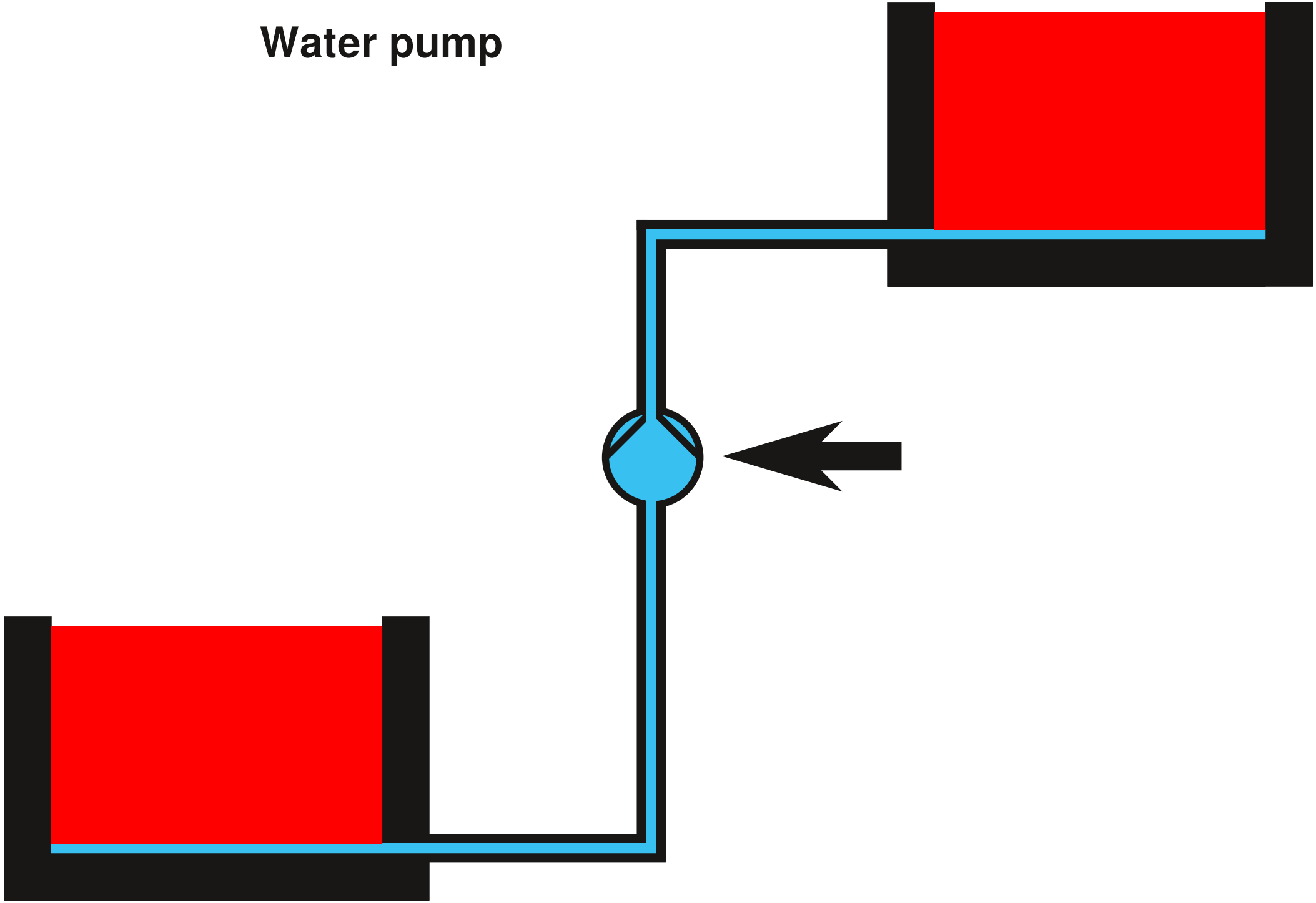
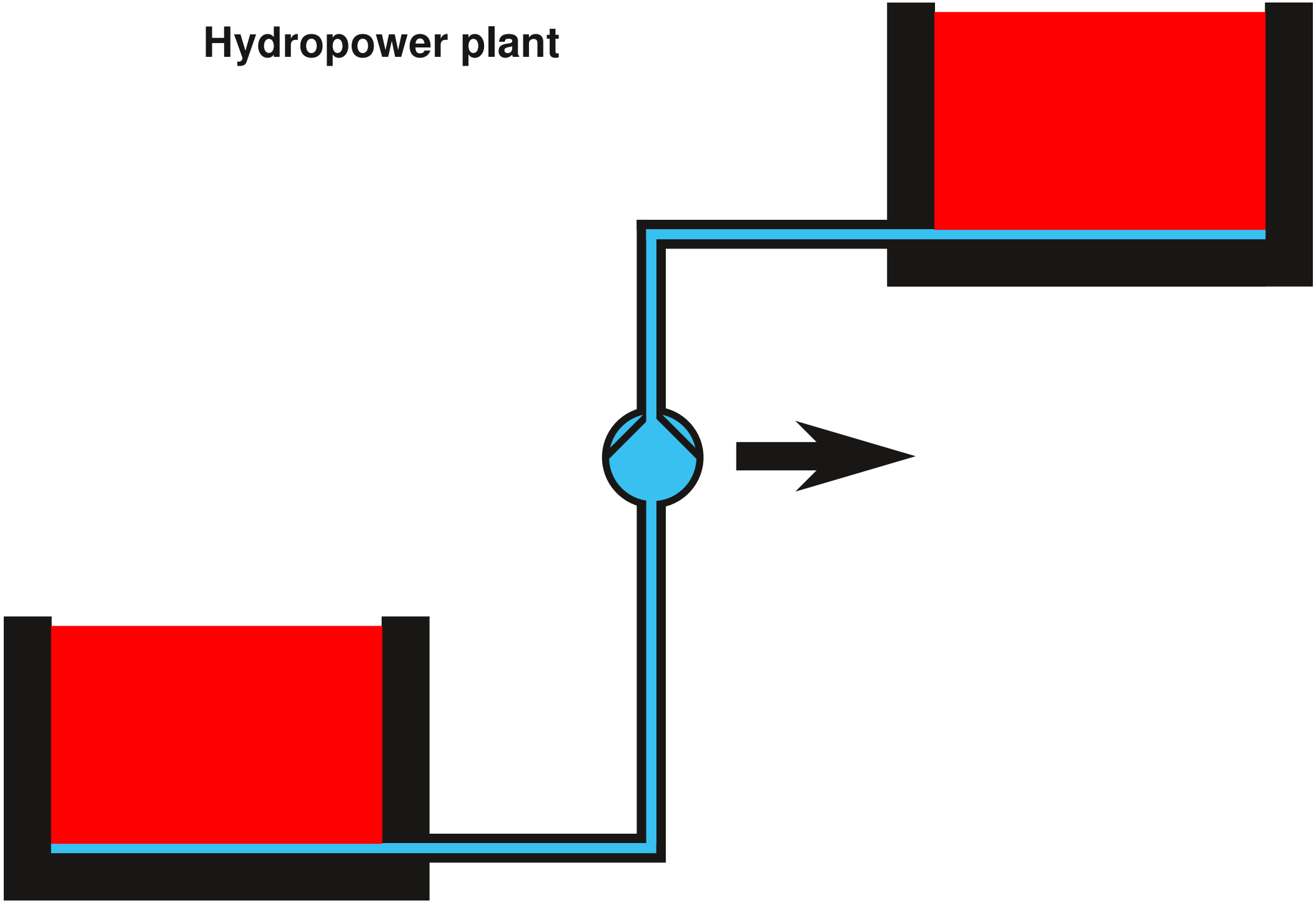
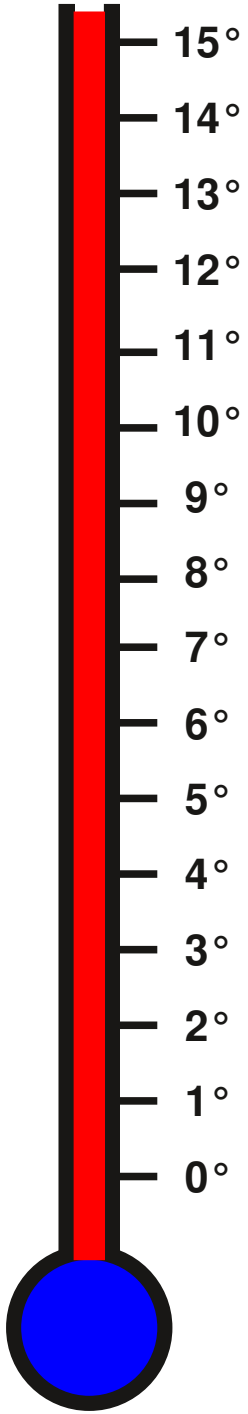
Water pump

