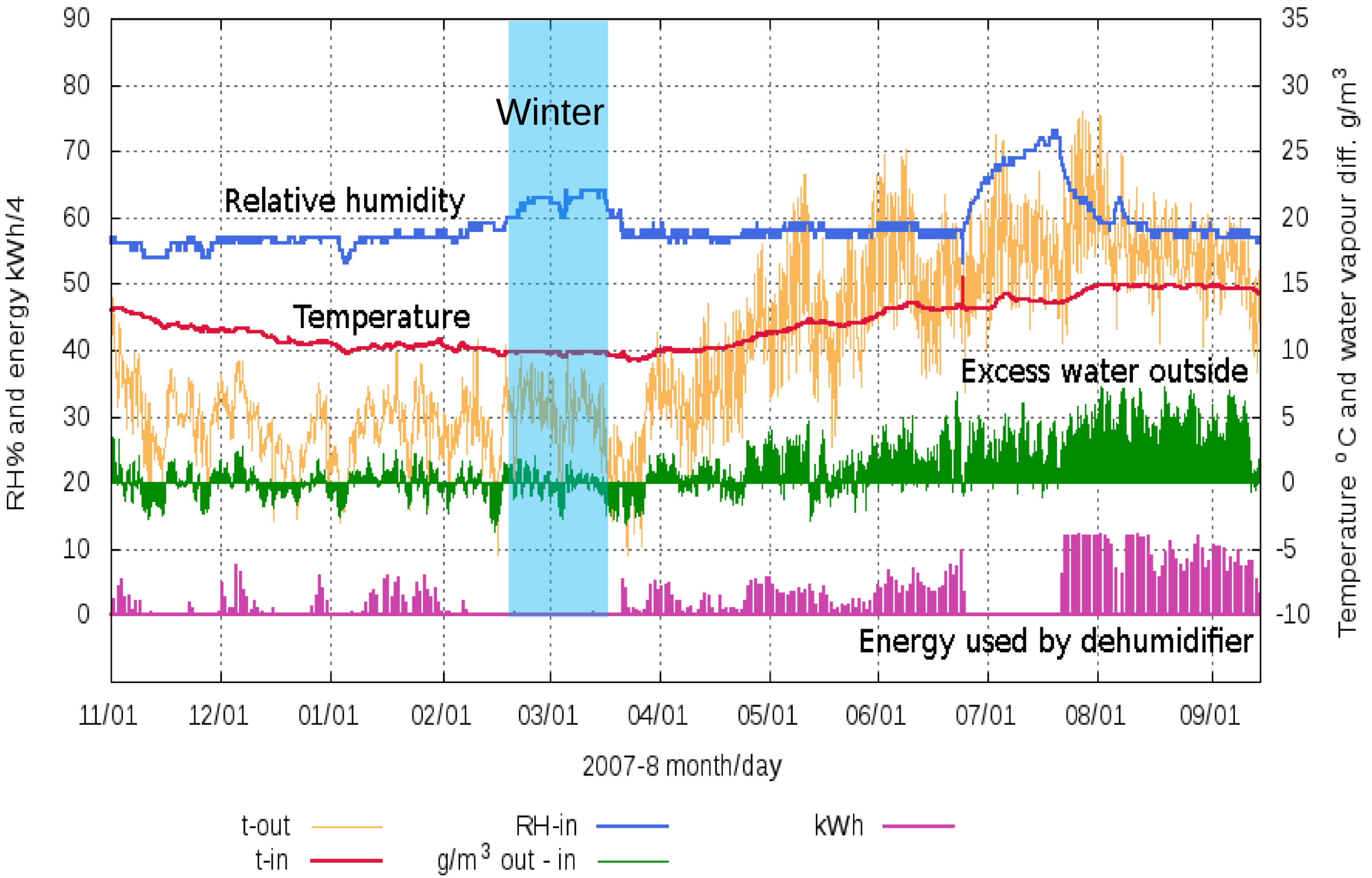
removed by dehumidification



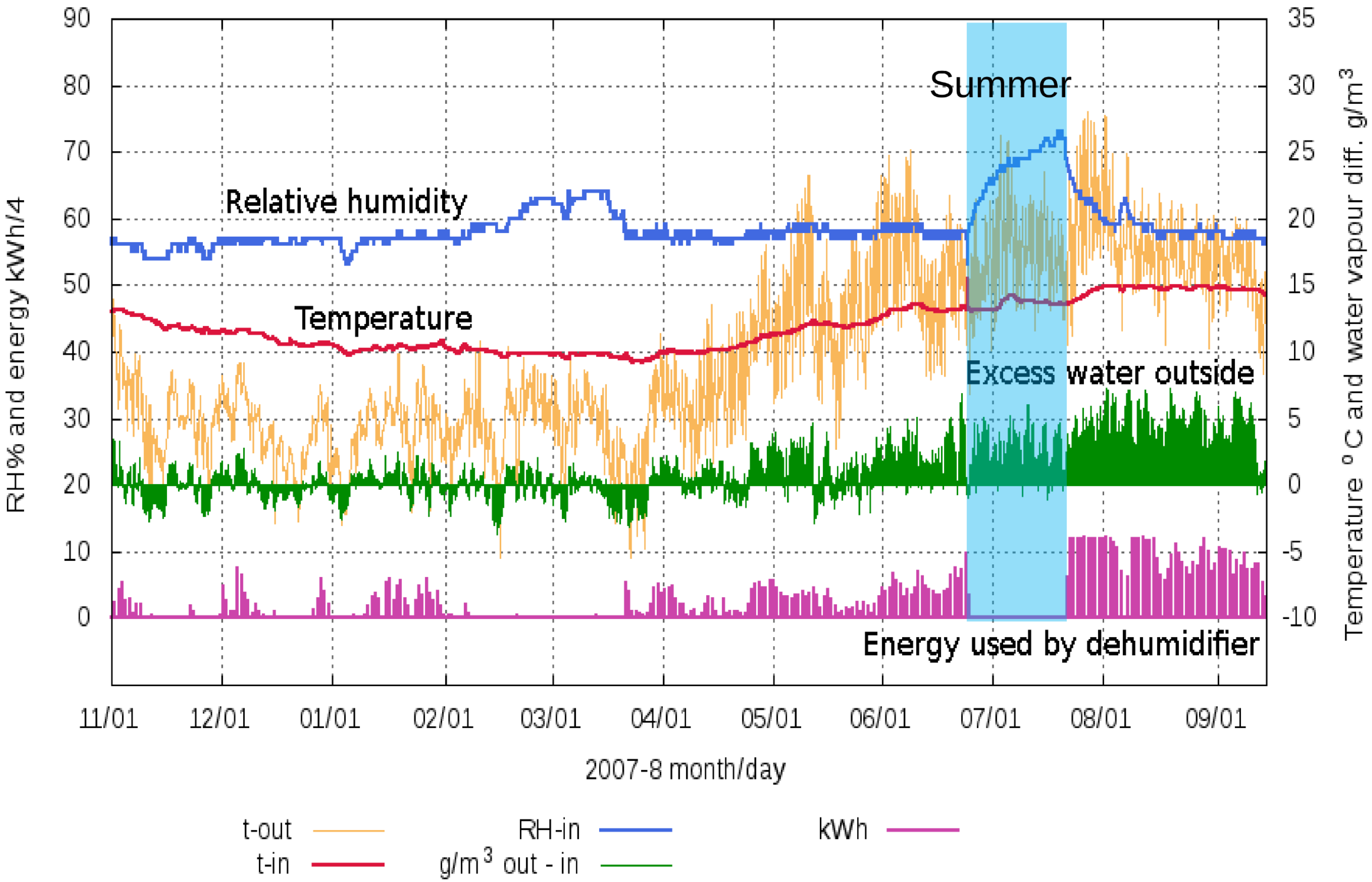
The temperature is 10 – 16 °C and the RH is 55 – 60%

