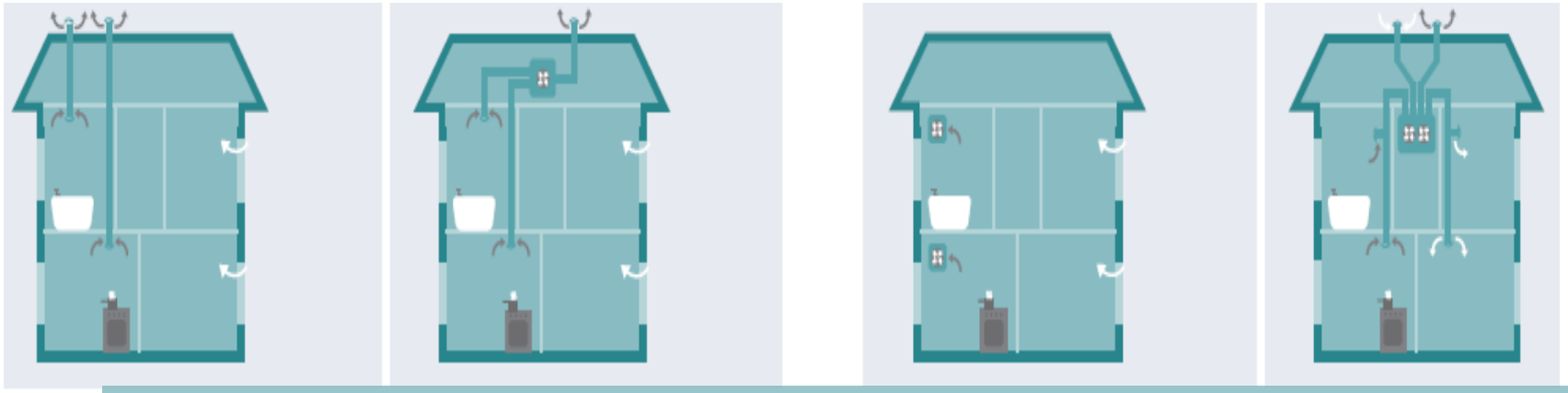


# Human Health:

## *Ventilation and materials for traditional buildings (part 2)*

Presented by Ian Mawditt | June 2017 | London

STBA
SUSTAINABLE TRADITIONAL BUILDINGS ALLIANCE

S·P·A·B

2017 STBA/SPAB Conference
*Sustainability of Traditional Buildings*

fourwalls

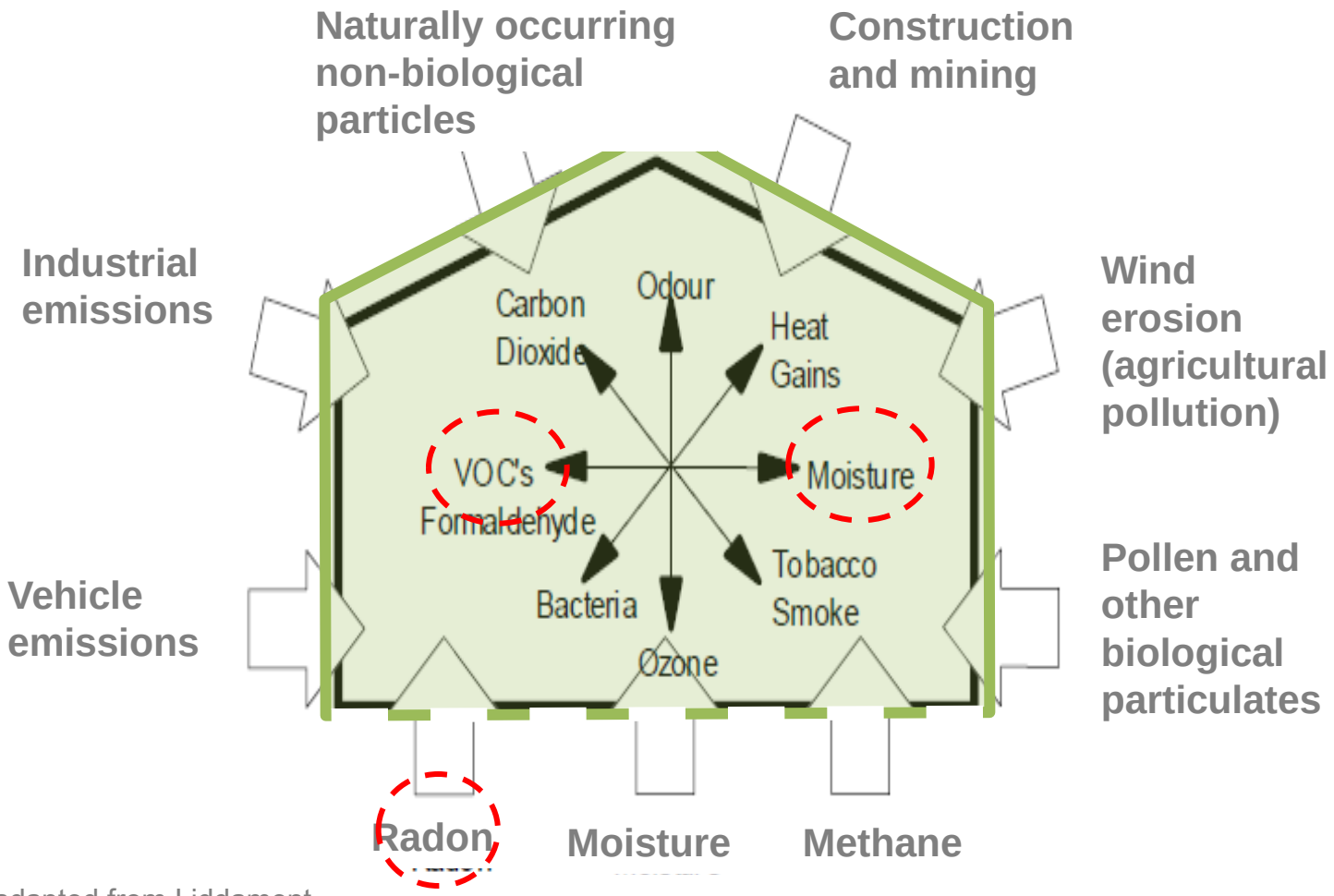
# Limit pollutant sources, then dilute by ventilation:
# *this is not news…*

*"A room that contains a rotting dung pile remains, despite all ventilation, a disgusting living quarter, a source of bad air.*

*The time for ventilation comes only after cleanliness, through removal or careful isolation of air polluting materials."*