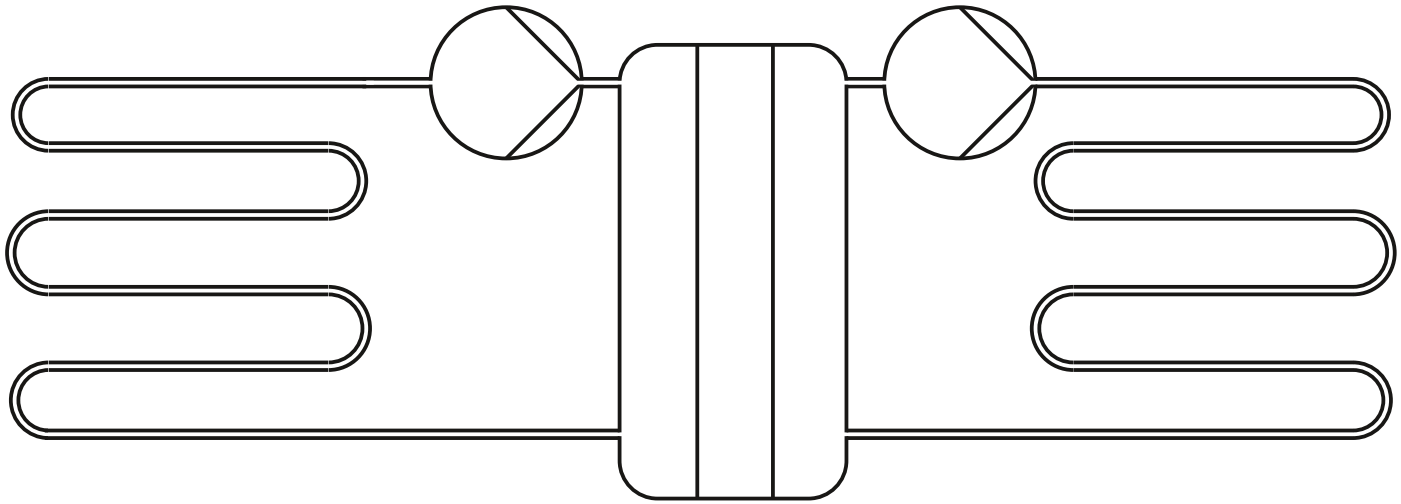


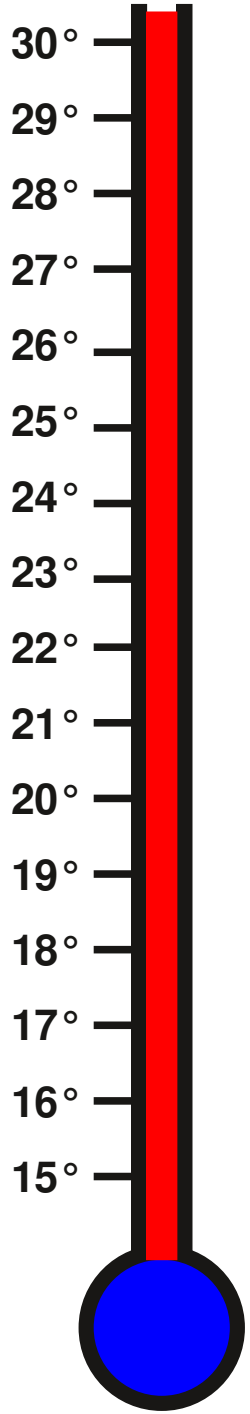
Hydropower plant



Heat pump

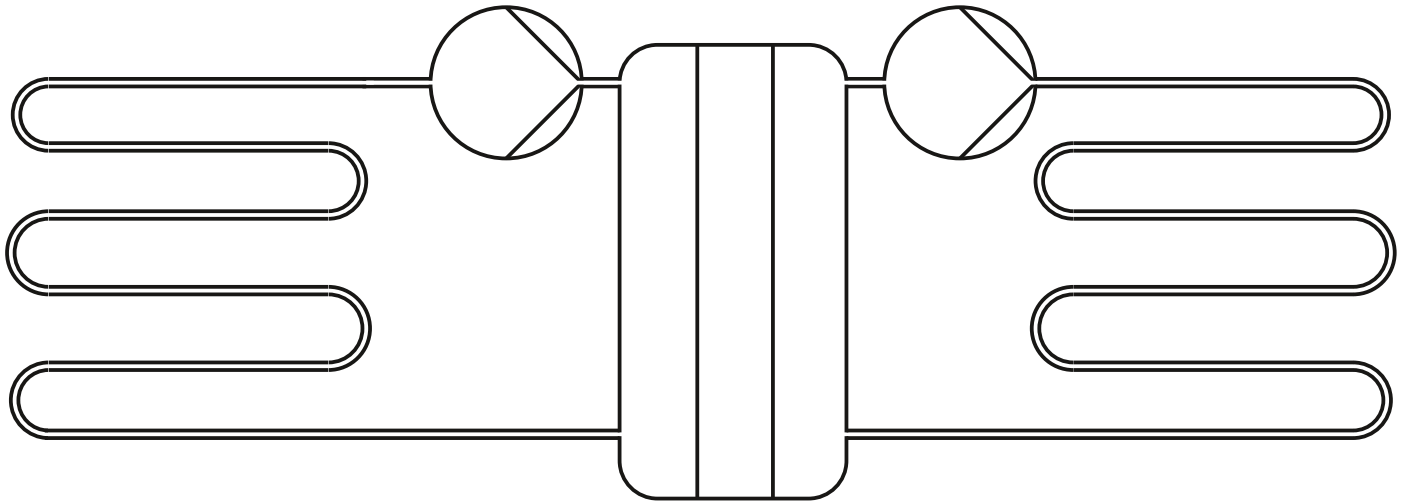

15°
14°
13°
12°
11°
10°
9°
8°
7°
6°
5°
4°
3°
2°
1°
0°



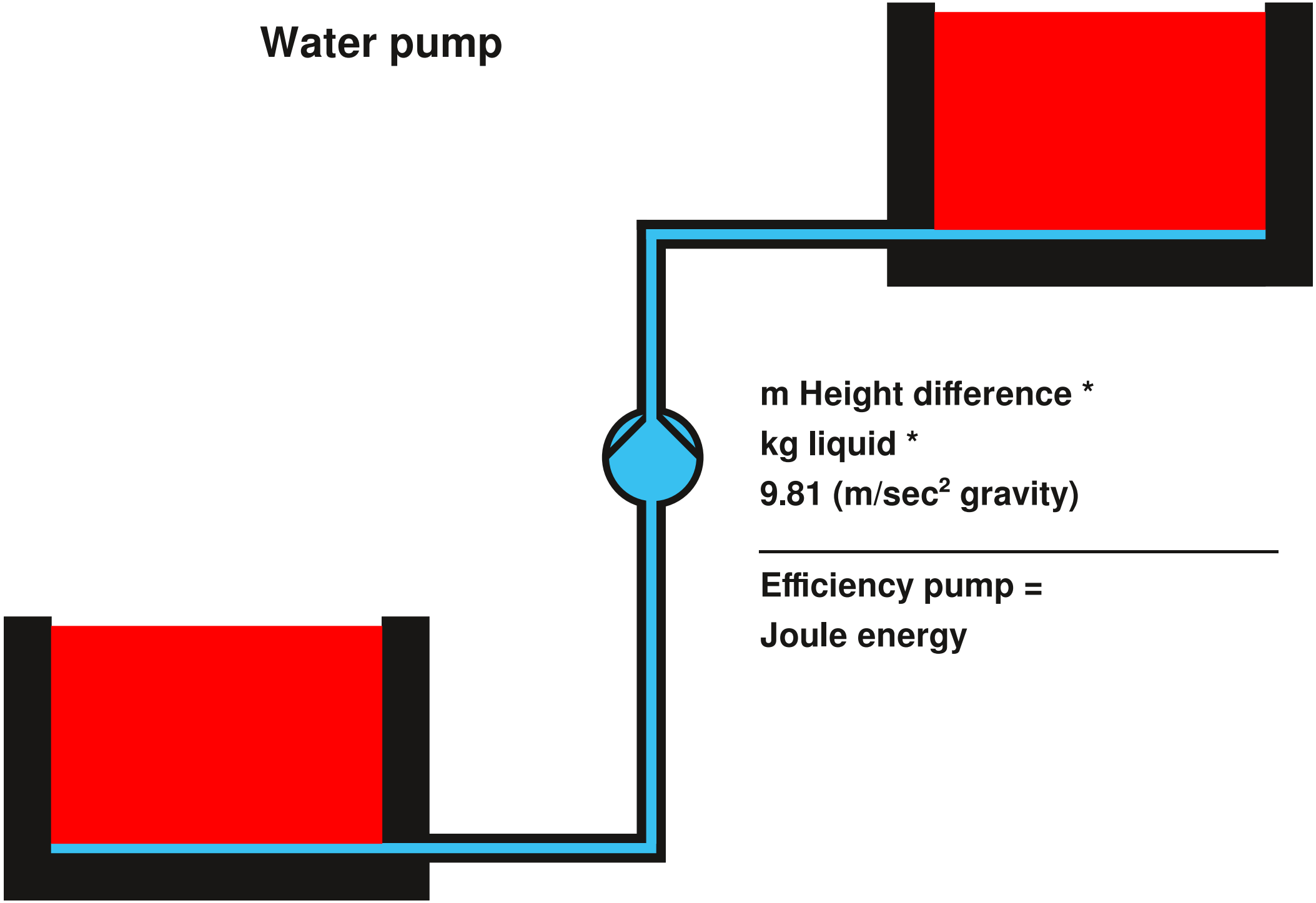

30°
29°
28°
27°
26°
25°
24°
23°
22°
21°
20°
19°
18°
17°
16°
15°

Heat pump

-3 kW heat **1 kW electricity** **+4 kW heat**



Water pump



m Height difference *

kg liquid *

9.81 (m/sec^2 gravity)

