Net Zero by 2025?

A deep eco-refurbishment

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TRANSITION by DESIGN

amc build

green building store

JOJUSOLAR

- WARM: Low Energy Building Practice

CLIENT BACKGROUND

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

LIVING THE CHANGE
Faithful choices for a flourishing world

GLOBAL ECOVILLAGE NETWORK

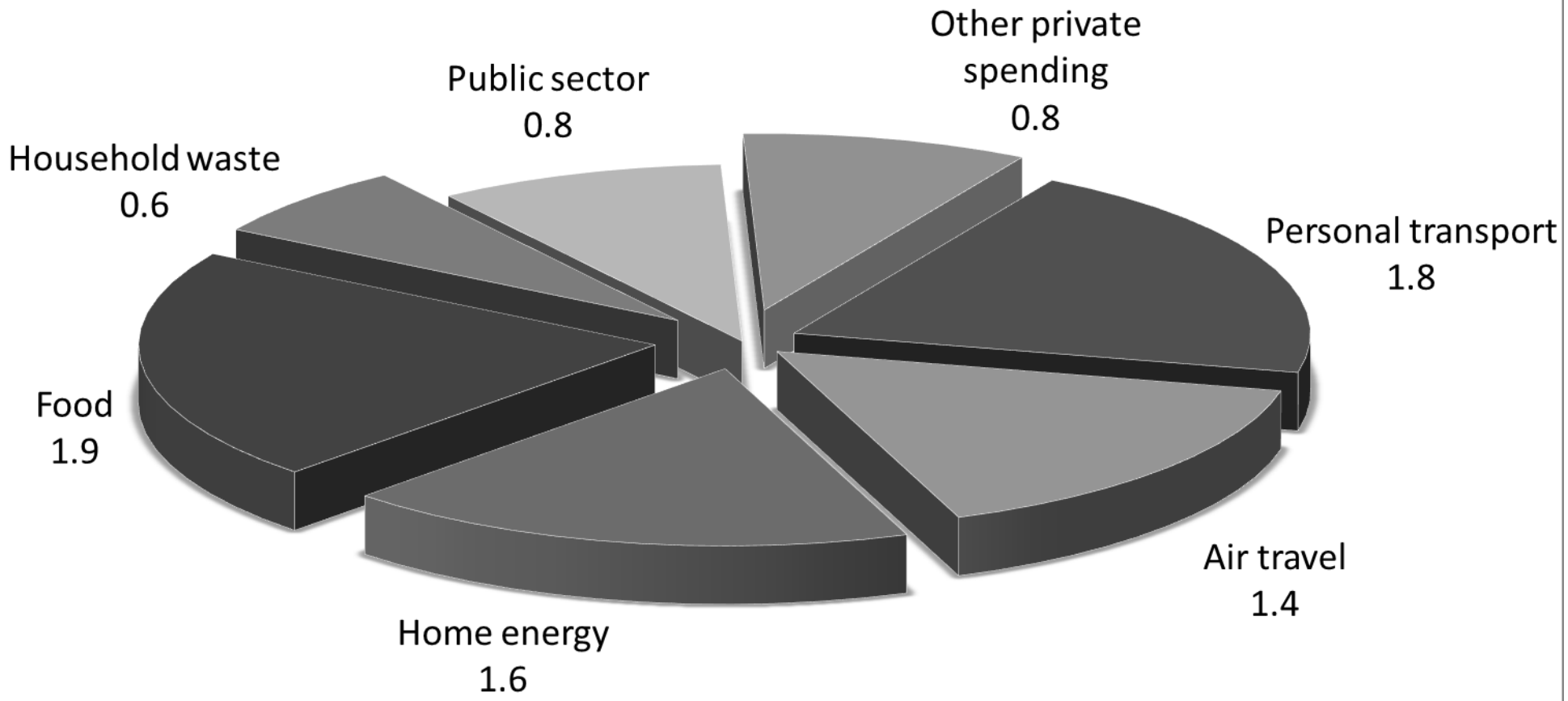
Oxford Commission on Sustainable Consumption

living witness
Quakers for Sustainability

FACING DIFFICULT TRUTHS
Climate Psychology Alliance

Most greenhouse gas emissions can be traced to lifestyles

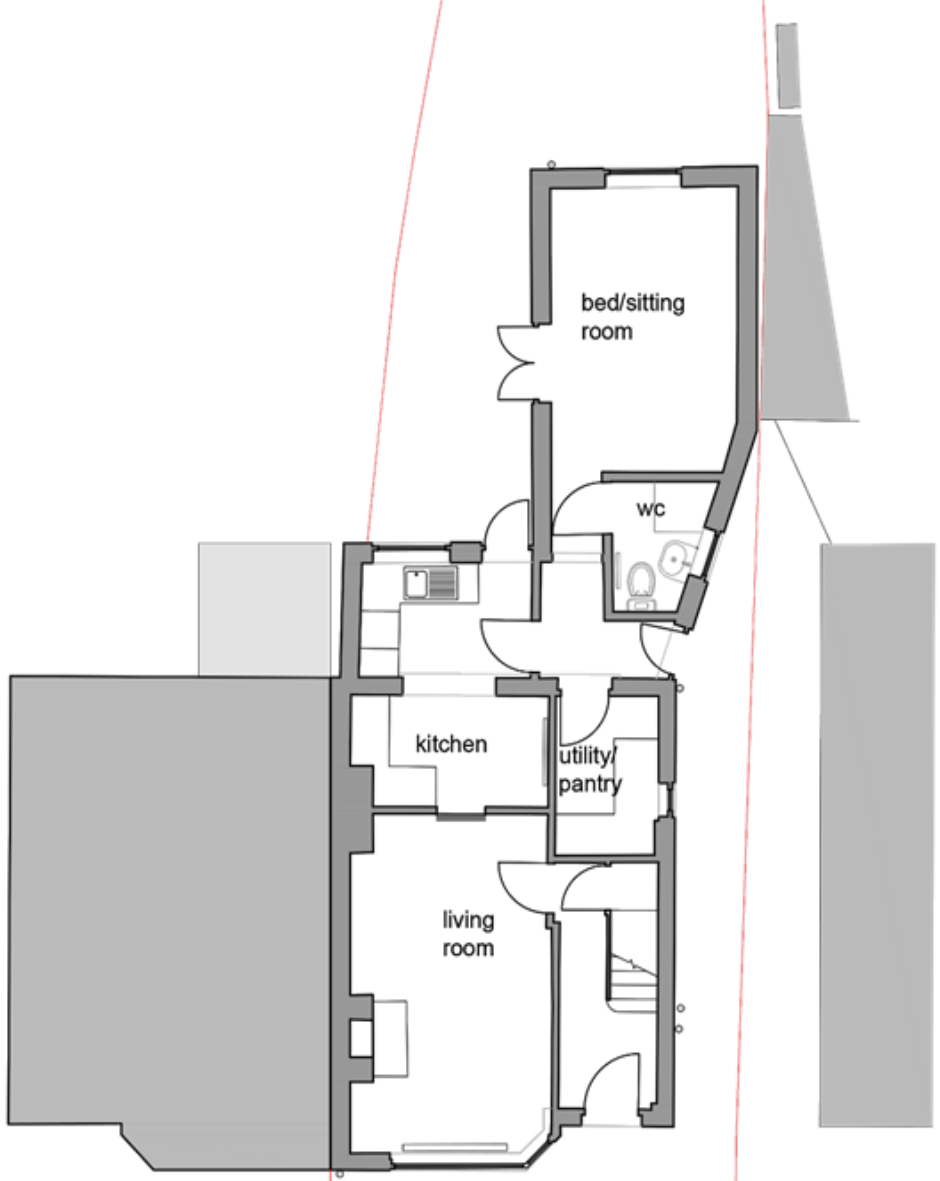
Emissions per average UK resident - approx 9 tonnes/year CO2-equivalent
Consumption basis - includes GHG embodied in trade

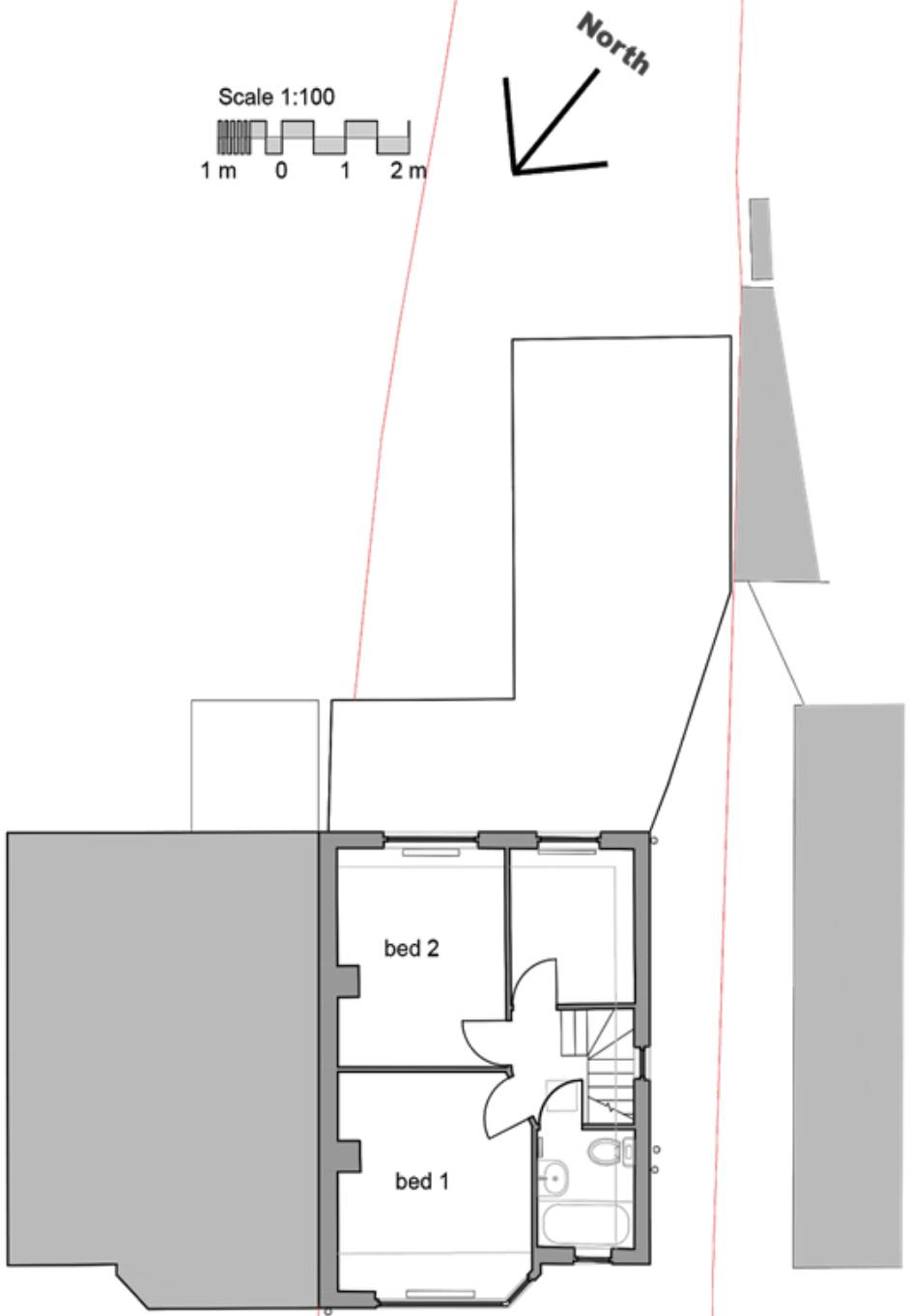


Public sector includes schools, hospitals, government buildings, the military etc.

"Other private spending" includes clothing, furniture, electrical equipment, house building, and services such as telecoms, finance and entertainment.