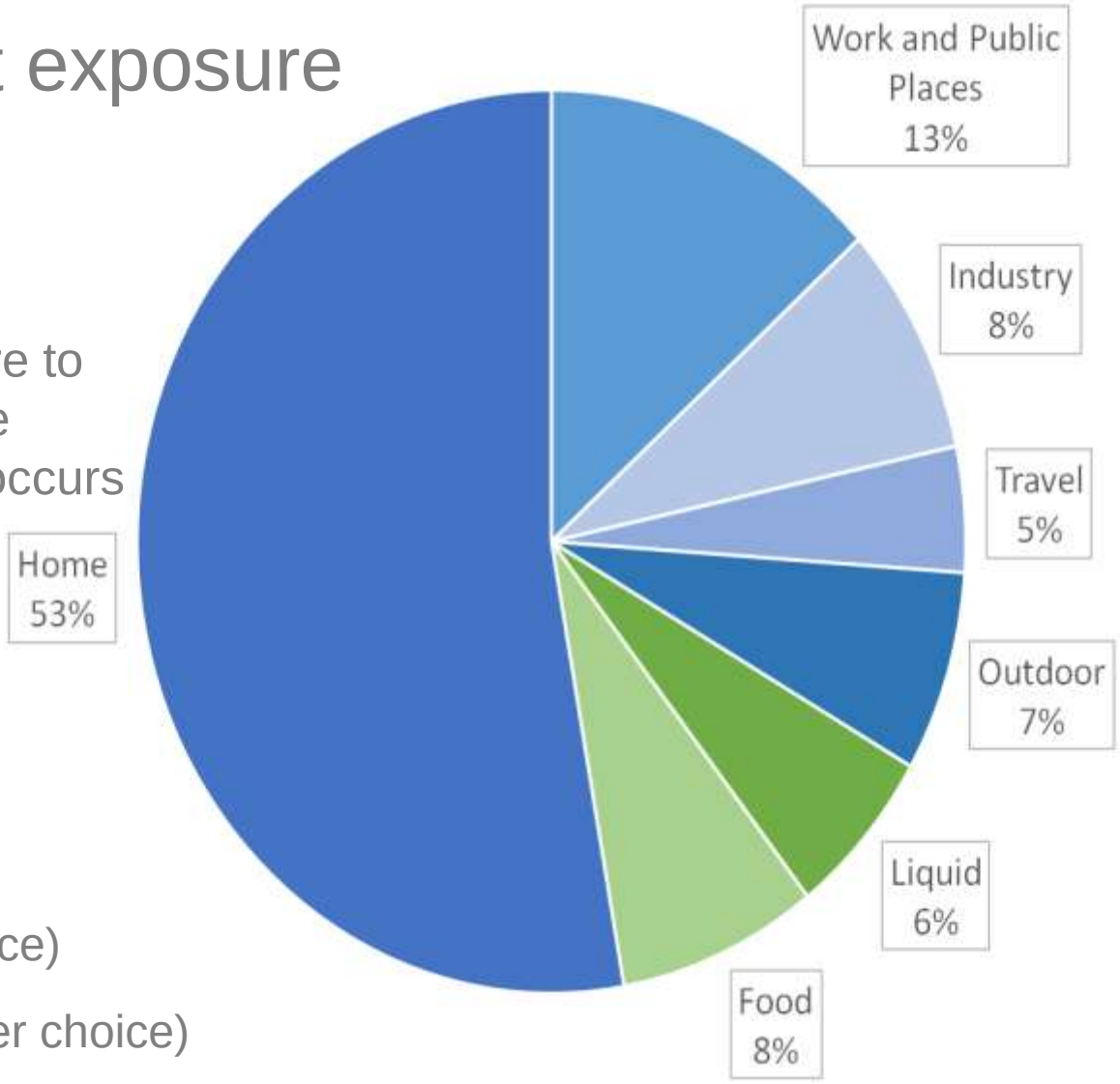
Pettenkofer, M. von, 1859
Chemist and Hygienist, Germany
1818 - 1901

# Building envelope: protection from the outside world?



# Total pollutant exposure over 70 years

- Most of our exposure to pollutants during the course of our lives occurs in our homes