Efficiency pump =

Joule energy

Heat to power

Sadi Carnot 1796 - 1832

Power for heat transport

Steam engine

ICE - Internal combustion engine

Stirling engine

Heat pump

Air conditioner

Refrigerator

$$\eta_c = \frac{T_h - T_k}{T_h} = 1 - \frac{T_k}{T_h}$$

Heat to power:

theoretical maximum efficiency:

$$1 - \frac{273.15 + 200^\circ\ C}{273.15 + 700^\circ\ C} = 0.486 = 48.6\,\%$$

Power for heat transport:

Theoretical maximum

Coefficient Of Performance:

$$1 - \frac{273{,}15 + \ 7^\circ\ C}{273{,}15 + 35^\circ\ C} = 0{,}091$$

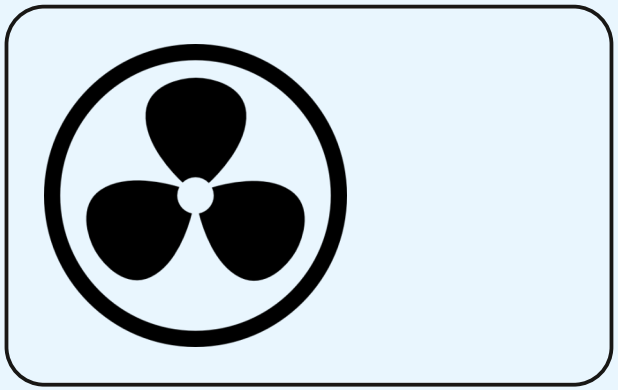
1 / 0,091 = COP 11

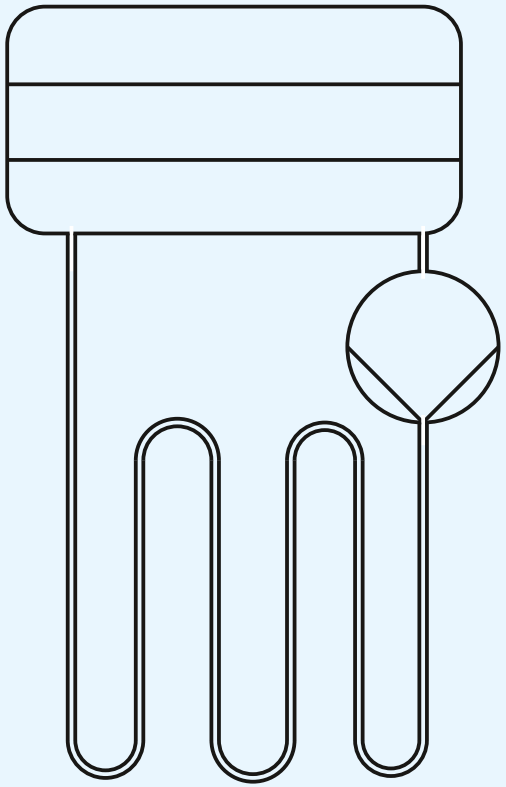
Heat to power:

Large temperature difference brings more efficiency:

Power for heat transport:

Small temperature difference brings higher Coefficient Of Performance:

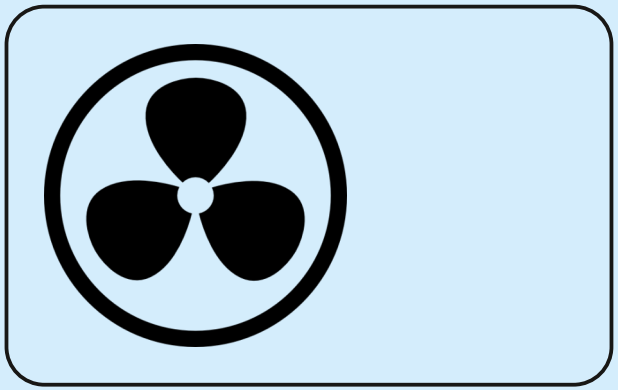


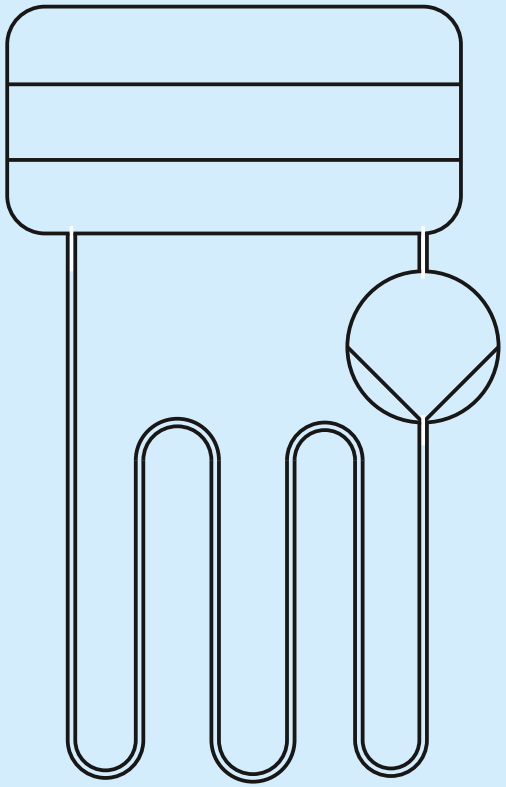


2° Air temperature
2° Ground collector temperature
20° room temperature
35° Flow temperature floor heating
5 kW heat demand

COP 3.74
Electricity 1,339 W

COP 3.74
Electricity 1,339 W

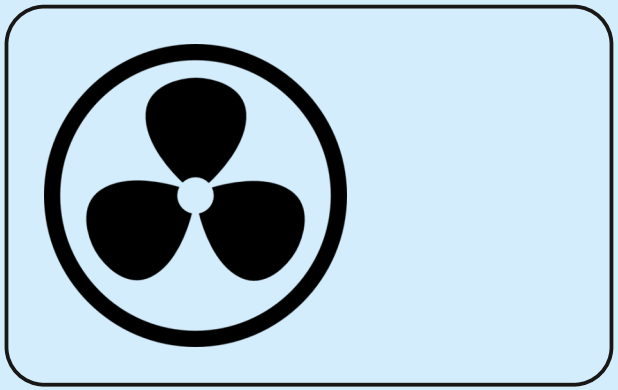


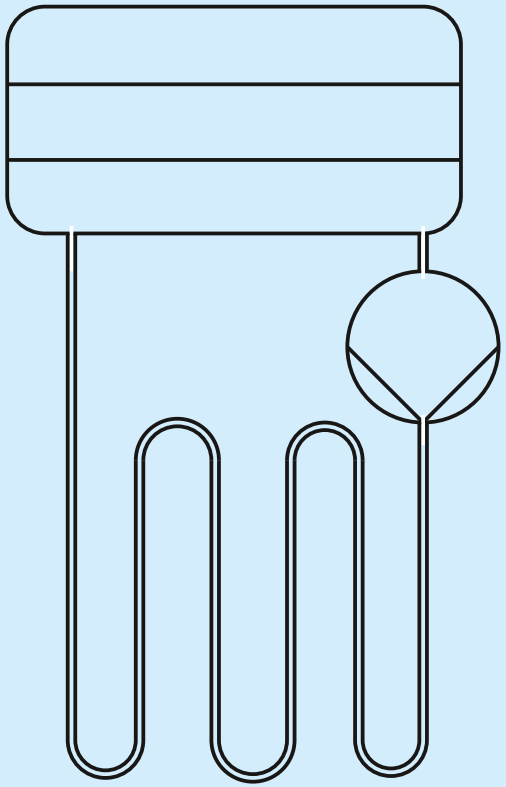


-16° Air temperature
2° Ground collector temperature
20° room temperature
35° Flow temperature floor heating
10 kW heat demand

COP 2.42
Electricity 4,138 W

COP 3.74
Electricity 2,678 W





-16° Air temperature
2° Ground collector temperature
20° room temperature
35° Flow temperature floor heating
10 kW heat demand

COP 2.42
Compressor 3,000 W
Heat output 7,250 W
Electric heating 2,750 W
Total 5,750 W

COP 3.74
Electricity 2,678 W

Expertise zum Einsatz von Luftwärmepumpen in Österreich

Endbericht

November 2015

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If everyone did that ...

Let's take a typical settlement with 100 houses connected to a 400 kVA medium-voltage transformer.

If everyone had such an air-source heat pump, the medium-voltage transformer would have to be expanded to 1000 kVA.

With one million of these devices in Austria, the power grid would really collapse.

What would it cost to expand the infrastructure to supply 1 million such air-source heat pumps on very cold days?

The manufacturers in the European heat pump industry are cherry-pickers, cake is not good enough. The follow-up costs are passed on to the general public.

