# Konceptfor renovering af almen bolig

Tilfredse beboereog sundt indeklima

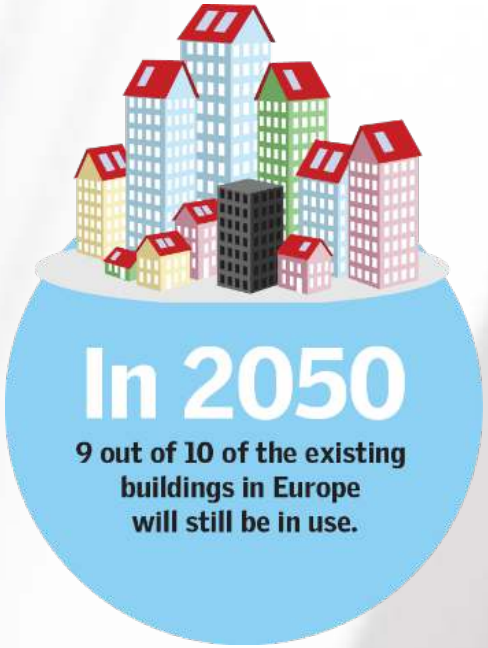
DANVAKtemamøde, 19.januar 20221
Peter Foldbjerg, VELUX A/S

Photo: Adam Mørk

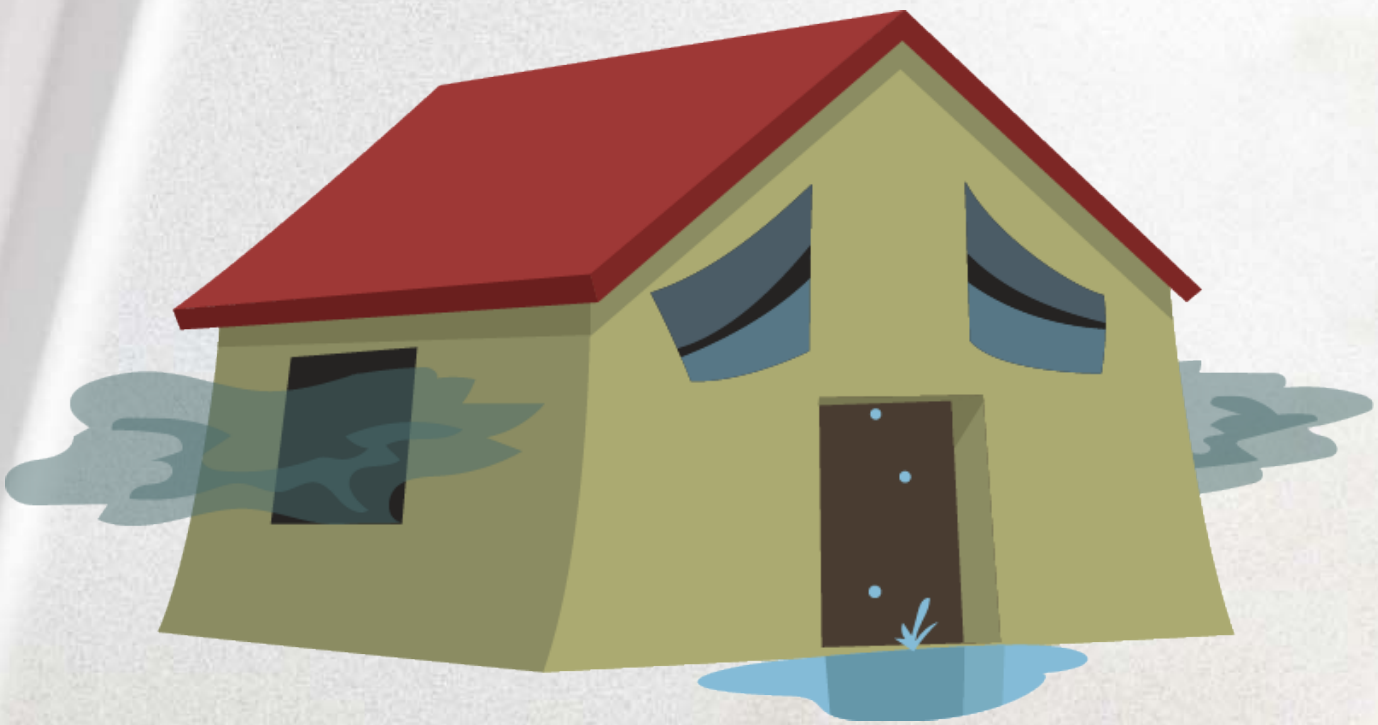
Projektgruppe: Jens Christoffersen, Thorbjørn Færing Asmussen, Lone Feifer og Sabine Pauquay

# A building stock in decline

- About half of the current dwellings in Europe are built between 1945 and 1980
- A 30% decline in construction output since 2008 (Eurostat)
- 9 out of 10 existing buildings will still be in use by 2050 (EuroAce)



# The challenges of social housing associations



Need for **affordable and flexible** solutions

- Ill-maintained homes are more common in rental properties due to tenants' lack of ownership
- Energy poverty means that nearly 11% cannot afford to heat their home sufficiently
- Behaviour, e.g. lack of regular airing and the drying of clothes indoors, sometimes lead to a bad indoor climate

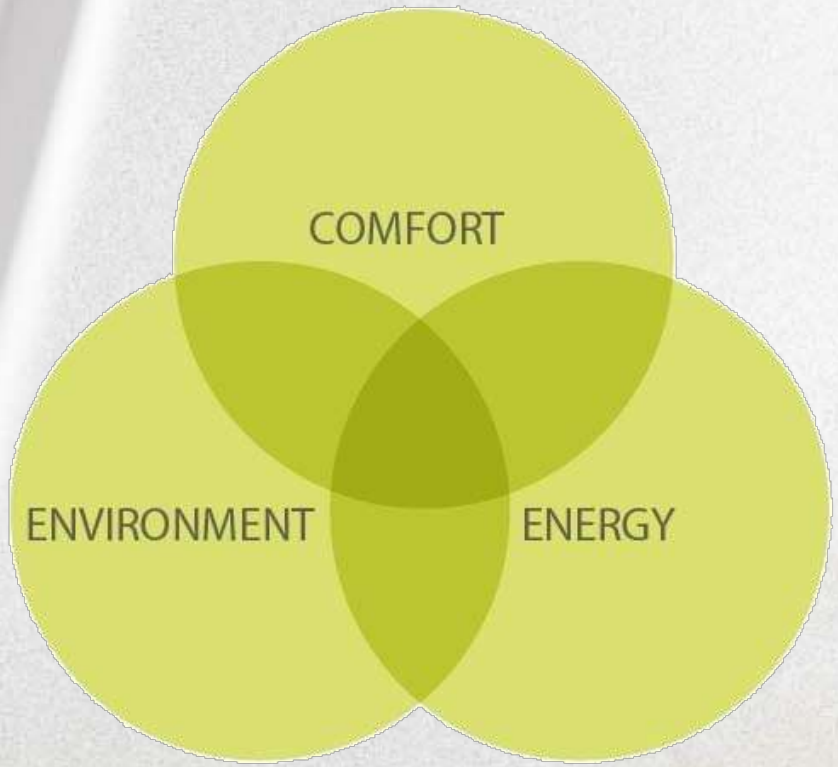
RenoVActive | VELUX®

# Model Home 2020 – experience based on reallife achievements

**26**
Projects and counting…

- Since 1999 we have built 26 full-scale demo houses across Europe and North America
- Six of these buildings spearheaded the programme as Model Home 2020 houses

