Multifamily house in Büren

Final analysis of Indoor Air Quality and Energy use
Comparison of balanced ventilation and window ventilation

B.E. Cremers - The resulting CO_2 levels and the heating/cooling consumption of apartments with balanced ventilation versus window ventilation - Healthy Buildings Conference Oslo 2021

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always the
best climate

Presentation background

The monitored building with four analysed apartments in Büren (CH)

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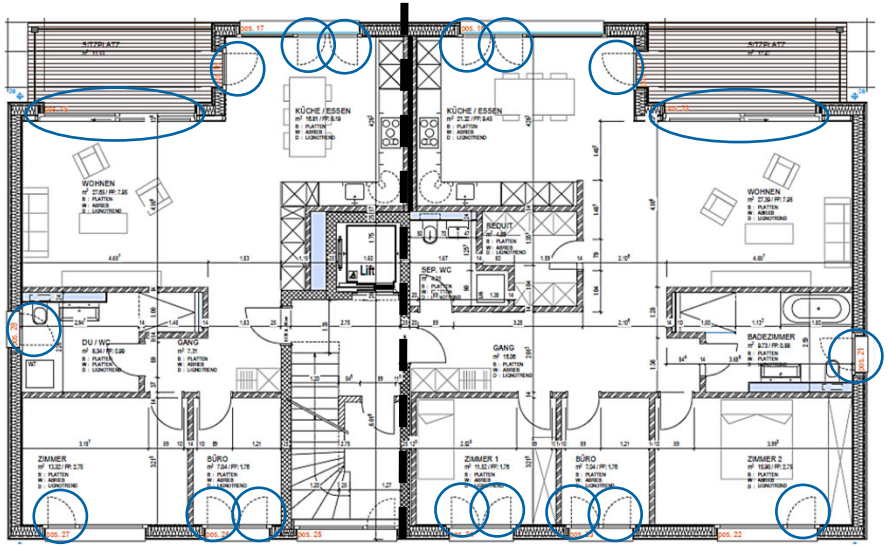
Four apartments with family sizes and ventilation systems

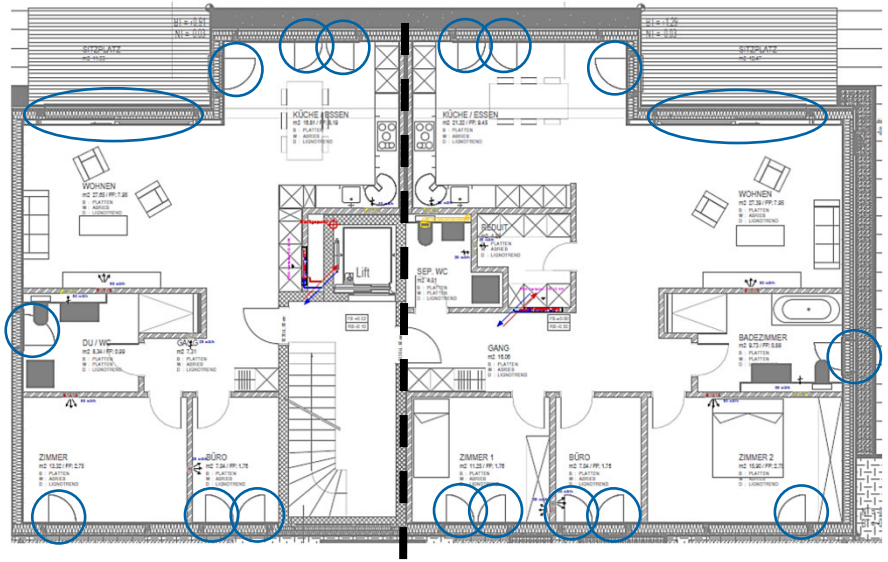


top

bottom

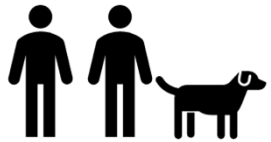
indication of openings

110 m³/h



left

right



140 m³/h

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Structure

Ventilation analysis

IAQ analysis

Energy analysis

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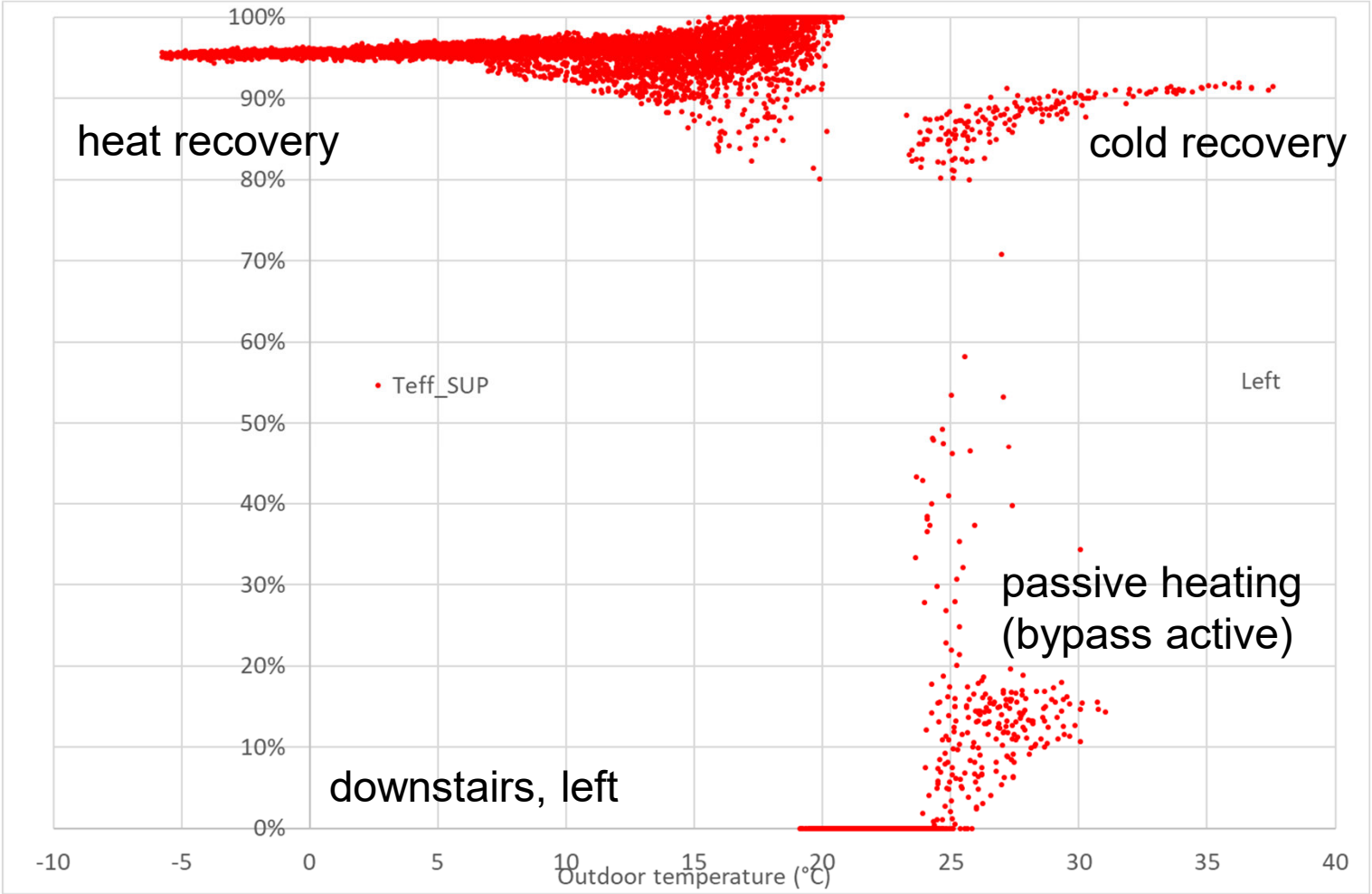
Temperature recovery efficiency