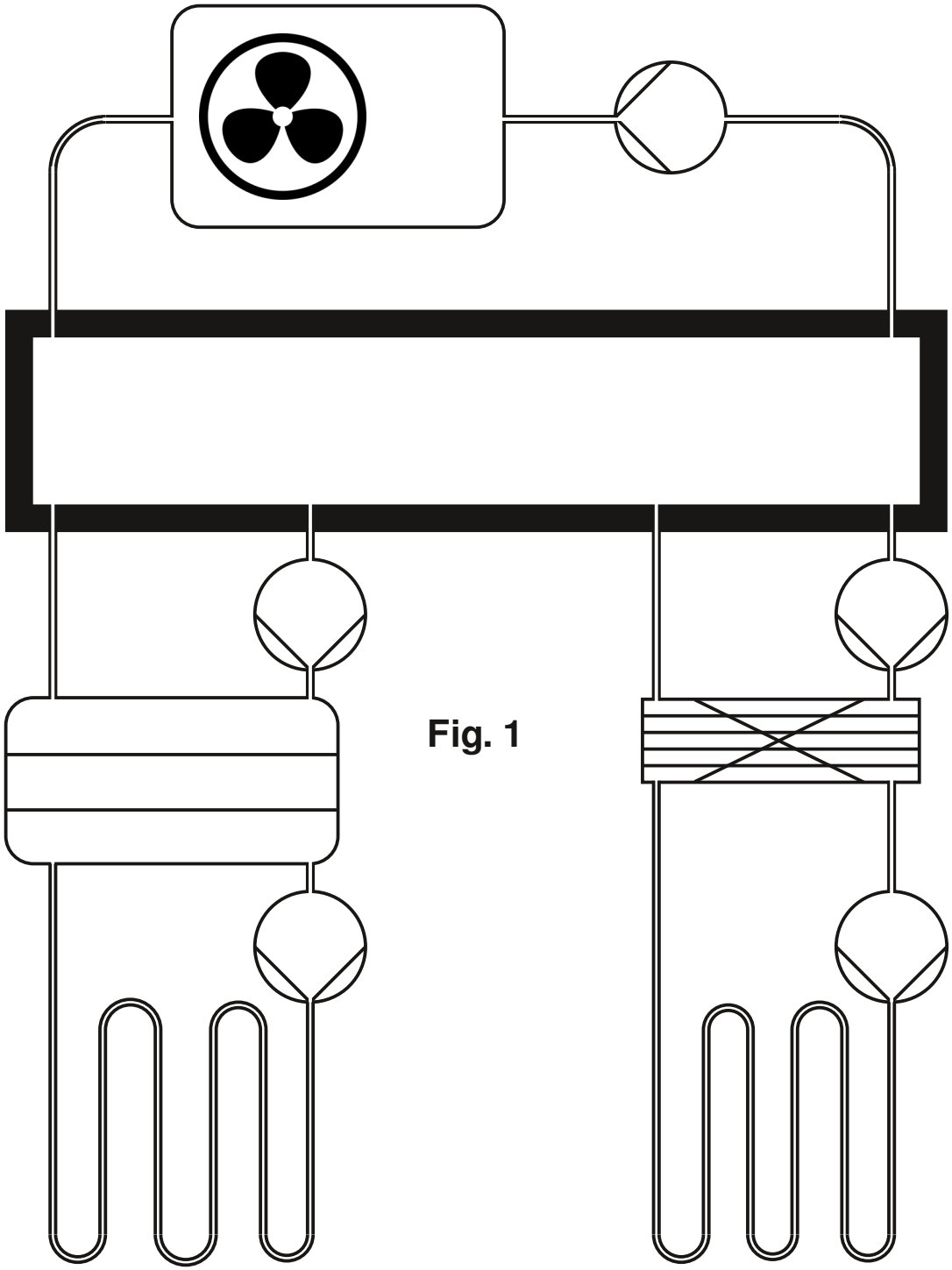
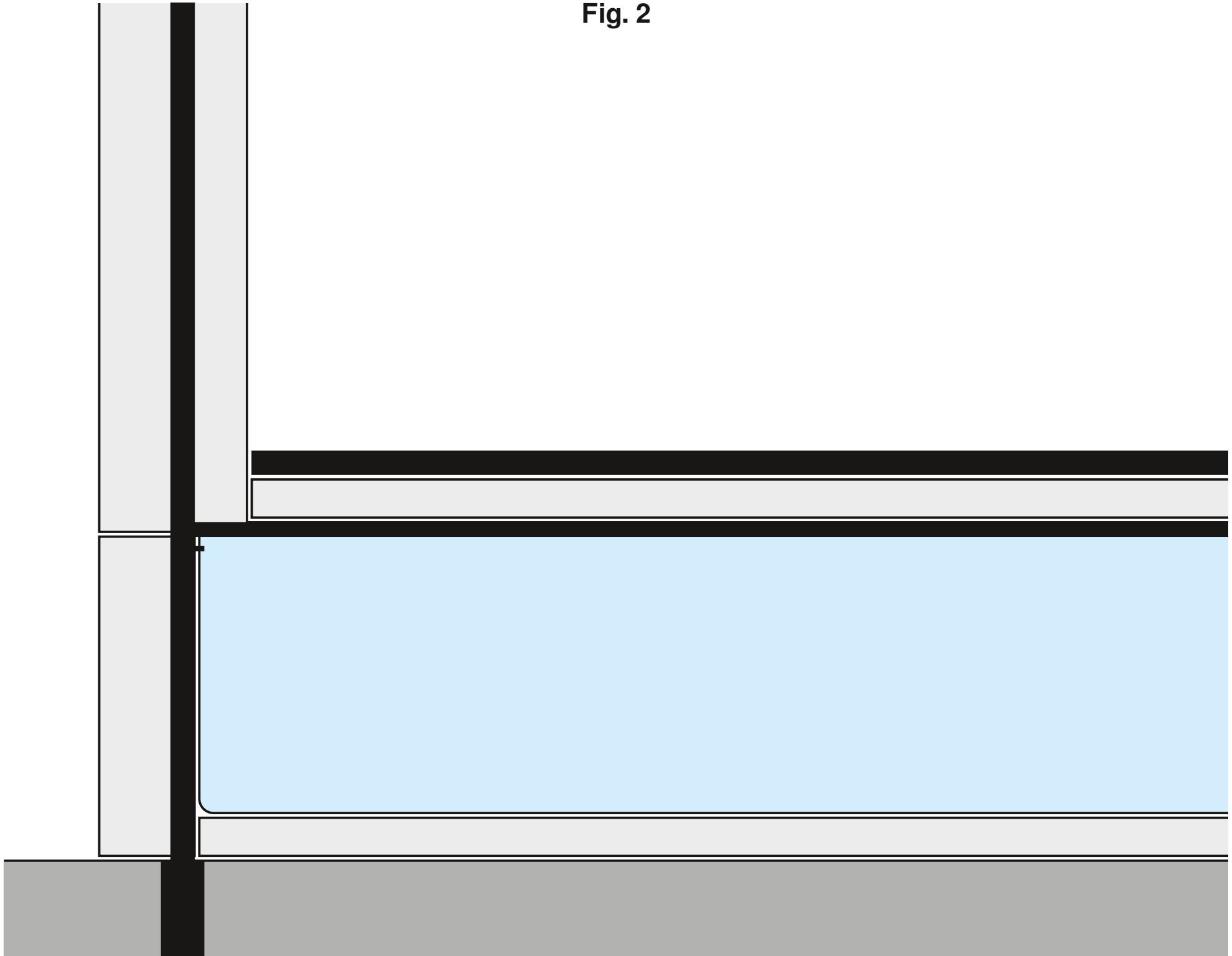
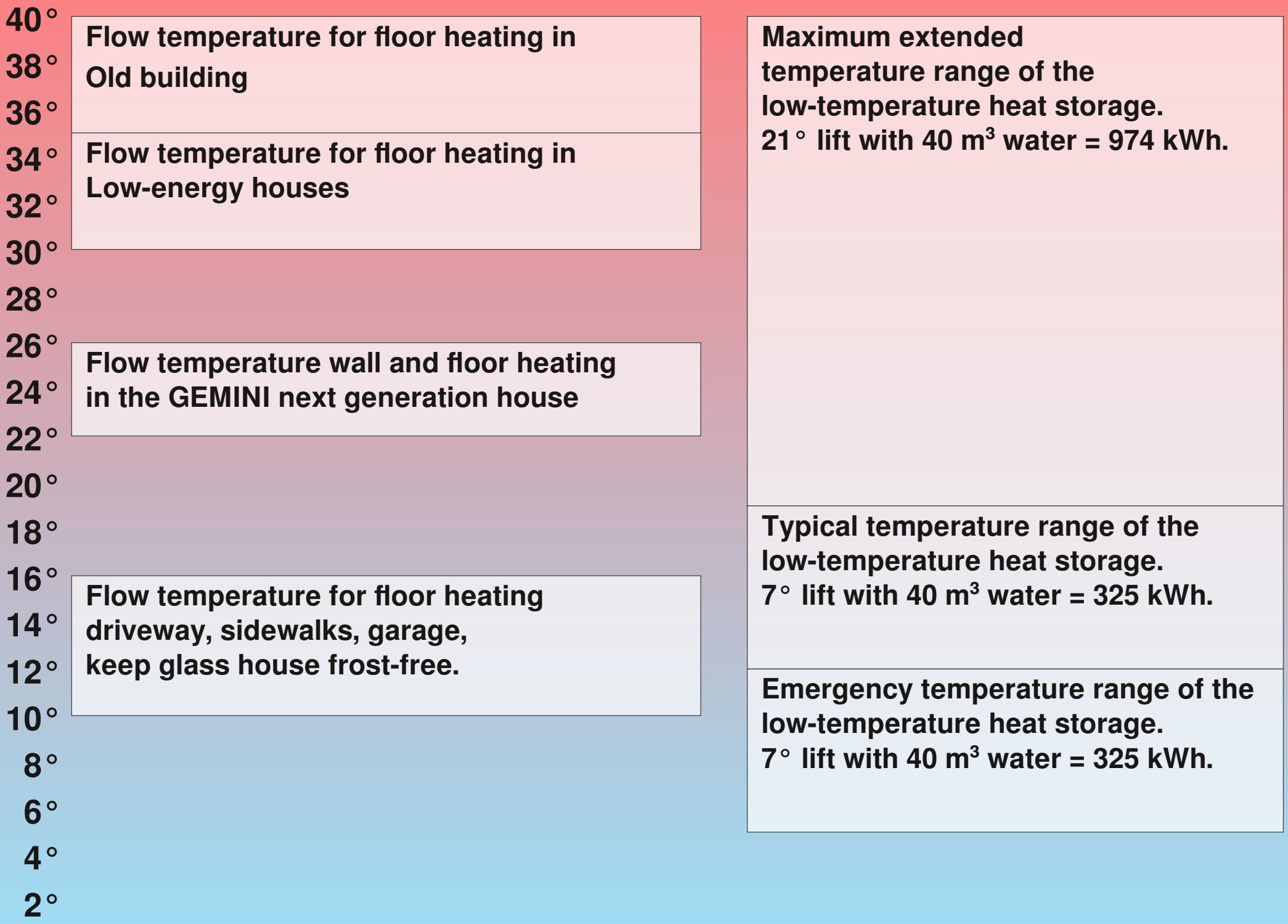