# Active House principles

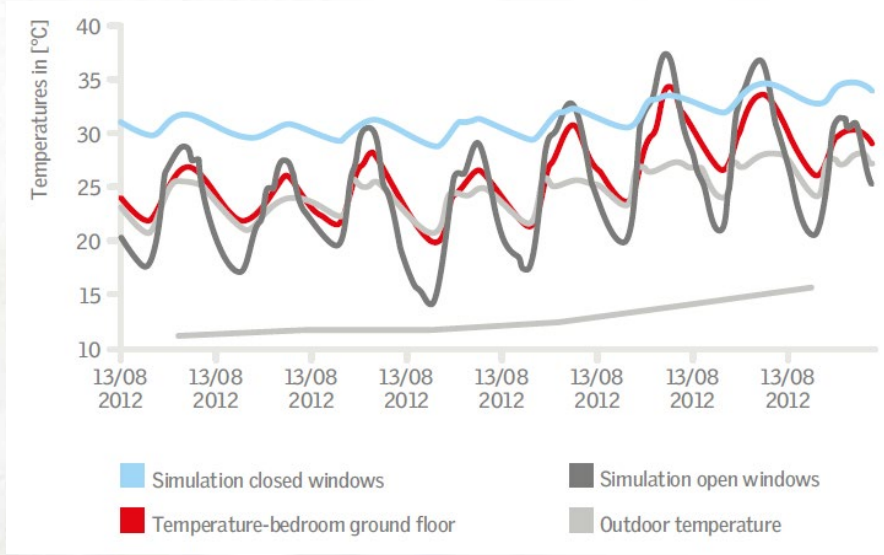


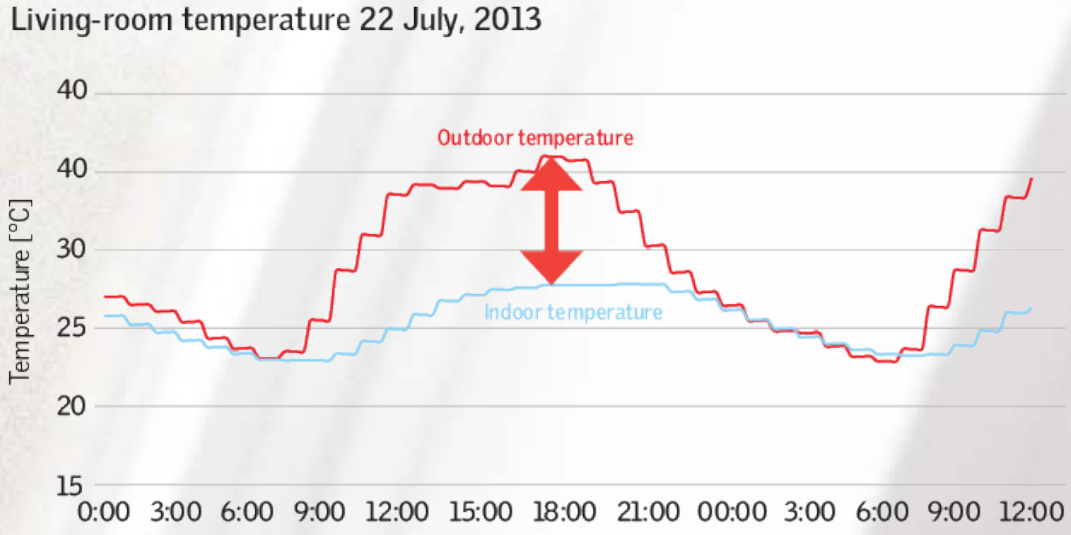

activehouse

- Active House focuses on comfort, energy and environment
- Active House puts the inhabitants' wellbeing and the environmental impact on a level with strict energy requirements

# MODEL HOME 2020: MAISON AIR ET LUMIÈRE

- *It was possible to keep the **indoor temperature below the outdoor temperature** during daytime*
- *Indoor temperature was typically 3-5°C lower than without ventilative cooling*
- *Control of windows by a WindowMastercontrol system, for overheating control parameters are indoor temperature and solar radiation*



# Good daylight one hour longer during the day

"We turned on the lights one hour later than our neighbours

*Extracts from the Pastour's blog*

"We spend most of our time in the living room where we get daylight from all corners of the world. Even on the shortest day we get six full hours of direct daylight into the living room.

*Dorfstetter Family, Sunlight House, AUT*

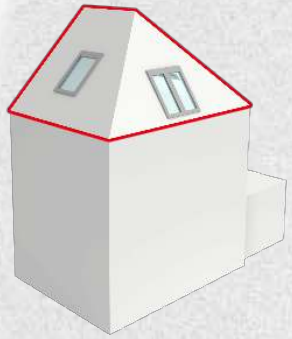
# RenovActive House


- RenovActive was implemented in an old, run-down house in Anderlecht, Belgium
- Comprises all seven elements and is the first of 86 similar projects in the community
- Performed in partnership with Le Foyer Anderlechtois social housing association