- Via lungs (little choice)
- Via stomach (greater choice)

Chart recreated from data by Prof Jan Sundell, Tsinghua University Beijing

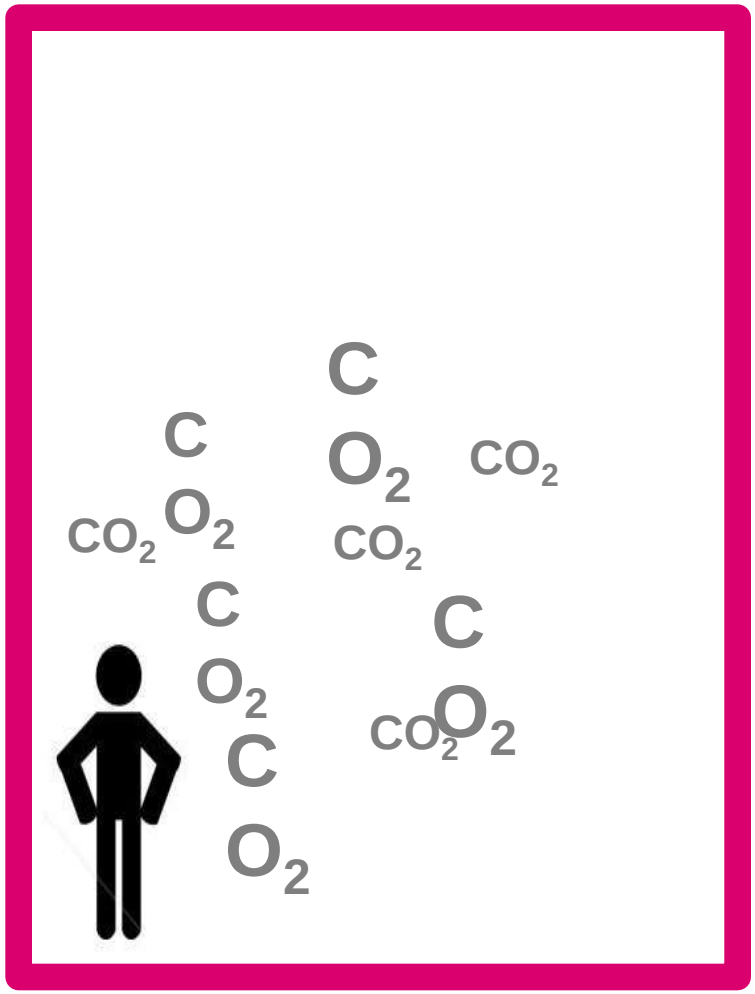
# Ventilation for continuous sources: chemical compounds



