TEADMISTEPÕHINE EHITUS 2026

Mitte-elamute soojuspumpade juhtimine tehisaruga

Let the building tell the heat pump what it needs

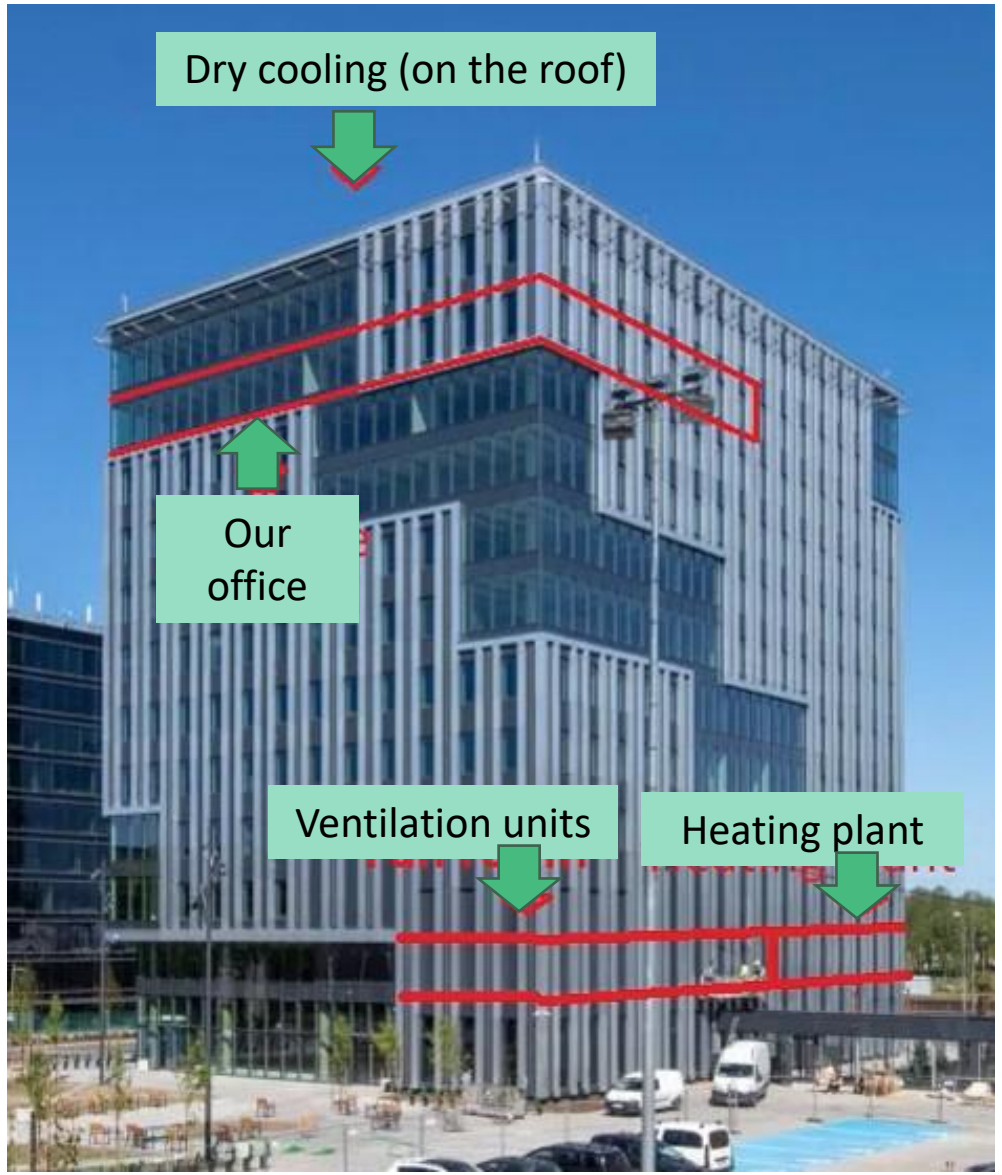
Ivan Sukhanov · R8 Technologies · Tallinn University of Technology