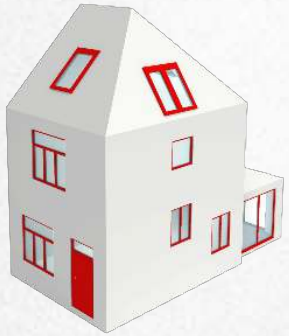
ONO architectuur

PEUTZ

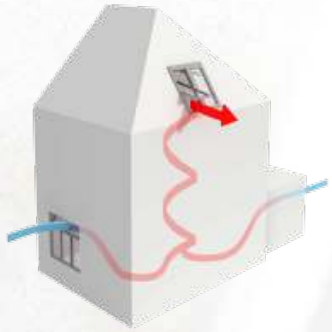
# RenovActive- the 7 elements



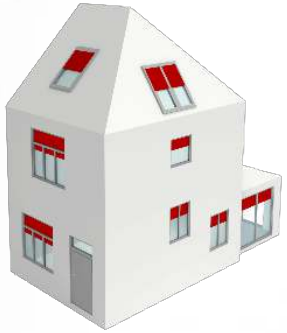
Growing from within



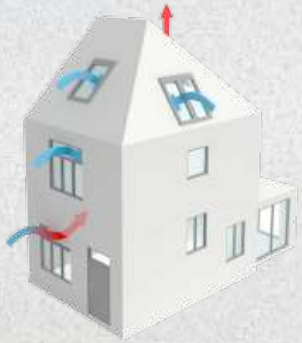
Daylight treatment



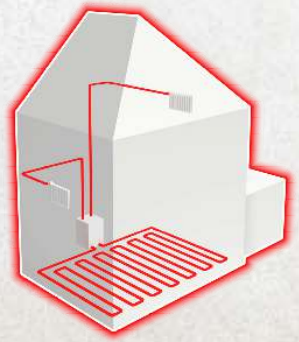
Respiratory channel



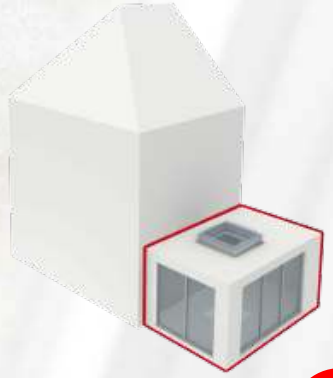
3rd skin



Hybrid breathing



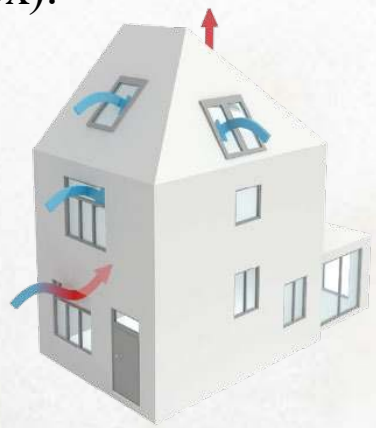
Envelope upgrade



New life space

# Ventilation of RenovActive

- Ventilation system in RenovActive (Renson HealthBox):
  - Ventilation system C (extract ventilation)
  - Natural supply vents above the windows
  - Extraction by fan
  - Automatically controlled window openings.

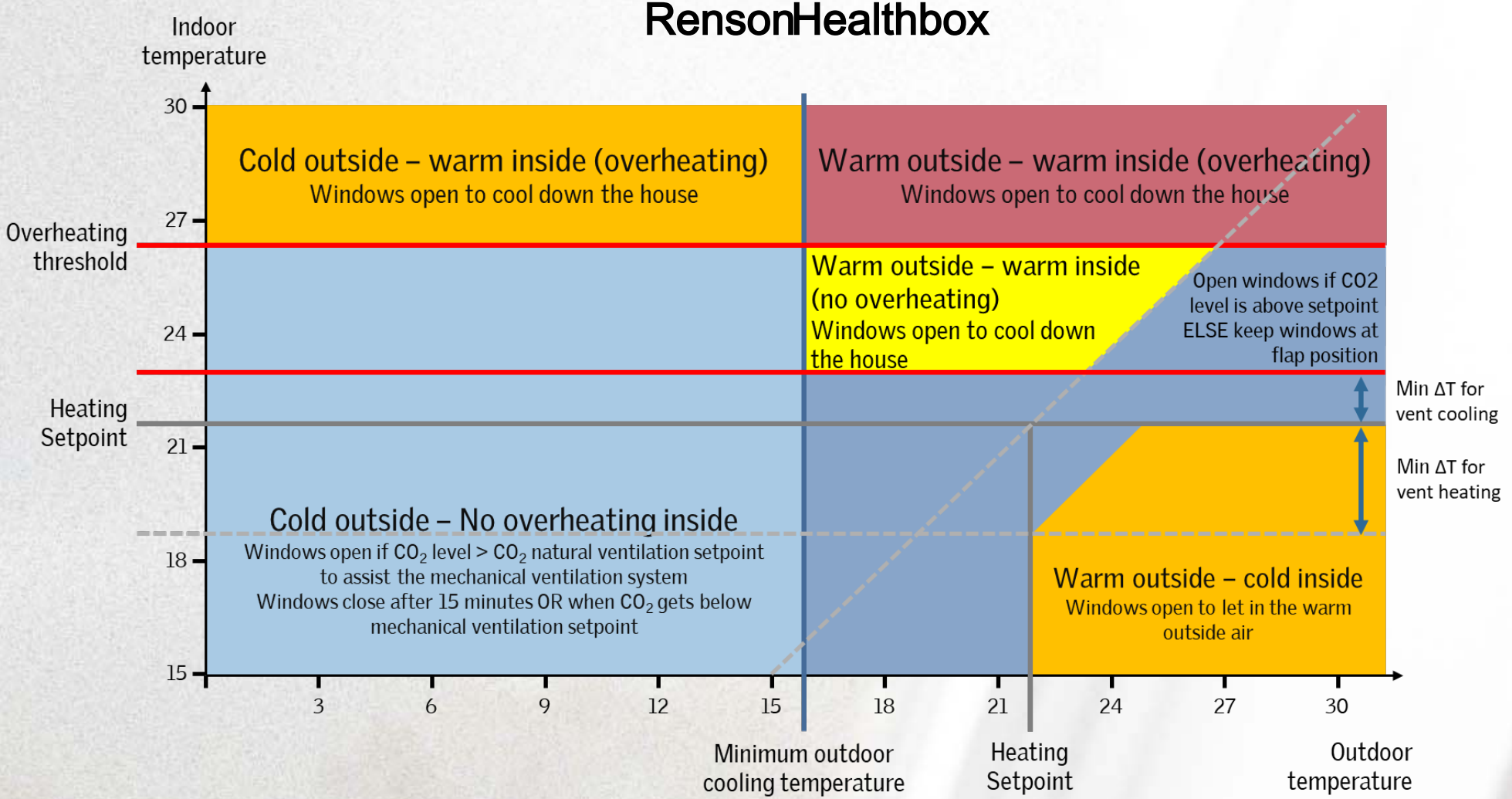


- The switch between hygienic and peak ventilation is controlled based on indoor air quality and in order to prevent overheating.

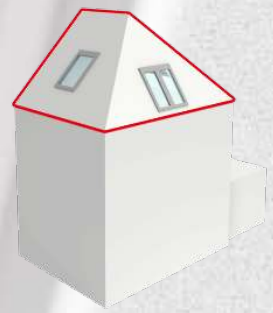
# RENSON HYBRID VENTILATION SYSTEM + CONTROL OF WINDOW OPENING

RenovActive | VELUX®

## RensonHealthbox

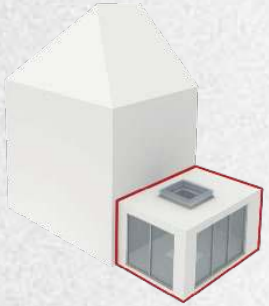


# Challenge: Dark buildings
# Our selected RenovActive elements



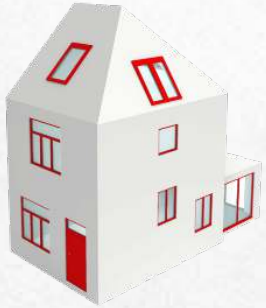
## Growing from within

- Add new, well-daylit spaces under the roof
- Bring daylight into your home through your roof.