House plan before rebuild





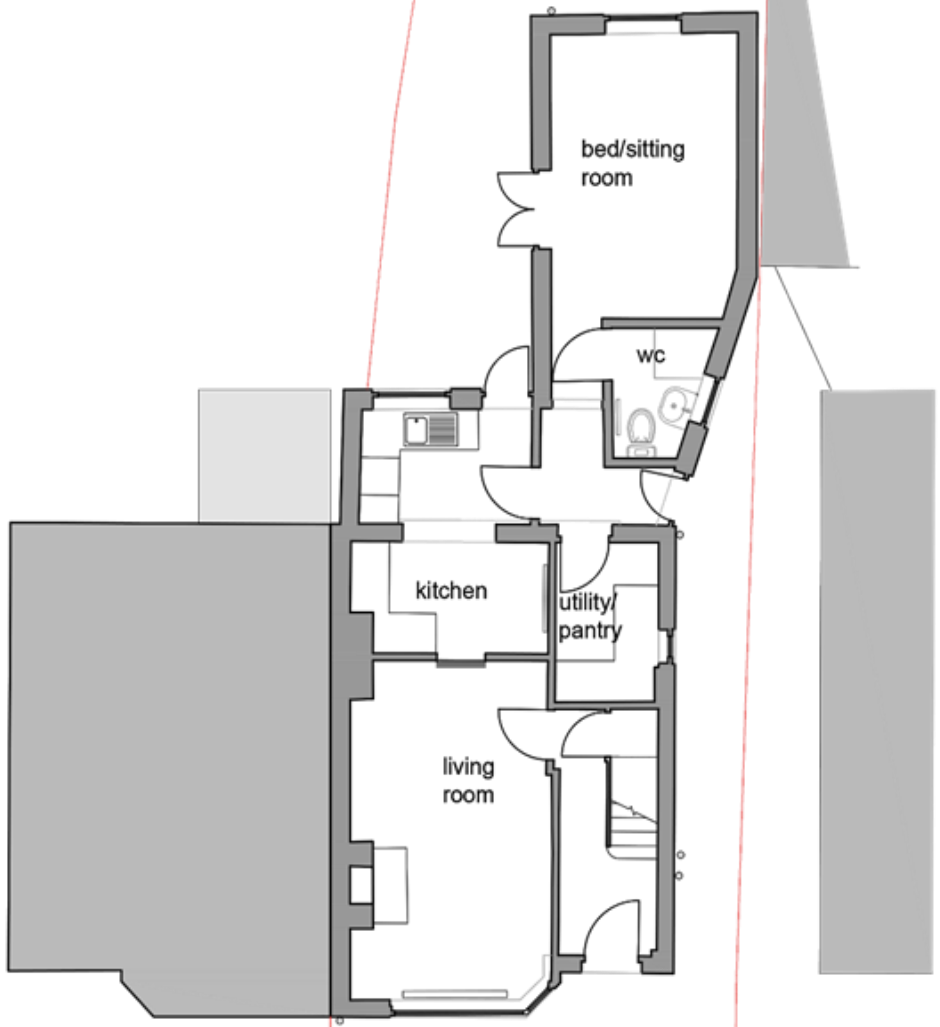
Design brief: comfort, health, sustainability

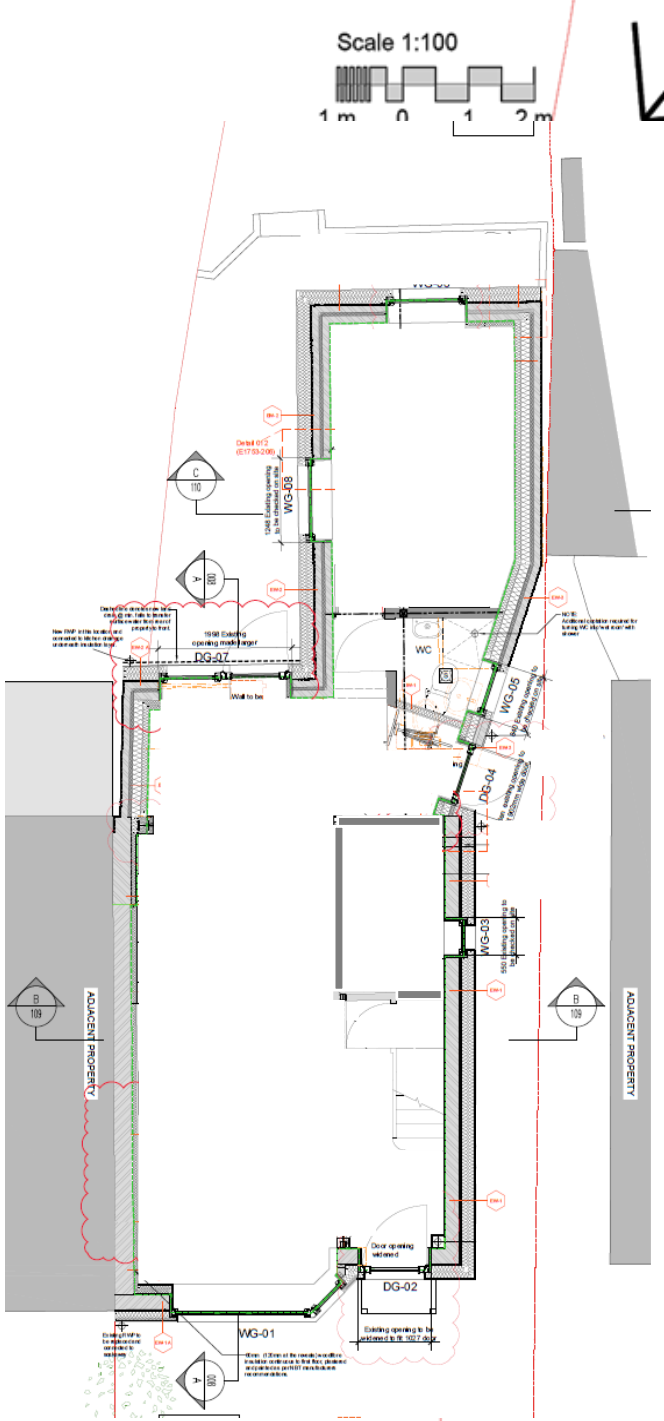
- A good house to live in over the next 20+ years, when I may become less fit and healthy (now aged 60)
- Warm throughout without use of fossil fuels or net consumption of grid electricity (min. 15°C, ideally 18°C in winter)
- Clean air, no mould (so lower humidity and no cold spots)
- More comfortable for guests who have different expectations of warmth, hot water etc.
- Consider composting toilet on ground floor
- Natural materials where possible, but trumped by energy efficiency

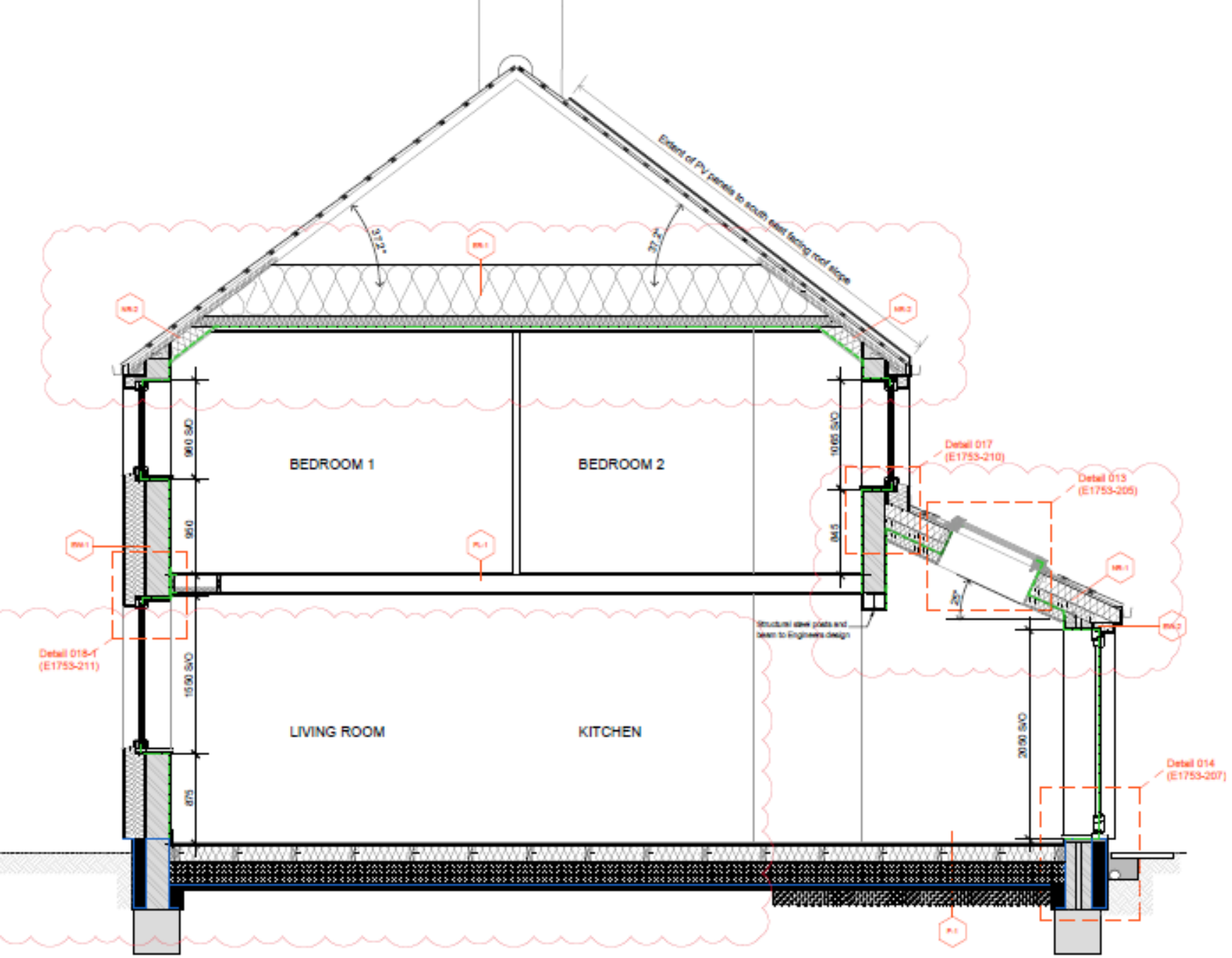
Design brief: remodelling

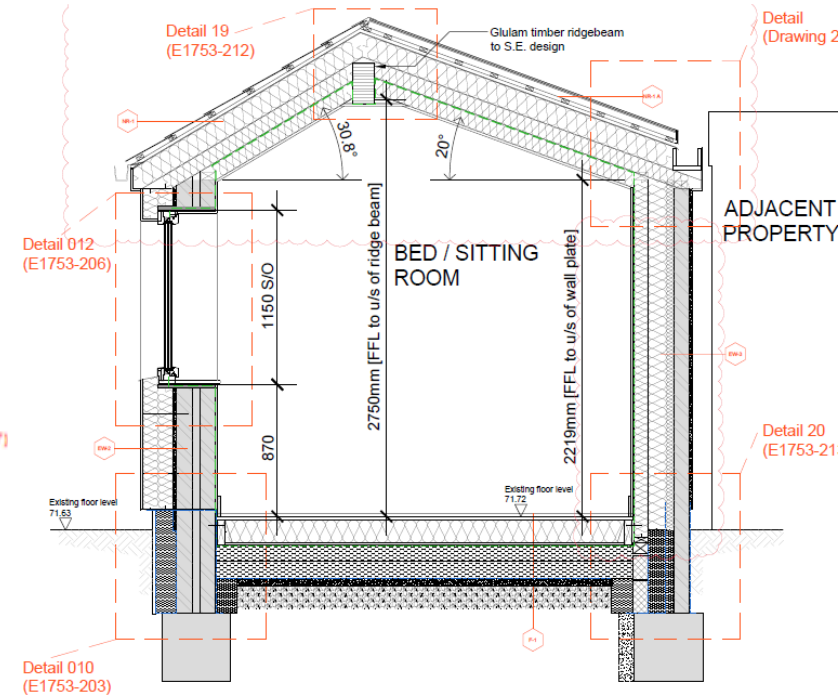
- Potential to share house with someone living fairly independently (separate kitchen and bathroom –potential for kitchenette in smallest bedroom)
- Open up ground floor to make it light and spacious
- Space for family gatherings (16 people around table)
- Replace flat roof on extension with pitched roof – again making it more spacious and also more durable
- Remove chimney breasts for space (also helpful to reduce thermal losses)
- Space for hanging bike storage
- Function and quality more important than aesthetics

Ground floor changes



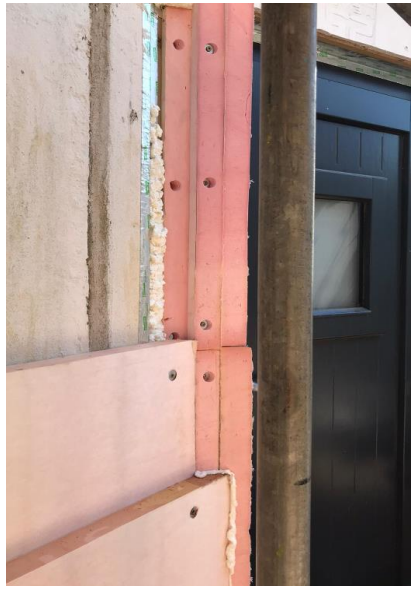



Extent of PV panels to south east facing roof slope
37.2°
37.2°
BEDROOM 1
BEDROOM 2
LIVING ROOM
KITCHEN
960 S/O
950
1590 S/O
875
1065 S/O
845
2090 S/O
20°
Structural steel posts and beam to Engineers design
Detail 017 (E1753-210)
Detail 013 (E1753-205)
Detail 018-1 (E1753-211)
Detail 014 (E1753-207)


