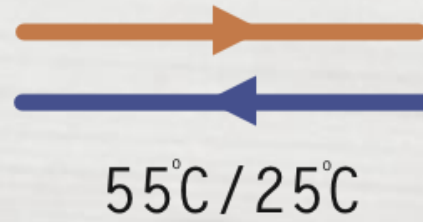




Low-temperature district heating for space heating in existing houses

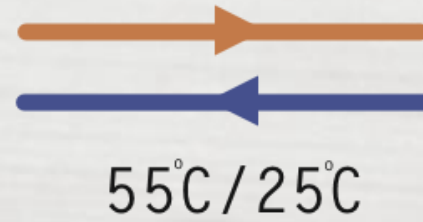
Low-temperature district heating for space heating in existing houses

Low-temperature district heating

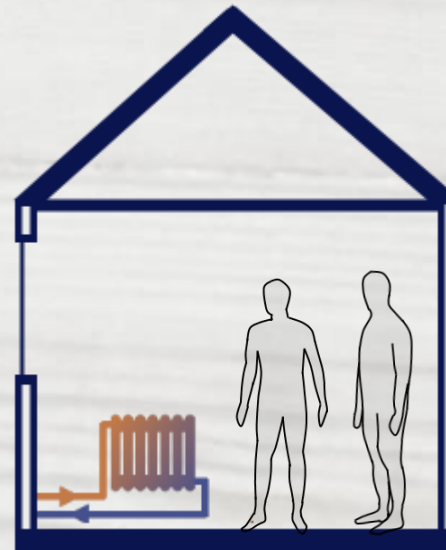


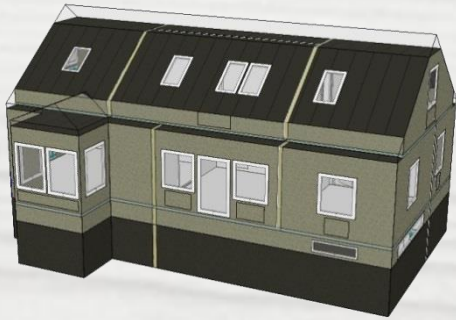
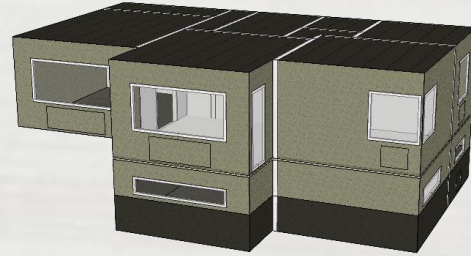
Low-temperature district heating for space heating in existing houses