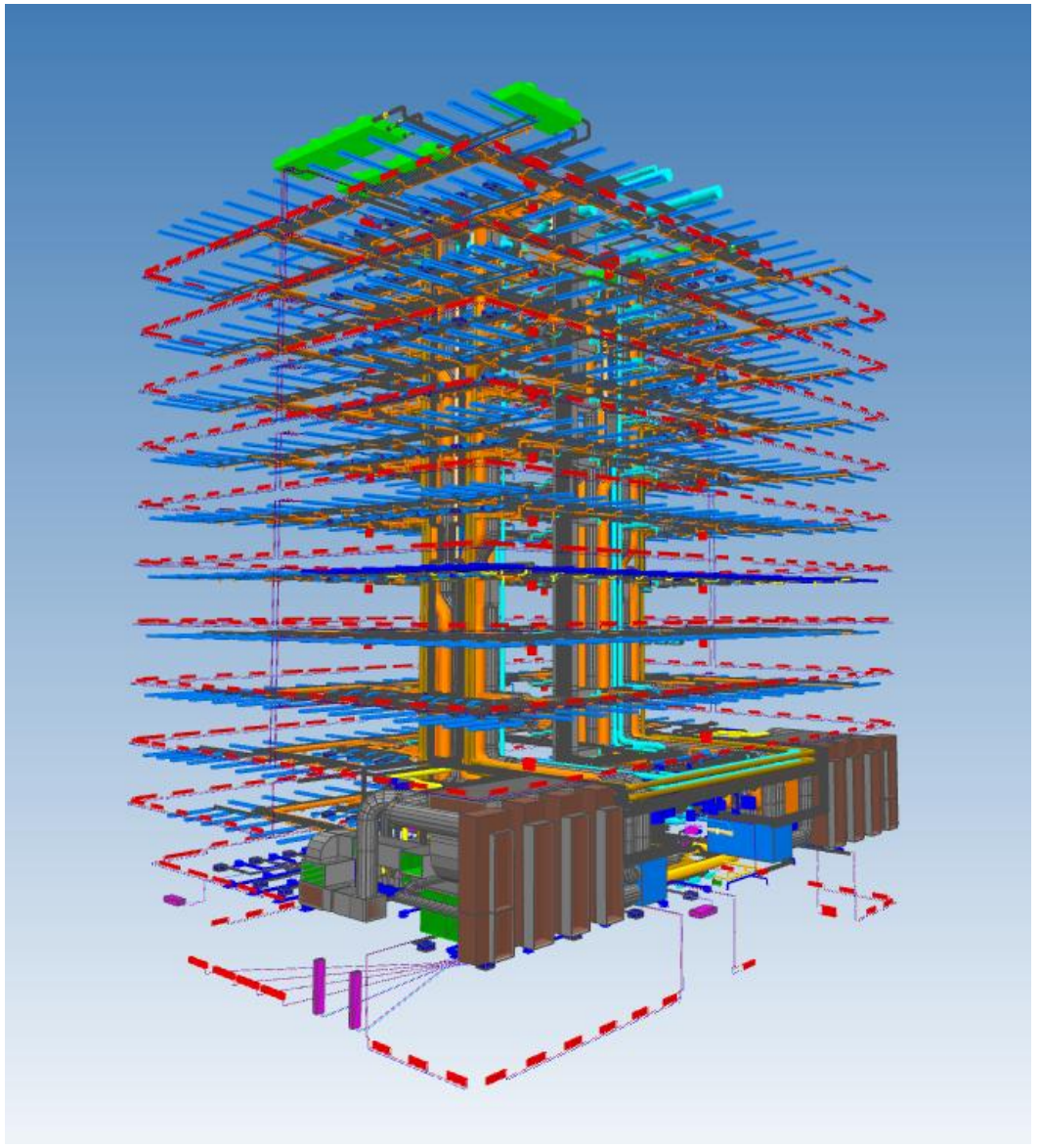
THE PROBLEM

A heating curve knows how cold it is outside. It does not know how much heat the building needs right now.

Most plants run at partial load, with changing occupancy and prices, on a curve set once at commissioning.

Building = COMPLEX technical systems





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THE PROBLEM

What a fixed curve costs a heat pump plant

01

Oversupply at partial load

Water hotter than the coils need. Higher lift, lower COP, extra pumping.

02

Heat pump sidelined

In hybrid HP + DH plants the heat pump often ends up as backup. On our Norwegian site it covered only 7.1 % of heat.

03

Blind to schedules and prices

No pre-heating before people arrive, no setback after, no shift away from expensive hours.

Rule of thumb: each 1 K lower supply temperature gives about 2 to 3 % higher heat pump COP

ENERGY INFORMATICS: ENERGY + INFORMATION

Energy informatics is a research field covering the use of information and communication technology to address energy utilisation and management challenges.