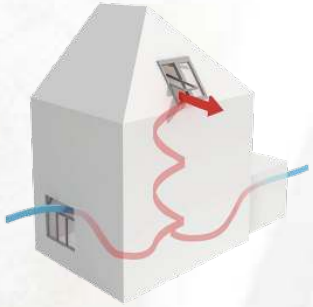
## New life space

- Build an extension with very good daylight
- Open your home to the new extension so the improved daylight also affects the existing space



## Daylight treatment

- Creating a feeling of space is essential to wellbeing.
- Light from above gives a more even distribution of daylight.
- Light from several orientations gives a better distribution of daylight.



## Respiratory channel

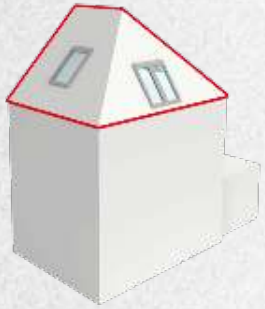
- Bring daylight to all floors with a roof window on top of your staircase.
- Possibly move the staircase to the center of your home.

Lack of daylight impedes everyday routines and has a demonstrated adverse effect on well-being and health

# Challenge: Energy waste
# Our selected RenovActive elements

### Envelope upgrade

- Use insulating frames for roof windows.
- Combine the use of double (South, East, West) and triple glazing (North).



### Growing from within

- From an energy perspective, an attic conversion is preferable to an extension.
- Attic conversions can reduce the energy consumption per $m^2$ by up to 10%.

### Daylight treatment

- Good daylighting results in less hours of artificial lighting. You save on electricity bills.

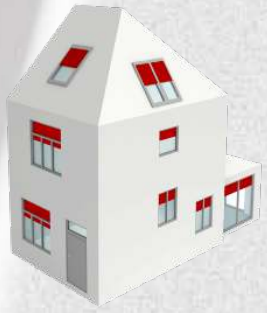
### 3rd skin

- Use automated sun screens to diminish the need for mechanical cooling or ventilating.

### Hybrid breathing

- Prioritise efficient natural ventilation in summer to cut your electricity bills.

# Challenge: Overheating
# Our selected RenovActive elements

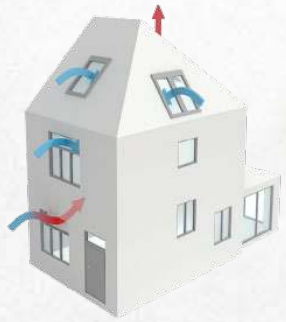


### 3rd skin

- Use sun screening to prevent the building from getting too hot.
- Equip windows with automated sun screening.

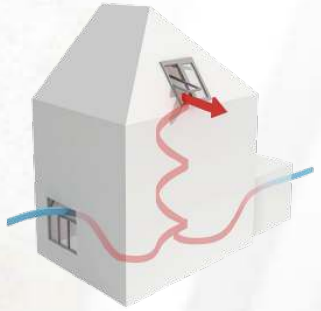
### Envelope upgrade

- For better thermal comfort, keep your home cool in summer.
- Some glasses can protect you from sun gains
- Ensure you have well insulated windows, walls and roof so you keep the heat outside.



### Hybrid breathing

- In summer, prioritise natural ventilation. In winter, combine natural and mechanical ventilation.
- Use cross-ventilation and stack effect to increase ventilation rates.



### Respiratory channel

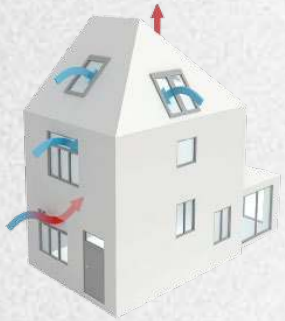
- Use ventilative cooling to cool the building when too hot.
- To do so efficiently, you may want to place the staircase in the center of your home, with 1 or 2 roof windows over it.

Improved insulation and air-tightness create a need for preventive solutions against excessive heat

# Challenge: Mould and smells
# Our selected RenovActive elements

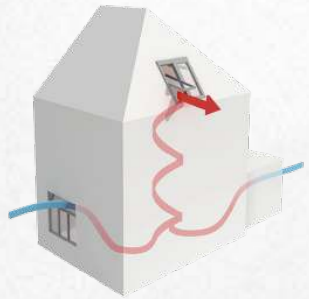
## Envelope upgrade

- Keep your home warm in winter.
- Ensure you have windows, walls and roof with no cold surfaces.
- Ensure good energy balance of windows (winter solar gains).



## Hybrid breathing

- Combine natural ventilation all year round and mechanical ventilation in the winter.
- Use adequate ventilation flows when the building envelope becomes more airtight (required by EPBD).



## Respiratory channel

- Use stack effect ventilation to renew the indoor air rapidly, e.g. when you have guests.
- To do so efficiently, you may want to move the staircase to the center of your home.

Humidity in buildings is a major factor for discomfort and health issues. Reducing humidity in buildings helps cut asthma by ½.

# MONITORING : PARTICIPANTS AND ROLES

| External monitoring partners | | | Products | Internal |
|---|---|---|---|---|
| Vrije Universiteit Brussel | Humboldt-Universität zu Berlin | DAIDALOS PEUTZ bouwfysisch ingenieursbureau | RENSON | VELUX |
| - Development of tools<br>- Field work<br>- Analysis & conclusions | - Scientific framework<br>- Development of sociological tools | - Physical measurements | - Hybrid ventilation system + control of window opening<br>- Logging of control system signals | - Measurement analyses and consolidation |