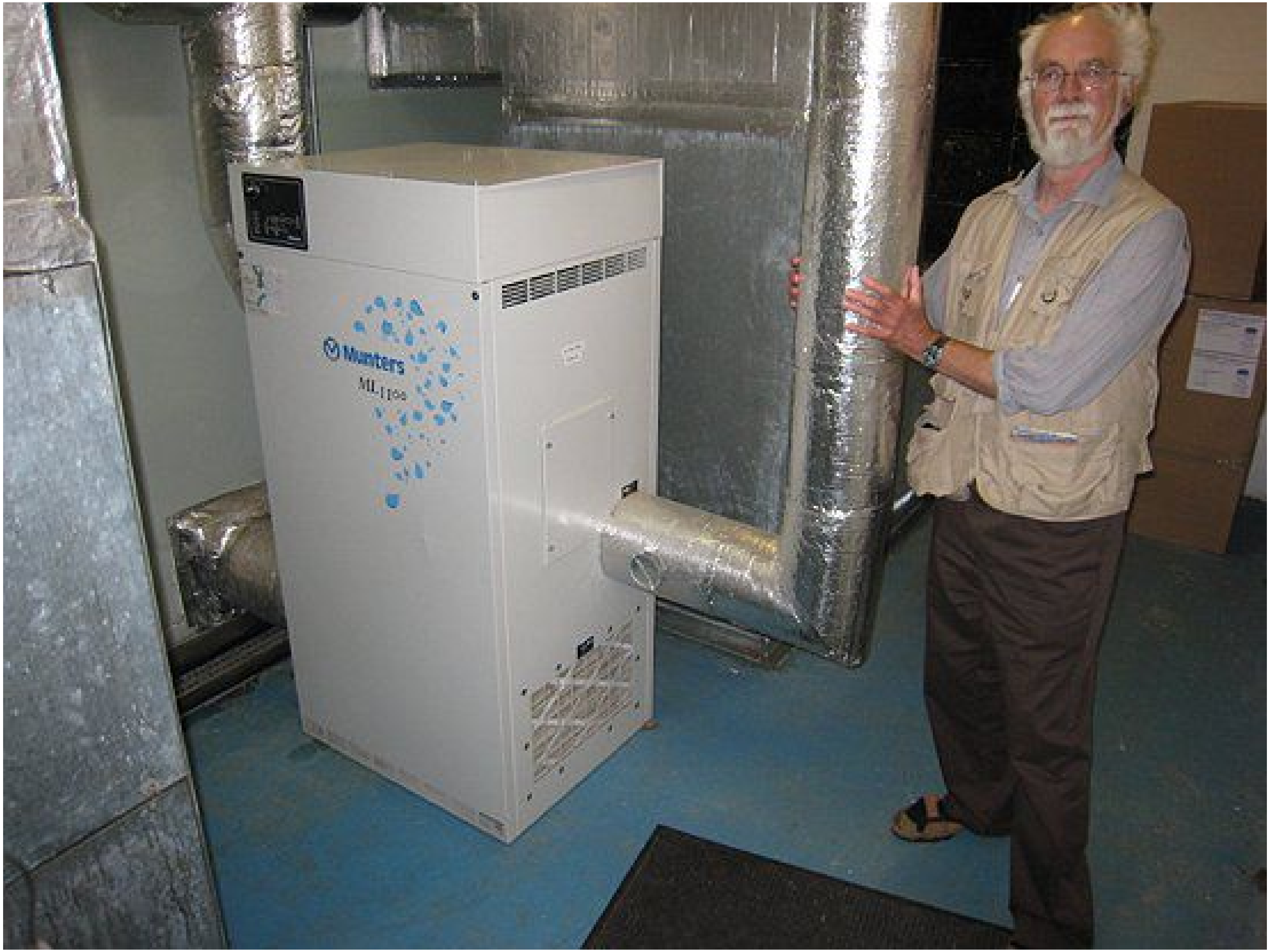


...except when the dehumidifier was turned off

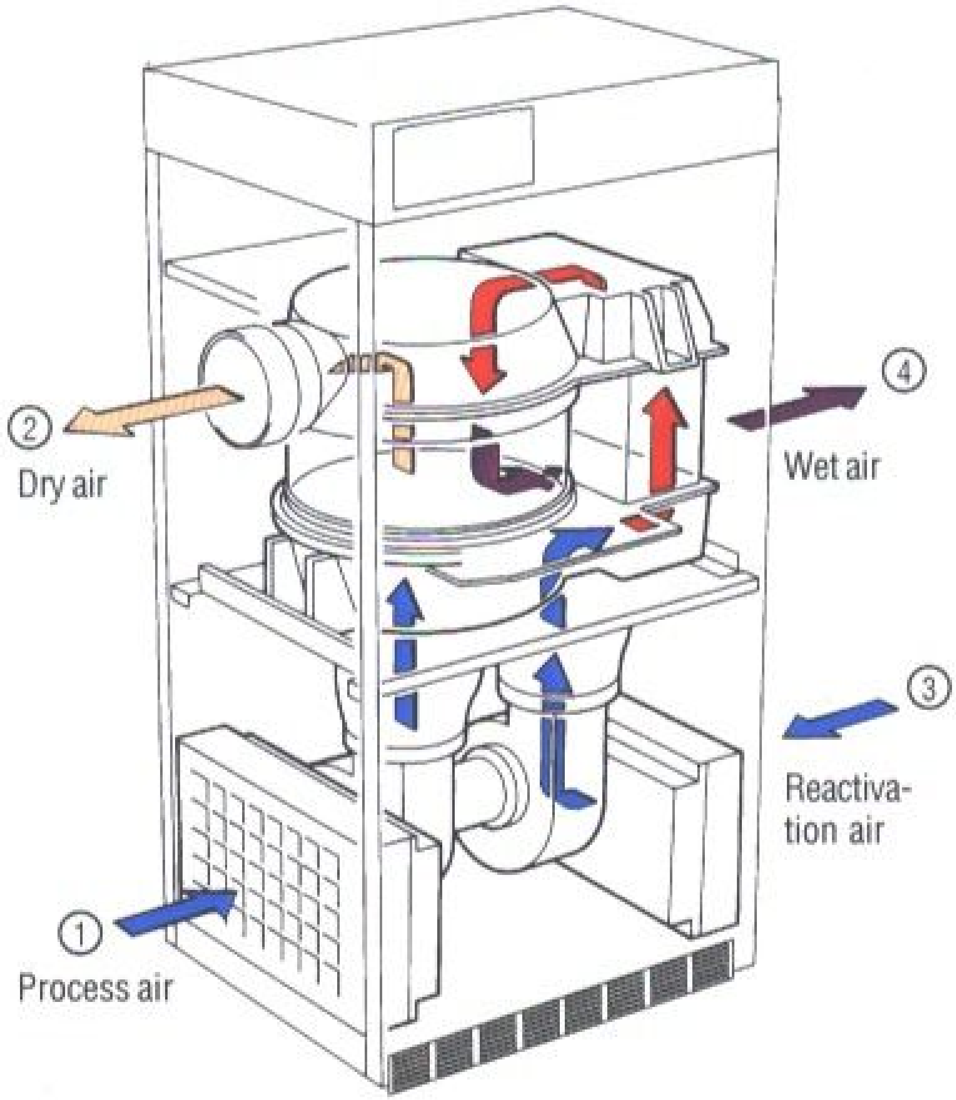


