New solutions for modern passive cooling and heat redistribution

Workshop ‘Ventilative Cooling’

Brussels March 19 – 20, 2013

Bas Knoll

Normal passive cooling

- Minimal 10 to 20 x basic ventilation (2 × 0.5 m² or 1 m³/s) → additional system necessary
- Burglar-free openings (no windows but grills) or simple mechanical system
- Automatic, proportional temperature control (while you sleep)
- Silent night mode

Cooling needs in low energy houses (results from simulations and measurements)

Summertime

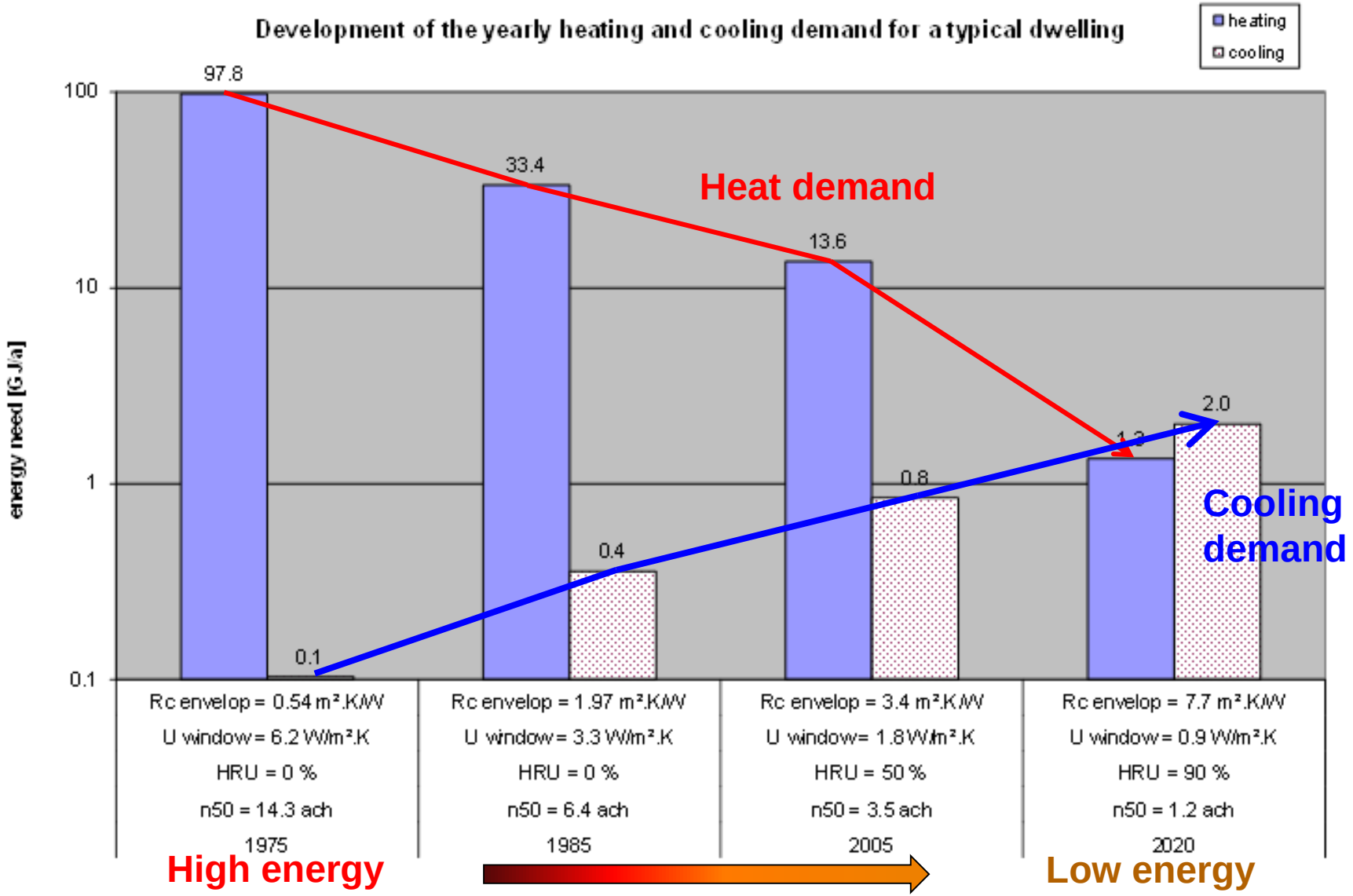
- Increase of cooling demand with decrease of heating demand