- Heat recovery efficiency (colder periods) around 96%
- Cold recovery efficiency (warmer periods) around 90%

(cf. PHI certificate for warm climates 81%)

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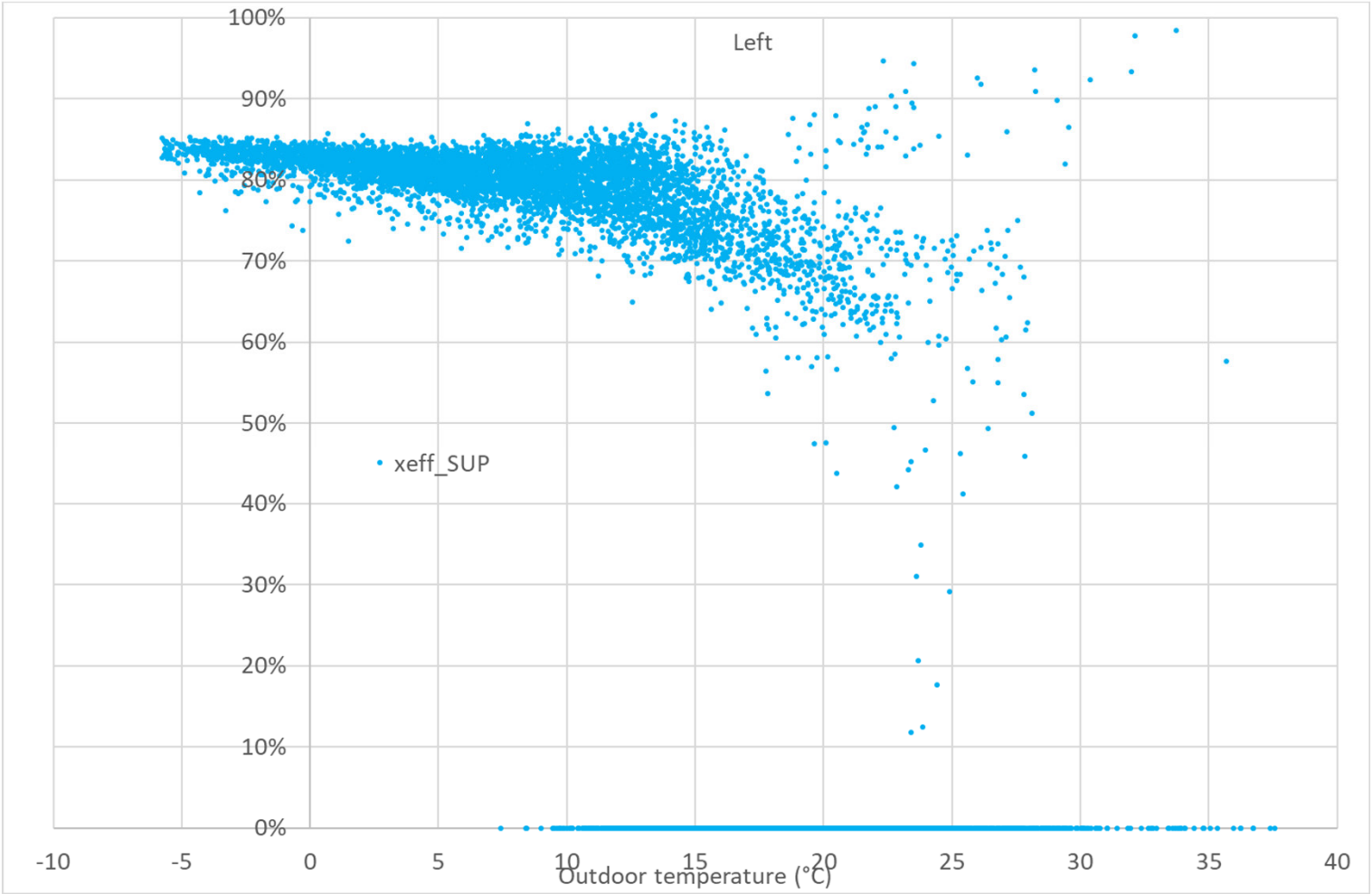
Humidity recovery efficiency



- Humidity recovery efficiency around 83% for colder outdoor temperatures
- For high outdoor temperatures, humidity difference between indoor and outdoor are too small to have meaningful efficiency

Structure

Ventilation analysis

IAQ analysis

Energy analysis

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Airing factor in the seasons

Airing factor: percentage of external doors and windows that are opened

	Time period	Outdoor temperature	 EGL	 EGR	 OGL	 OGR
	1-7-19 until 30-9-19	18.3°C	9%	7%	6%	17%
	1-10-19 until 31-12-19	6.9°C	6%	5%	6%	6%
	1-1-20 until 31-3-20	4.8°C	4%	6%	1%	3%
	1-4-20 until 30-6-20	13.9°C	4%	9%	7%	5%
	heating season HS	5.8°C	5%	6%	4%	5%
	entire year	10.9°C	6%	7%	5%	8%

- People tend to use less airing when outdoor temperatures go down
- In the heating season, people with mechanical ventilation still use airing (and they can!)