Energy + Information < Energy

This equation is attributed to: Jørgensen, B. N. (2018). Energy Informatics. *Energy Informatics*, 1(7). https://doi.org/10.1186/s42162-018-0014-6

CLASSIC SOLUTIONS

focus on one part of HVAC and do not maximize energy performance

Heating

OR

Cooling

OR

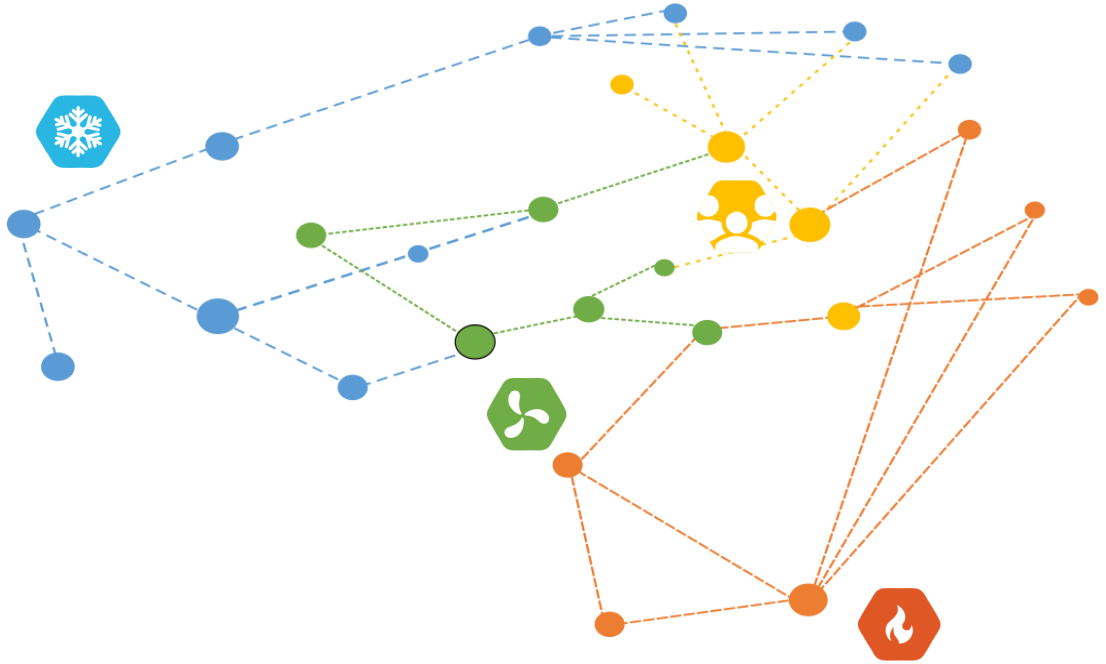
Ventilation

OR

Rooms

PROPOSED SOLUTION

synchronizes all sub-components by micro adjustments

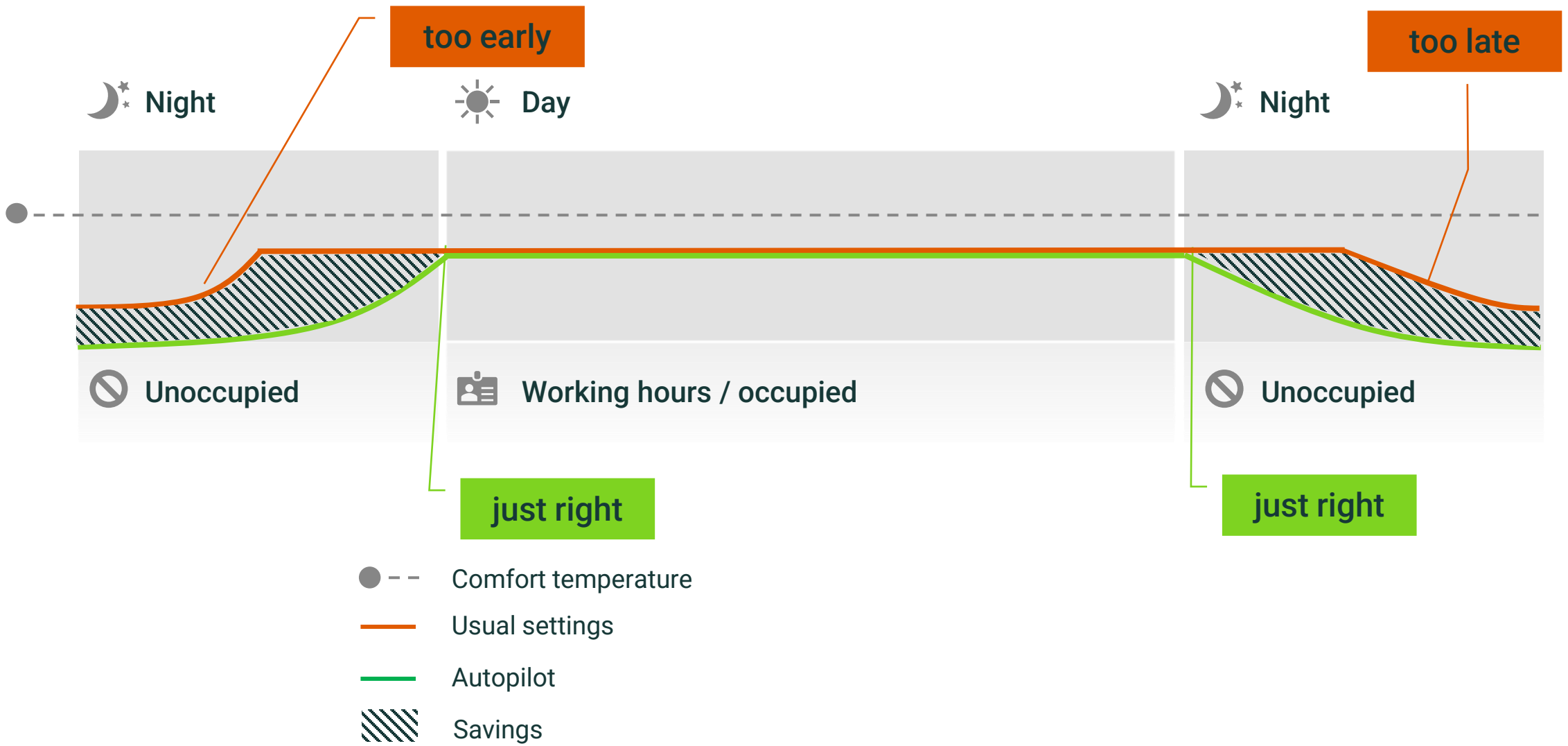


with other dynamic inputs

ENERGY PRICES

OCCUPANCY

WEATHER


too early
too late
Night
Day
Night
Unoccupied
Working hours / occupied
Unoccupied
just right
just right
Comfort temperature
Usual settings
Autopilot
Savings

THE OPTIONS

Between a fixed curve and MPC

	Fixed curve	MPC	Reinforcement learning	This approach
Follows real demand	No	Yes	Yes	**Yes**
Needs a plant model	No	Yes, identified per site	Training, often in simulation	**No, learns from BMS history**
Operator can see why	Yes	Partly	Hardly	**Yes, rules are visible**
Engineering effort	Low	High	High	**Low to moderate**

THE IDEA

Keep the curve. Add a correction.

Existing heating curve

Outdoor temperature gives the baseline setpoint, as today

+

ML correction

Learns from valve opening, ΔT and occupancy what the building needs

→

Rule-based supervisor

Hydraulic limits, comfort, price, failsafe

→

Supply setpoint to BMS