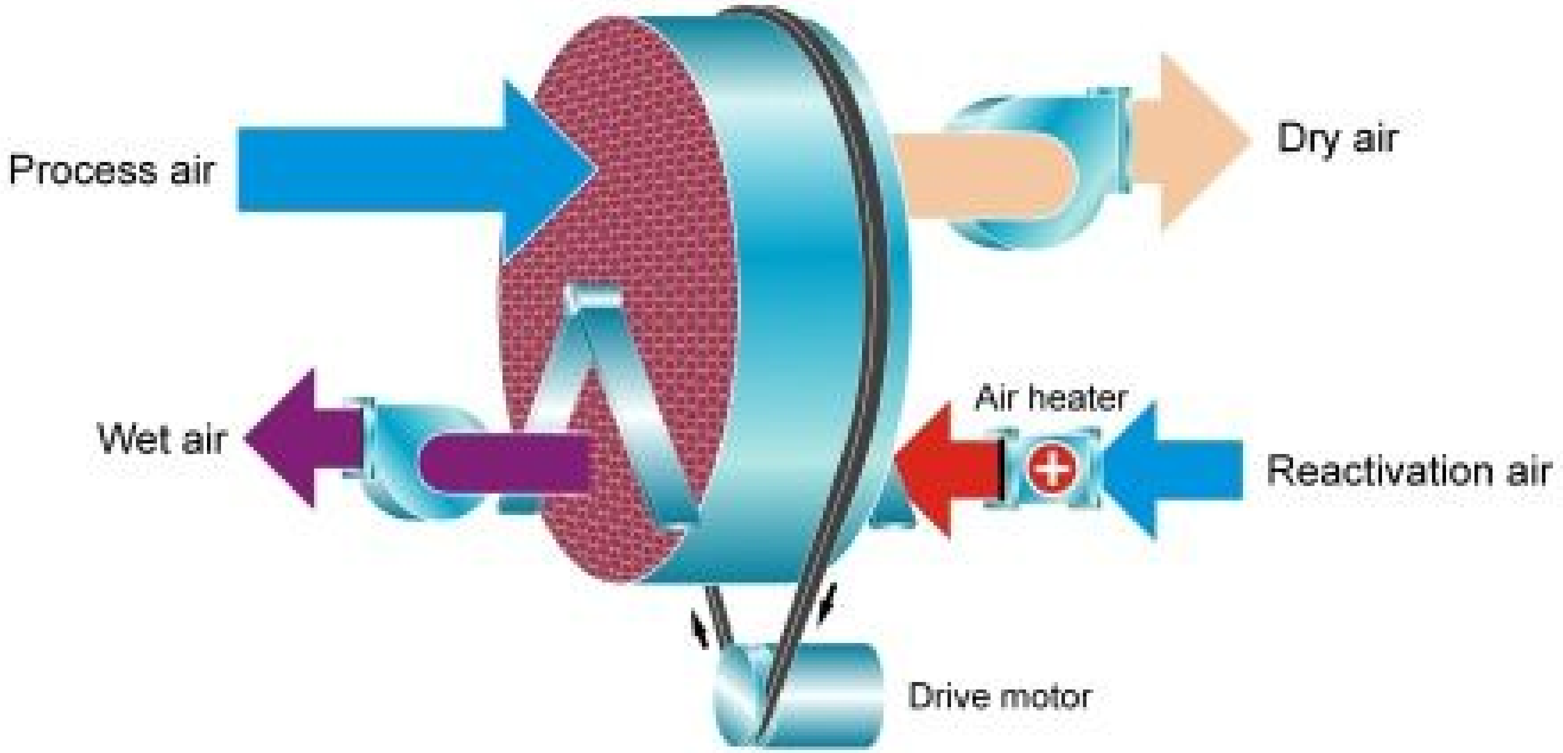
Dehumidification is always needed in summer