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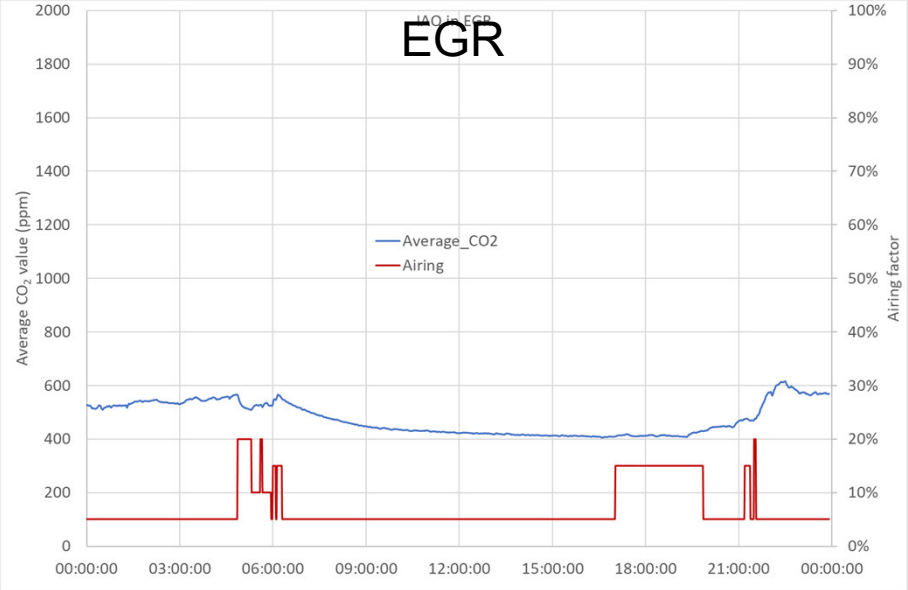
Wisely AllSense used for IAQ

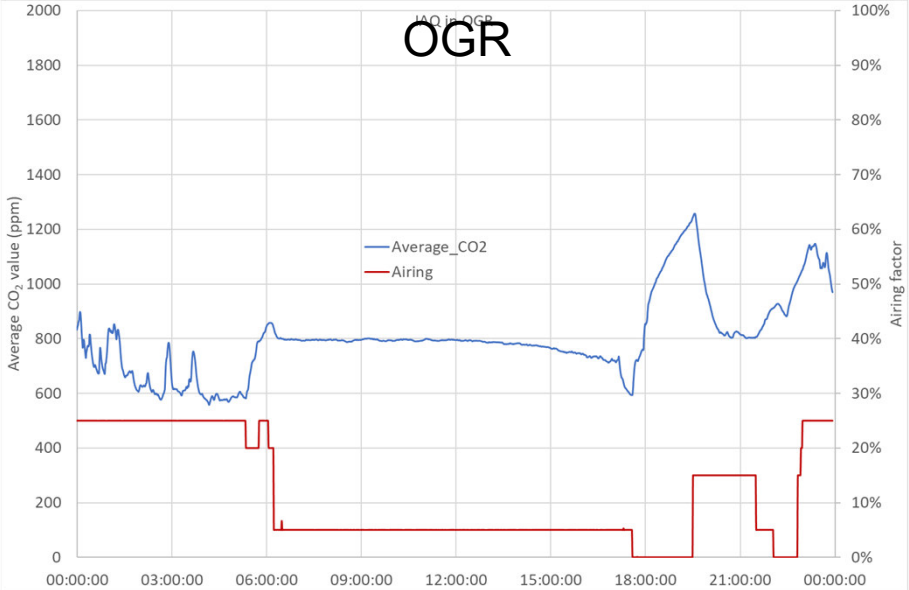
- Thermal comfort
- Temperature
- Humidity
- Air pressure
- CO_2 concentration
- LED with limit indication
- Volatile organic compounds (VOC)

Typical day with CO_2 levels averaged over all rooms

Airing factor: percentage of external doors and windows that are opened
0% means all windows closed; 100% means all windows open