Low-temperature district heating

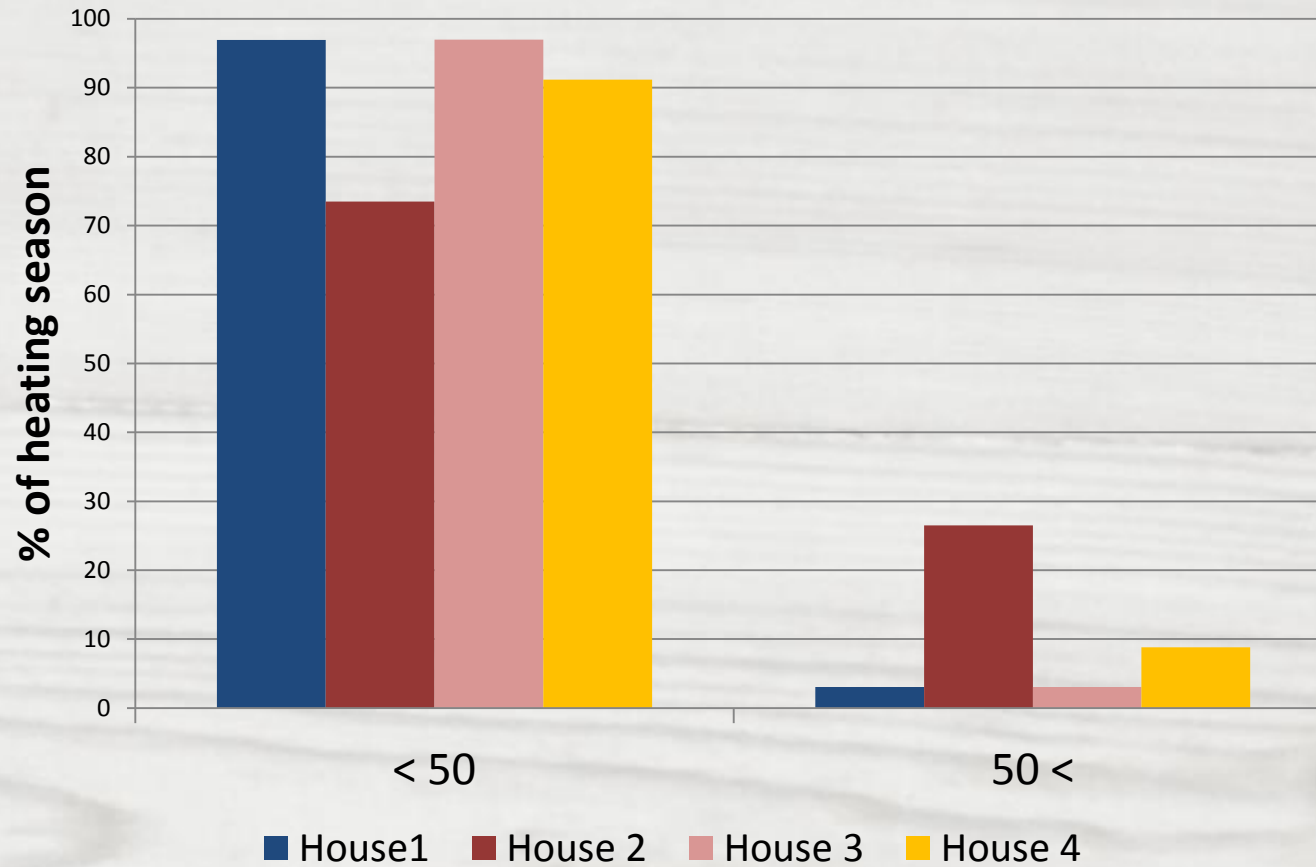


Occupant comfort?