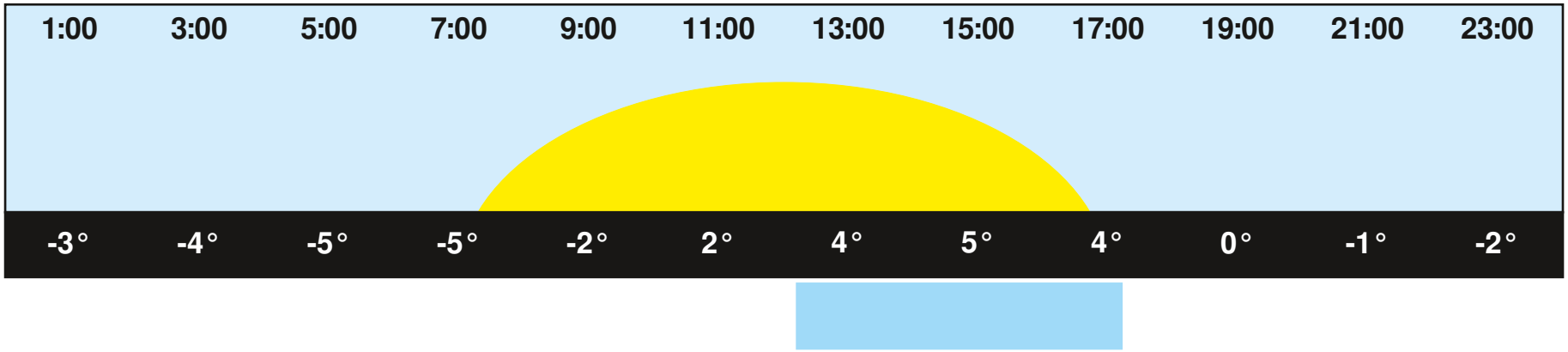
Fig. 1

Fig. 2

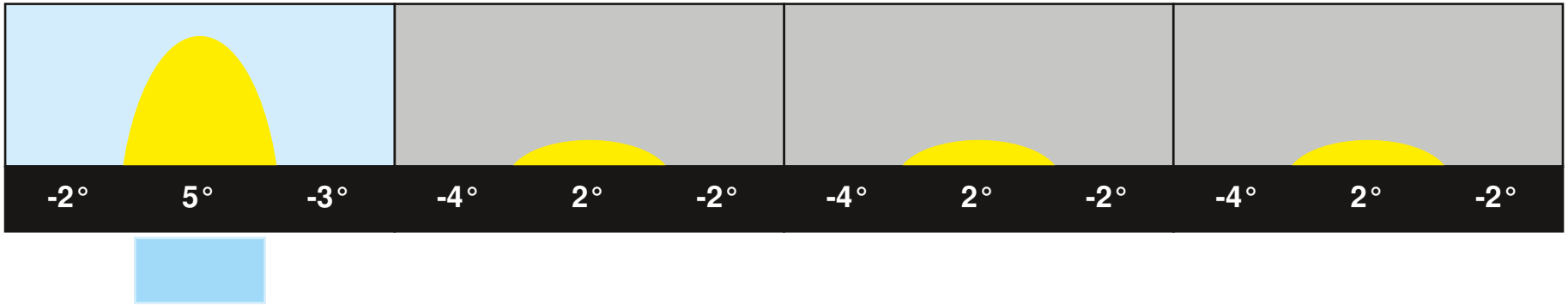



40°
38°
36°
34°
32°
30°
28°
26°
24°
22°
20°
18°
16°
14°
12°
10°
8°
6°
4°
2°
Flow temperature for floor heating in Old building
Flow temperature for floor heating in Low-energy houses
Flow temperature wall and floor heating in the GEMINI next generation house
Flow temperature for floor heating driveway, sidewalks, garage, keep glass house frost-free.
Maximum extended temperature range of the low-temperature heat storage. 21° lift with 40 m³ water = 974 kWh.
Typical temperature range of the low-temperature heat storage. 7° lift with 40 m³ water = 325 kWh.
Emergency temperature range of the low-temperature heat storage. 7° lift with 40 m³ water = 325 kWh.

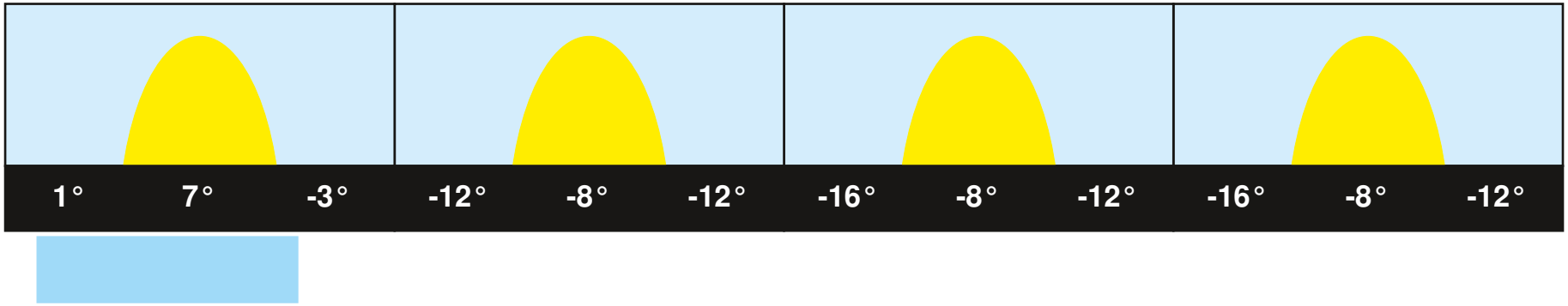
On a winter day, air source heat pumps operate only during the warmest hours of the day.