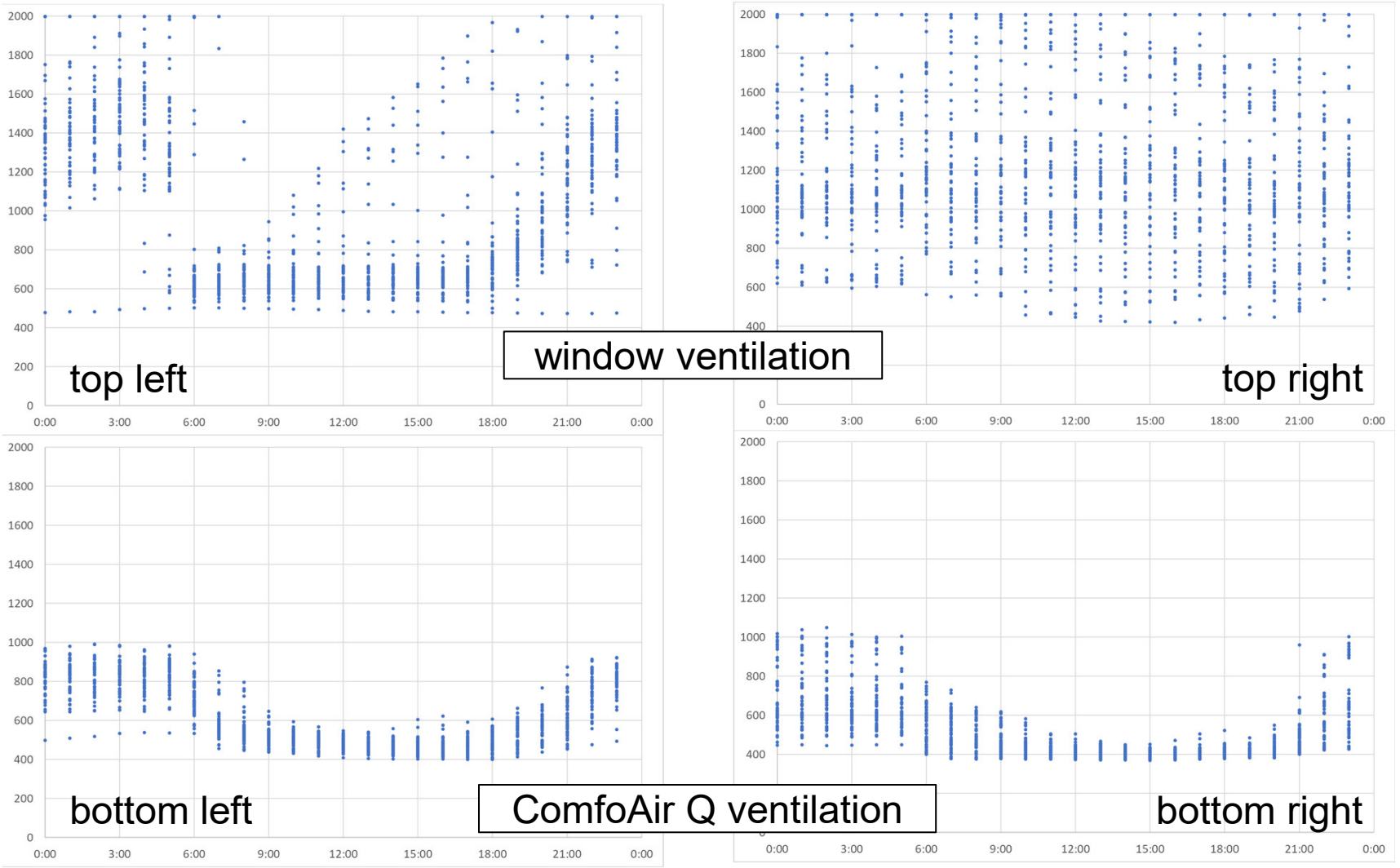
ComfoAir Q ventilation



window ventilation

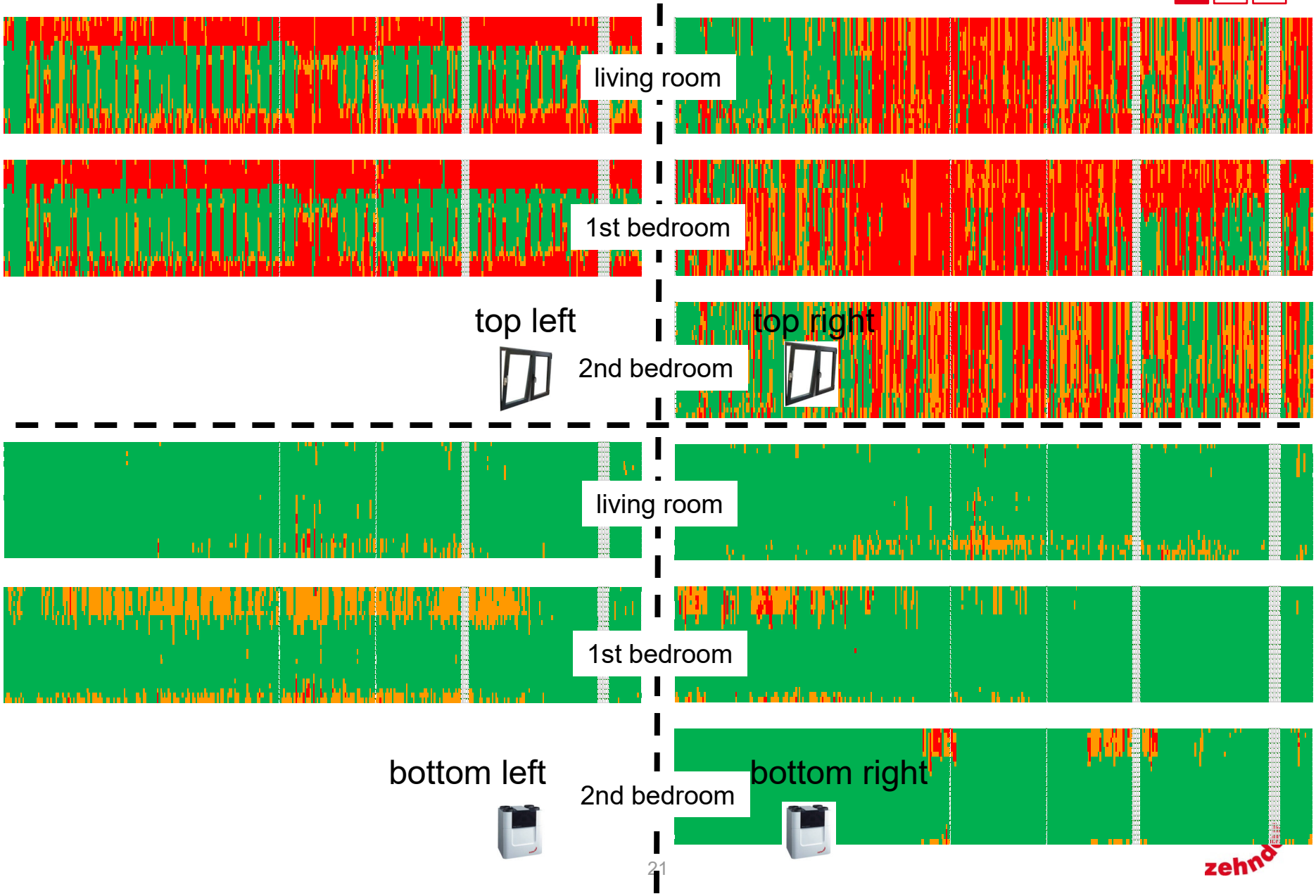
- ComfoAir Q ventilation brings constant refreshment, even with only one window slightly open
- Window ventilation needs 25% of all available windows open for similar refreshment