Munters

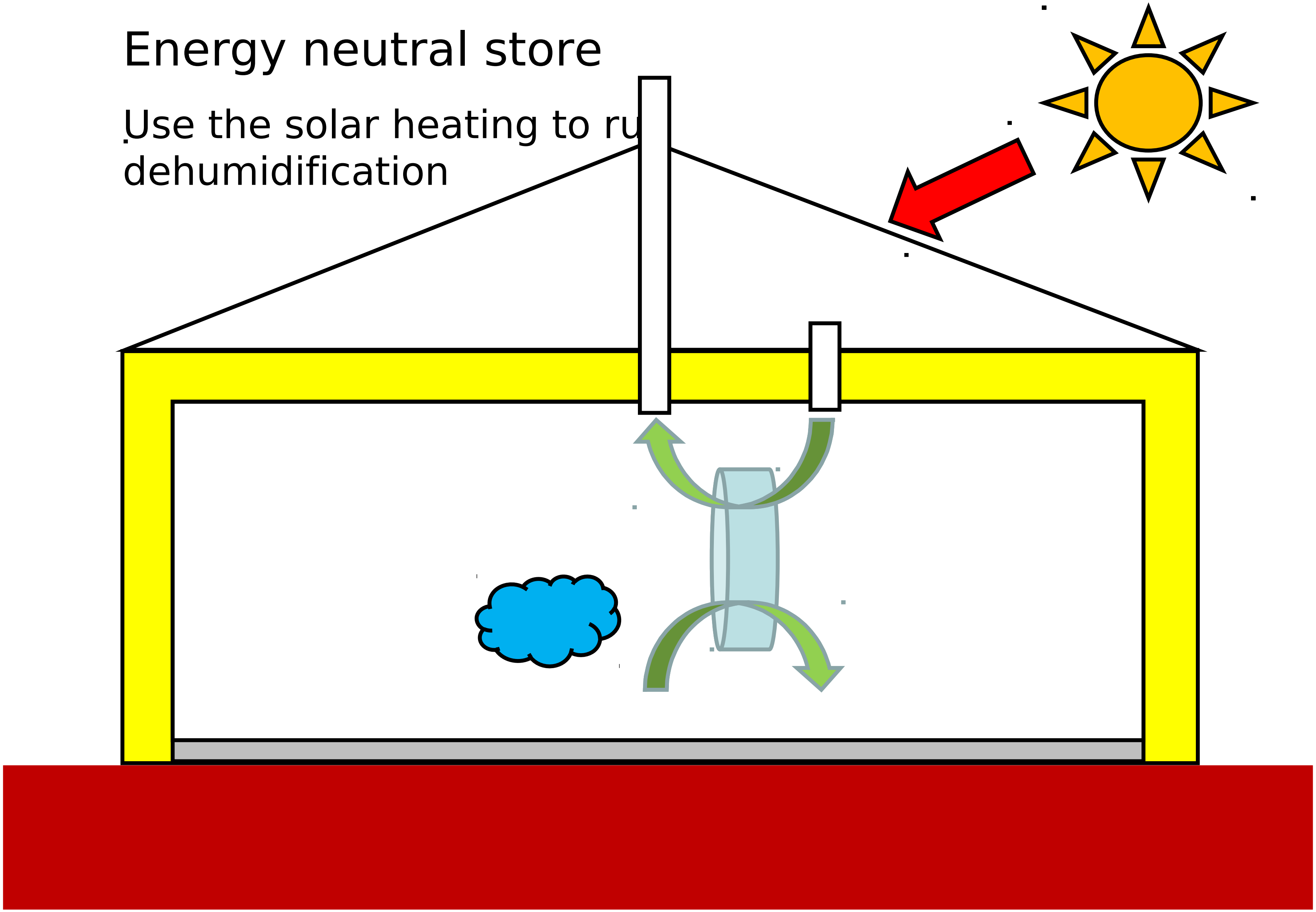

Munters
ML1100


2
Dry air
4
Wet air
3
Reactiva-
tion air
1
Process air


Process air