One value written every 15 minutes

Setpoint = curve + **λ** × correction, then the rules. No new hardware, no change to plant logic.

λ starts at 0, so the plant runs on the plain curve, and is raised step by step to 1 during commissioning while the operator watches the effect.

THE INPUTS

Signals you already have in the BMS

AHU heating valve opening

Valves near fully open: coils are short of heat. Valves barely open: we are oversupplying.

Supply minus return, ΔT

How much heat the loop is pulling. A difference, so it tolerates sensor offset.

AHU on/off state

Idle hours are filtered out, so the model learns only from real operation.

Outdoor temperature, schedule

Weather plus a simple weekday and hour profile for pre-heating and setback.

Not needed: flow meters, coil ΔP, zone setpoints, CO_2 sensors. 15-minute BMS logs are enough.

THE SAFETY LAYER

Rules an operator can read and tune

Rule	What it does
ΔT ceiling	ΔT above limit: raise supply. Below: lower it.
Valve authority band	Valves saturated: raise supply. Far below band: lower it.
Occupancy bias	Pre-heat before arrival, set back after leaving.
Room feedback	Too many cold rooms: raise supply.
Price bias	Shift heat pump load away from expensive hours.
Clamps and failsafe	Min and max limits, ramp limit, back to the curve on bad data.

MODEL ACCURACY

How accurate is the model?