CO_2 values in master bedroom on Tuesdays

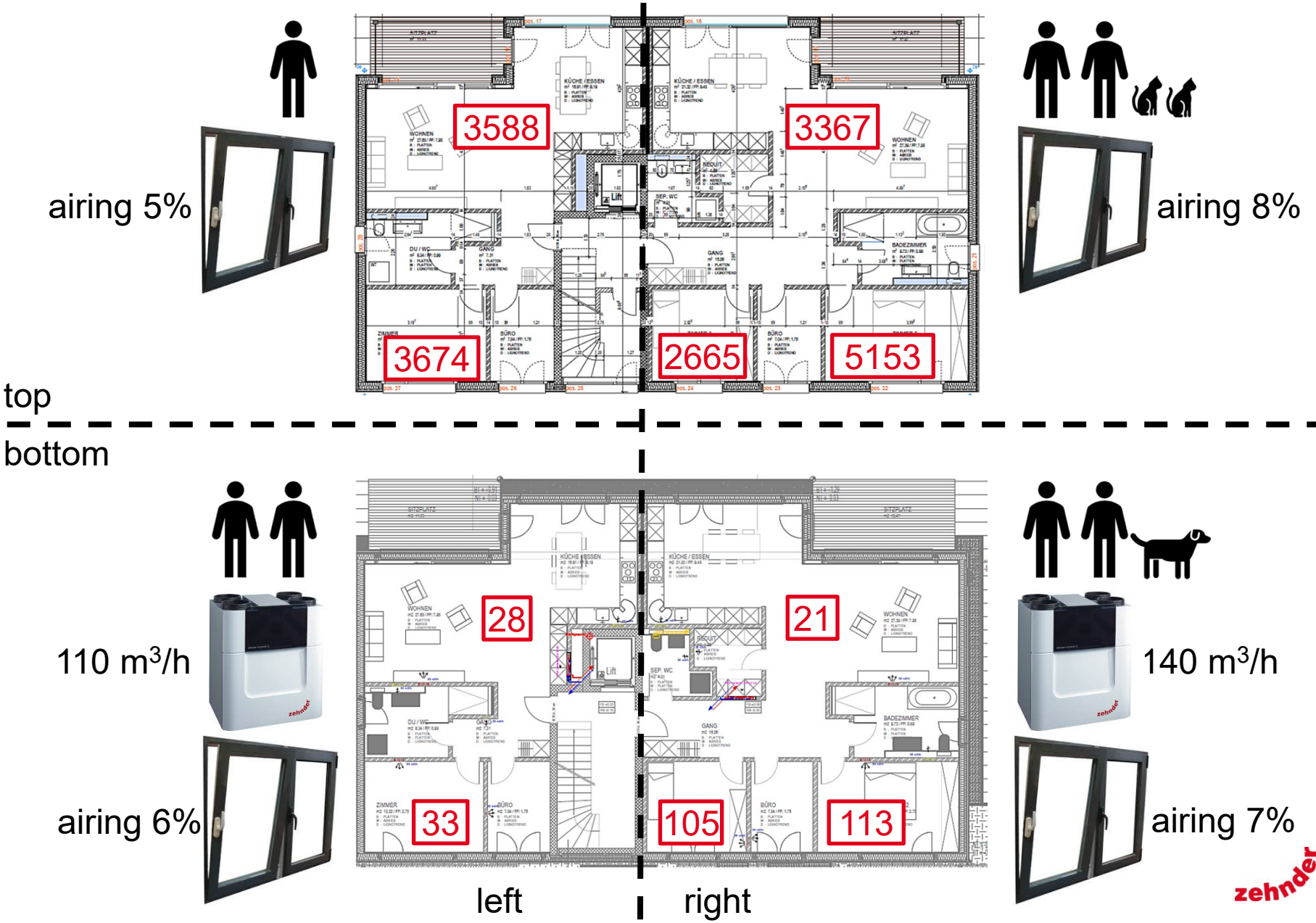


- Very regular and good IAQ levels with ComfoAir Q ventilation
- Anything can happen with window ventilation,
  even above 2000 ppm which cannot be measured!

Carpet plots of CO_2 values



Unhealthy hours above 1000 ppm (from total 8616 hours)



Structure

Ventilation analysis

IAQ analysis

Energy analysis

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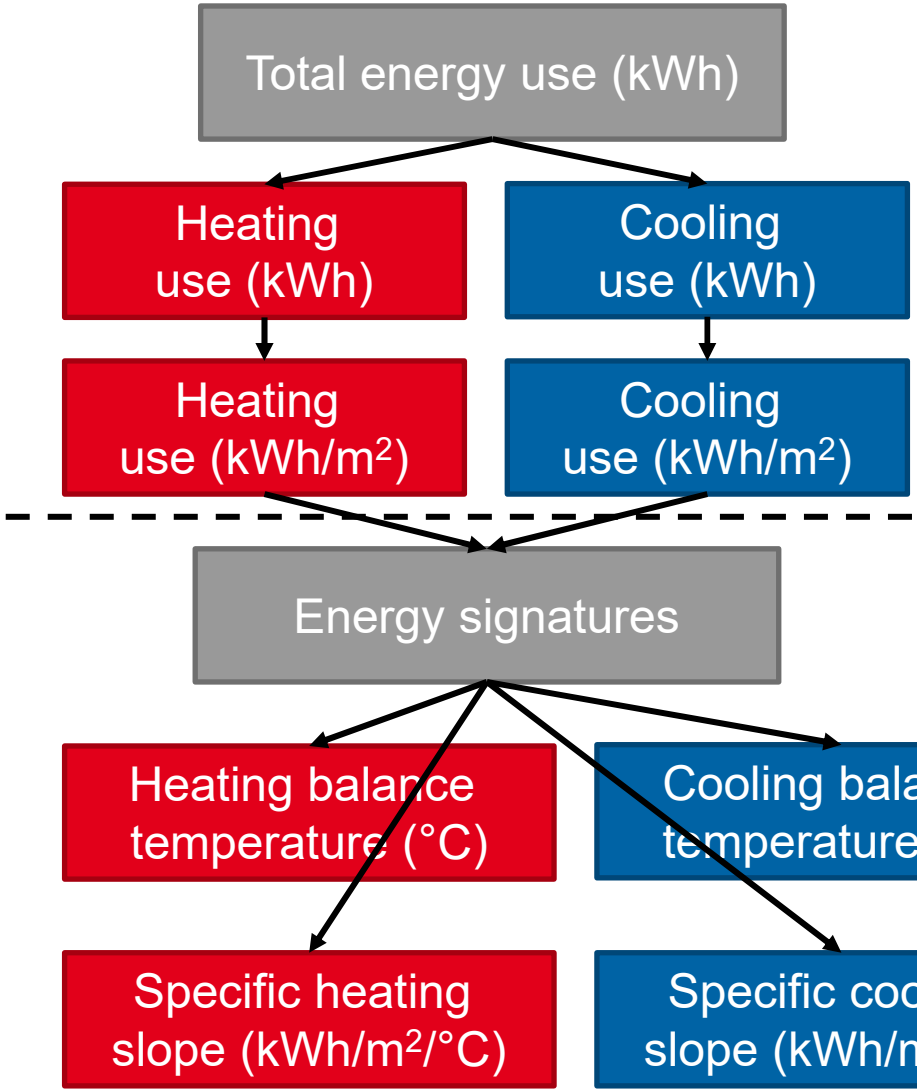
Energy analysis for one year