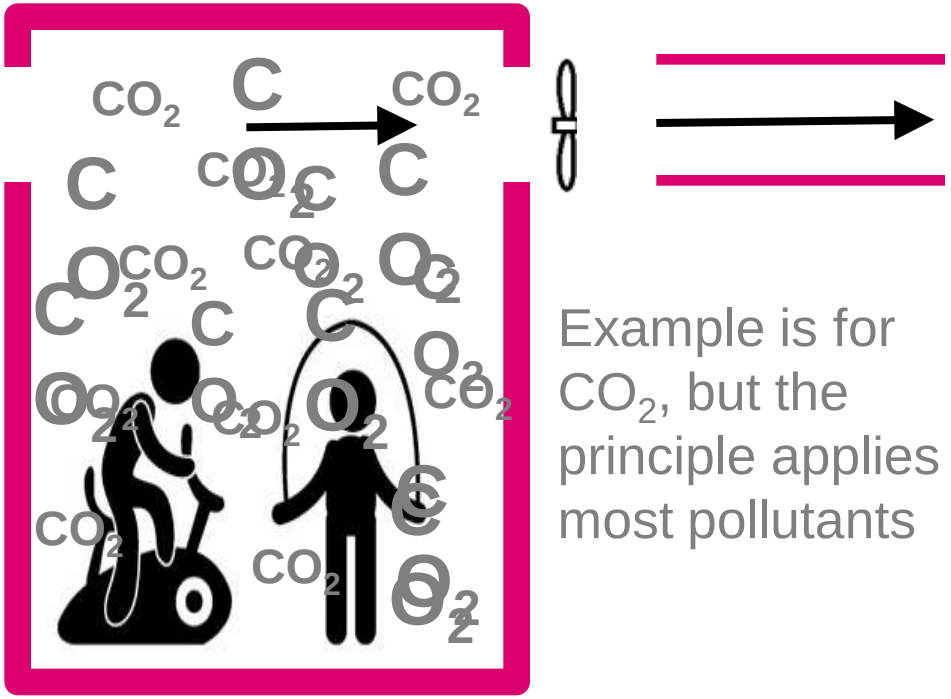





# Pollutant concentration:

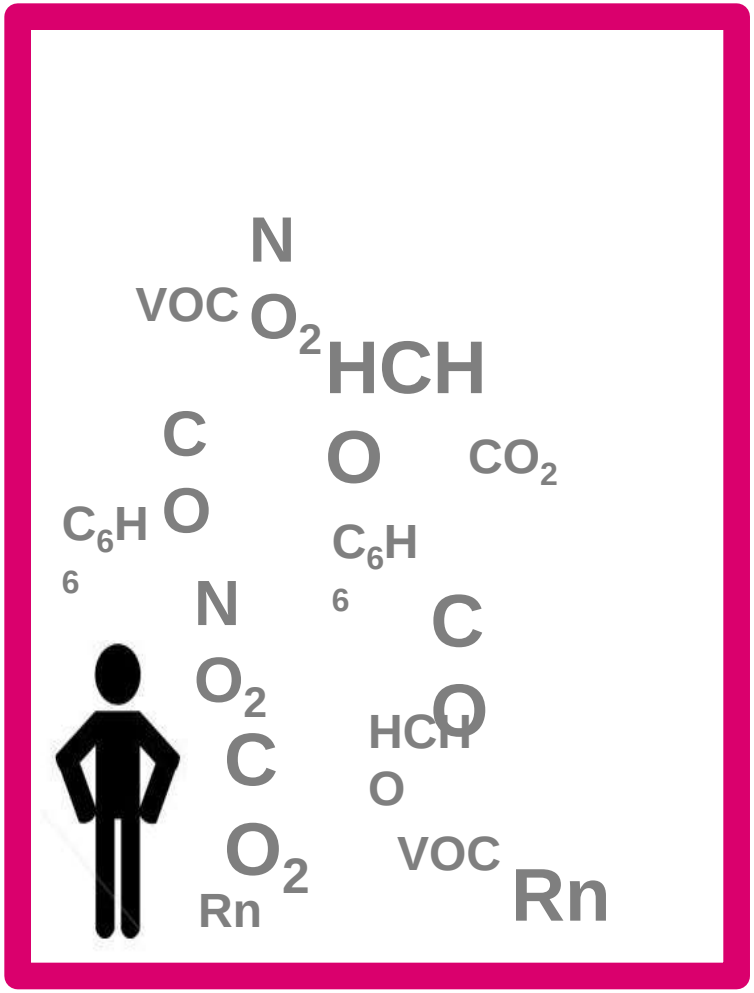


- Is proportional to emission rate and volume (fresh air reservoir)
- And ventilation rate