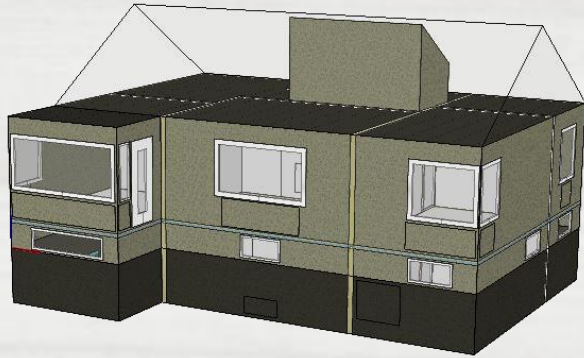




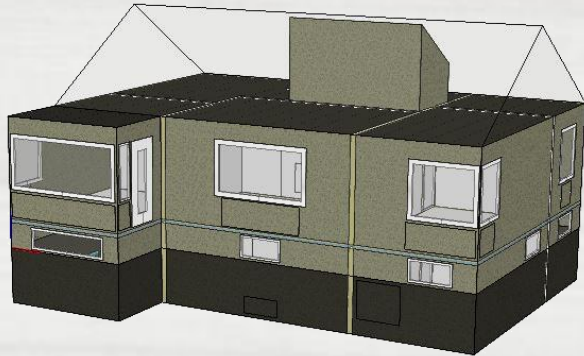
Supply temperatures



Simulation models



Simulation models



Building constructions

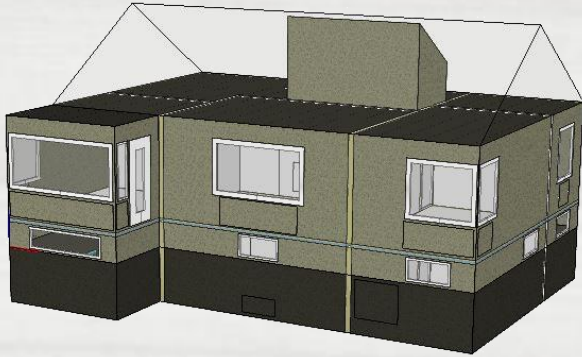
Simulation models



Building constructions

Internal heat gains

Simulation models

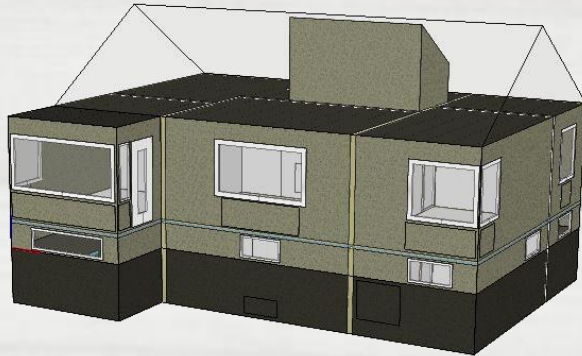


Building constructions

Internal heat gains

Installations / heat loss from pipes

Simulation models



Building constructions

Internal heat gains

Installations / heat loss from pipes

Actual radiators

Measurements



Indoor temperatures in all rooms

Measurements



Indoor temperatures in all rooms



Return temperatures from radiators
and boiler temperatures