Detail 19 (E1753-212)
Glulam timber ridgebeam to S.E. design
Detail (Drawing 2
30.8°
20°
ADJACENT PROPERTY
Detail 012 (E1753-206)
BED / SITTING ROOM
1150 S/O
2750mm [FFL to u/s of ridge beam]
2219mm [FFL to u/s of wall plate]
870
Existing floor level 71.63
Existing floor level 71.72
Detail 20 (E1753-21
Detail 010 (E1753-203)

Main insulation types

EWI, some IWI
and new roof
phenolic foam



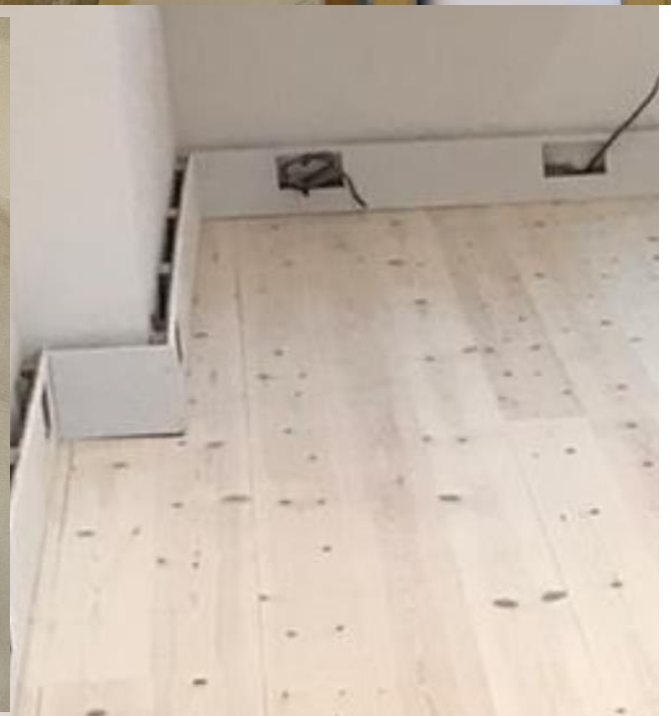
Some IWI
Woodfibre

Floor
PIR (polyisocyanurate)

Walls below DPM to
foundations
XPS (expanded polystyrene)

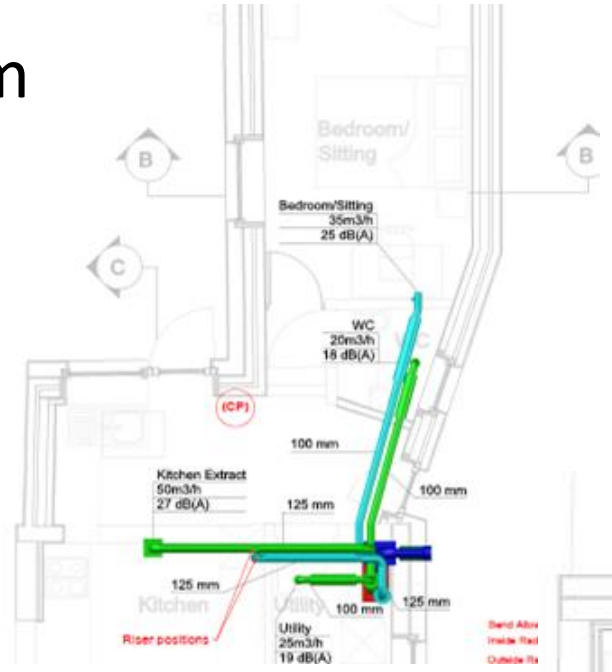
Loft, studwork, rafters etc
Mineral wool

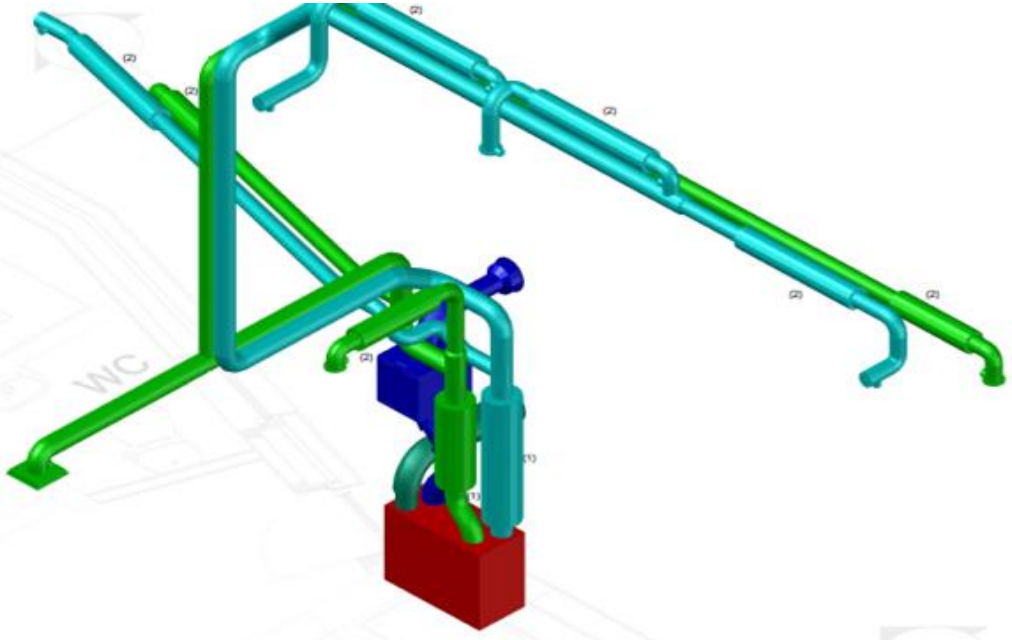
Airtightness

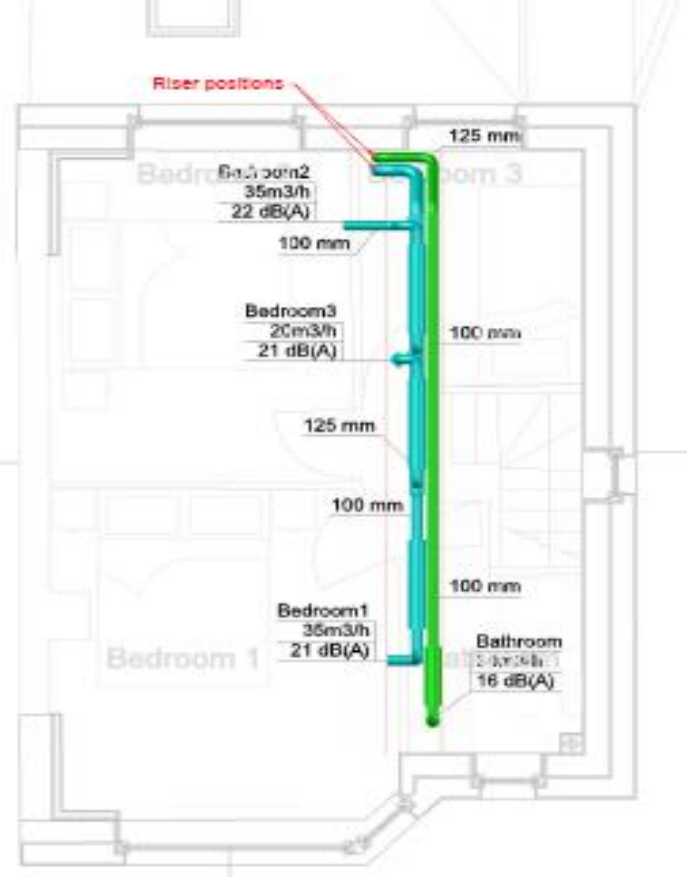


Passivhaus windows built into wall insulation

MVHR system

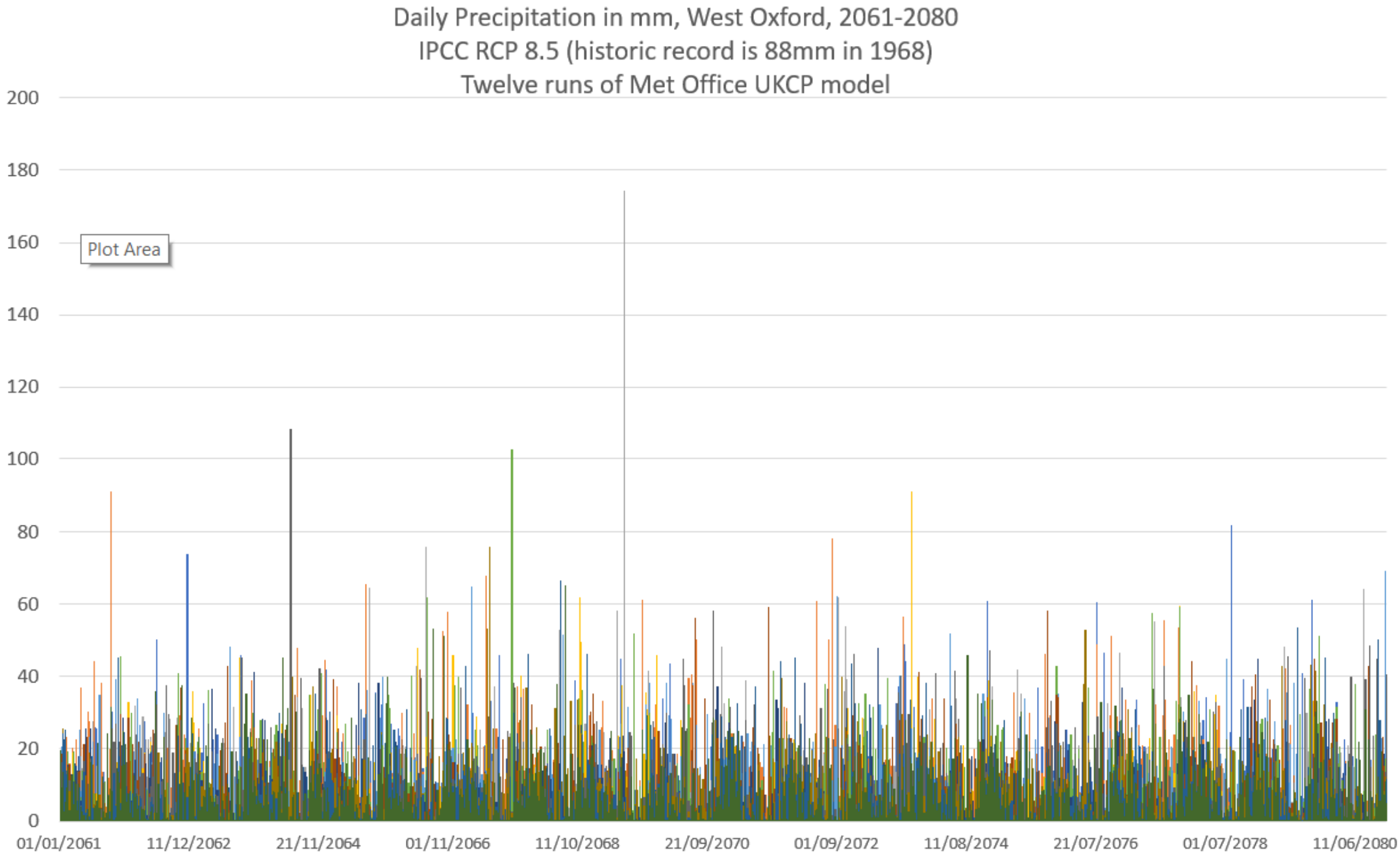

Bedroom/Sitting
35m3/h
25 dB(A)
WC
20m3/h
18 dB(A)
(CP)
100 mm
Kitchen Extract
50m3/h
27 dB(A)
125 mm
100 mm
125 mm
Riser positions
Utility
25m3/h
19 dB(A)
100 mm
125 mm