Example is for $CO_2$, but the principle applies to most pollutants

# Exposure effects

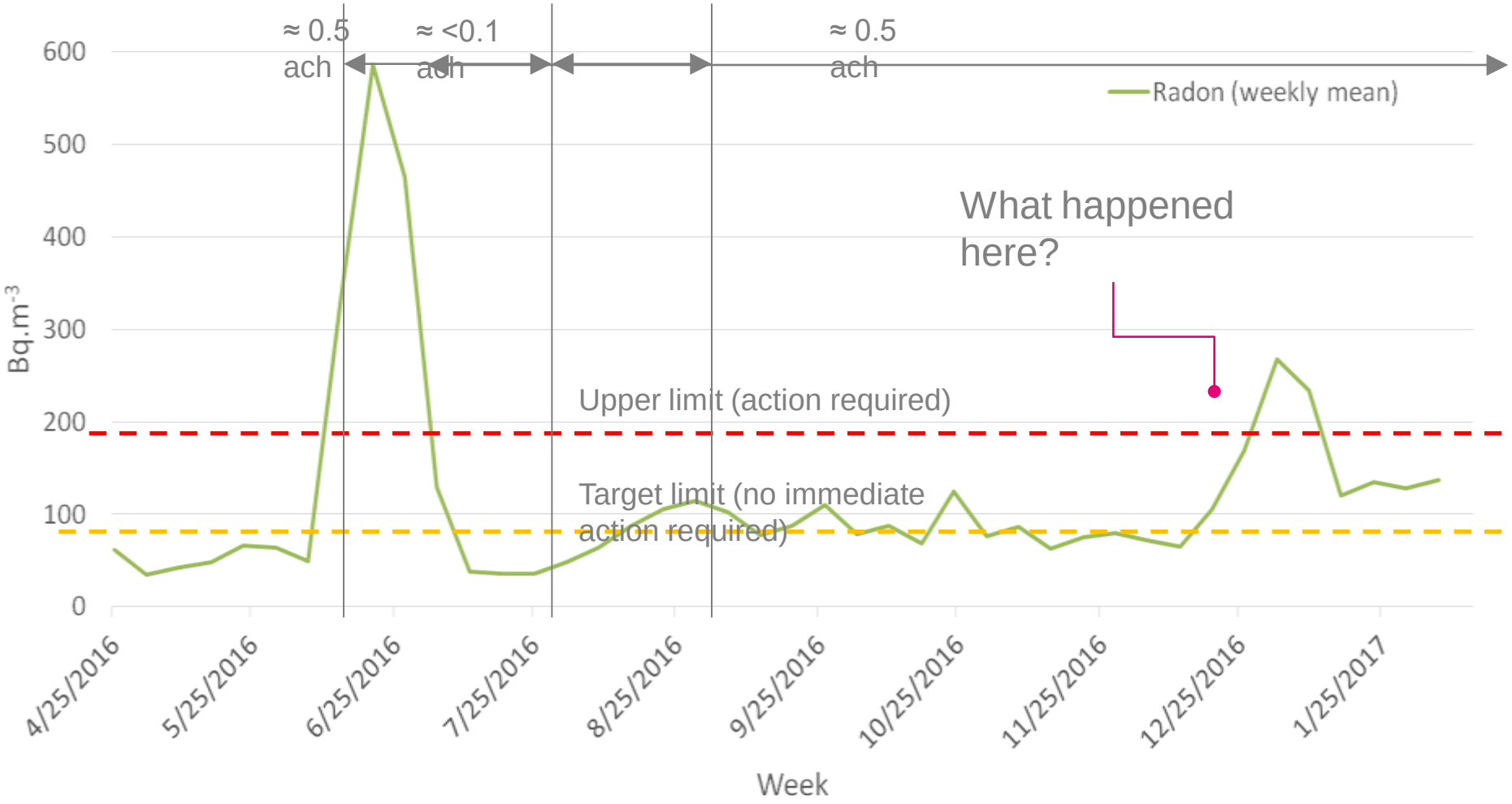



- Depends upon:
  - pollutant concentration
  - toxicity of pollutant
  - exposure time
- Pollutant concentration should not exceed health-based limits for a time above the averaging period…

# AD F: Performance criteria (gaseous pollutants)

| Indoor pollutant | Guideline concentration value | | Averaging Time |
|---|---|---|---|
| TVOC | 300 | µg $m^{-3}$ | 8 hours |
| Carbon Monoxide (CO) | 100 (87.29) | mg $m^{-3}$ (ppm) | 15 minutes |