include seasonal effects

exclude effect of dwelling size

more detailed analysis

include daily variation as function of outdoor temperature

gives information on room thermostat setting and 'neighbour effect'

gives information on infiltration, ventilation and recovery

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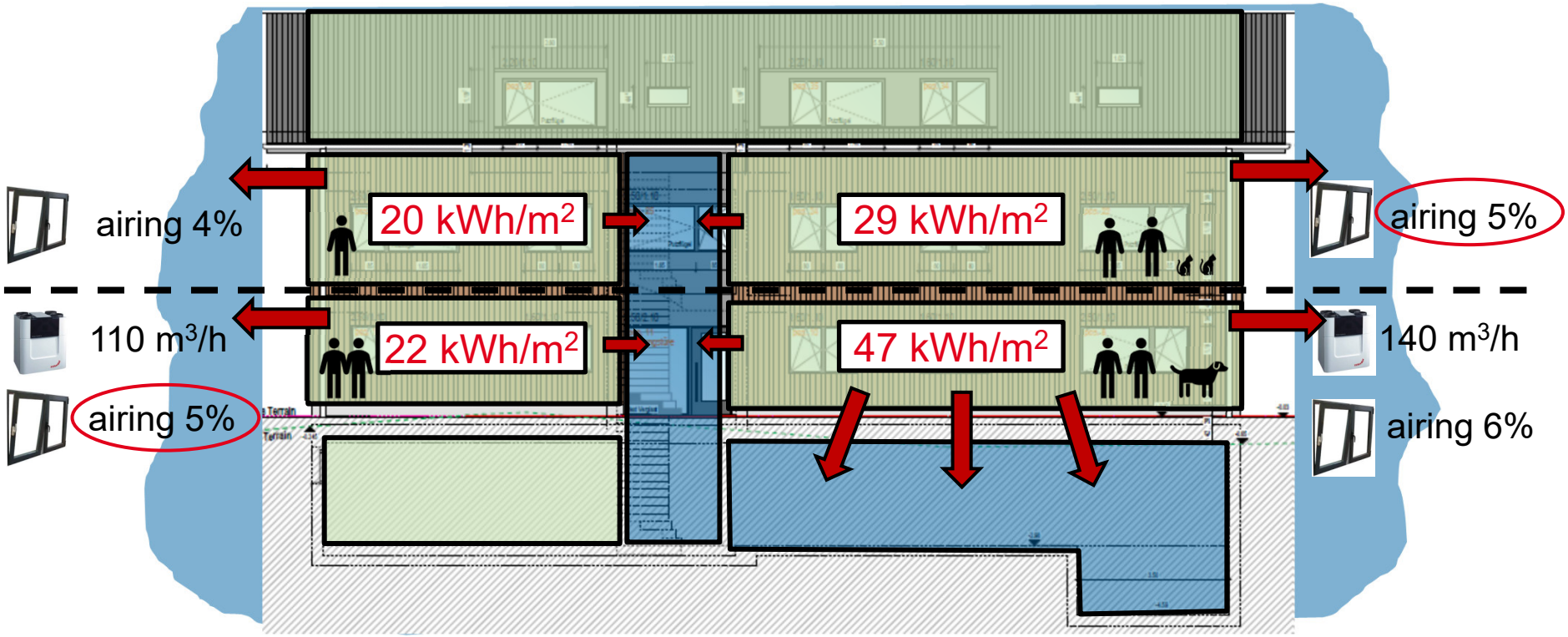
Heating energy – total year

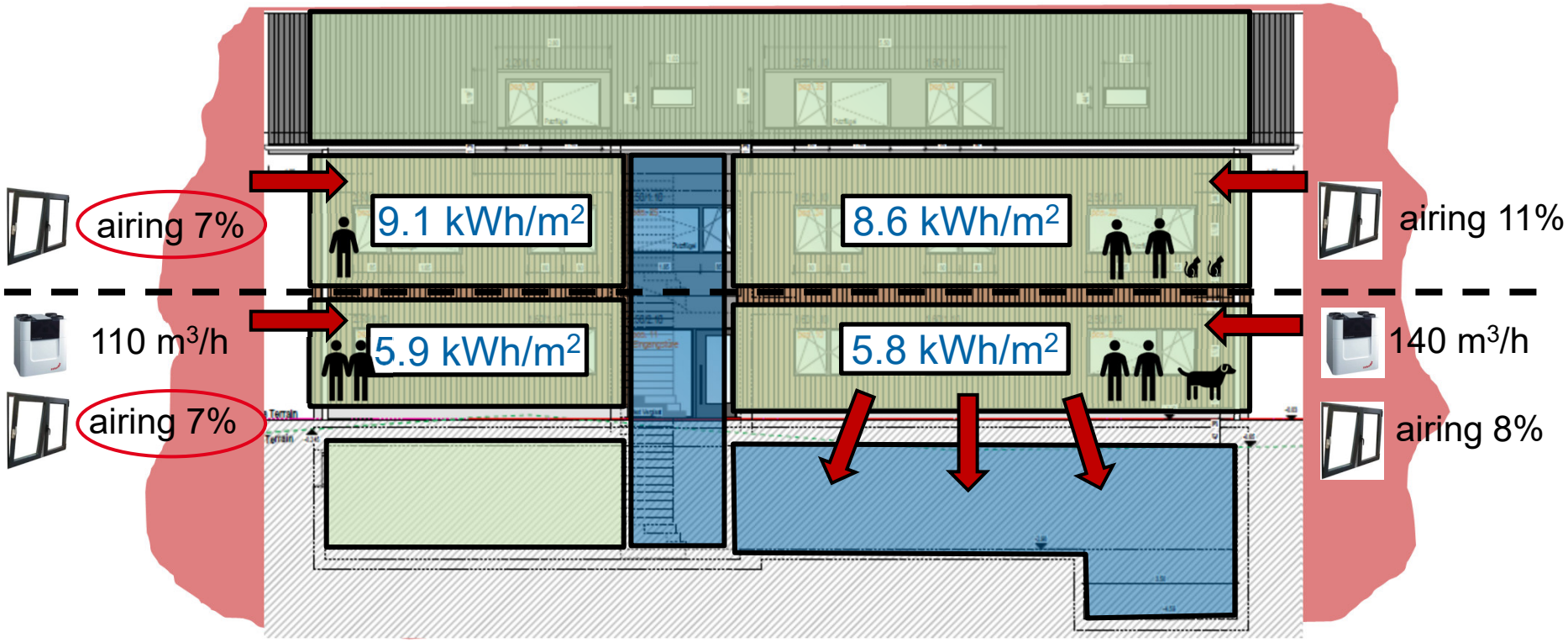
Airing factor during autumn and winter (1 Oct ‘19 – 31 Mar ‘20)