Heating season

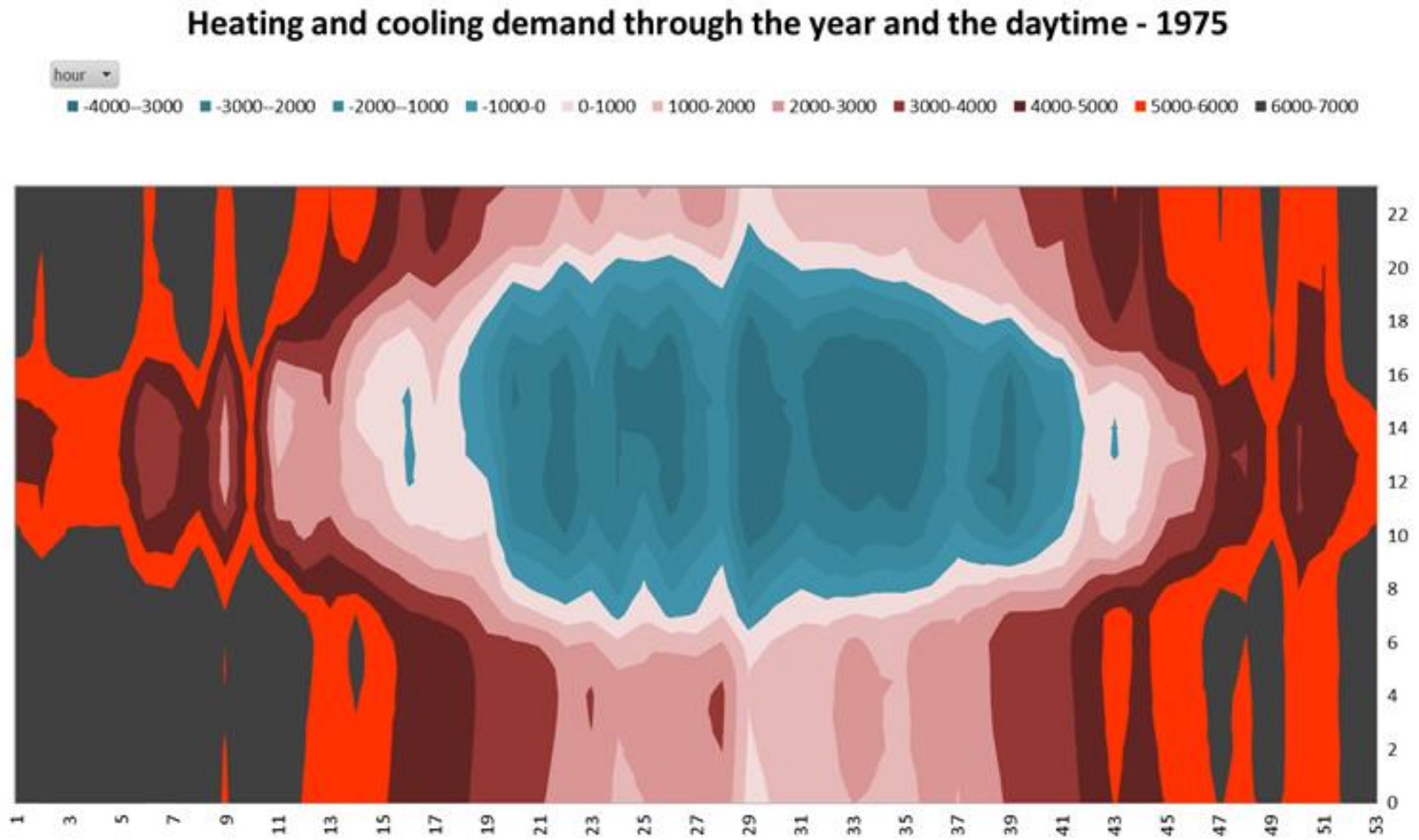
- Need for mitigation
- Time shift preferred
- Zonal temperature differentiation