Dry air
Air heater
Wet air
Reactivation air
Drive motor

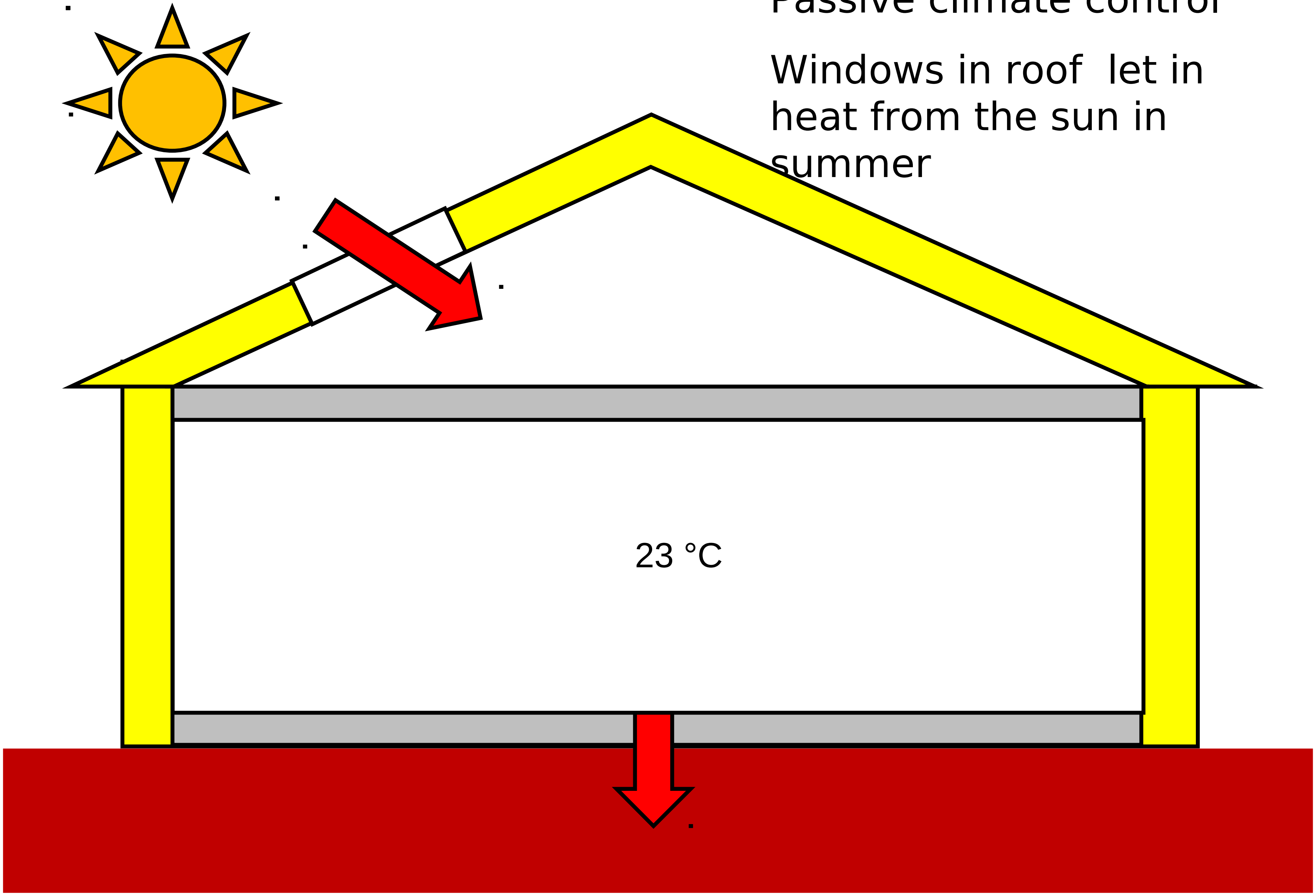
Energy neutral store

Use the solar heating to ru