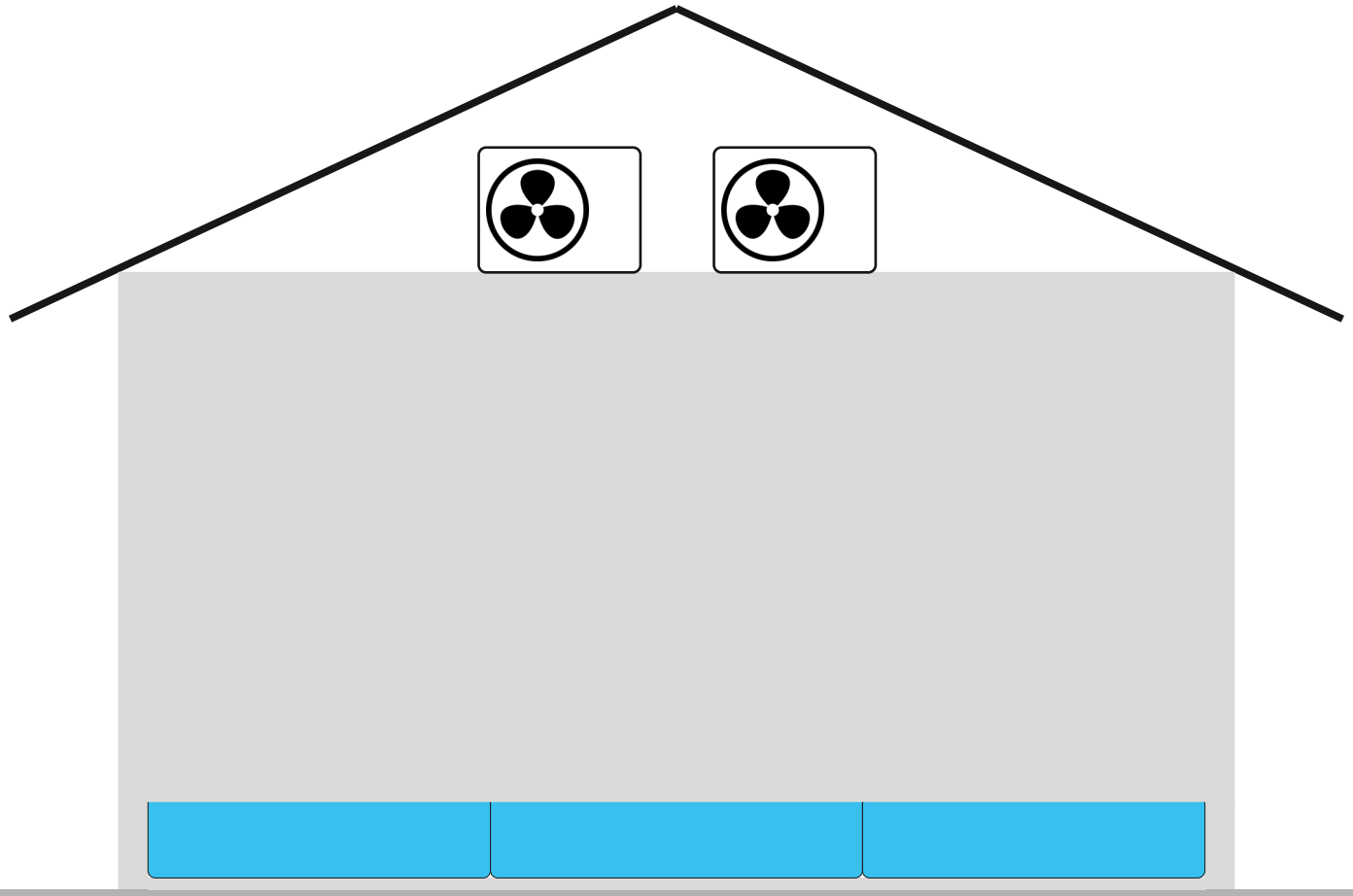


Stock up on heat for very cloudy days to compensate for lower solar power output.

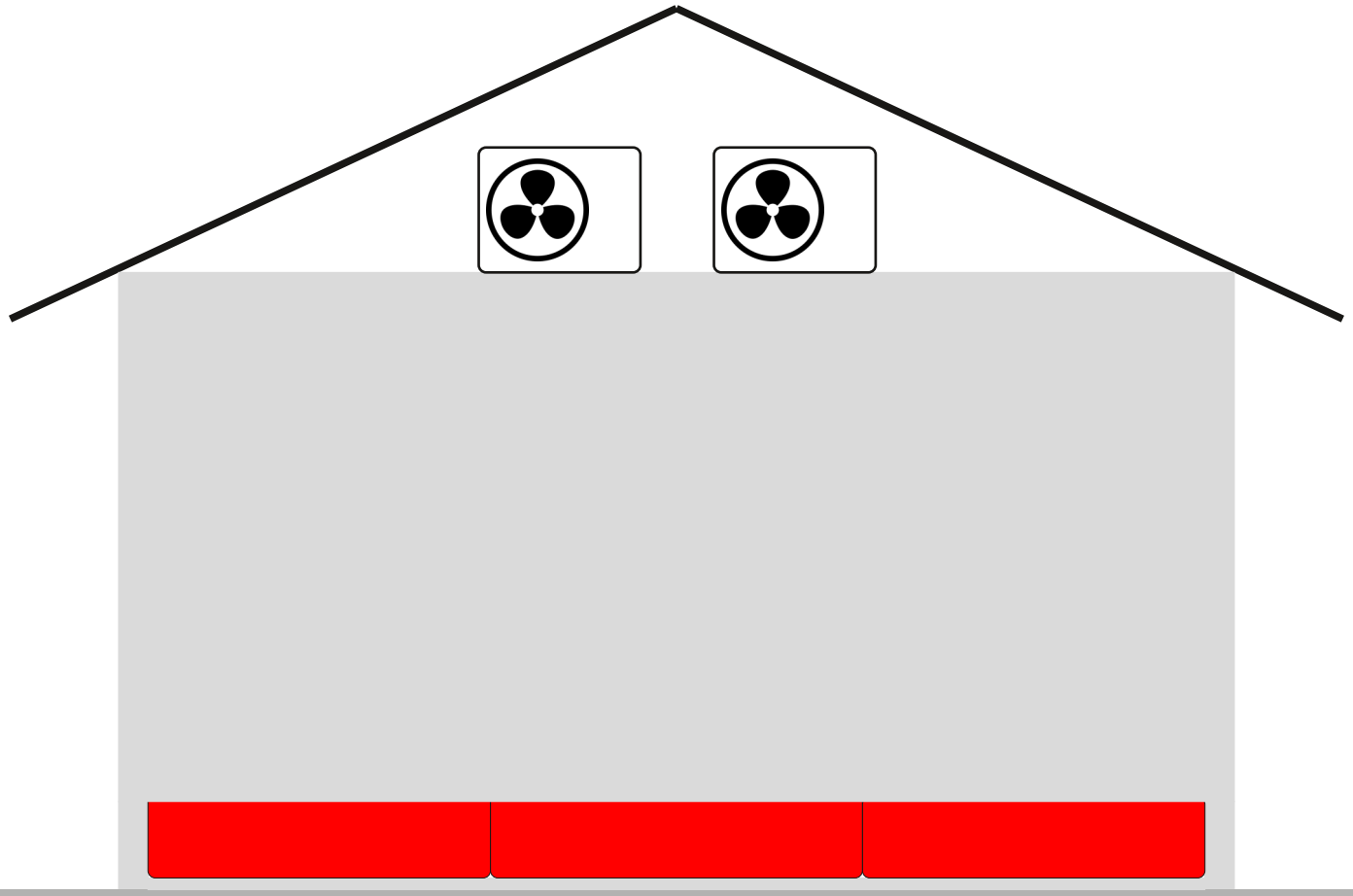


Stock up on heat for very cold days to avoid the unfavorable COP in cold conditions.