Measurements



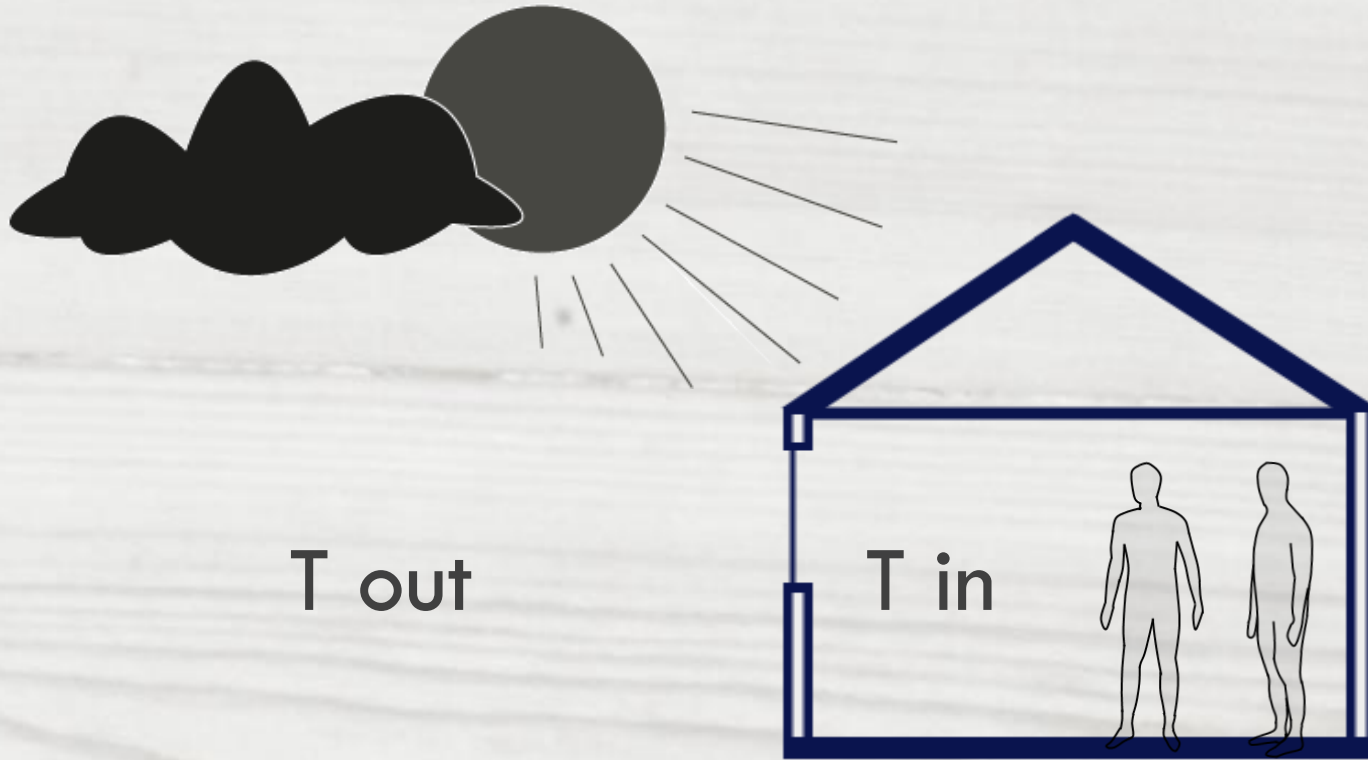
Indoor temperatures in all rooms



Return temperatures from radiators
and boiler temperatures

→ Validation of model and occupant behaviour

Dynamic evaluation



Comparison of heat demand and radiator sizes

Comparison of heat demand and radiator sizes

- Calculate hourly heat demand

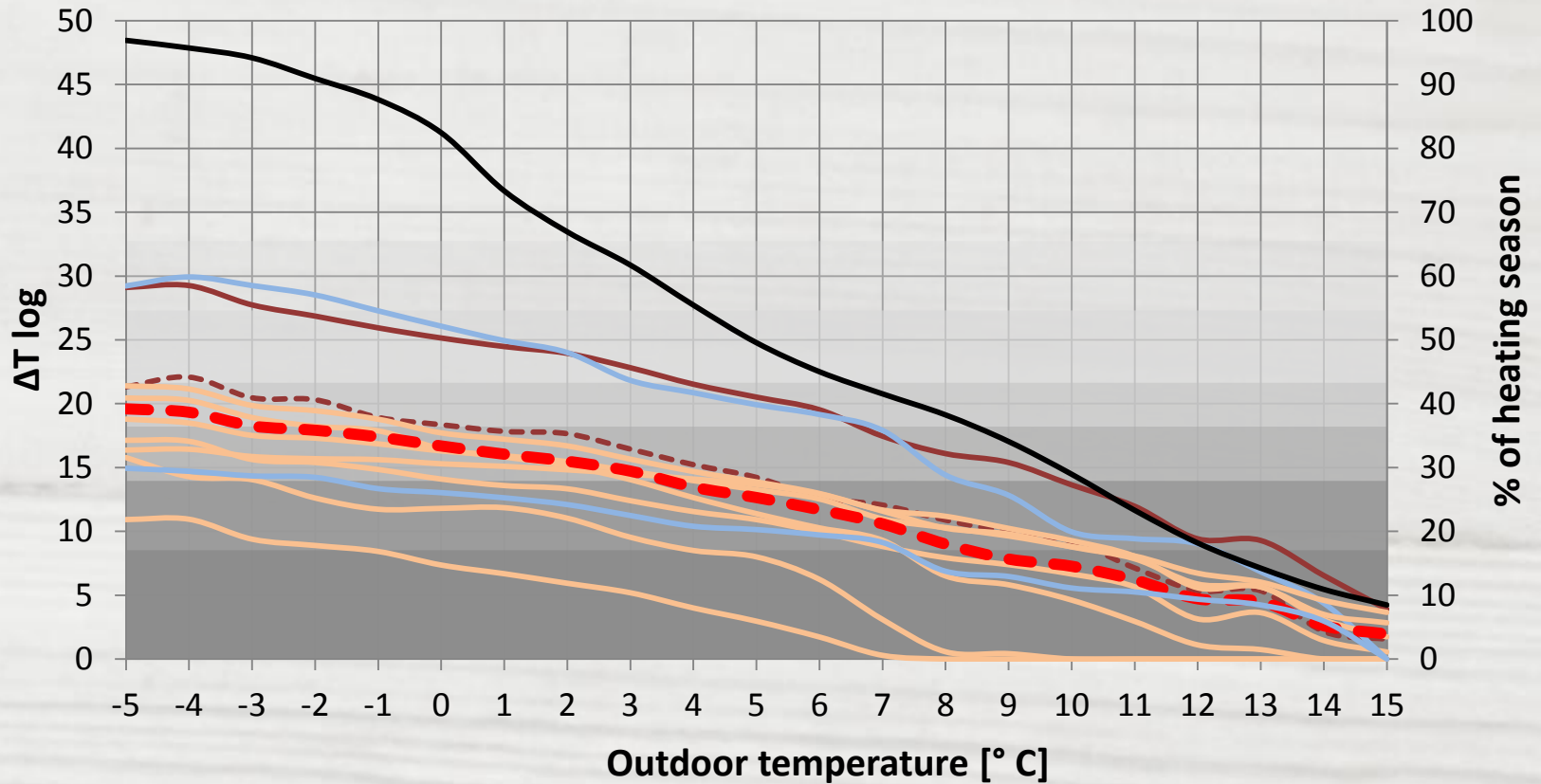
Comparison of heat demand and radiator sizes

- Calculate hourly heat demand
- Compare to actual radiator size

Comparison of heat demand and radiator sizes

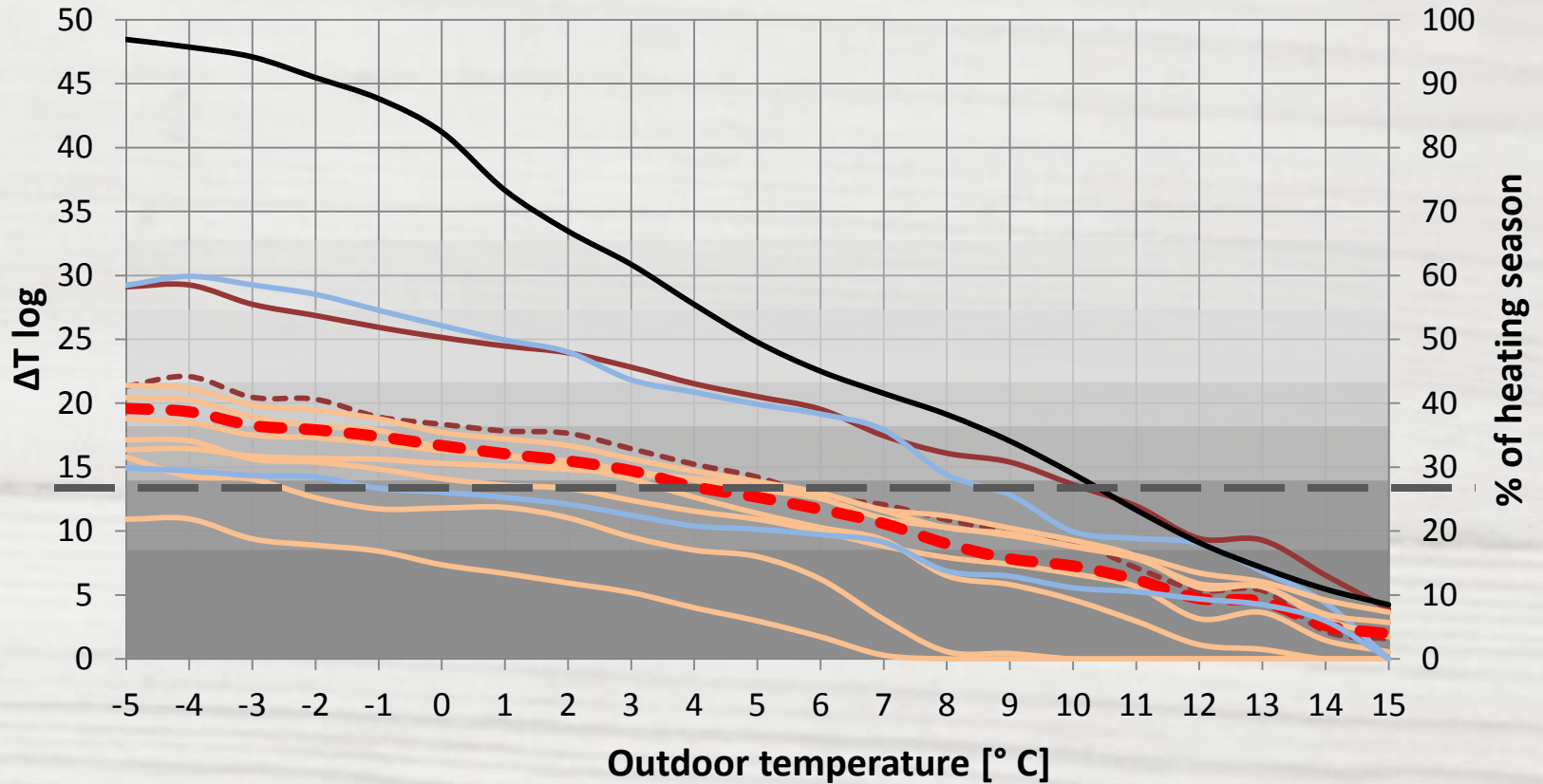
- Calculate hourly heat demand
- Compare to actual radiator size
- Calculate necessary ΔT_{log} to cover heat demand