| | 60 (52.37) | mg $m^{-3}$ (ppm) | 30 minutes |
| | 30 (26.19) | mg $m^{-3}$ (ppm) | 1 hour |
| | 10 (8.73) | mg $m^{-3}$ (ppm) | 8 hours |
| Nitrogen Dioxide ($NO_2$) | 288 (0.15) | µg $m^{-3}$ (ppm) | 1 hour |
| | 40 (0.02) | µg $m^{-3}$ (ppm) | long-term |

# Managing Radon – can we rely on ventilation?

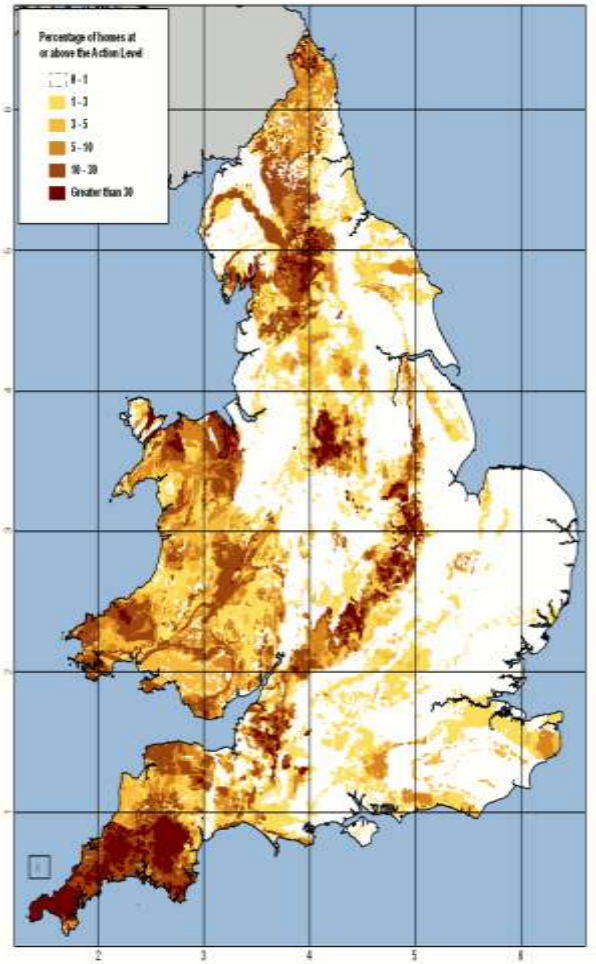


# Radon

- Radon represents around 50% of our annual radiation dose
- It is the leading cause of lung cancer in non-smokers
- Approximately 1100 lung cancer deaths attributed to Radon each year