→ **Illustrations**

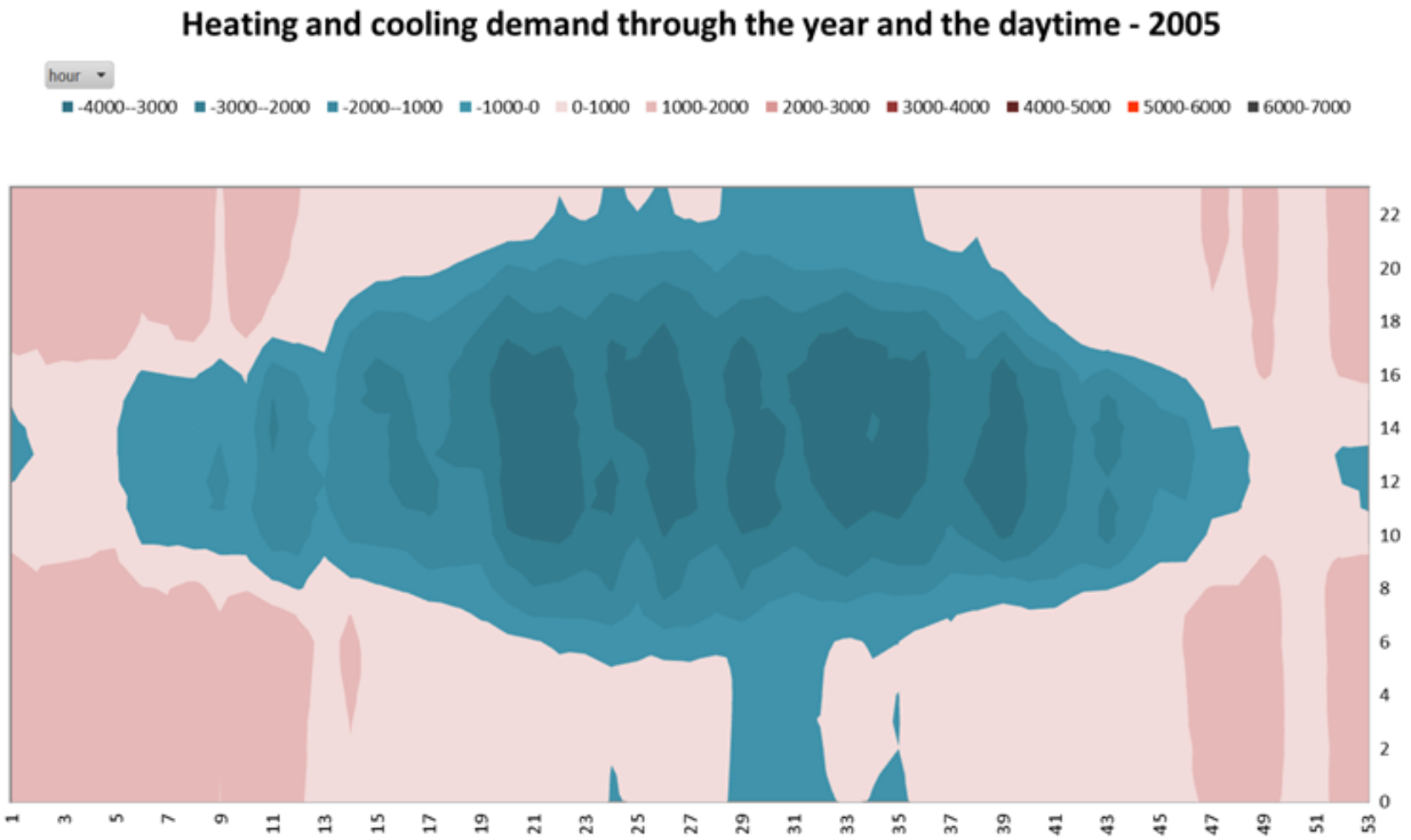
Cooling demand increases while heat demand decreases