# PROJECT TIMELINE

RenovActive | VELUX®

Spring 2017

Building Monitoring
Existing Home

Oct '15

**CONSTRUCTION**
6 months – end March '16

Spring '16

**OPEN FOR VISITS**
1 year

Spring '17

**FAMILY IN HOUSE MONITORING**
2 years

July 2017 — September 2019

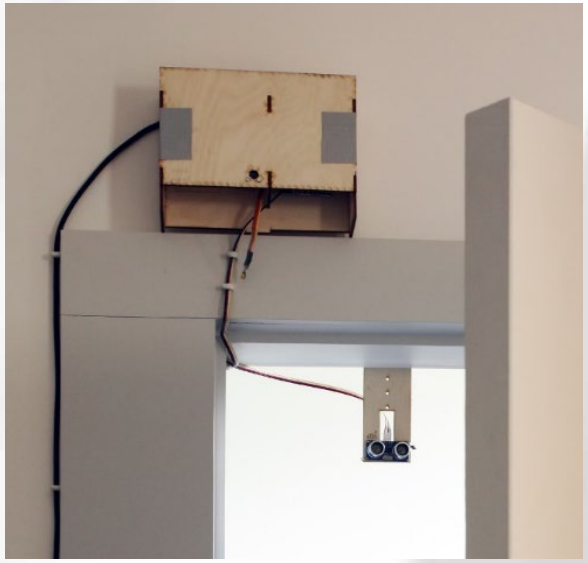
Building Monitoring
RenovActive

## From an occupant perspective

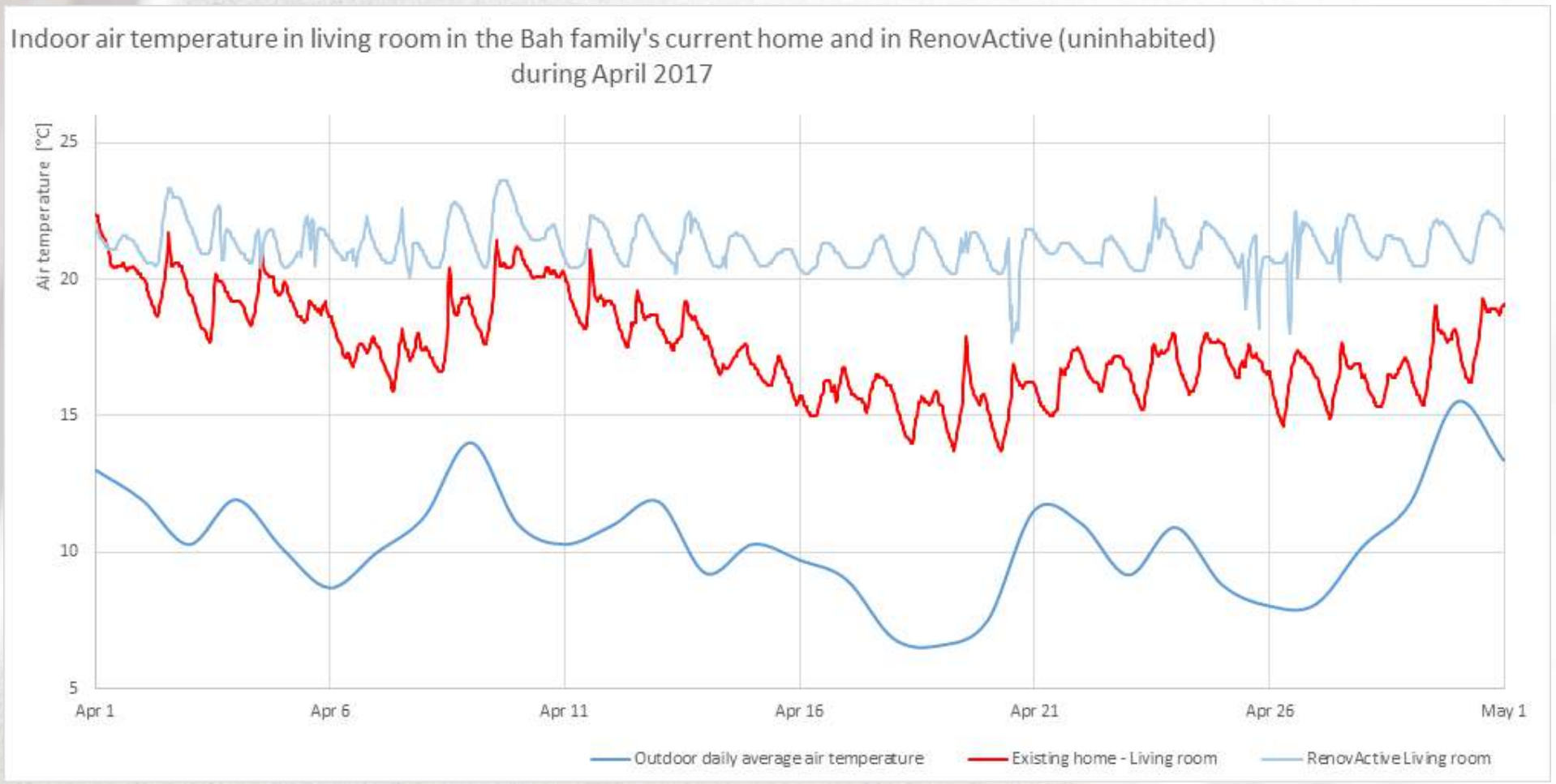
- Three different instruments of data collection and several data collection points.
  - Face-to-Face-interviews
  - Online questionnaires
  - Time-diary-tool

## From a monitoring perspective

- One instrument of data collection and continuous collection points
  - Indoor air quality (e.g. $CO_2$, RH)
  - Temperature (e.g. thermal comfort)
  - Manual reading of energy use.



# EXISTING RESIDENCE - TEMPERATURE




Netatmo
weather station

Existing home

RenovActive (empty)

Outdoor

# EXISTING RESIDENCE - INDOOR AIR QUALITY

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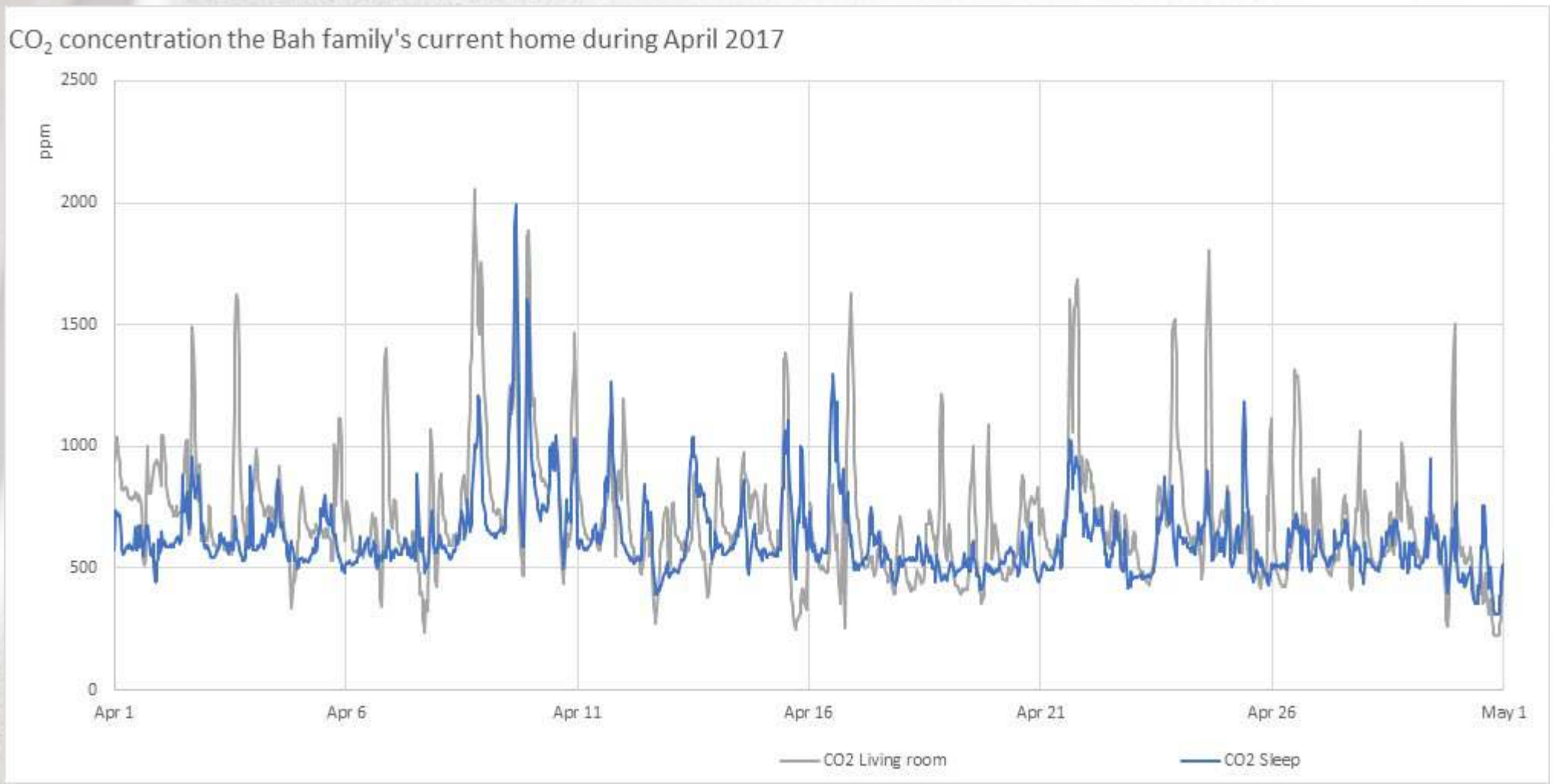