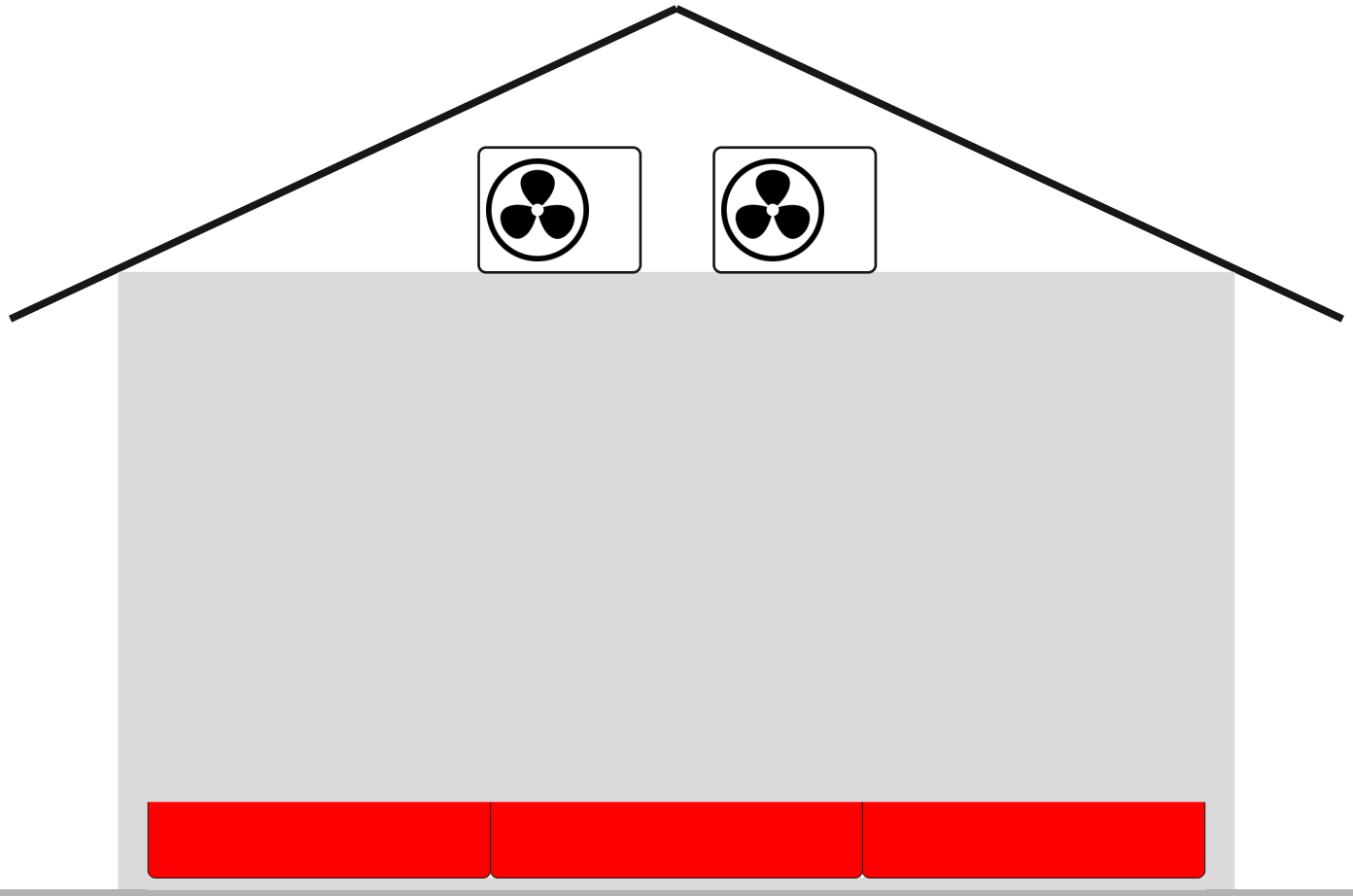




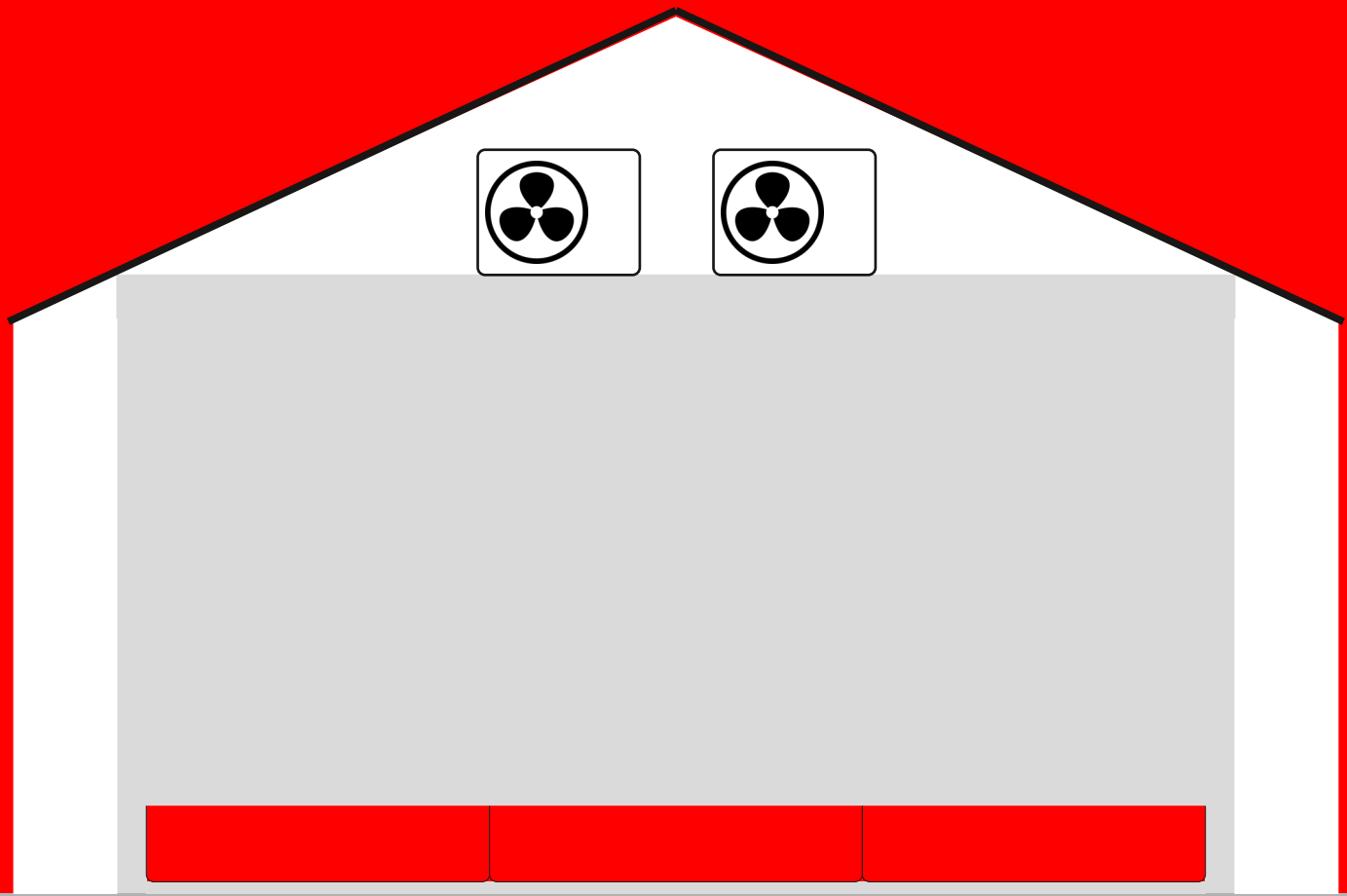
Monday: Weather forecast: extreme rain expected for Thursday



Tuesday: make room for so much rainwater

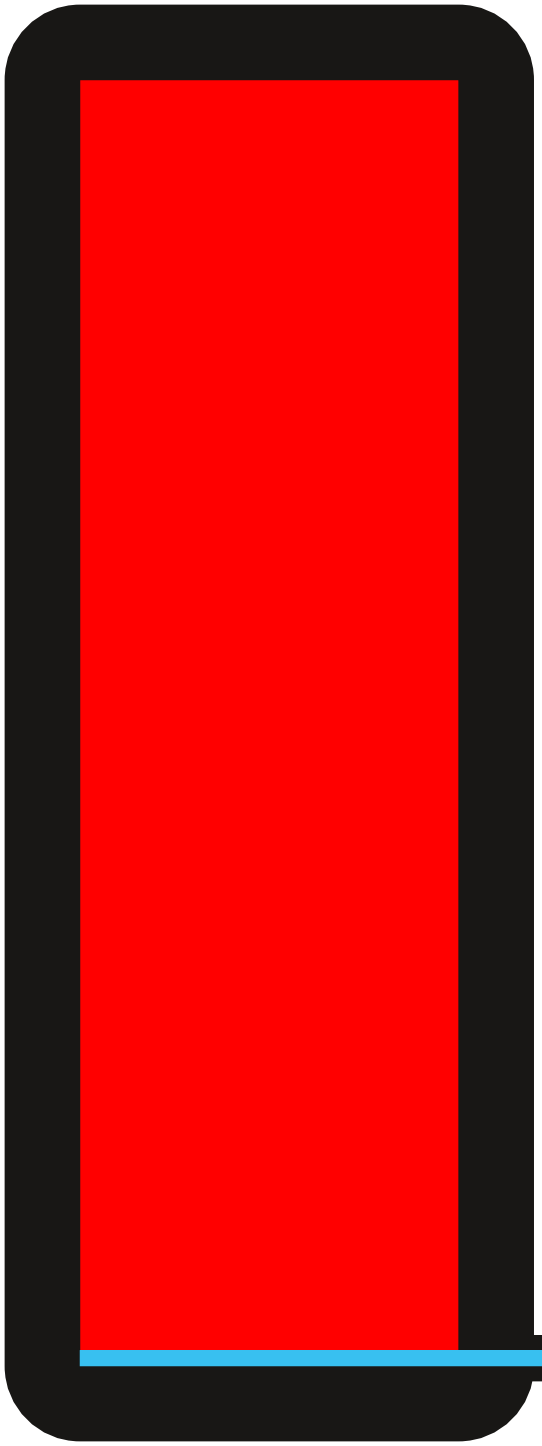


Wednesday: well prepared for the extreme rain



Thursday: negative soil sealing:

the built-over area absorbs more water than a meadow.



Boiler

The water from the water pipe must be heated to 62° to kill legionella.

The water in the boiler can be used to the last drop.

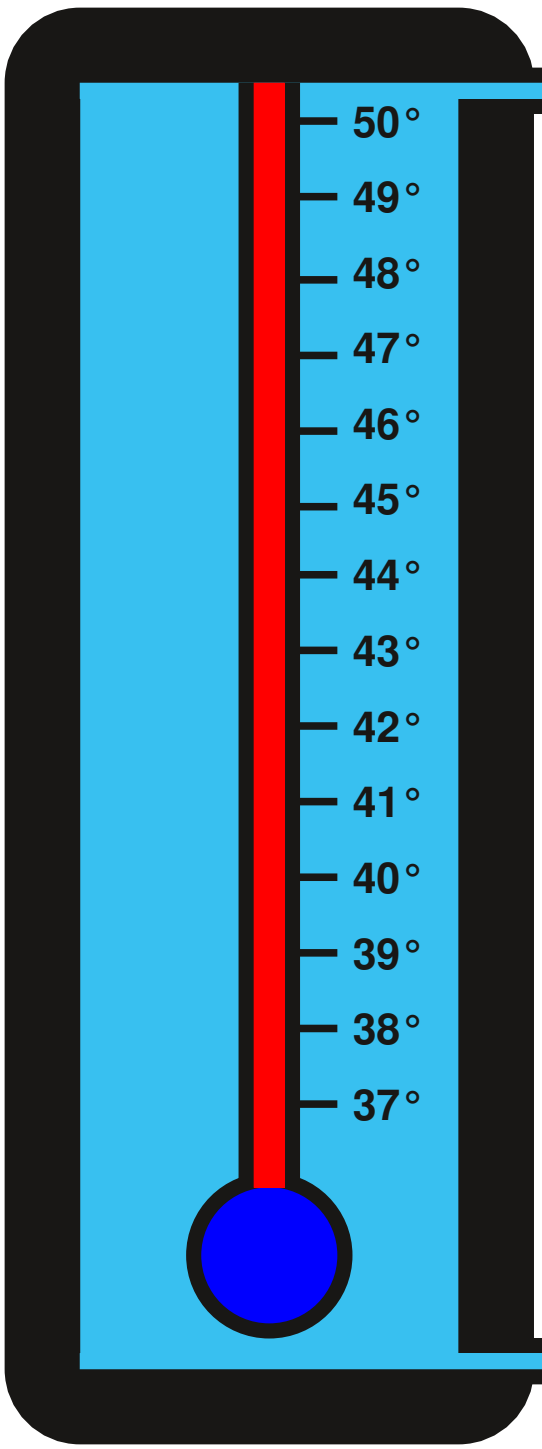
Air temperature 2°

Target temperature 62°

COP 2,23

Electric power requirement for 3 kWh heat:

1,343 Wh



6°

Fresh water station

Drinking water is heated in seconds in a heat exchanger.