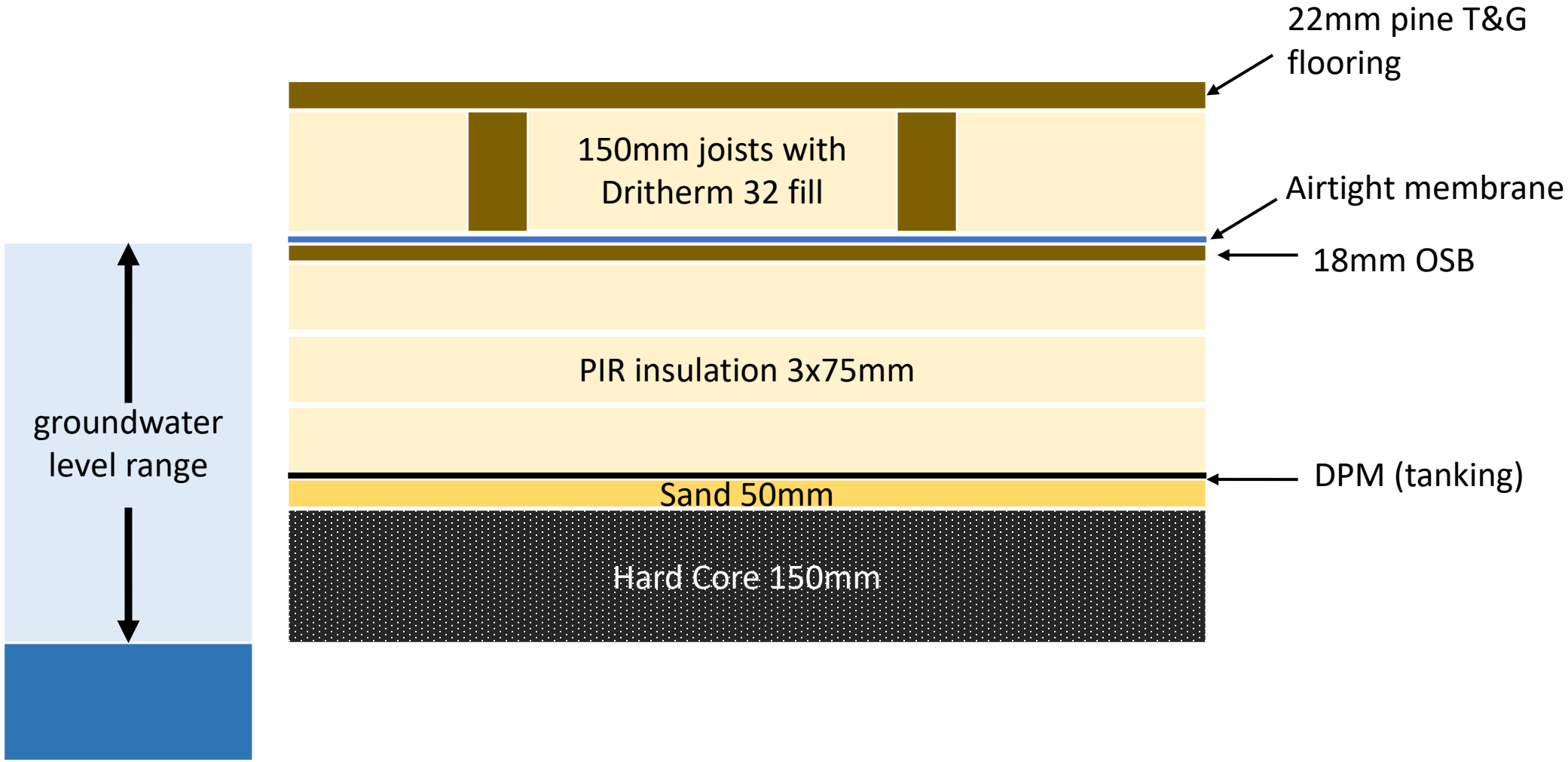

Riser positions
125 mm
35m3/h
22 dB(A)
100 mm
Bedroom3
20m3/h
21 dB(A)
100 mm
125 mm
100 mm
100 mm
Bedroom1
35m3/h
21 dB(A)
Bathroom
16 dB(A)

Air to air heat pump

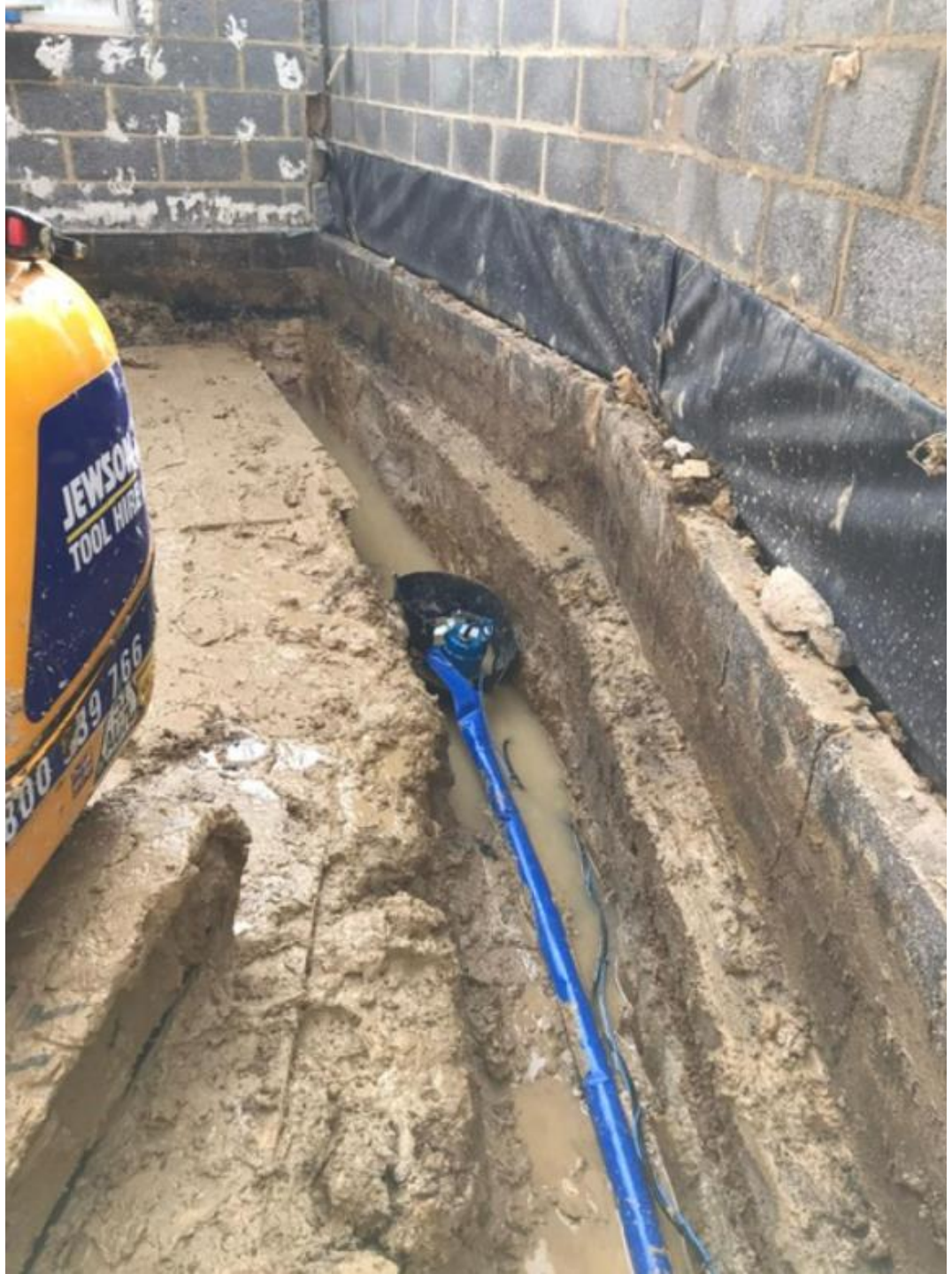
Point of use tankless water heaters


Daily Precipitation in mm, West Oxford, 2061-2080
IPCC RCP 8.5 (historic record is 88mm in 1968)
Twelve runs of Met Office UKCP model
Plot Area
200
180
160
140
120
100
80
60
40
20
0
01/01/2061
11/12/2062
21/11/2064
01/11/2066
11/10/2068
21/09/2070
01/09/2072
11/08/2074
21/07/2076
01/07/2078
11/06/2080

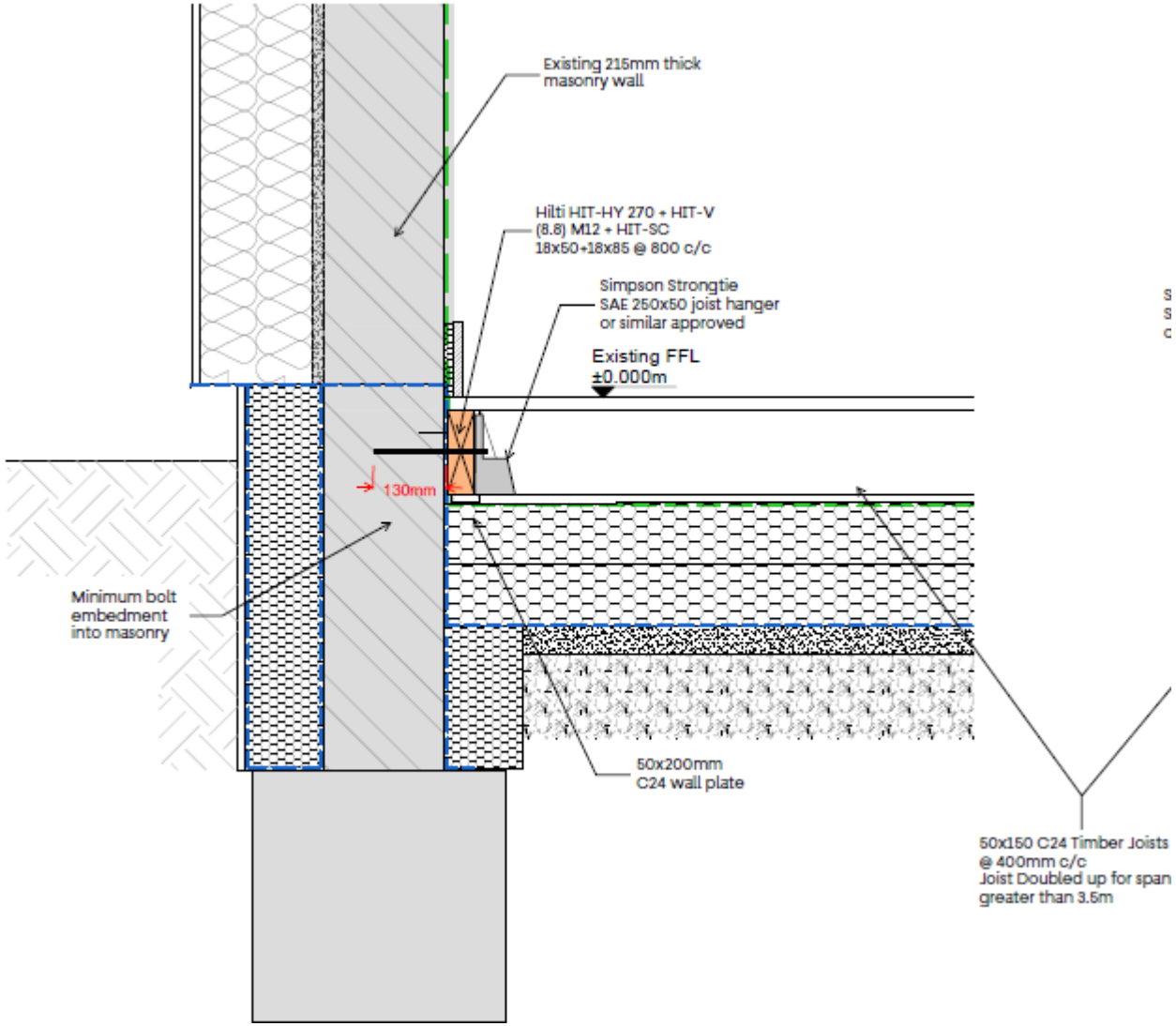
Floor structure can withstand ground water rising to surface (flash flooding)