dehumidification

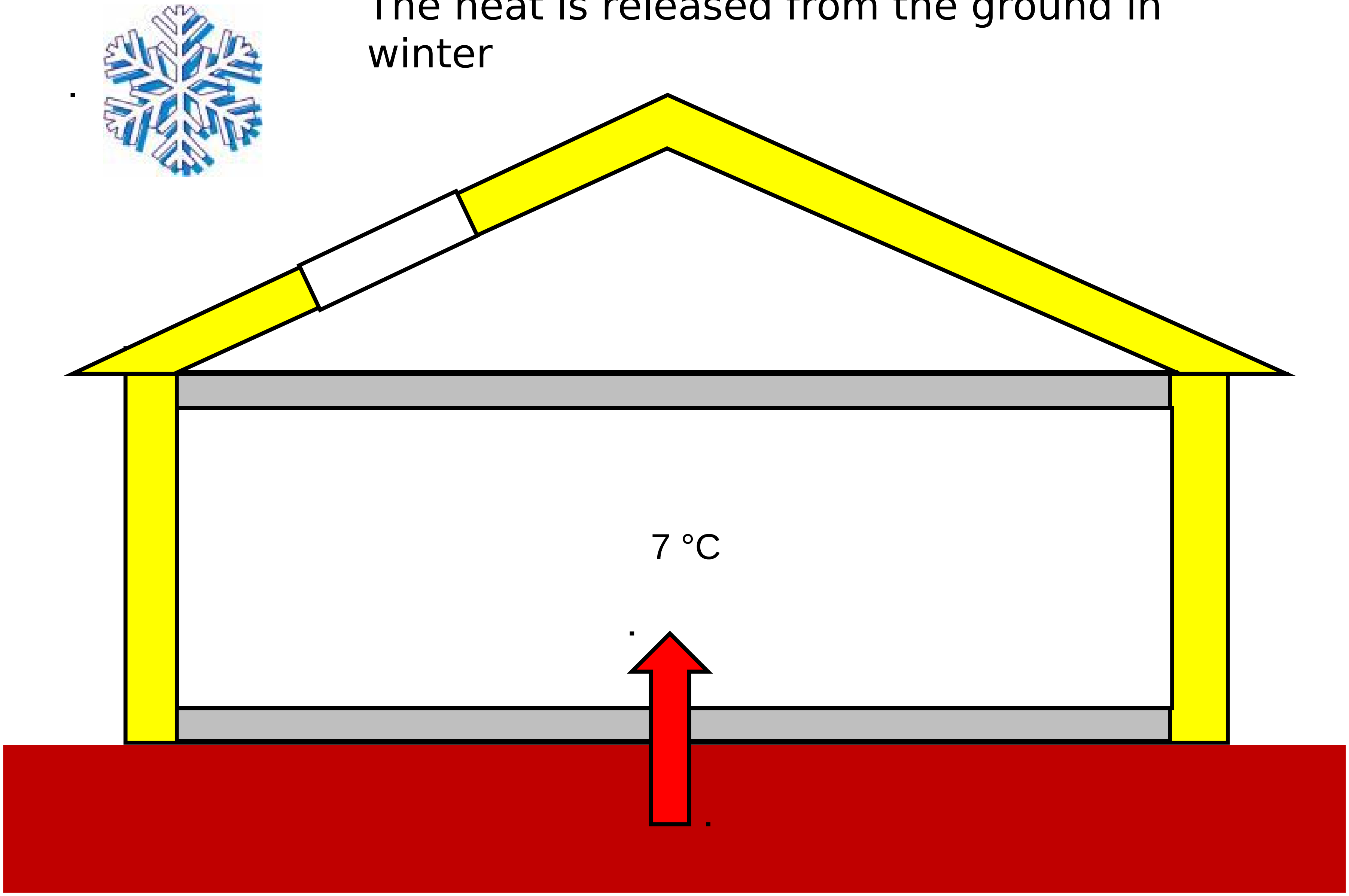


Passive climate control

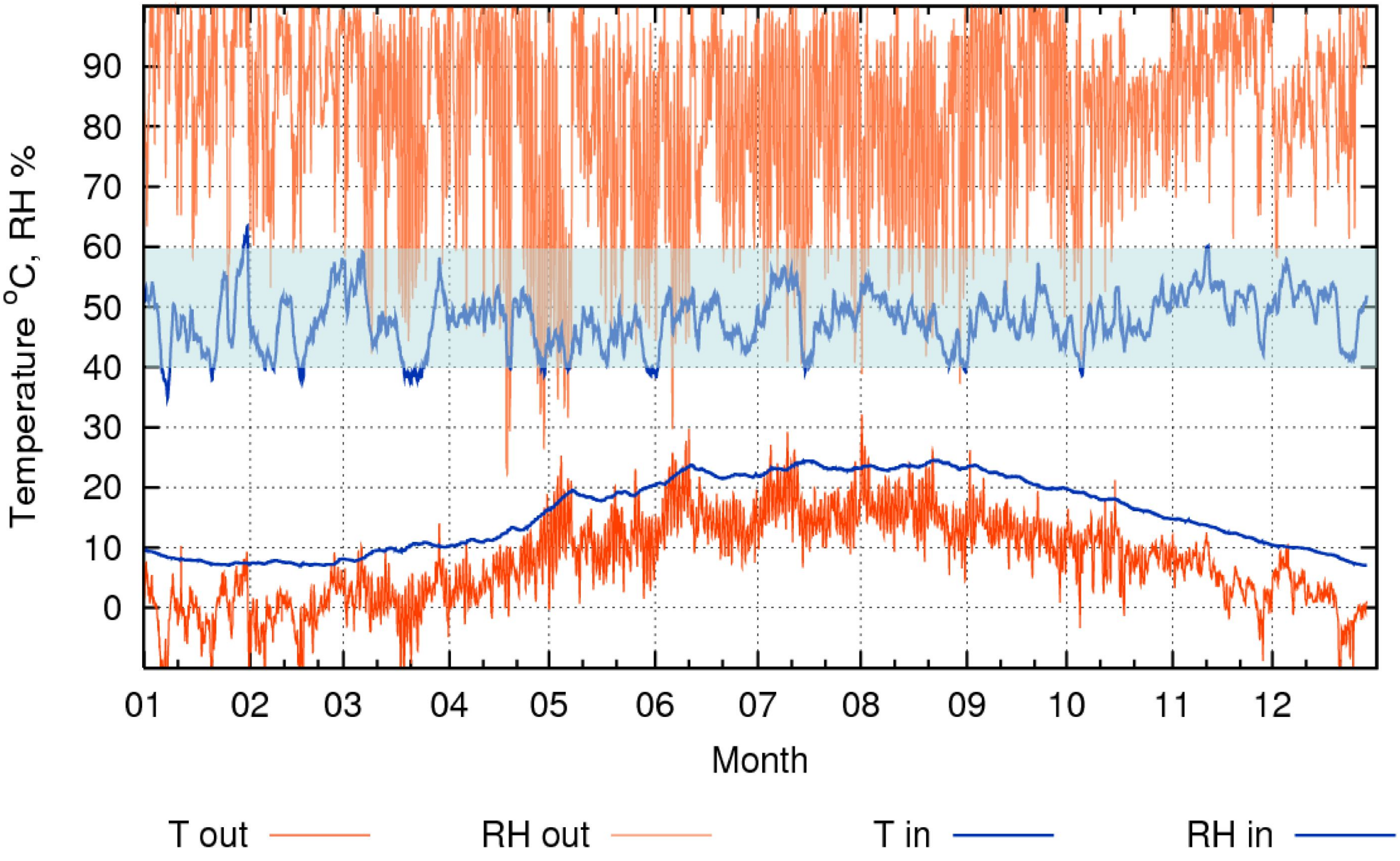