- For the same window use, heating use with balanced ventilation is 24% lower (from 29 to 22 kWh/m²)

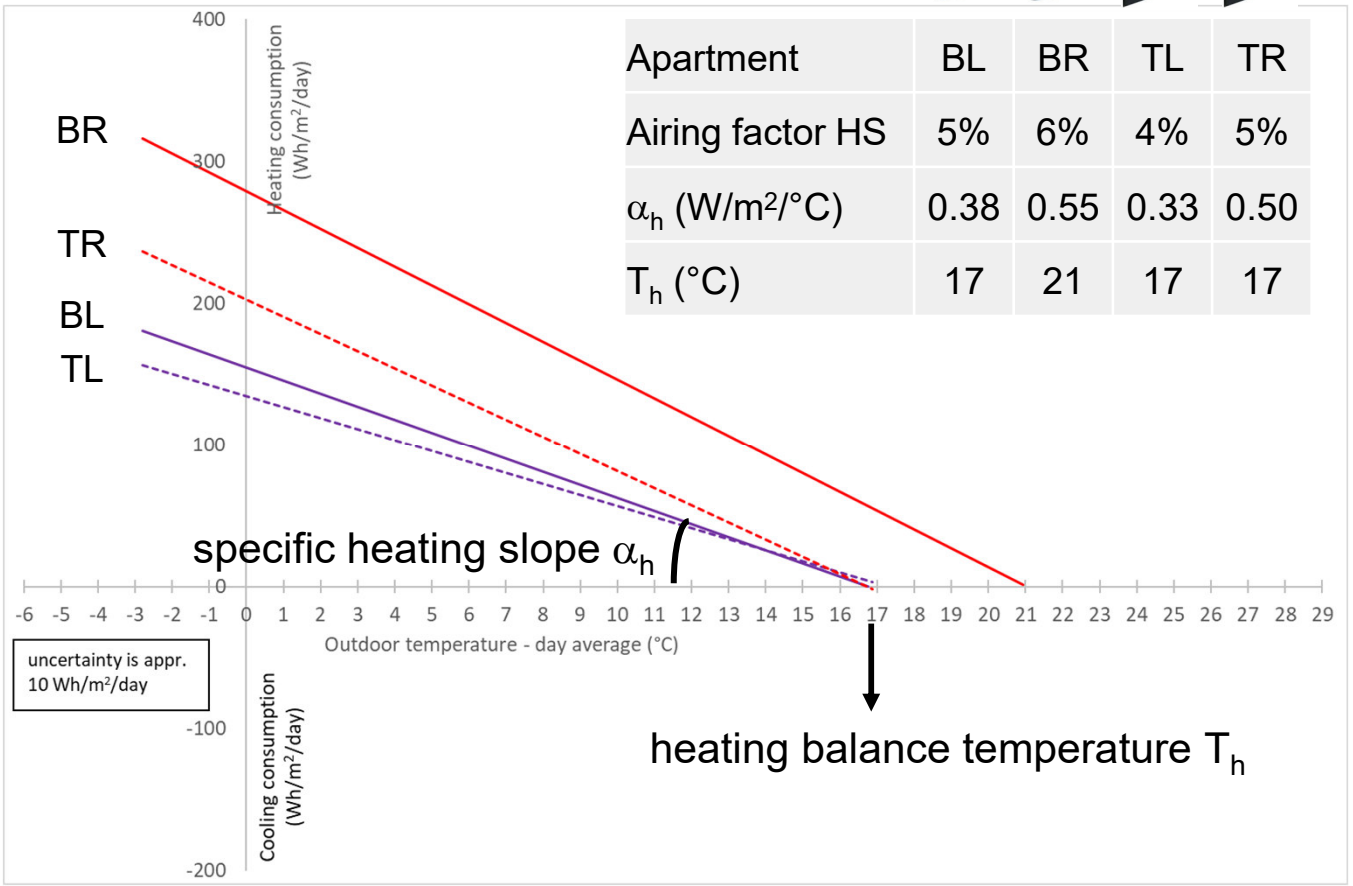
Cooling energy – total year

Airing factor during spring and summer (1 Apr ‘20 – 30 Sep ‘20)



- For the same window use, cooling use with balanced ventilation is 35% lower (from 9.1 to 5.9 kWh/m²)