Old (high energy): clearly heat demand occurs in winter and during summer night

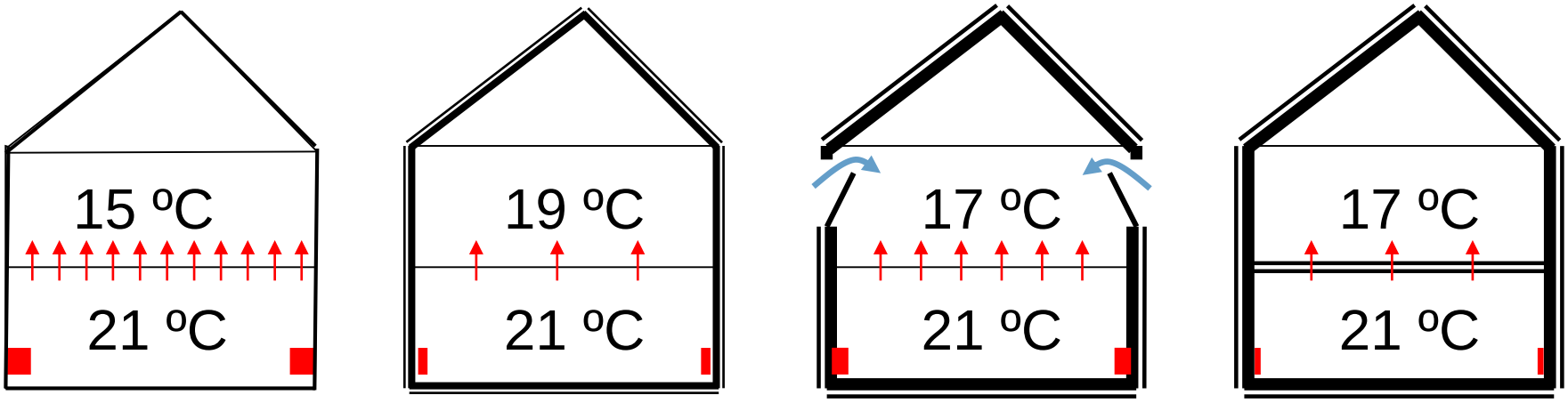


Modern (low energy): cooling demand already in winter and even at summer nights



Zonal temperature differentiation

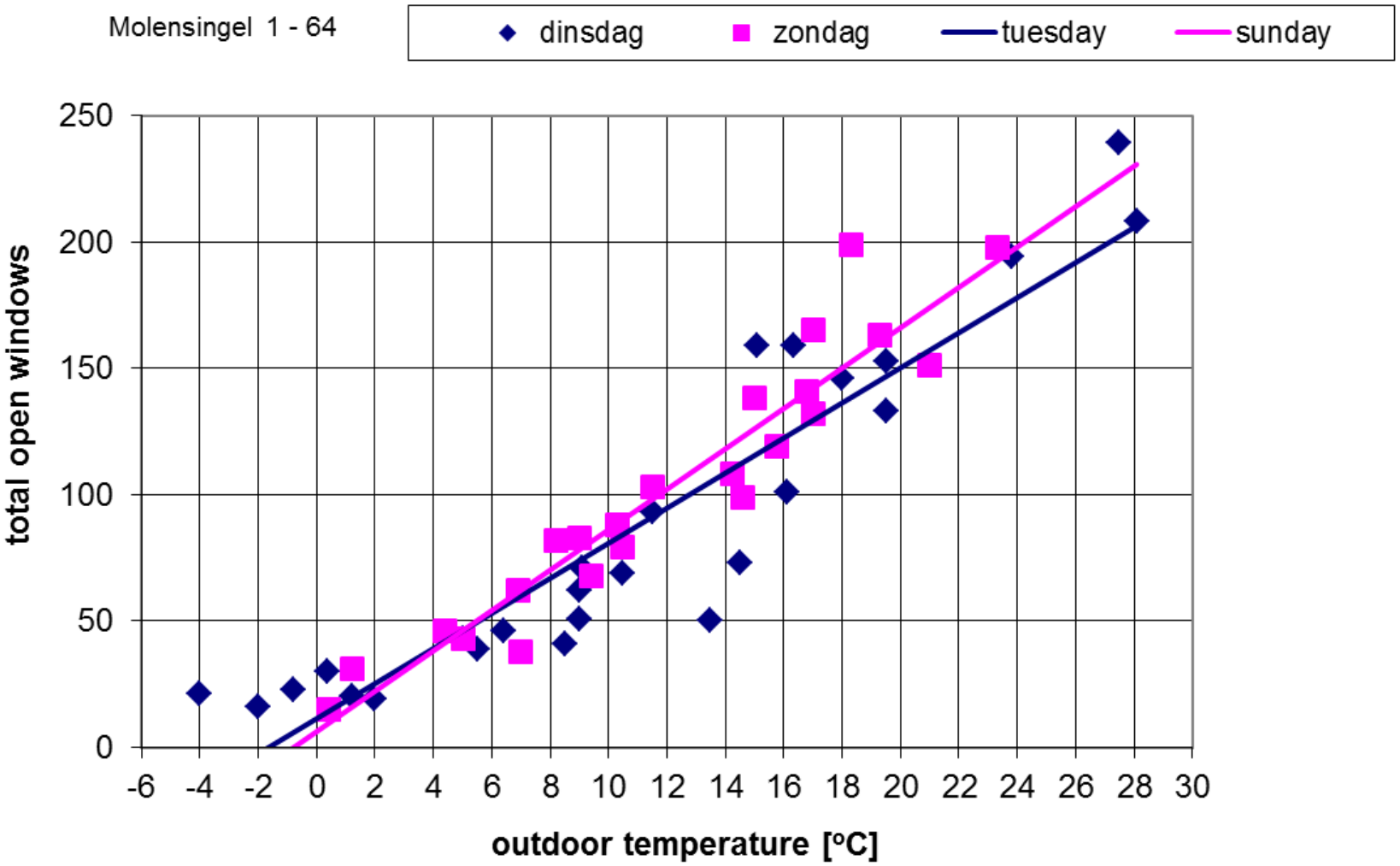
In bed rooms the desired temperature (optimal sleeping condition) is about 17°C, which is about 4 K lower than the living room. Due to increased energy efficiency this cannot be accomplished anymore, resulting in excess heat loss by window opening.



"old" EPC = 0.8 EPC < 0.8 Zonal differentiation

High energy → **Low energy**

Observed window behaviour in HR ventilated low energy dwellings depending on temperature



Desired functional improvements

Summer:

- Extend cooling range
  - Use ground cooling or another ‘high temperature’ buffer
  - Use indirect evaporative cooling (more effective than adiabatic and no undesired humidification of indoor air)

Heating season:

- Increase damping (at least daily cycle), use short term storage
- Apply demand control for both ventilation and heat
- Differentiate in heat distribution over place and time (dynamic)

Low energy:

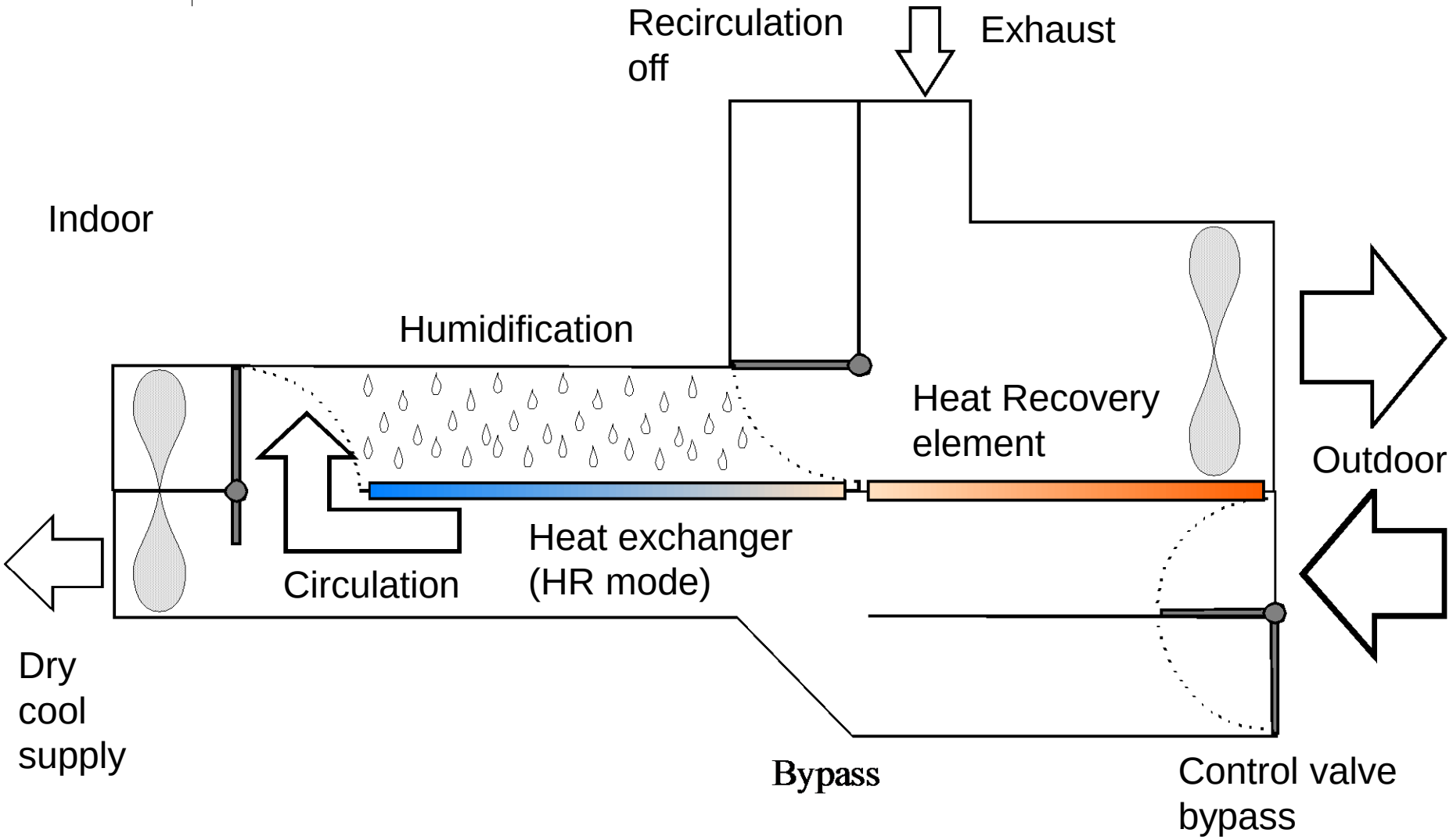
- Rather store than waste excess heat (load night/winter buffer)