House 3 - Required Heating temperatures



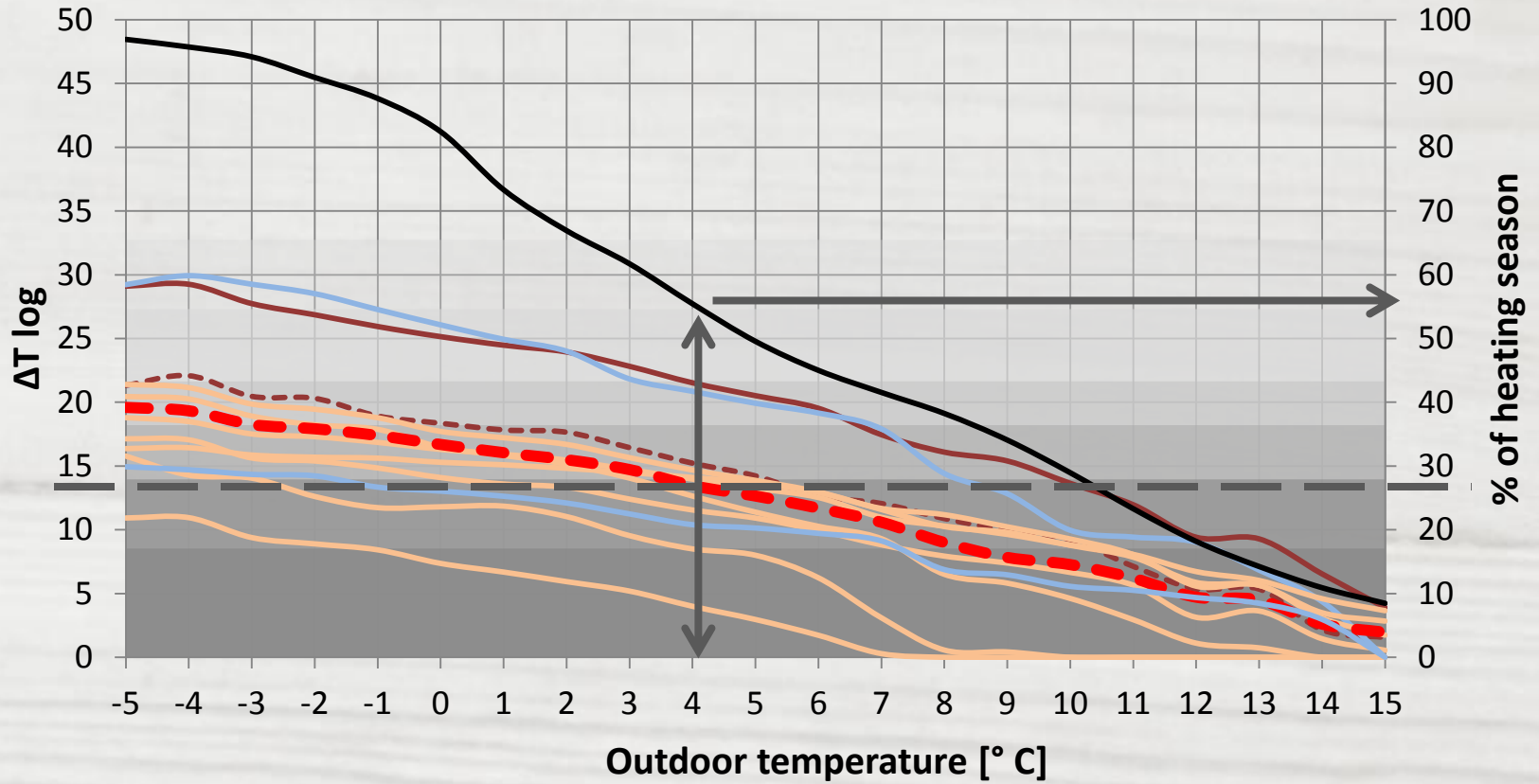
- 70/40/20
- 65/35/20
- 50/35/20
- 50/30/20
- 50/25/20
- 50/21/20
- Bathroom
- Office Man
- Other rooms
- Basement rooms
- Total
- Duration curve T_{out} [%]