Energy signatures heating



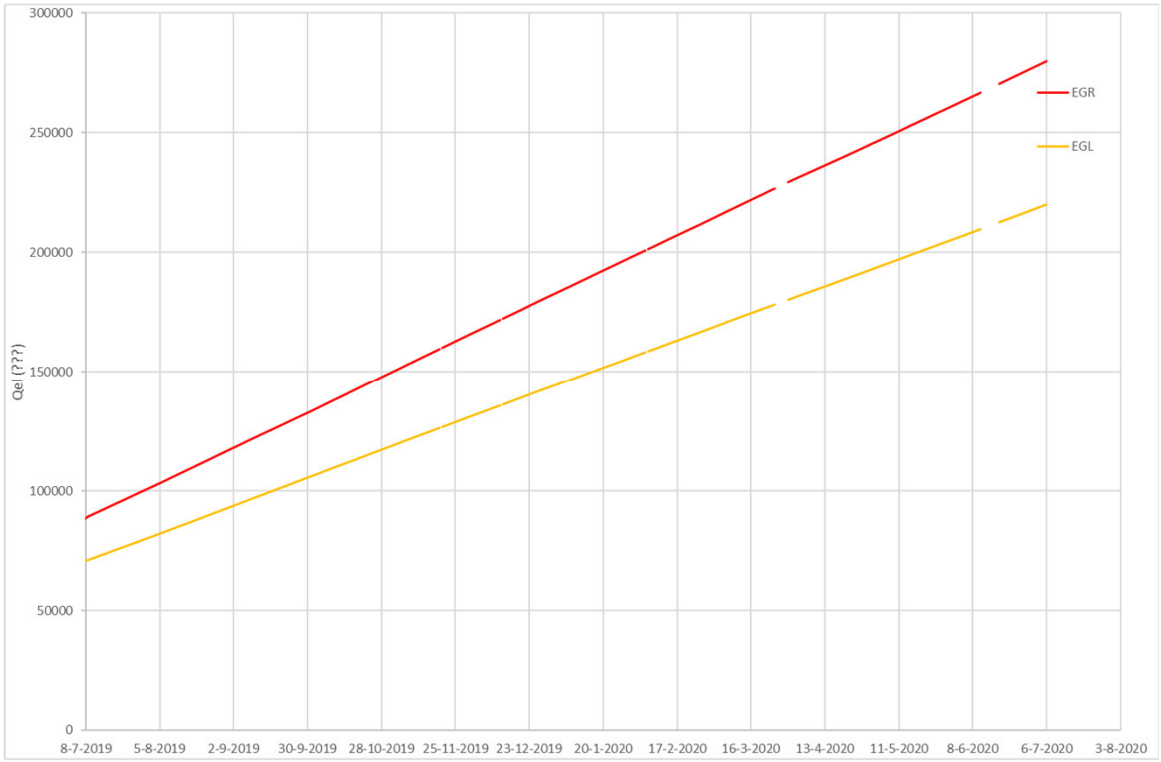
Apartment	BL	BR	TL	TR
Airing factor HS	5%	6%	4%	5%
α_h (W/m²/°C)	0.38	0.55	0.33	0.50
T_h (°C)	17	21	17	17

Ranking specific heating slope:

1. Top left: because of the lowest airing factor (4%)
2. Bottom left: because of higher airing factor (5%), but with heat recovery ← heating slope −24%
3. Top right: same airing factor as bottom left (5%), but without heat recovery
4. Bottom right: because of highest airing factor (6%), with heat recovery

The heating balance temperature depends on the thermostat setting and the neighbour effect.

Electricity consumption of ComfoAir Q ventilation units

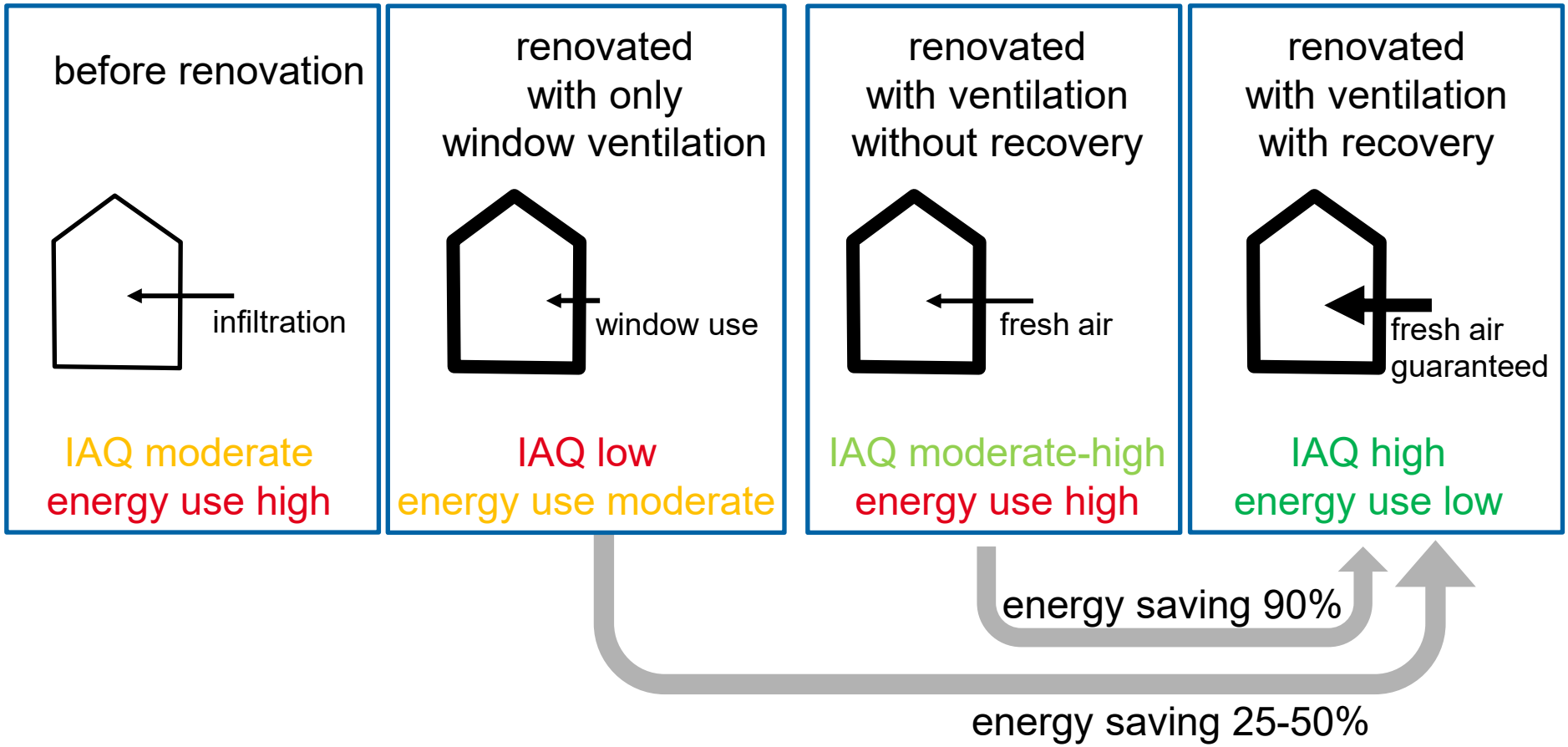


- EGL (110 m^3/h): consumption 220079 – 70753 = 149326 Wh/yr (= constant 17.1 W)
- EGR (140 m^3/h): consumption 279948 – 88489 = 191459 Wh/yr (= constant 21.9 W)

electricity power only 20 W!

same as 60 W light bulb for 8 hrs/day

In general



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