Improved passive cooling

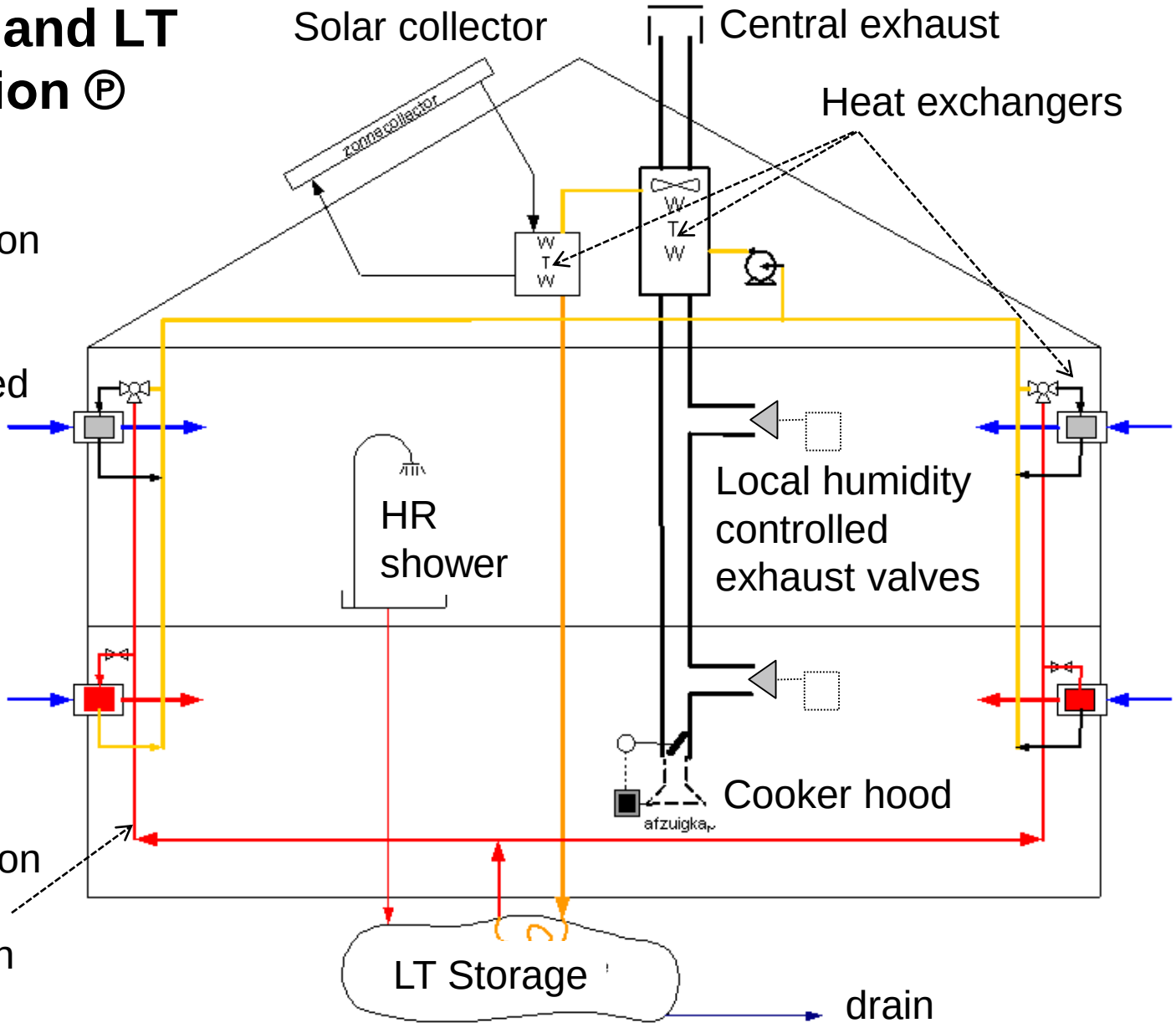
- Precooling by use of a ground duct →
  dew point control necessary to prevent mould growth

- Evaporative cooling 3 to 6 x basic ventilation (0.3 m^3/s) will do →
  additional system necessary
- Possible combination with high volume cooker hood exhaust or with air heating system (recirculation switches to outdoor air)

Evaporative cooling



Decentral HR and LT heat distribution ®



Conclusions

- Low energy houses have a higher cooling demand in summer. Therefore, the use of a cold storage or more extensive natural cooling is preferred
- The cooling needs extend to the heating season. They differ per room and in time
- Hence, new ventilative cooling possibilities are propagated to control the temperature in low energy buildings
- The collection of excess heat is preferred above wasting it
- Demand control has to deal with not only ventilation but also with heat
- The ventilation system is an ideal LT-heat distributor, while it already has the distribution function and it is the rare medium with temperatures below room level