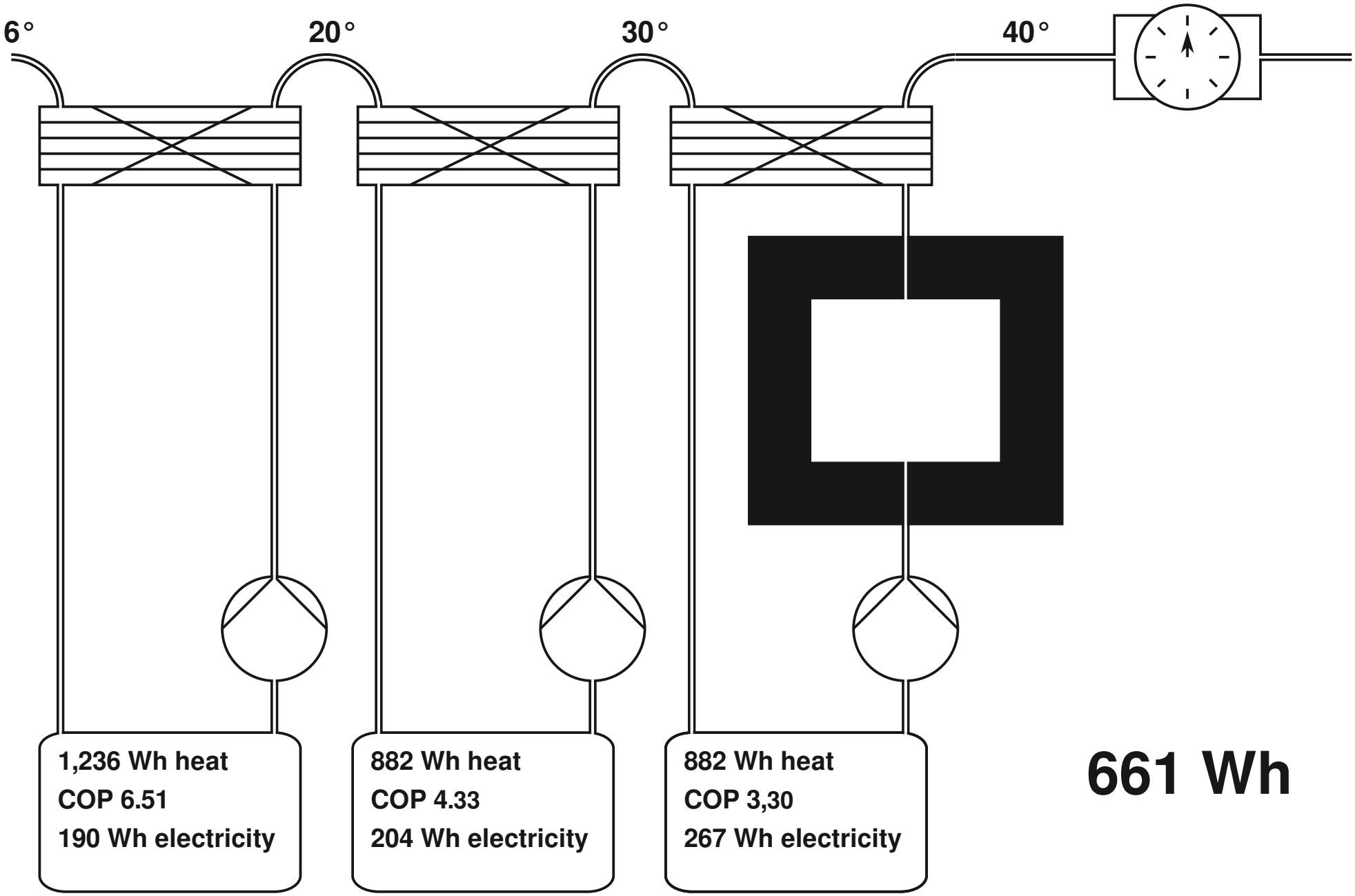
The water in the heat storage tank never comes into contact with a human being, therefore no temperature is required to kill legionella.

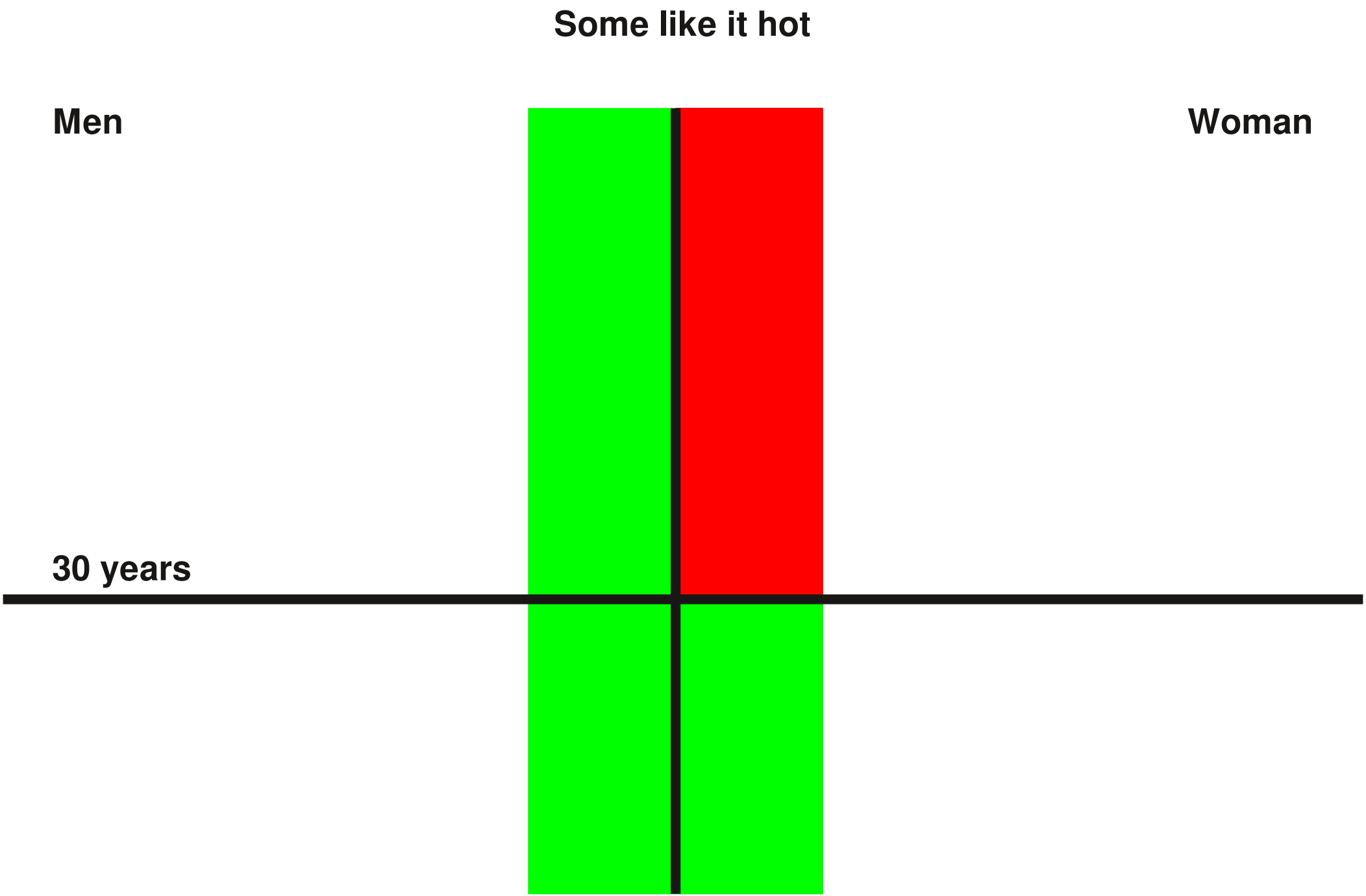
Air temperature 2°

Target temperature 50° COP 2.69

Electric power requirement for 3 kWh heat:

1,114 Wh


6°
20°
30°
40°
1,236 Wh heat
COP 6.51
190 Wh electricity
882 Wh heat
COP 4.33
204 Wh electricity
882 Wh heat
COP 3,30
267 Wh electricity
661 Wh


Some like it hot
Men
Woman
30 years