R^2 0.87

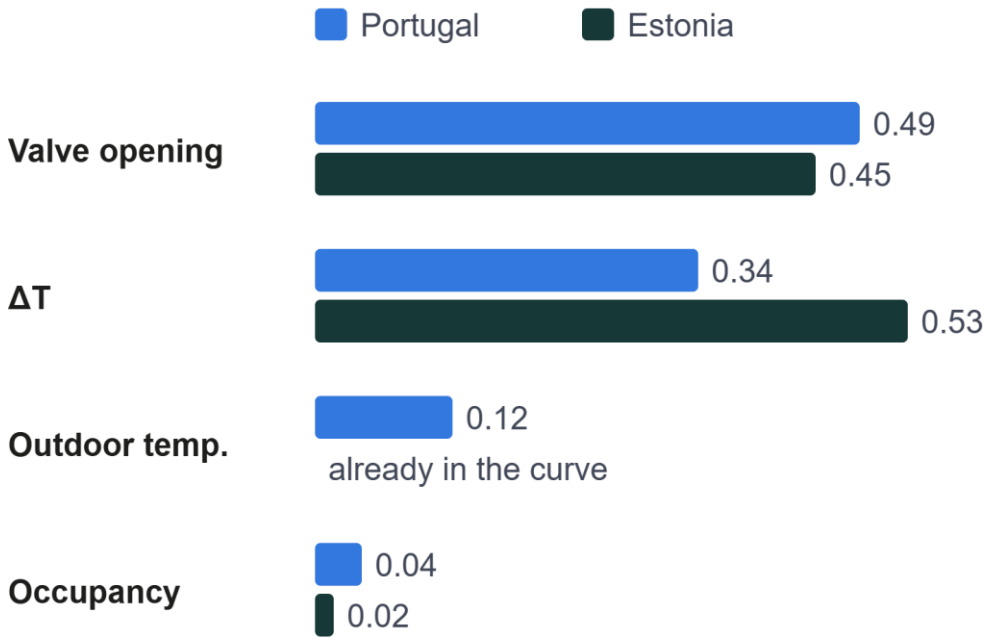
Estonia, cold climate, radiators + AHUs, DH + heat pump. Typical error 2.0 K.

R^2 0.70

Portugal, mild climate, AHU coils, reversible heat pump. Typical error 1.7 K.

Tested on the last 20 % of each year, never seen in training. The field results that follow come from a third site in Norway, where outdoor temperature ranked first (0.51).

What the model listens to



FIELD RESULT

Norway: hybrid heat pump + district heating

Annual average COP

6.26 → 7.25

+15.8 %

Heat pump share of total heat

7.1 → 14.4 %

About double

22,000 m² office, air-source heat pump + district heating in bivalent mode. The 55 °C bivalent threshold lives in the rule layer: below it the heat pump runs first with the adaptive setpoint, above it district heating covers the peak.

Method: COP = metered heat pump heat / metered heat pump electricity, same boundary before and after, compared in matched outdoor temperature bins.