House 3 - Required Heating temperatures



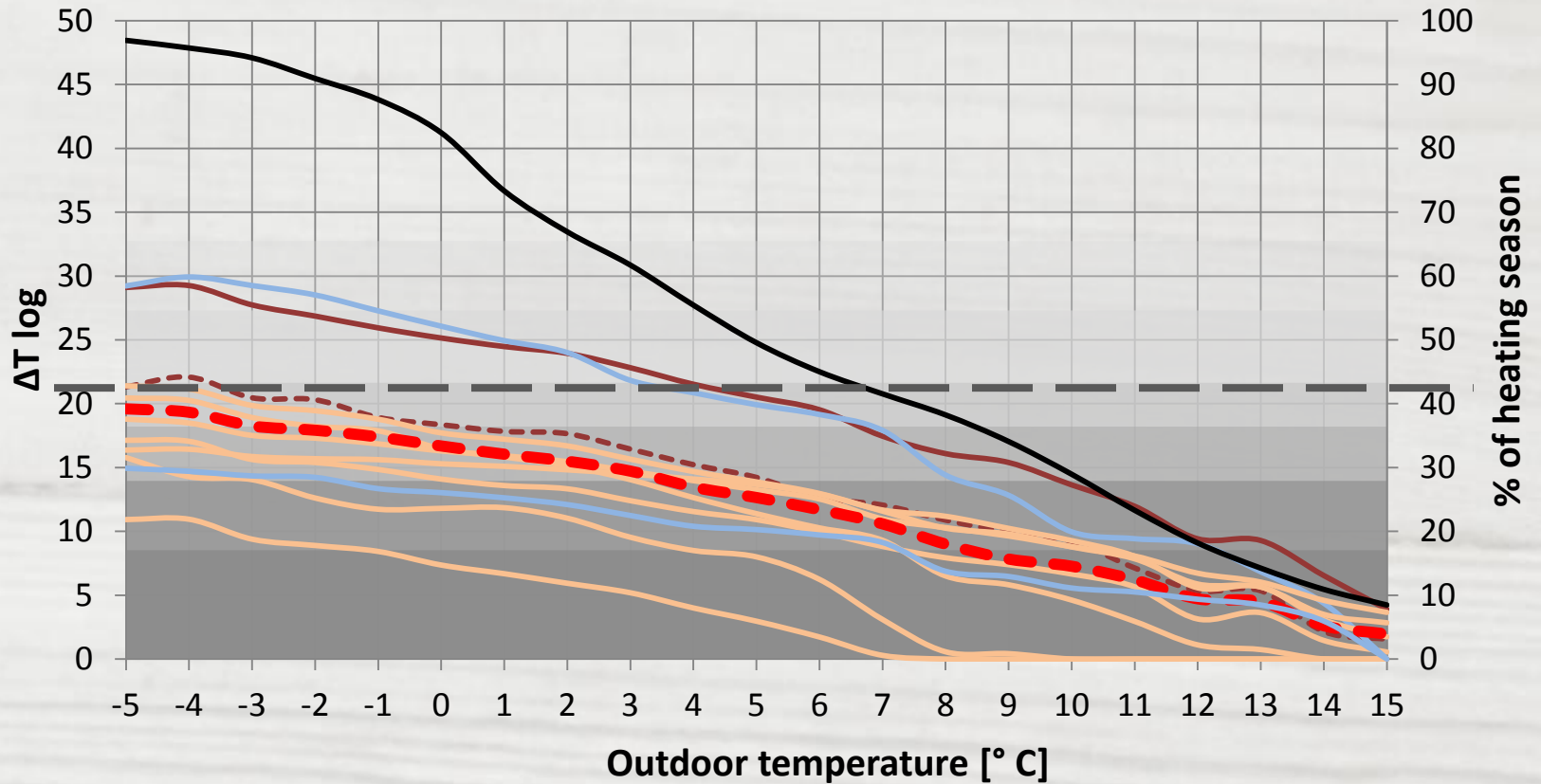
- 70/40/20
- 50/30/20
- Bathroom
- Basement rooms
- 65/35/20
- 50/25/20
- Office Man
- Total
- 50/35/20
- 50/21/20
- Other rooms
- Duration curve T_{out} [%]

House 3 - Required Heating temperatures



- 70/40/20
- 65/35/20
- 50/35/20
- 50/30/20
- 50/25/20
- 50/21/20
- Bathroom
- Office Man
- Other rooms
- Duration curve T_{out} [%]
- Basement rooms
- Total