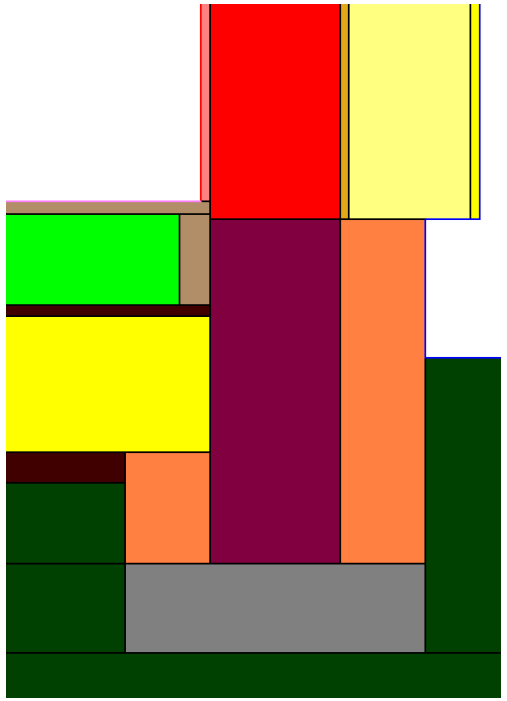
Under floor drainage



Floor buildup

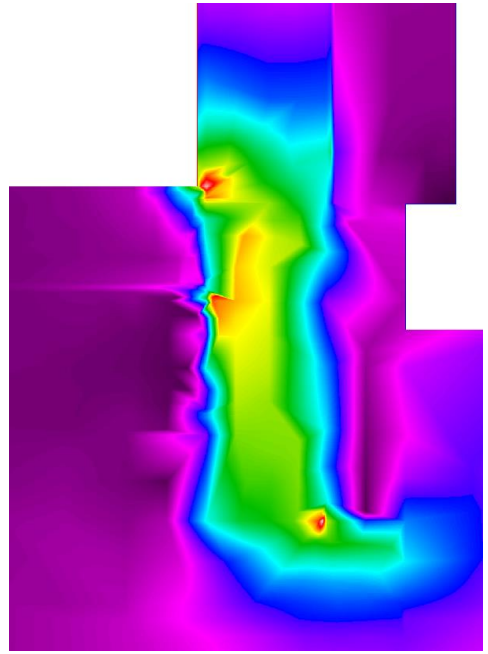

Existing 215mm thick masonry wall
Hilti HIT-HY 270 + HIT-V (8.8) M12 + HIT-SC 18x50+18x85 @ 800 c/c
Simpson Strongtie SAE 250x50 joist hanger or similar approved
Existing FFL ±0.000m
130mm
Minimum bolt embedment into masonry
50x200mm C24 wall plate
50x150 C24 Timber Joists @ 400mm c/c
Joist Doubled up for span greater than 3.5m

Modelling of thermal bridge to foundations



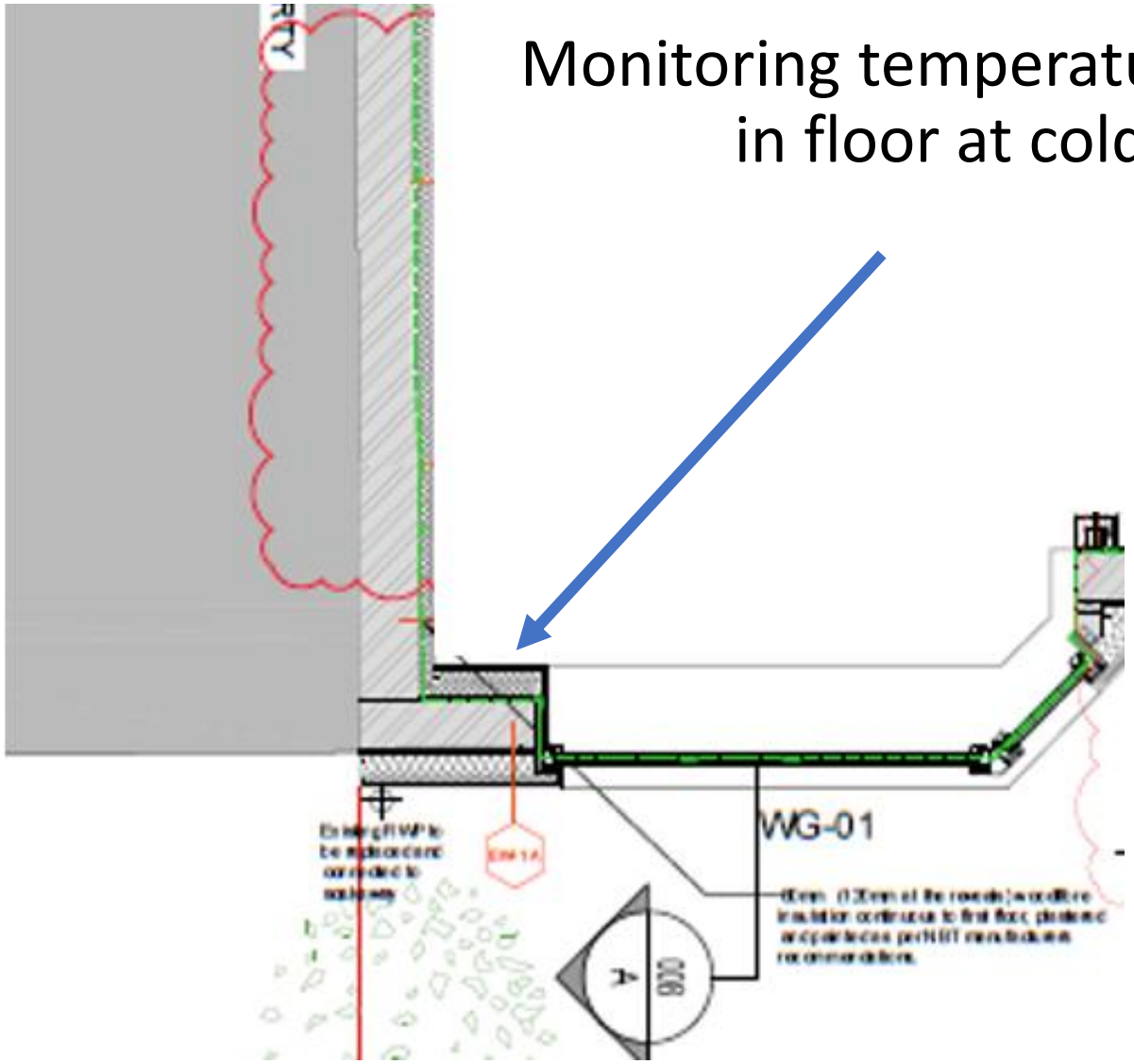
Main components

Isotherms (temperature)

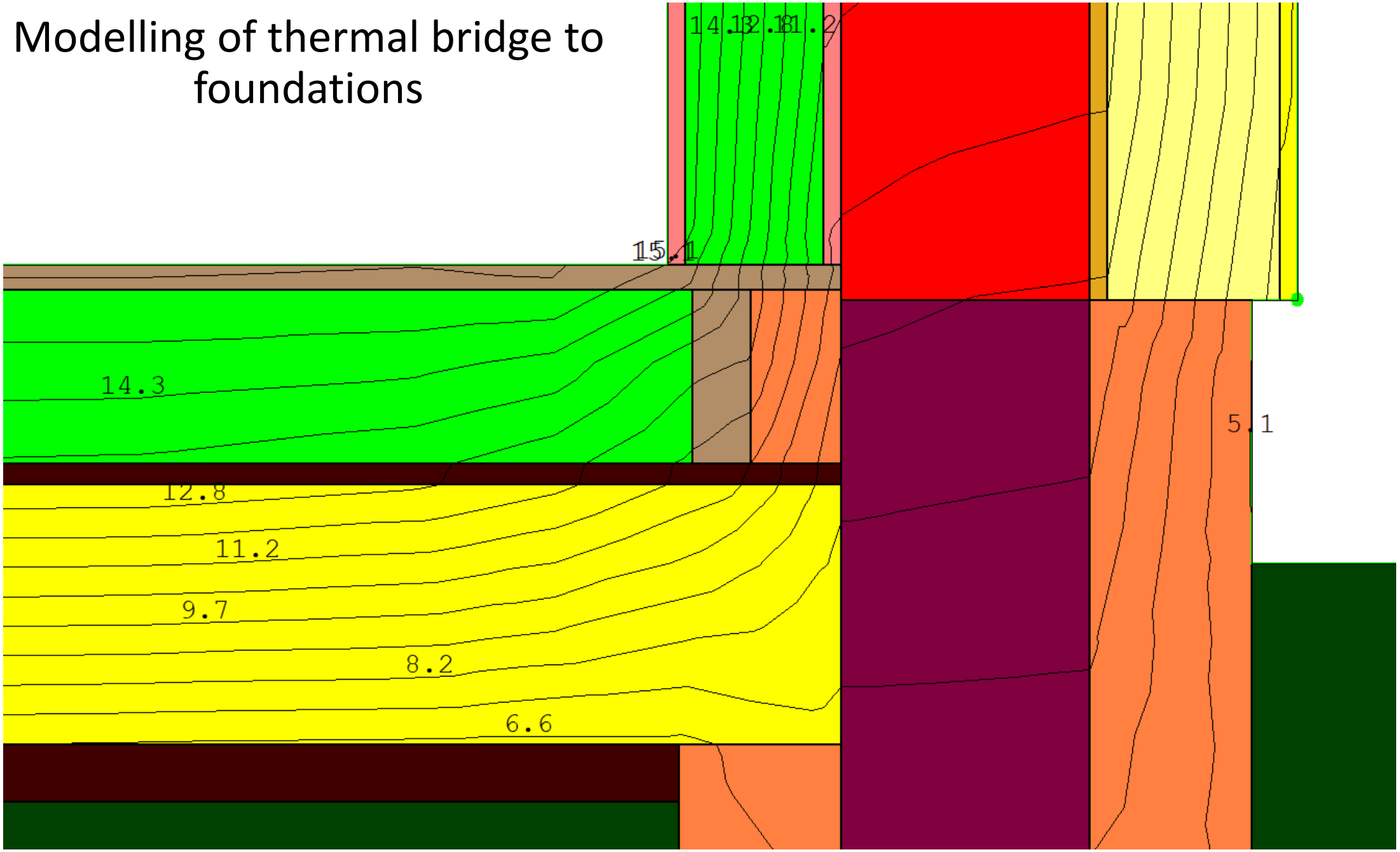


Heat flow

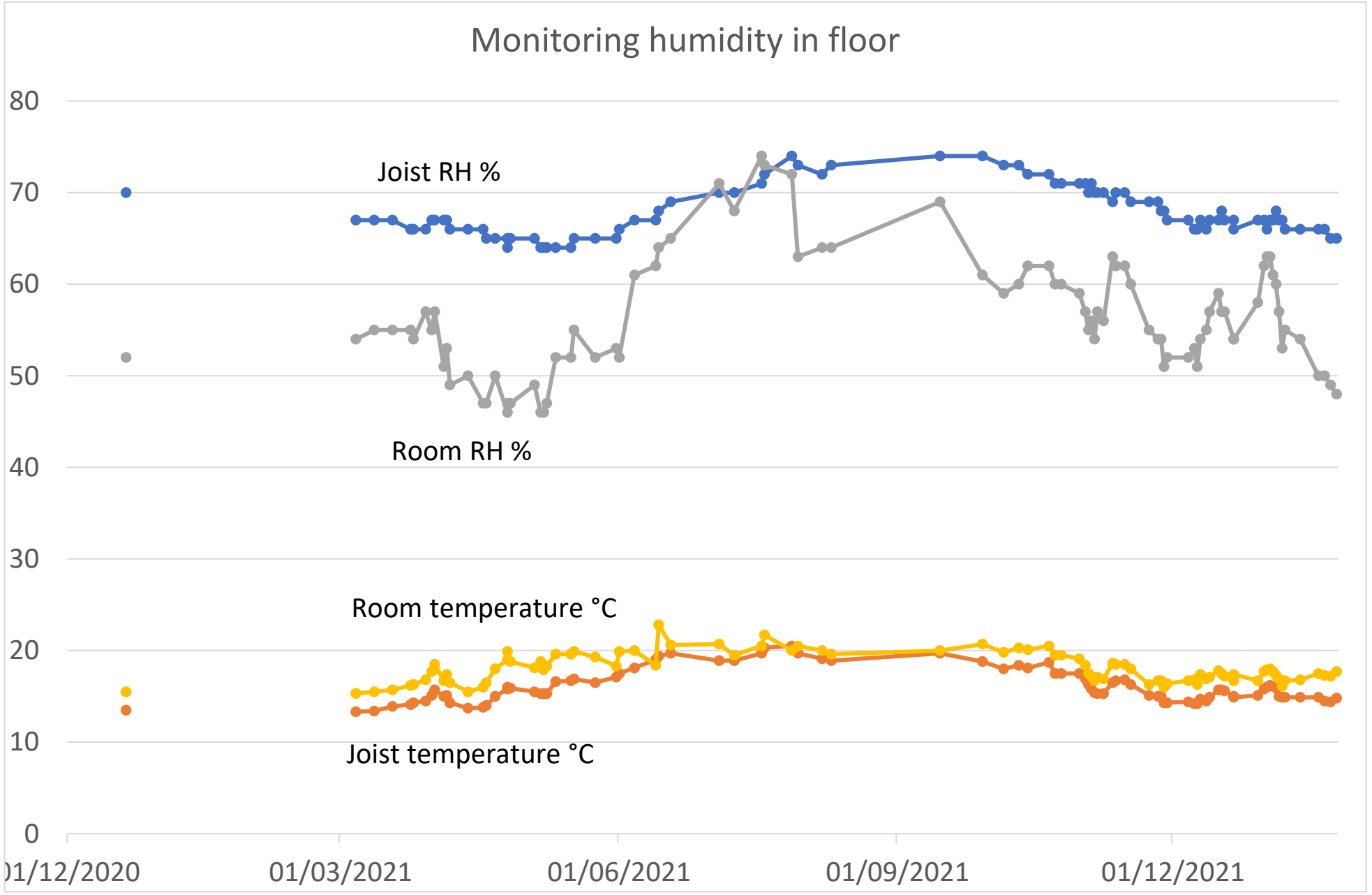
Monitoring temperature and humidity in floor at coldest point