Netatmo
weather station

$CO_2$ Living room

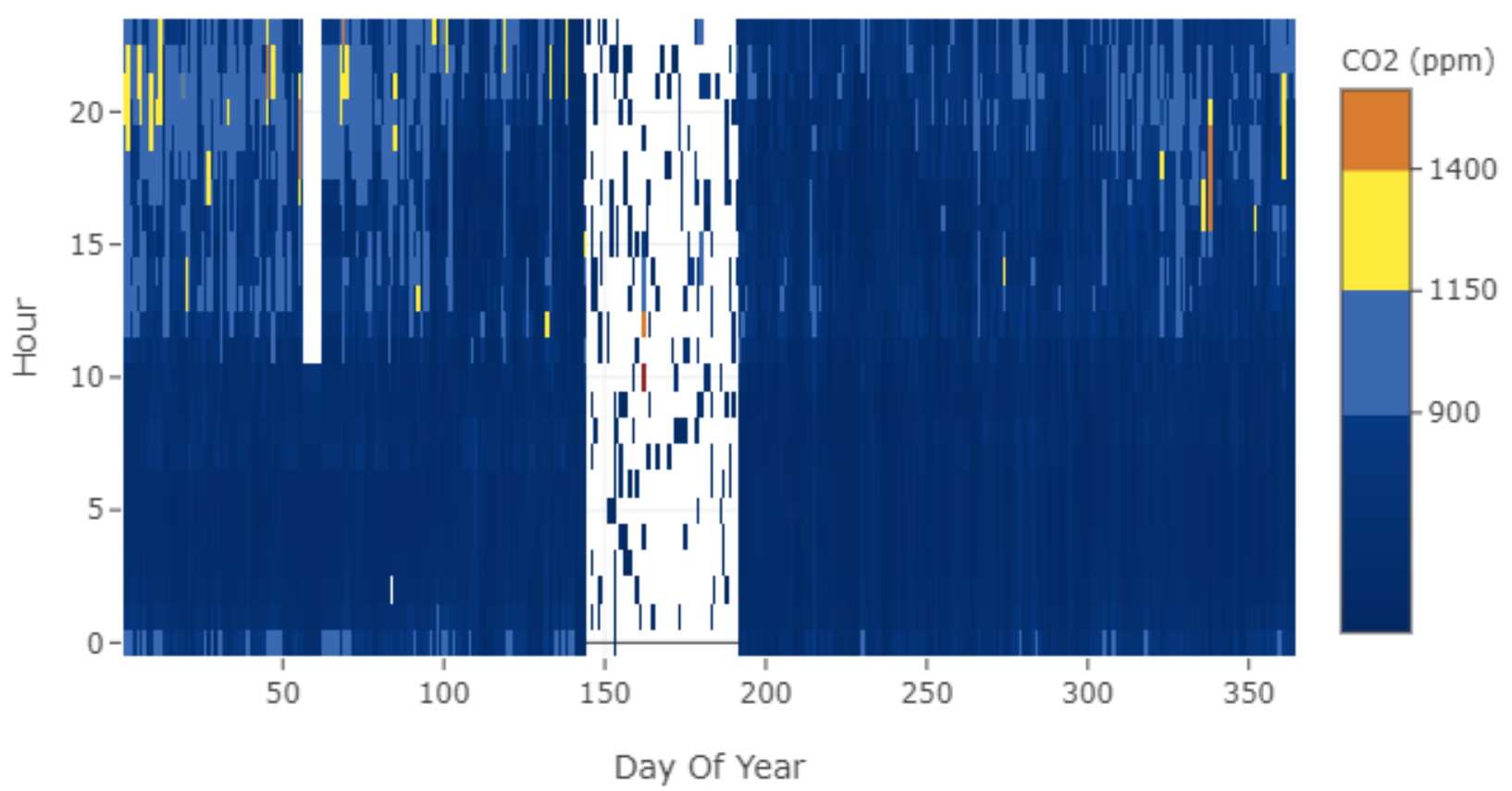
$CO_2$ Bedroom

# From an occupant perspective

In general, the family is very satisfied with RenovActive, and the level of indoor comfort.

- Interview and questionnaire show high satisfaction with indoor temperature, air quality and daylight.
  - Comfortable indoor temperatures, in the winter, is the most important aspect of housing.
    - At ground floor, the heating system is always set on 23°C.
    - In the bedrooms, the temperature is adjusted
  - Solar shading, at ground floor, is often, manually, changed by the family in order to cope with their privacy concerns.
- From a health perspective, the mother had irritated airways or hay fever in the former home, but this has disappeared. She also report less coughing and running nose. They also state improved quality of sleep.
- Good feeling of personal control and able to adjust the different indoor parameters according to their needs – "a feeling of being in control instead of being controlled"
  - When adjusting, they experience an improvement of the indoor environment.
  - But the ventilation system as well as the home automation system were left unadjusted, along with sporadic manual window opening to cool down the house.