House 3 - Required Heating temperatures



70/40/20

50/30/20

Bathroom

Basement rooms

65/35/20

50/25/20

Office Man

Total

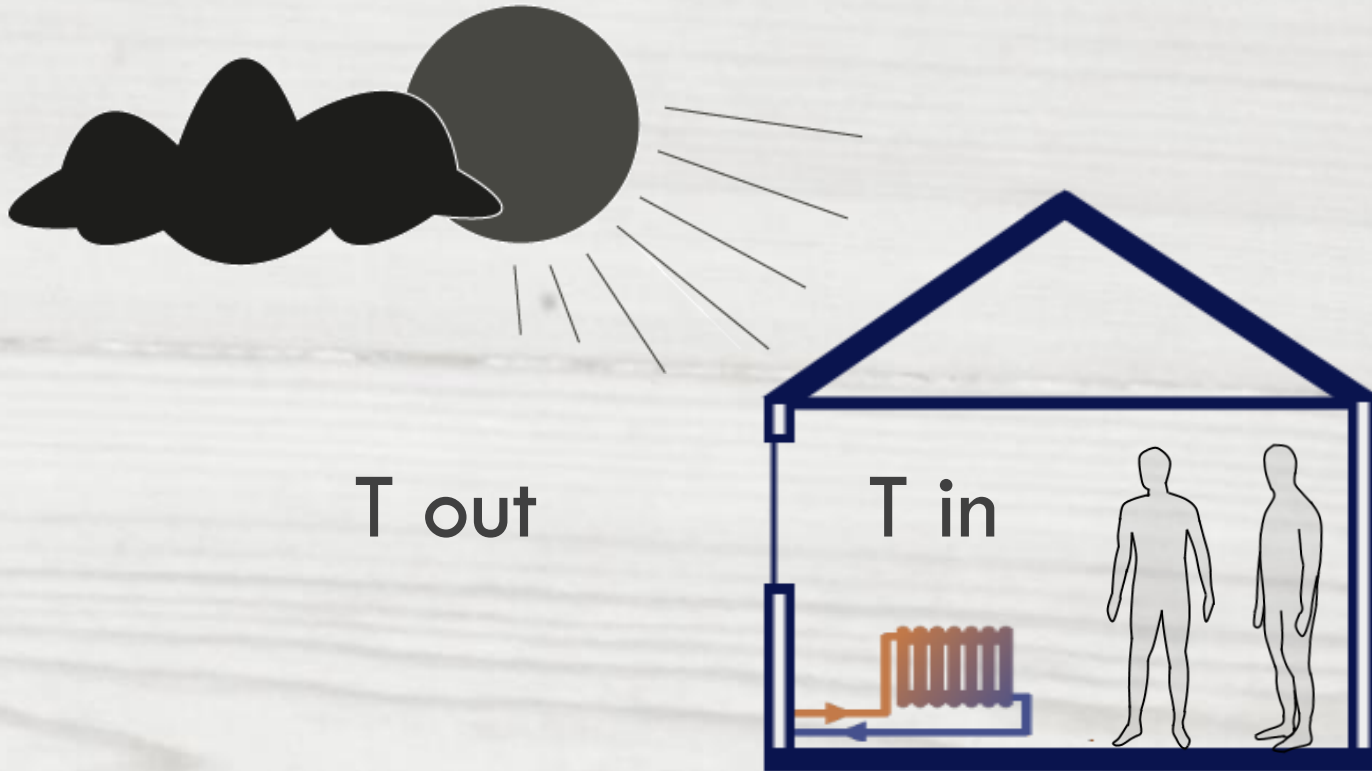
50/35/20

50/21/20

Other rooms

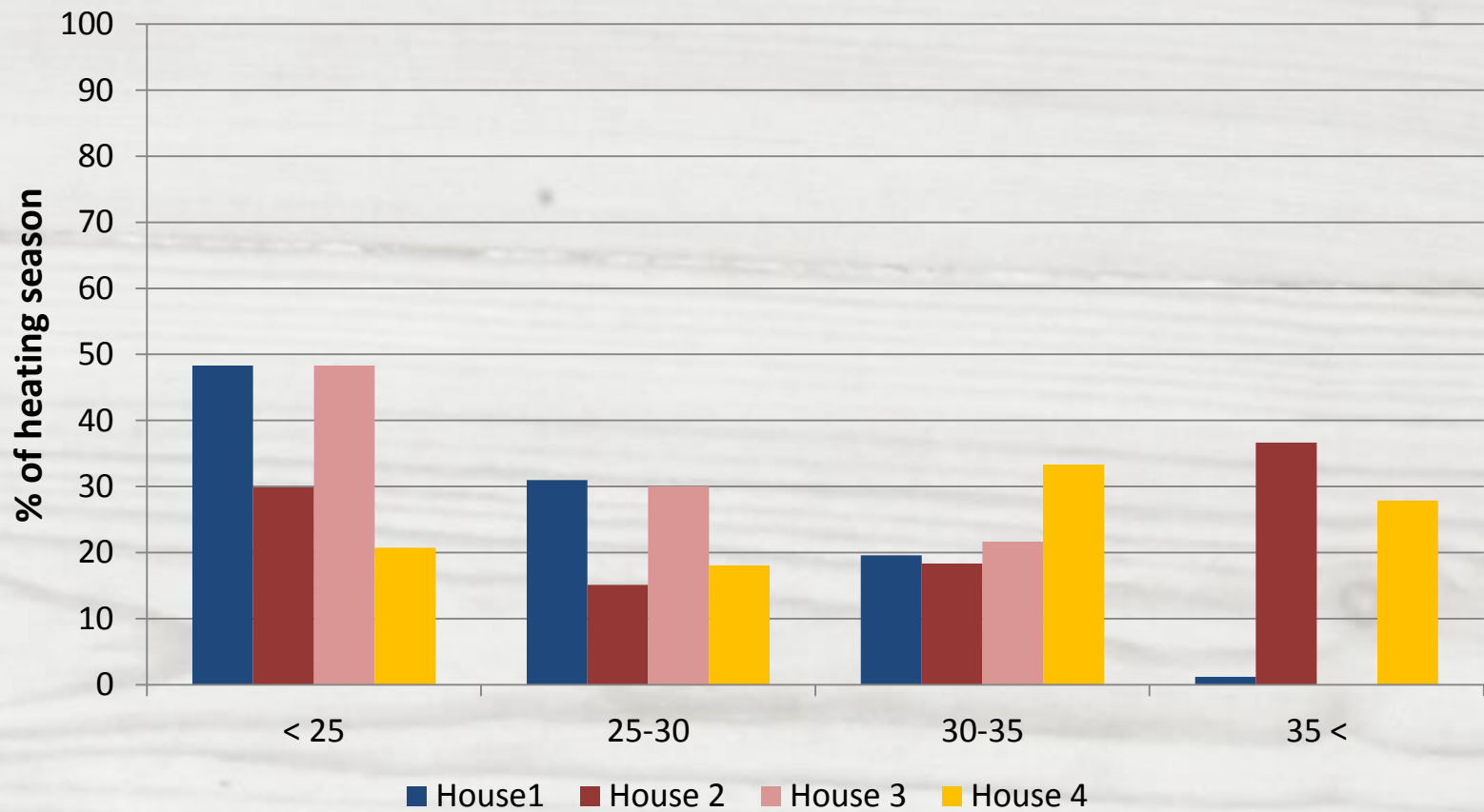
Duration curve T_out [%]

Annual simulation



Return temperatures