Windows in roof let in heat from the sun in summer



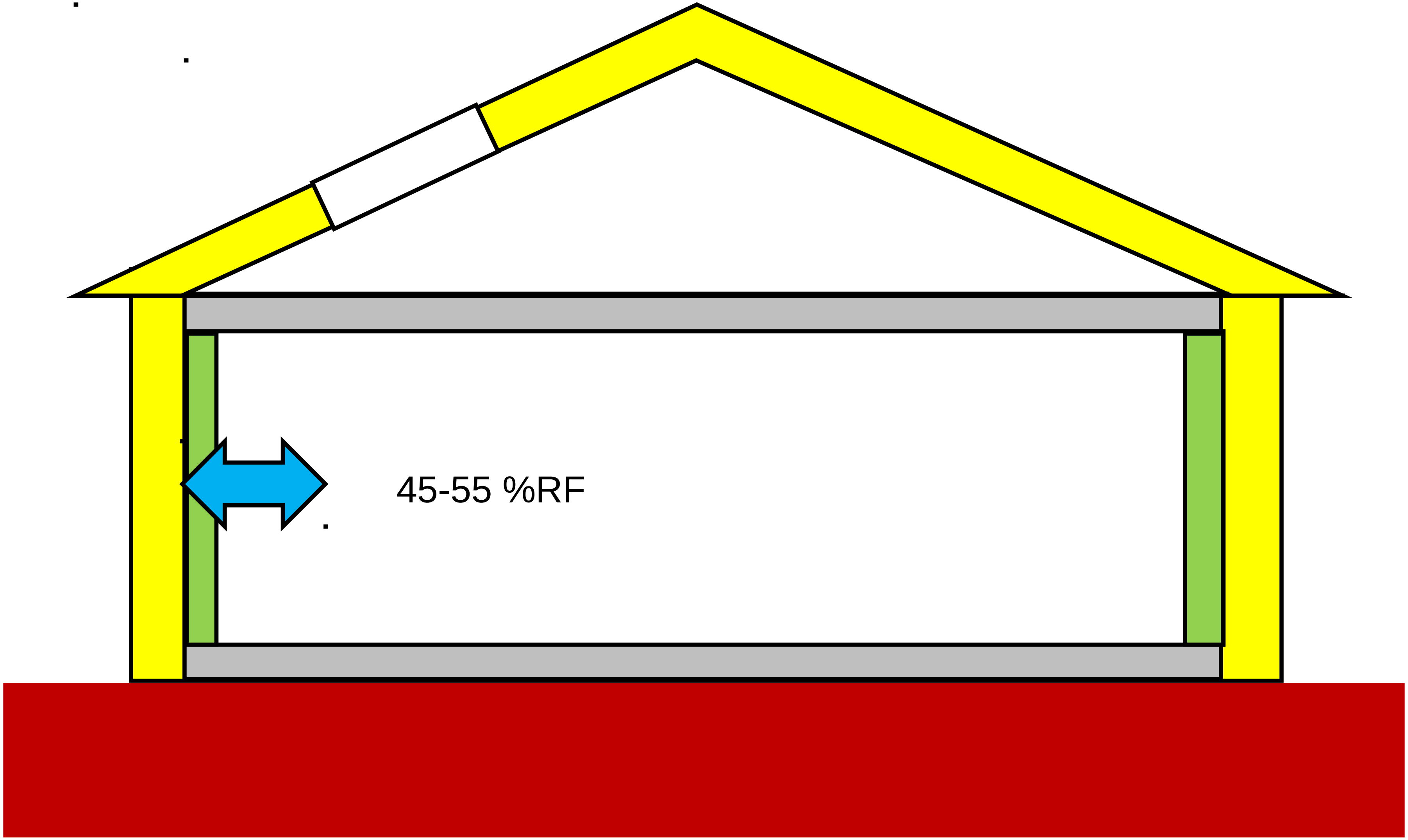
The heat is released from the ground in winter