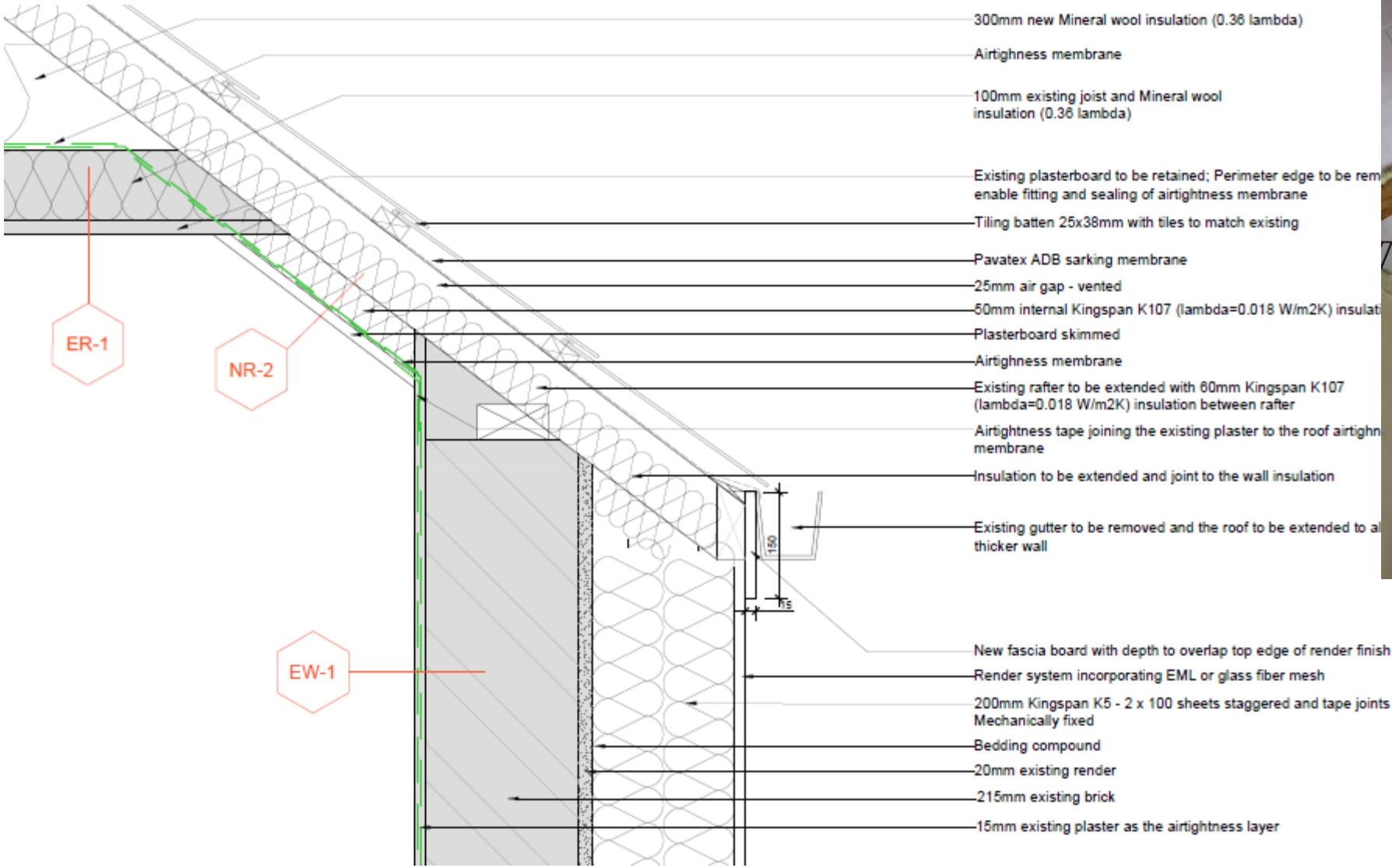
Modelling of thermal bridge to foundations



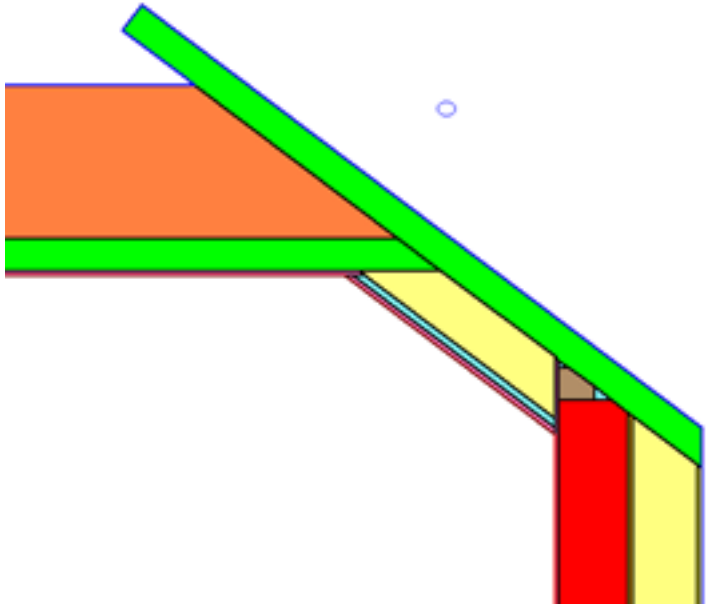
Joist stays warmer than expected



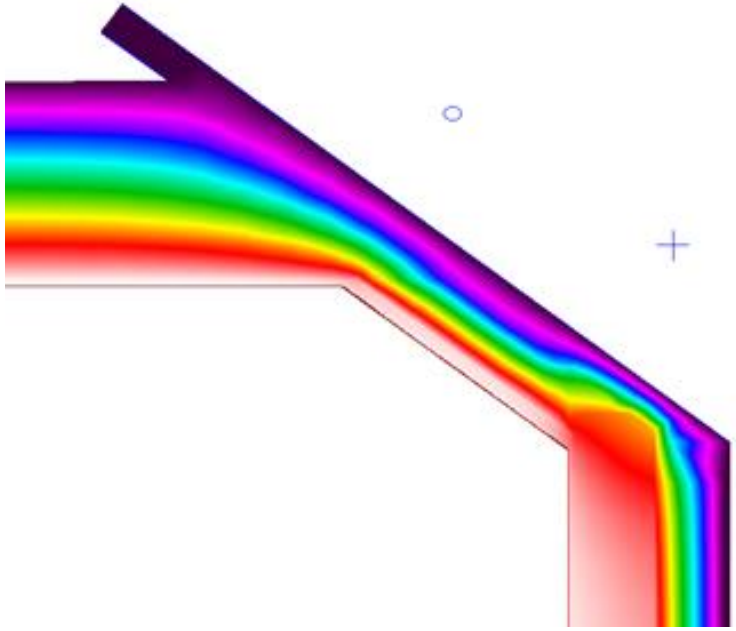
Skeeling insulation – one of the trickiest bits in the house



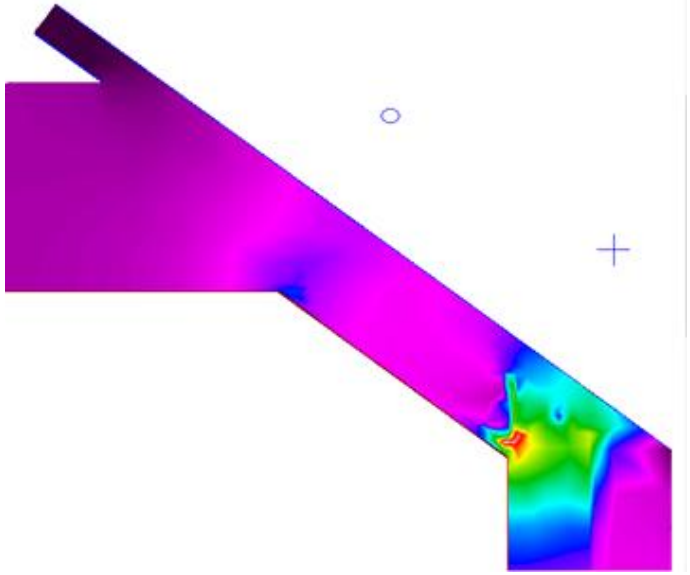
Thermal modelling of skeeling



Main components

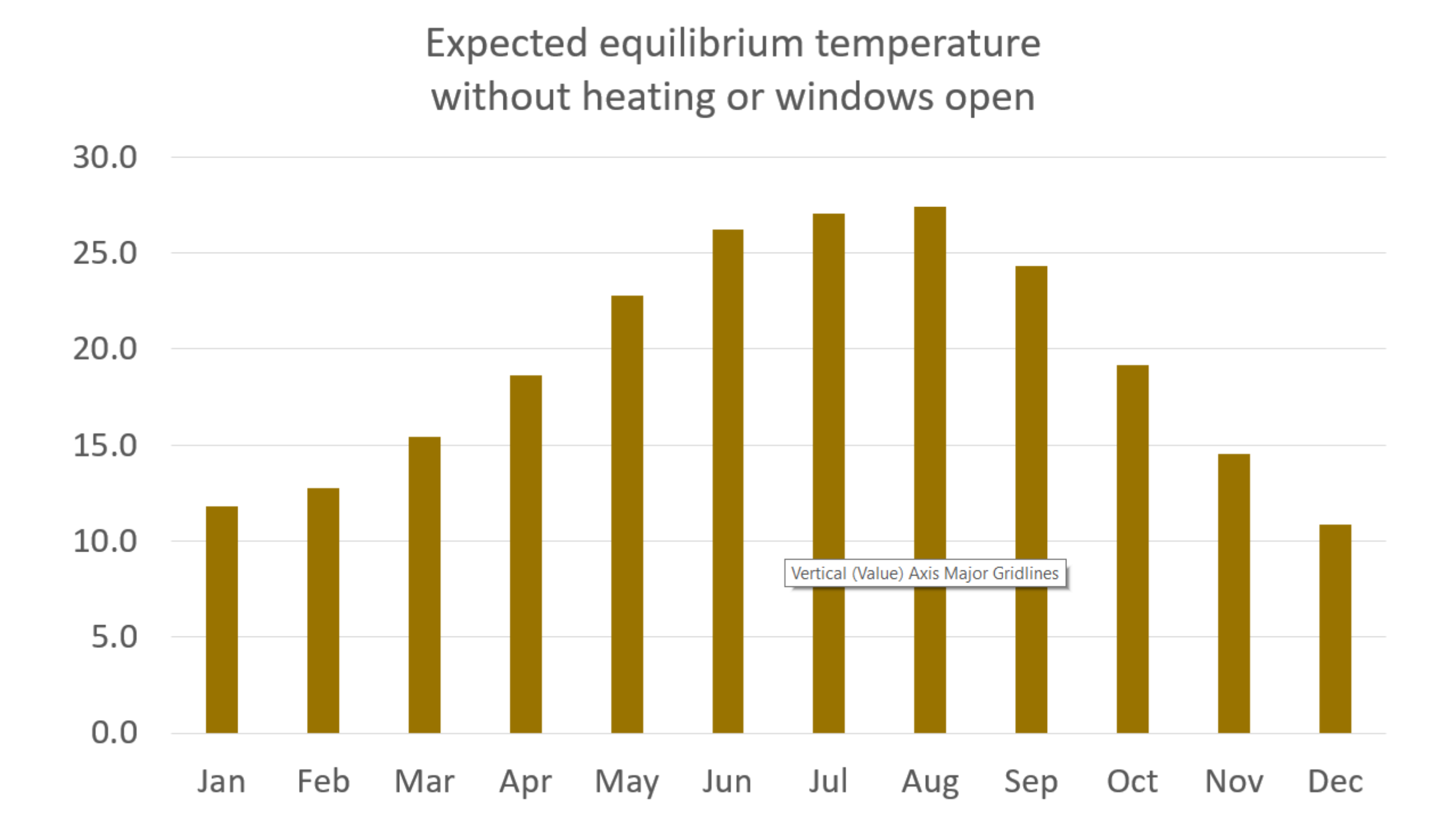


Isotherms (temperature)