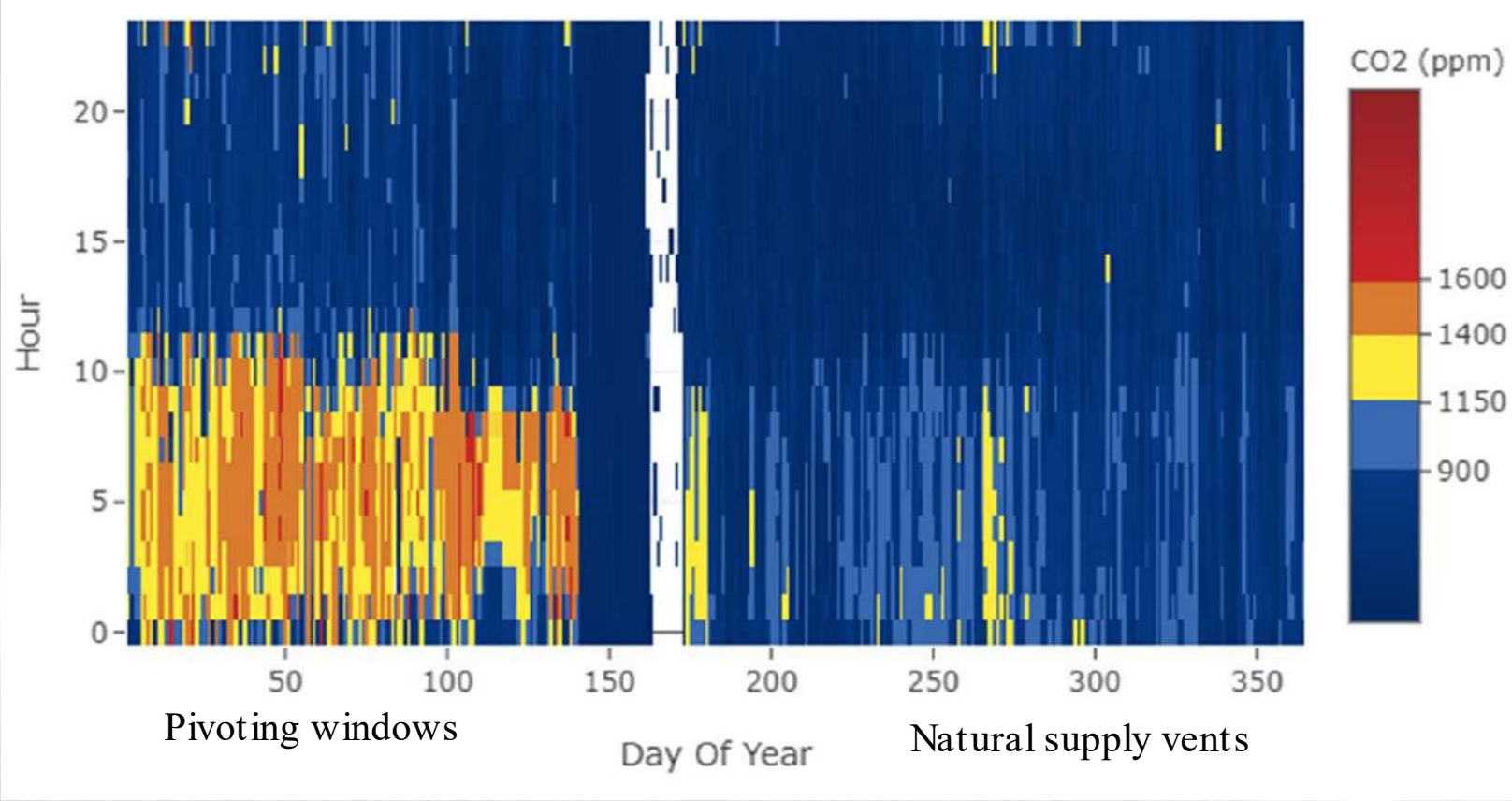
# $CO_2$ concentration in the living room




For more than 95% of the time, the $CO_2$-concentration in the house, in general, is below 900 ppm.

Each column represents one day of the year and each of the rows the hours.
The colour scale indicates the $CO_2$ level. The white area around May is due to a period of missing data.

# $CO_2$ concentration in the parent's bedroom




**Slightly higher values in the parents sleeping rooms ≈1100 ppm**

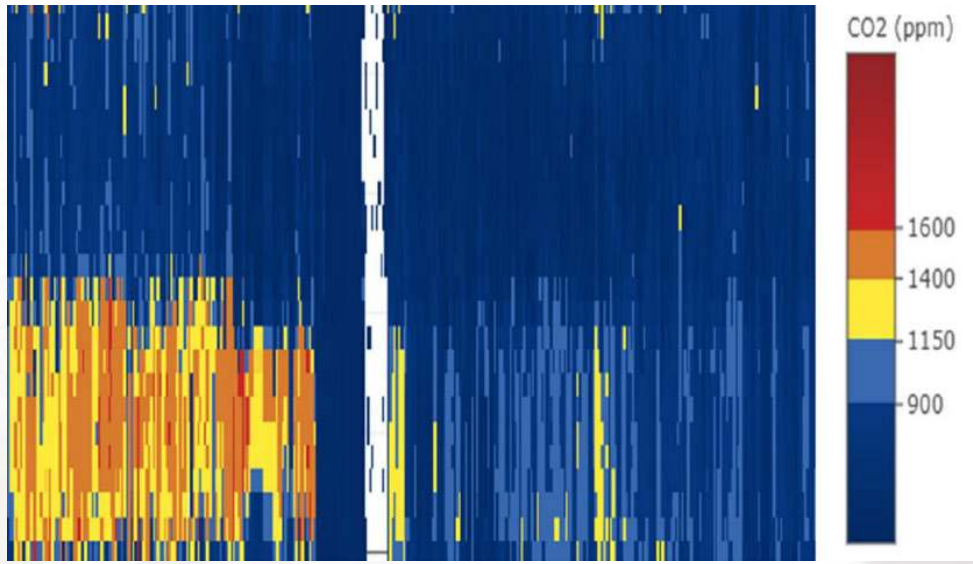
Winter 1
ventilation by
- pivoting windows
- fan extraction

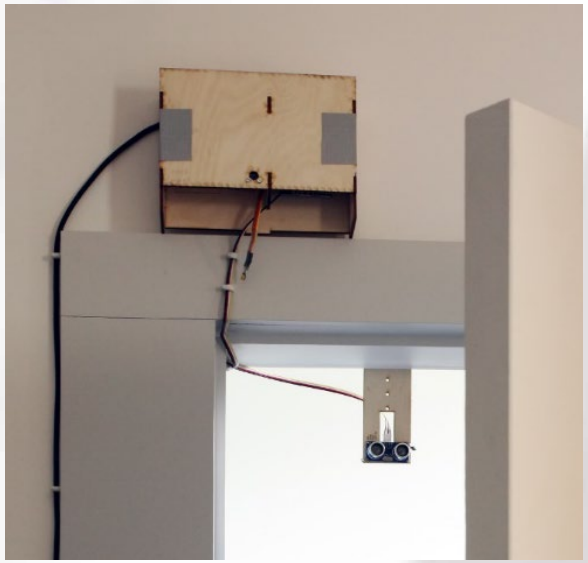
Winter 2
ventilation by
- natural supply vents
- fan extraction

# From a monitoring perspective

## Indoor Air Quality in parent's bedroom

- Ventilation system did not perform according to the intended strategy from the beginning:
  - Some of the supply vents unintentionally closed
  - Fan system was set to eco mode instead of demand control mode due to noise, resulting in low ventilation rates (e.g. family).
  - Automatic operation of the staircase windows, and attic window was turned off at night (as a mosquito protection).
  - As a consequence, the 95th percentile $CO_2$ concentration where slightly above 1300 ppm.