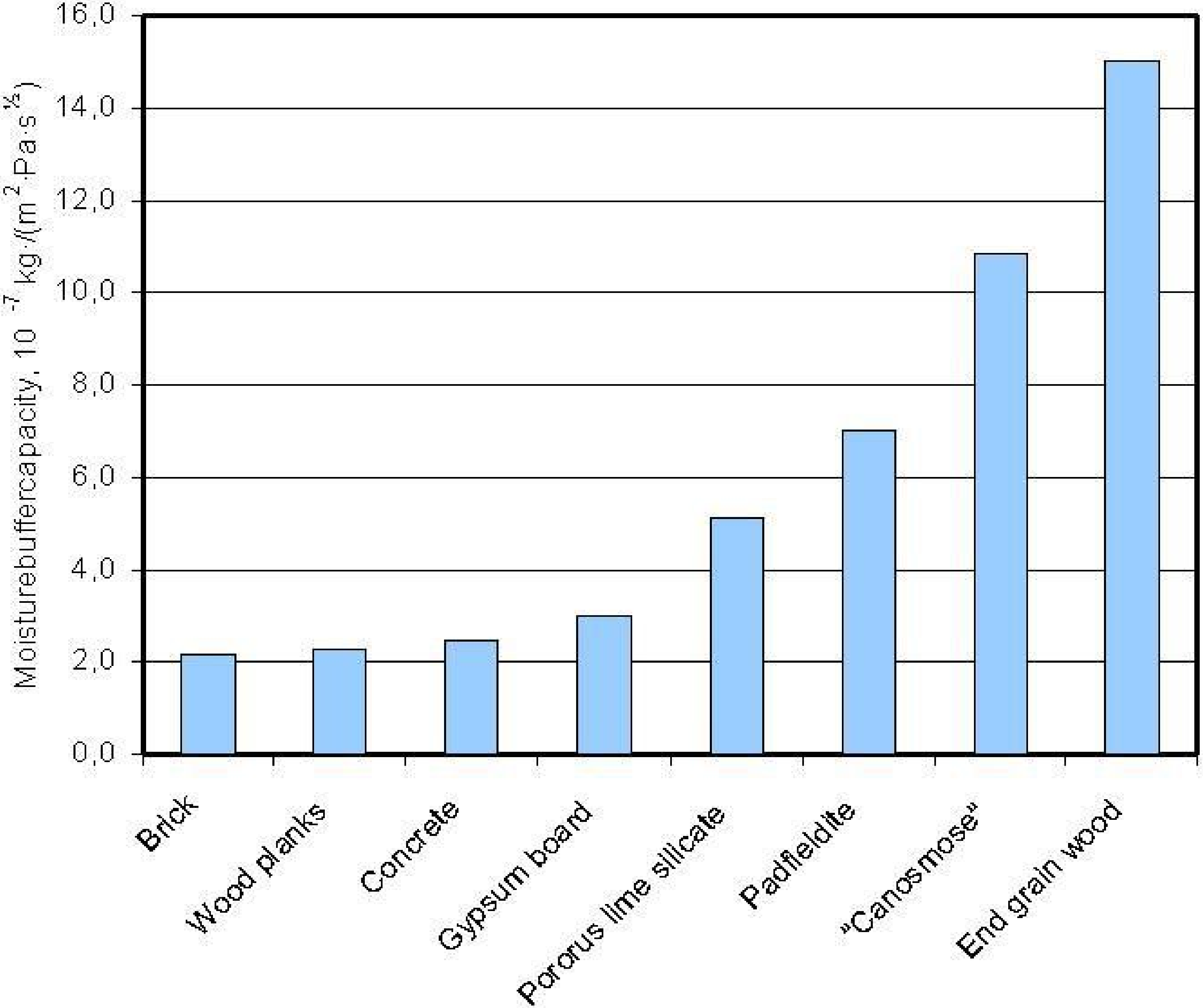


Computer simulation of empty store, AER = 0,1 h^{-1}



Unfired perforated clay bricks used for humidity buffer





Moisturebuffercapacity, 10 -7 kg·/(m 2·Pa·s ½)
16,0
14,0
12,0
10,0
8,0
6,0
4,0
2,0
0,0
Brick
Wood planks
Concrete
Gypsum board
Pororus lime silicate
Padfieldite
„Canosmose"
End grain wood

	Climate control	Energy consumpt (pr. year)	Tempera ture	Relative humidity
Royal library, CPH	Full AC	30 kWh/m^3	18-20°C	45-55%
P-hal Oerholm	Heating Hum cont	10 kWh/m^3	10-25°C	50-60%
Værløse shelter	Dehumidi fication	6 kWh/m^3	0-25°C	45-55%
Ribe store	Dehumidi fication	1,5 kWh/m^3	7-15°C	45-55 %

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Humidity buffer
capacity


Humidity buff
capacity


Thermal


Humidity buff
capacity


Thermal


Thermal insulation


Humidity buff
capacity


Thermal


Thermal insulation


Air thightness


FATHER