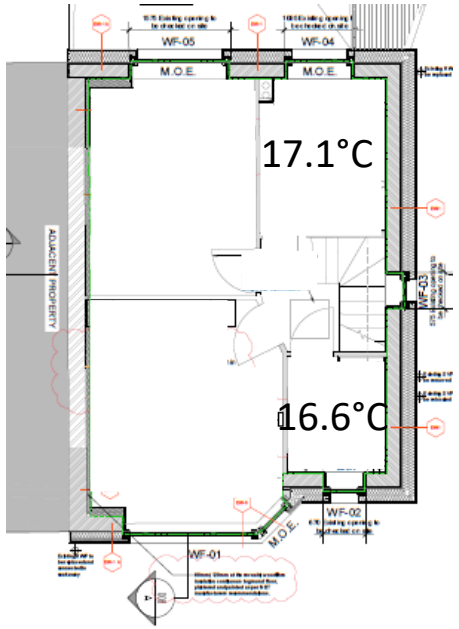


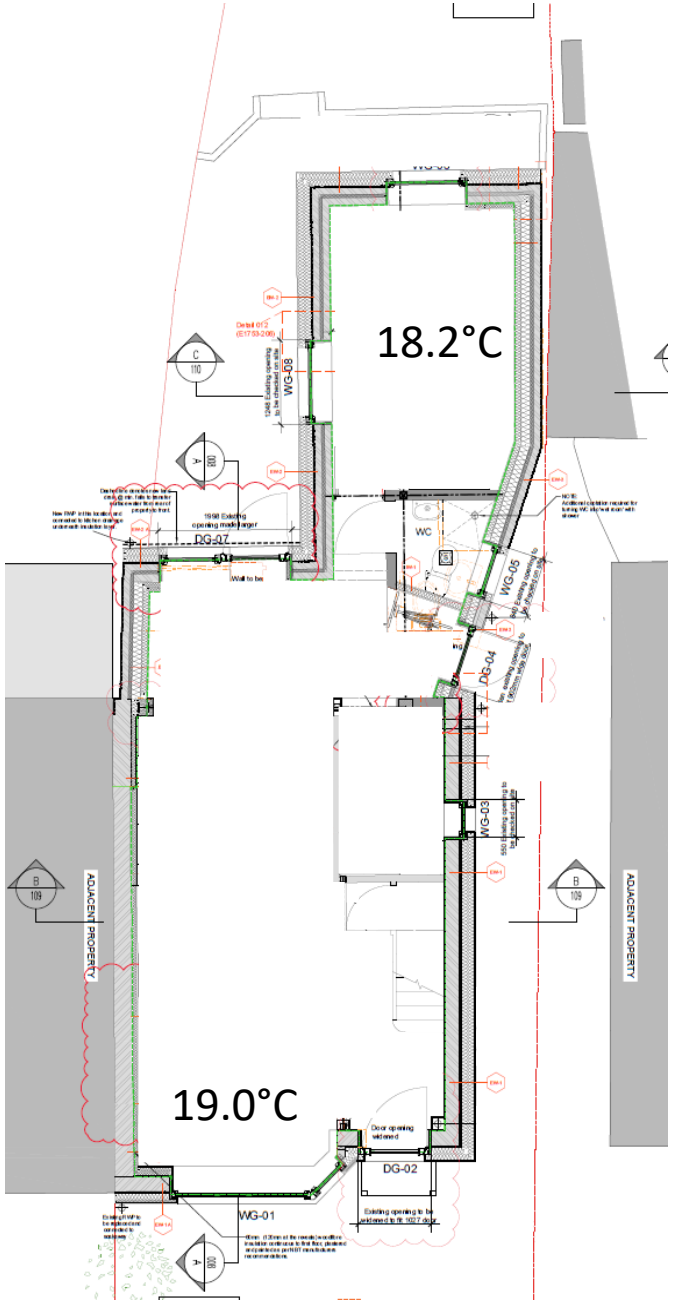
Heat flow


°C
1.0
-9.0
S51°45'1.33"
W1°17'50.24"
0° N
FLIR

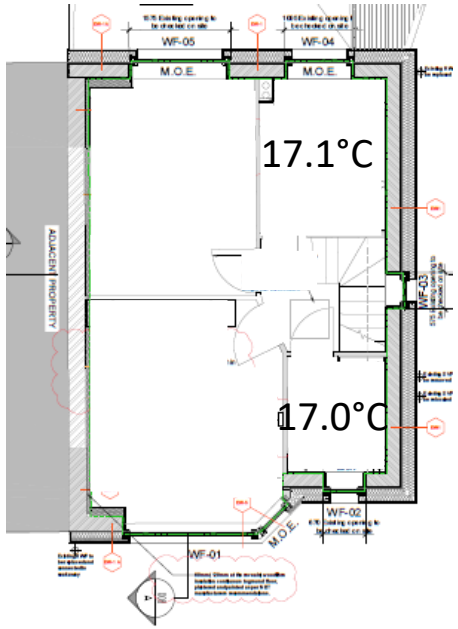

Expected equilibrium temperature
without heating or windows open
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Vertical (Value) Axis Major Gridlines
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

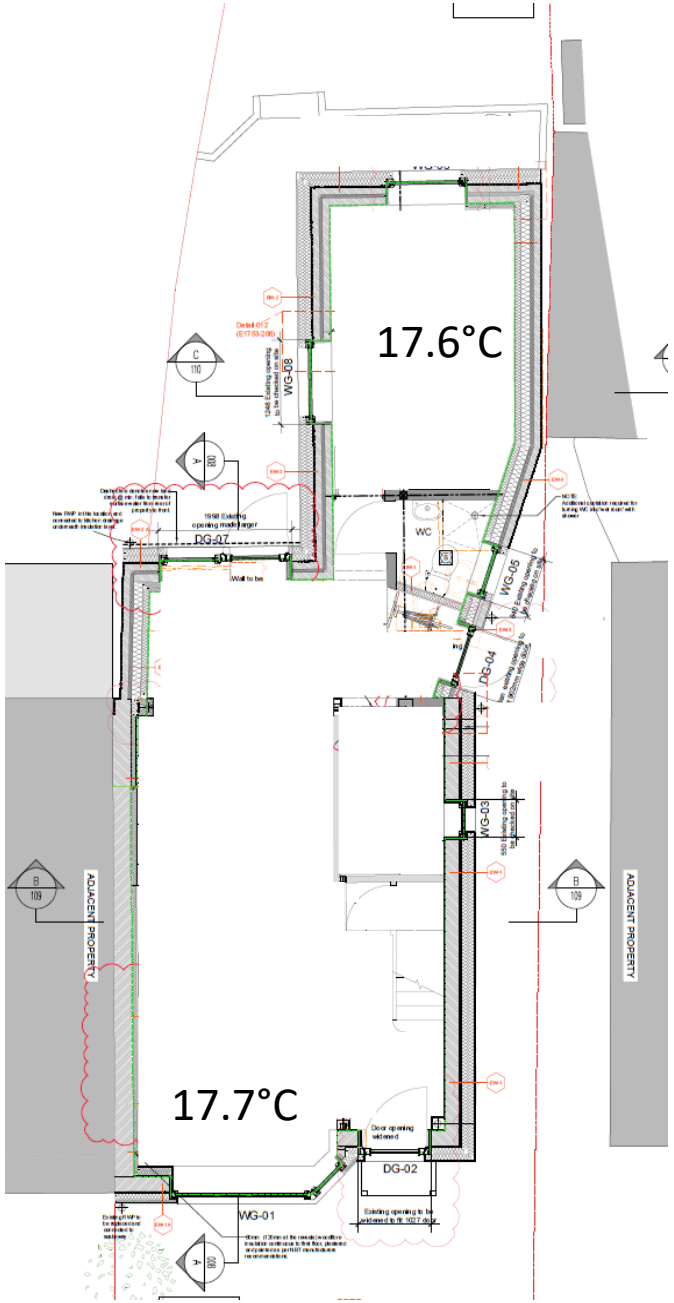
Temperature, winter 6pm (after heat pump running 12-4pm)