Return temperatures

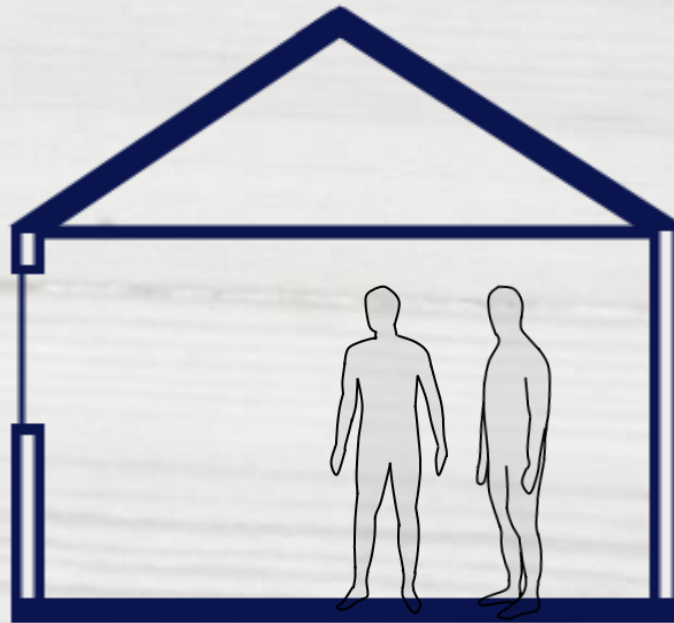


Indoor temperatures



Important parameters

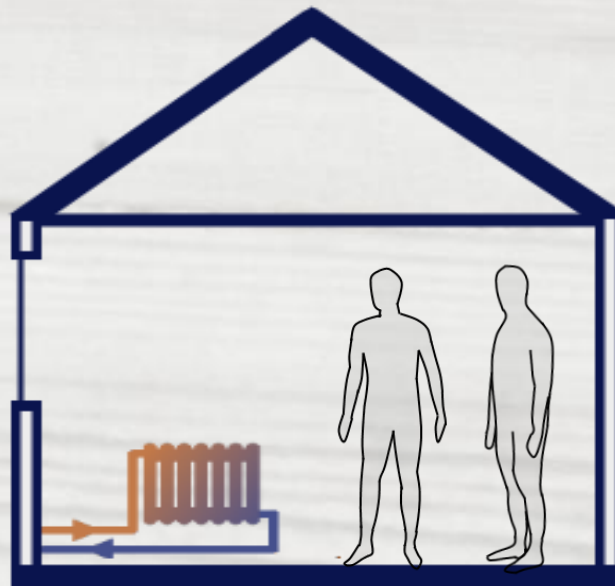
Important parameters



What now?

What now?

Measurements during real tests in the winter of 2015



Questions or comments?

(or come find me afterwards)