WHY IT WORKED

One setpoint, two effects

1 · SIGNAL

Valves and ΔT show the building needs less than the curve gives

→

2 · ACTION

Correction mostly negative: supply moves down from near 55 °C

→

MORE HP HOURS

More time below the bivalent point.
HP share 7.1 → 14.4 %

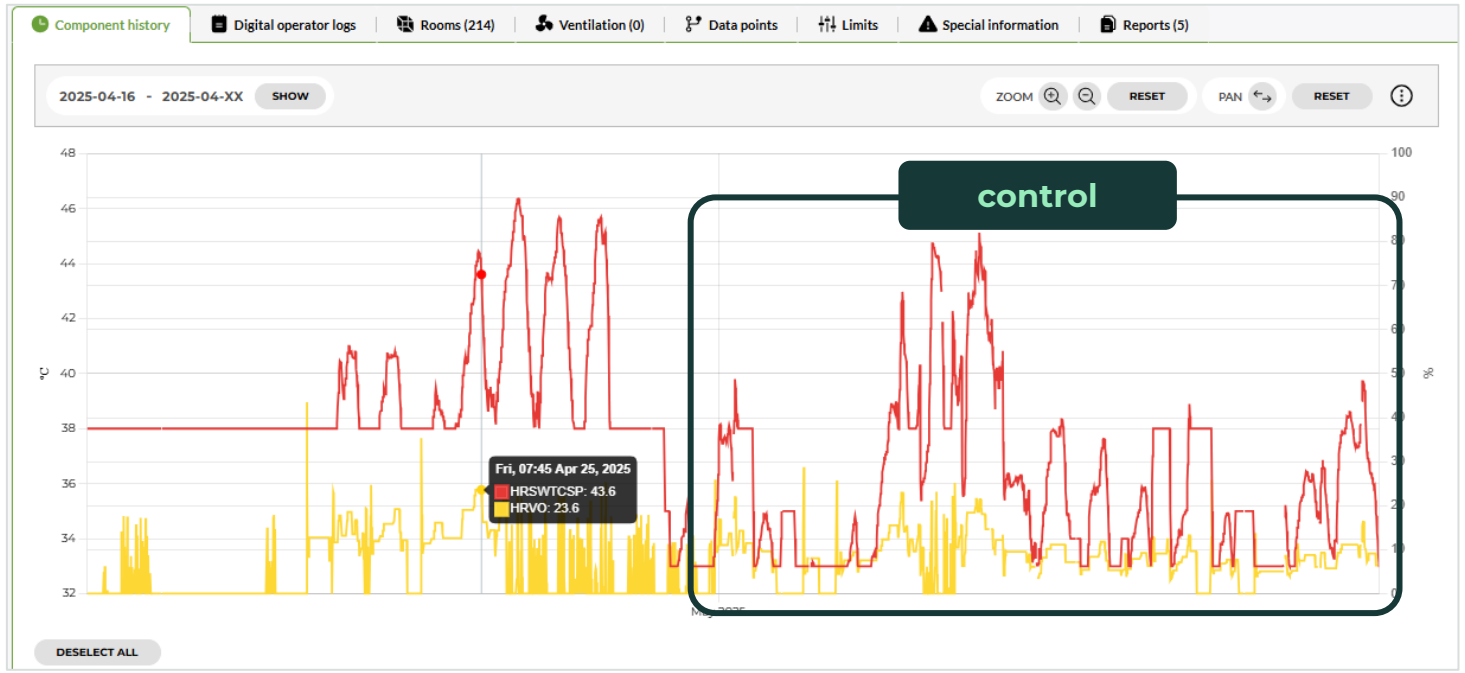
BETTER HP HOURS

Lower lift for the compressor.
COP 6.26 → 7.25

Our reading of the Norway supply temperature trend, October to December 2024.

IN THE BMS

The same change, seen in the trend



AHU supply water
56.5 → 44.3 °C **−12.2 K**

Radiator supply water
45.9 → 33.1 °C **−12.8 K**

District heating valve
60.1 → 49.5 % **−10.6 pts**

Heat pump heating hours per month
371 → 556 h **+185 h**

Red: supply water setpoint, °C **Yellow**: heating circuit valve opening, %

Office building with heat pump and district heating, April to May 2025. Values: before → during R8 control, as reported by the R8 platform.

COMFORT CHECK

And the rooms stayed comfortable

90.2 %

of room temperature readings inside S1 limits during occupied hours

21.3 °C

average indoor

7.2 °C

average outdoor

Norway site, October to December 2024, 15-minute room sensor data. S1 is the strictest class of the Finnish Classification of Indoor Climate 2018.

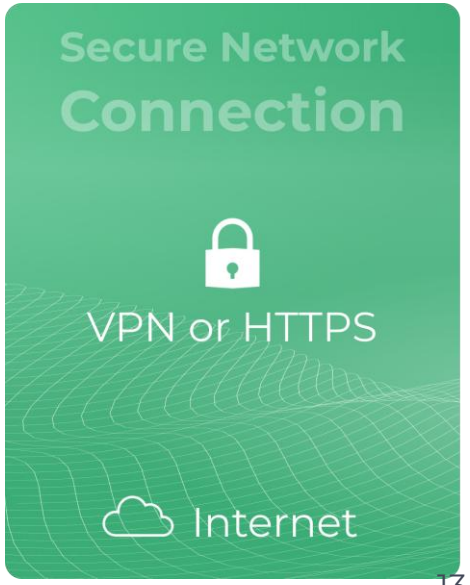
What plant is a good candidate?

- ✓ BMS logs valve positions, supply and return temperatures
- ✓ Supply water setpoint can be written from outside
- ✓ A weather-compensated curve is in place, we keep it
- ✓ Heat pumps at partial load most of the year, or a hybrid HP + DH plant

If yes: no new hardware needed.

BMS API | OPC UA | BACnet/IP





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Thank you

Questions?

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