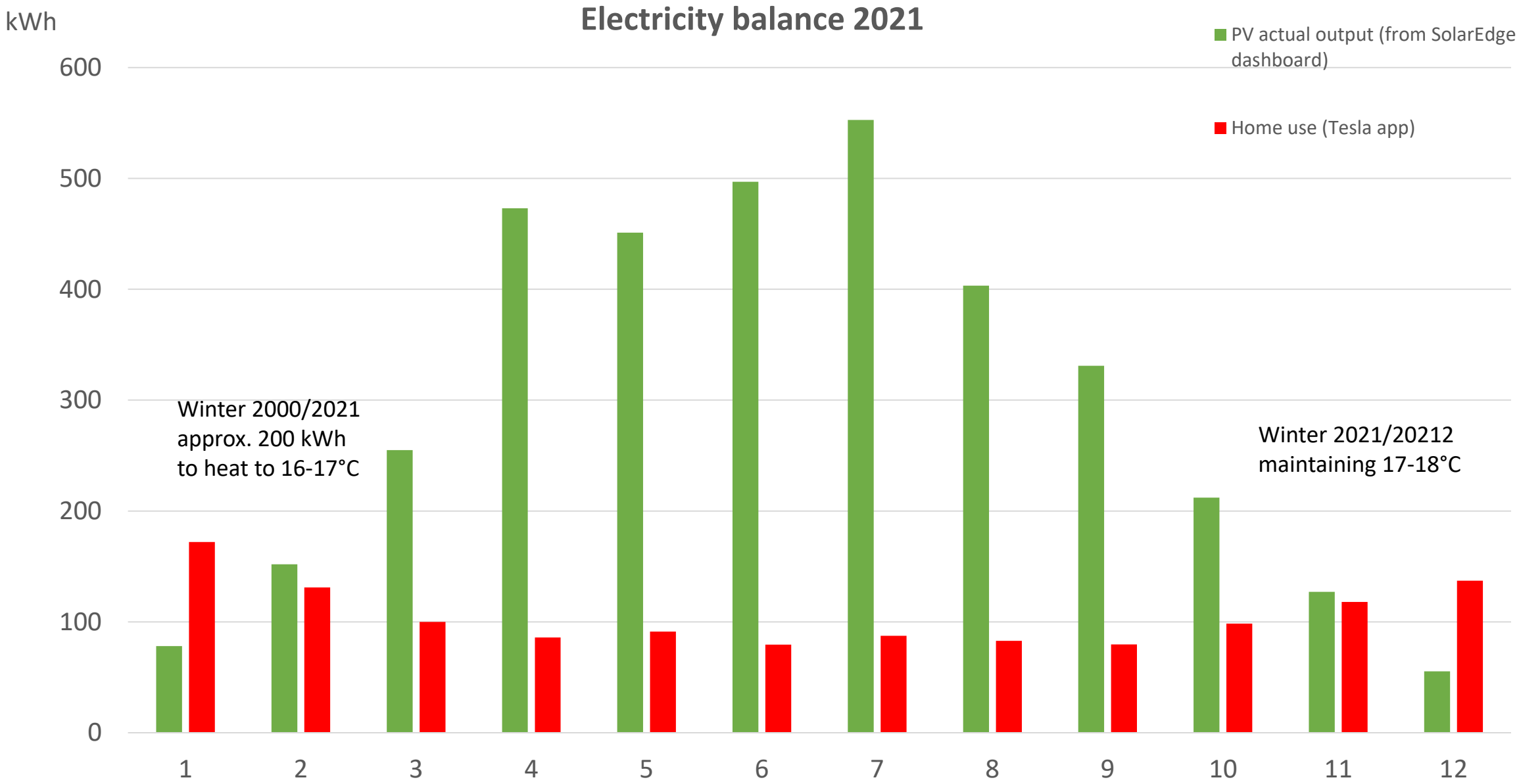


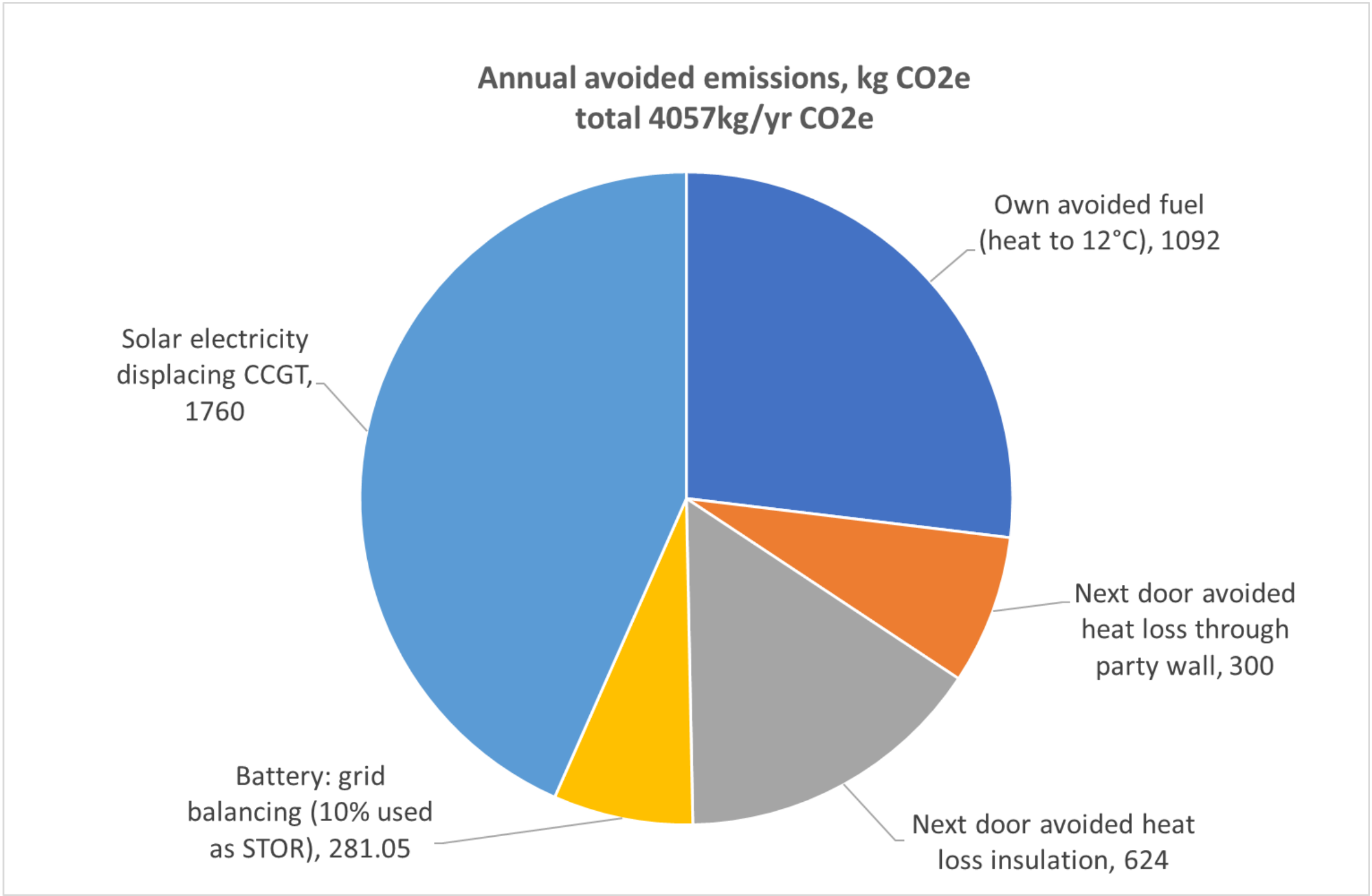


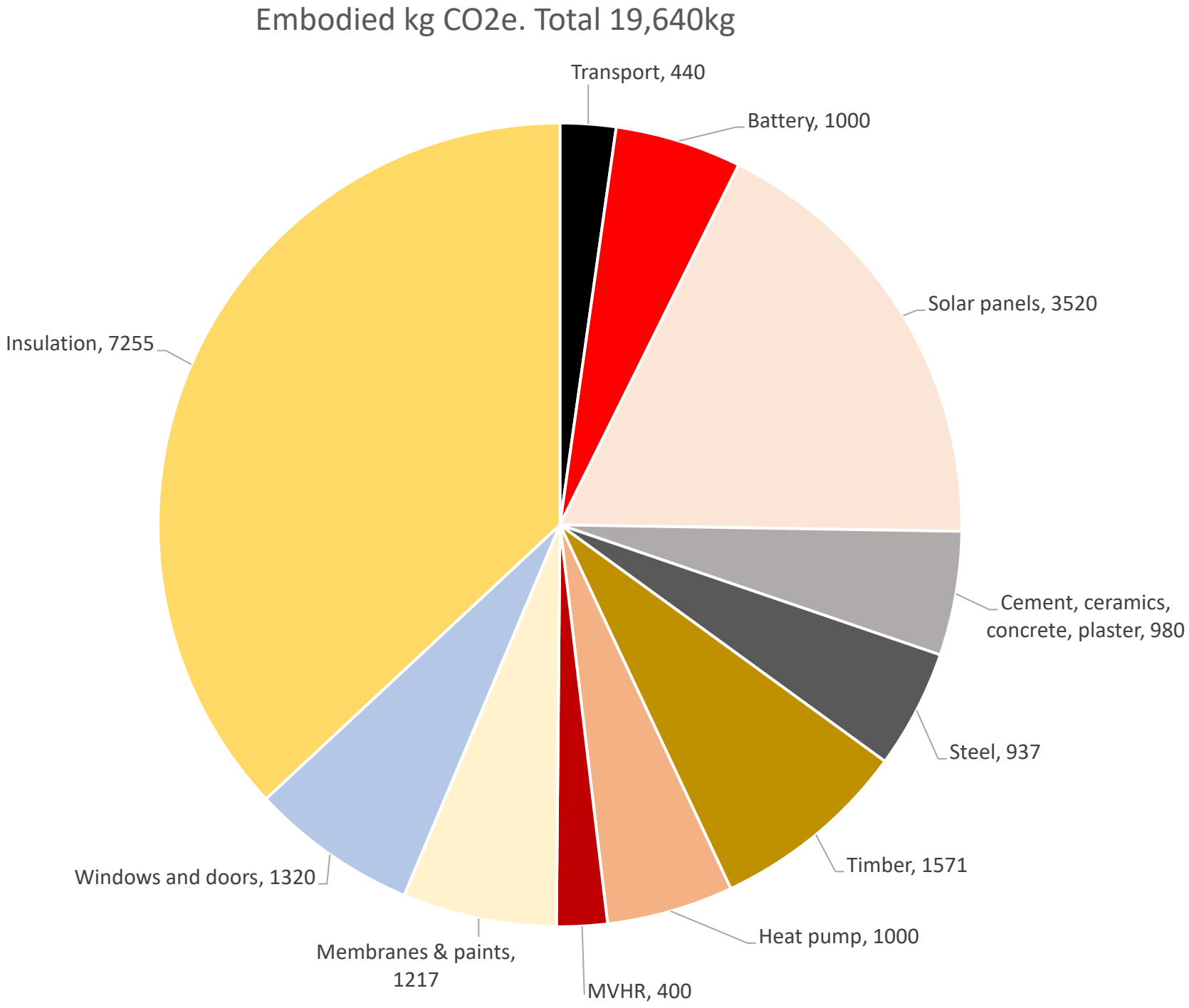
Temperature, winter 6am

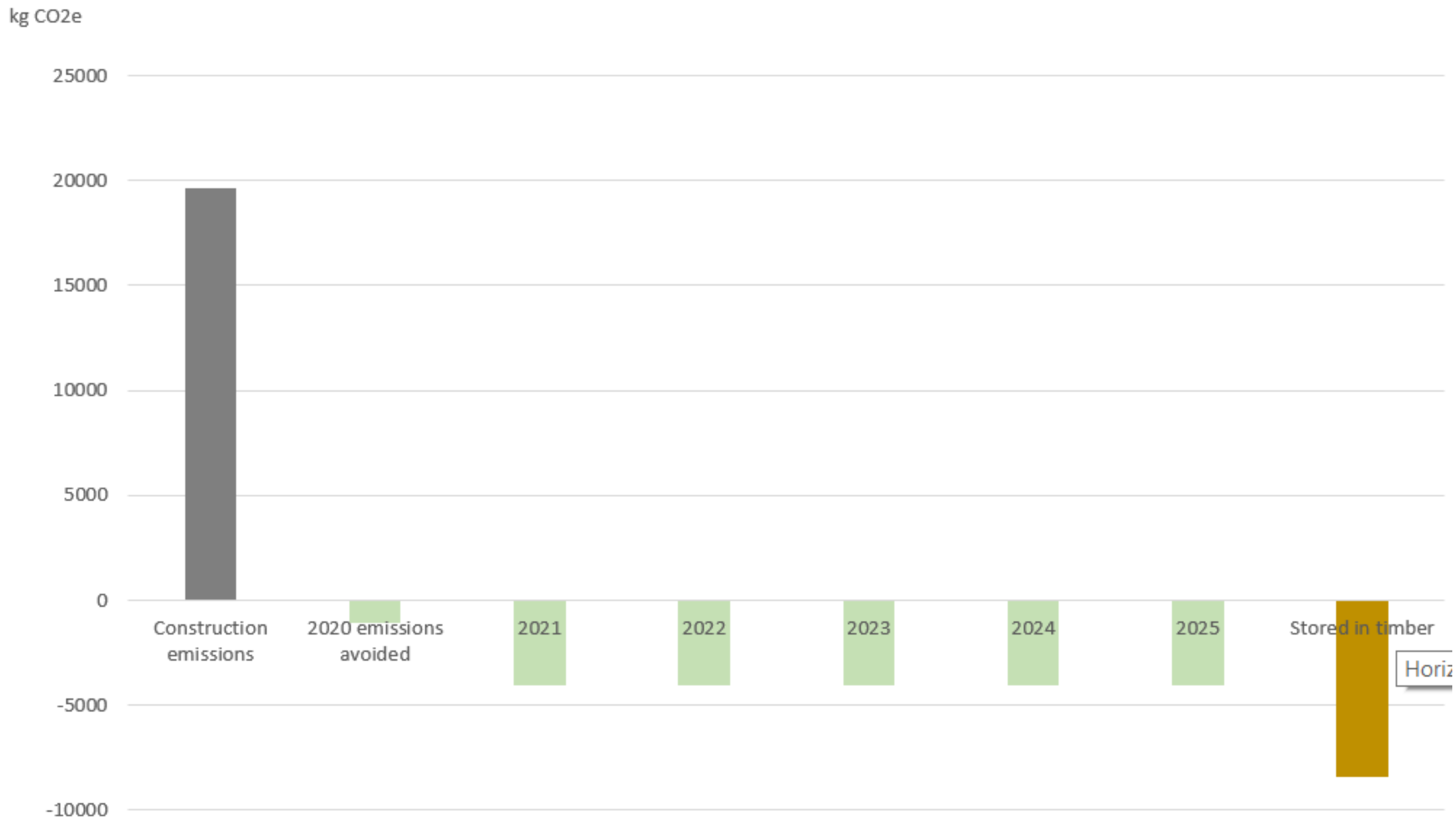





Electricity balance 2021
kWh
PV actual output (from SolarEdge dashboard)
Home use (Tesla app)
600
500
400
300
200
100
0
1
2
3
4
5
6
7
8
9
10
11
12
Winter 2000/2021
approx. 200 kWh
to heat to 16-17°C
Winter 2021/20212
maintaining 17-18°C


Annual avoided emissions, kg CO2e
total 4057kg/yr CO2e
Own avoided fuel (heat to 12°C), 1092
Next door avoided heat loss through party wall, 300
Next door avoided heat loss insulation, 624
Battery: grid balancing (10% used as STOR), 281.05
Solar electricity displacing CCGT, 1760


Embodied kg CO2e. Total 19,640kg
Transport, 440
Battery, 1000
Solar panels, 3520
Cement, ceramics, concrete, plaster, 980
Steel, 937
Timber, 1571
Heat pump, 1000
MVHR, 400
Membranes & paints, 1217
Windows and doors, 1320
Insulation, 7255


kg CO2e
25000
20000
15000
10000
5000
0
-5000
-10000
Construction emissions
2020 emissions avoided
2021
2022
2023
2024
2025
Stored in timber
Horiz