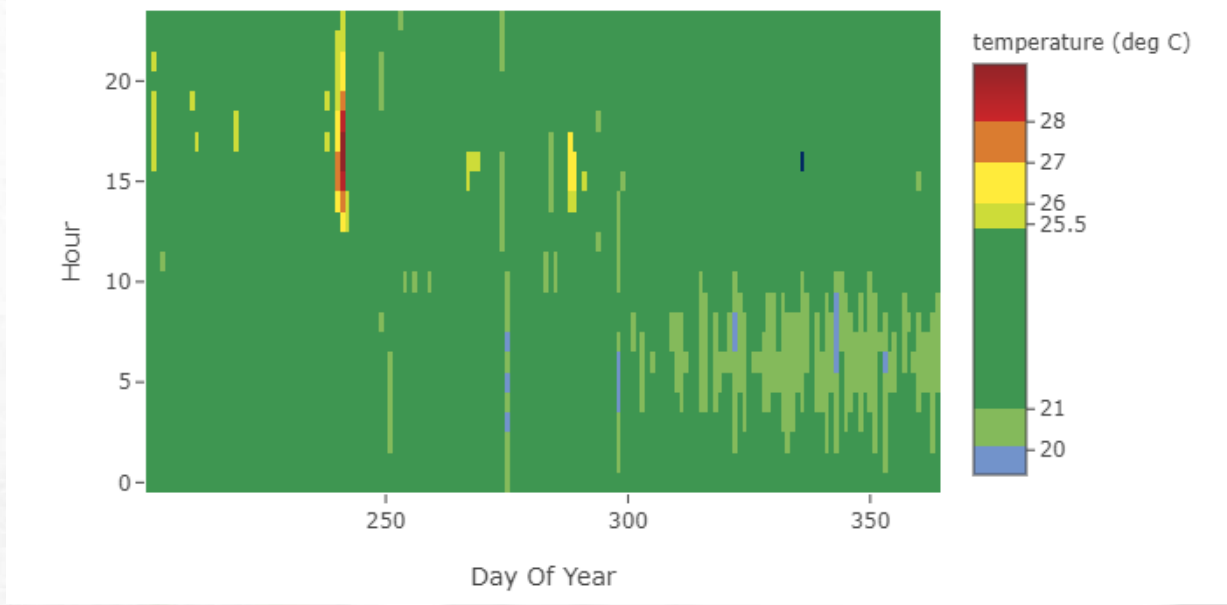


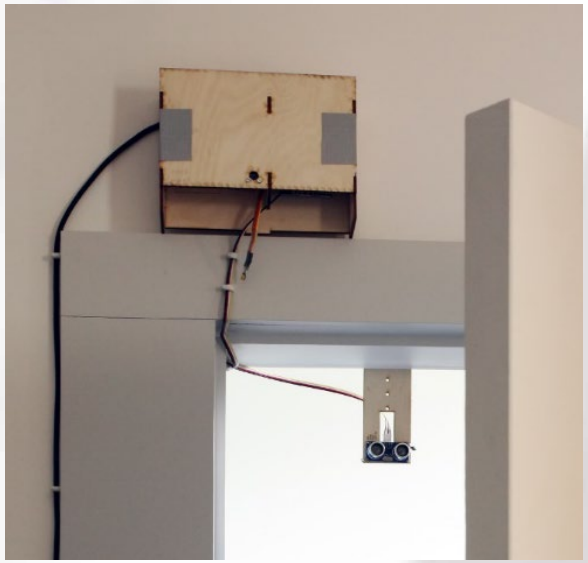



# From a monitoring perspective

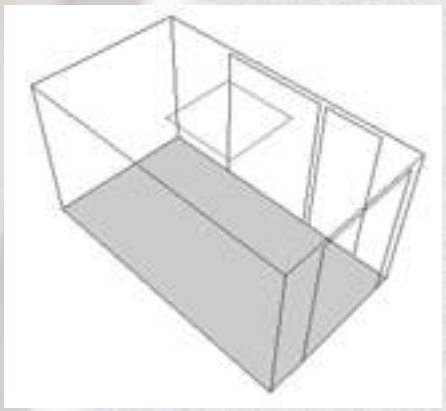
## Indoor temperature

- The temperatures in the house stay for more than 95% of the time between 21°C and 26°C (e.g. similar to category II of EN 16798-1)
- The attic has slightly higher values, but stays under 28°C, after improved staircase- and attic-window openings
  - Added new solar shading
  - Added VELUX Active
- We encouraged the family to use cross ventilation in the attic to reduce peak temperatures.
- During the 2018 hot spell, the indoor temperatures were too high, and the automatic system did not resolve this, but could have been improved by ensuring cross-ventilation operation.

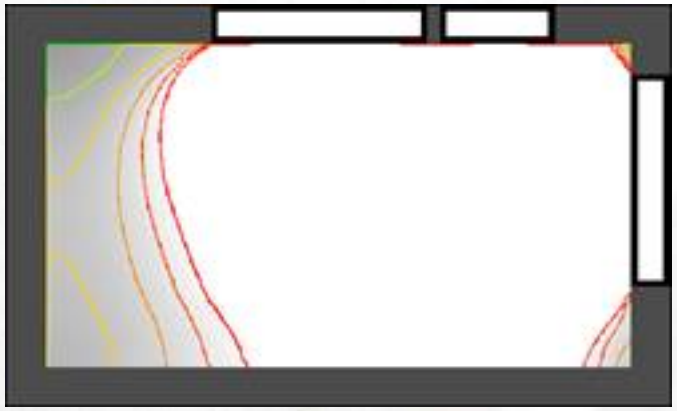


# Daylight analysis



| Zone 0 (DF%) | |
|---|---|
| **Mean** | 14,00 |
| **Median** | 14,23 |
| **Minimum** | 5,02 |
| **Maximum** | 22,68 |
| **Uniformity 1** | 0,36 (min/mean) |
| **Uniformity 2** | 0,22 (min/max) |
| **Above 2,00** | 100% |



Mean daylight factor: 14%

# From one to many – RenovActive is being replicated widely

- The RenovActive concept is currently being applied on 86 houses in Anderlecht


FA owned

FA owned, chosen for renovation

Documentation

RenovActive

VELUX®

# Konceptfor renovering af almen bolig

## Tilfredse beboereog sundt indeklima

DANVAKtemamøde, 19.januar 20221
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