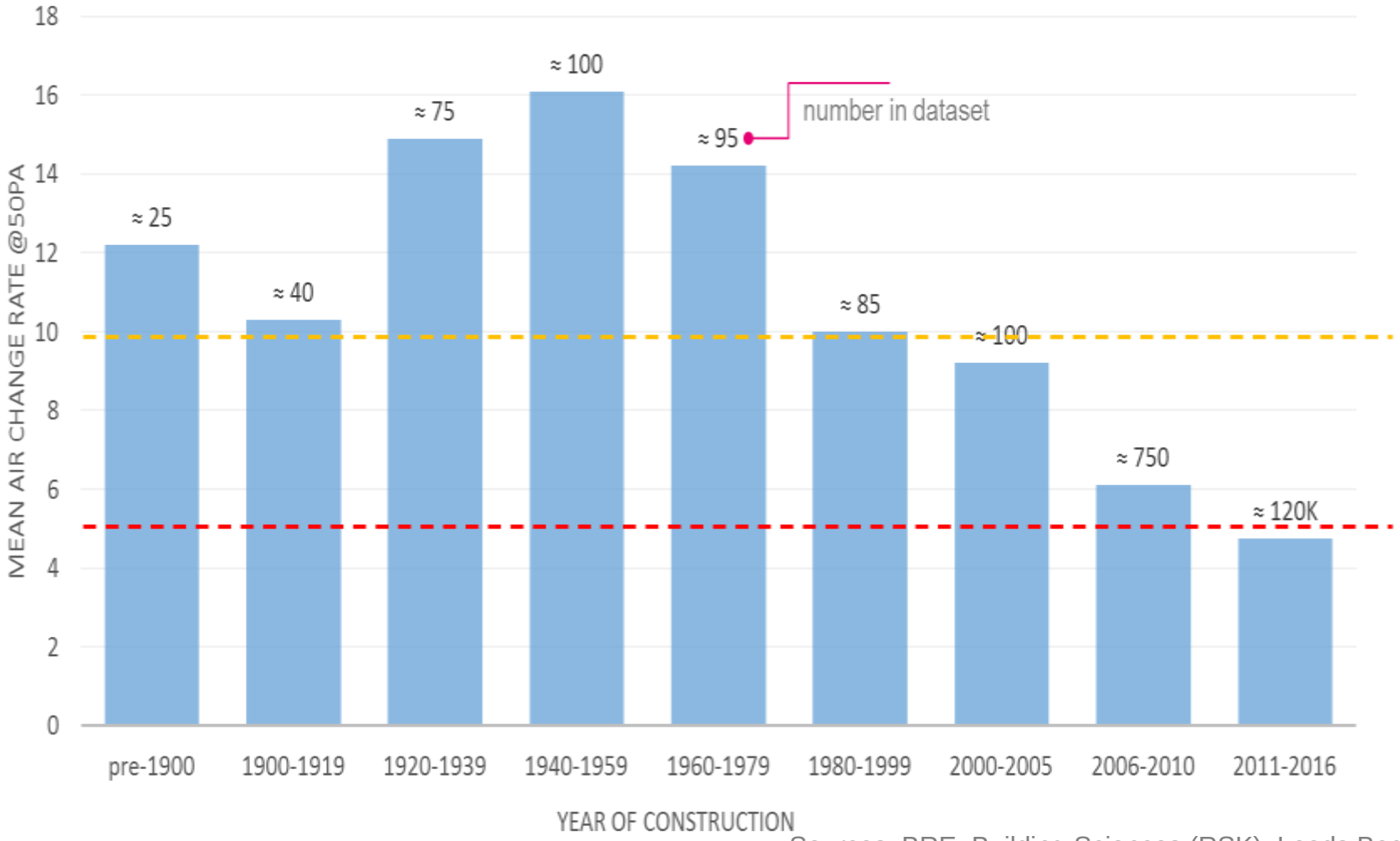
Source: Public Health England / UK Radon

- Radon mitigation measures are fairly simple to apply to new build – retrofit is likely to be more tricky
- Go to: [www.ukradon.org/information/ukmaps](www.ukradon.org/information/ukmaps) for further information



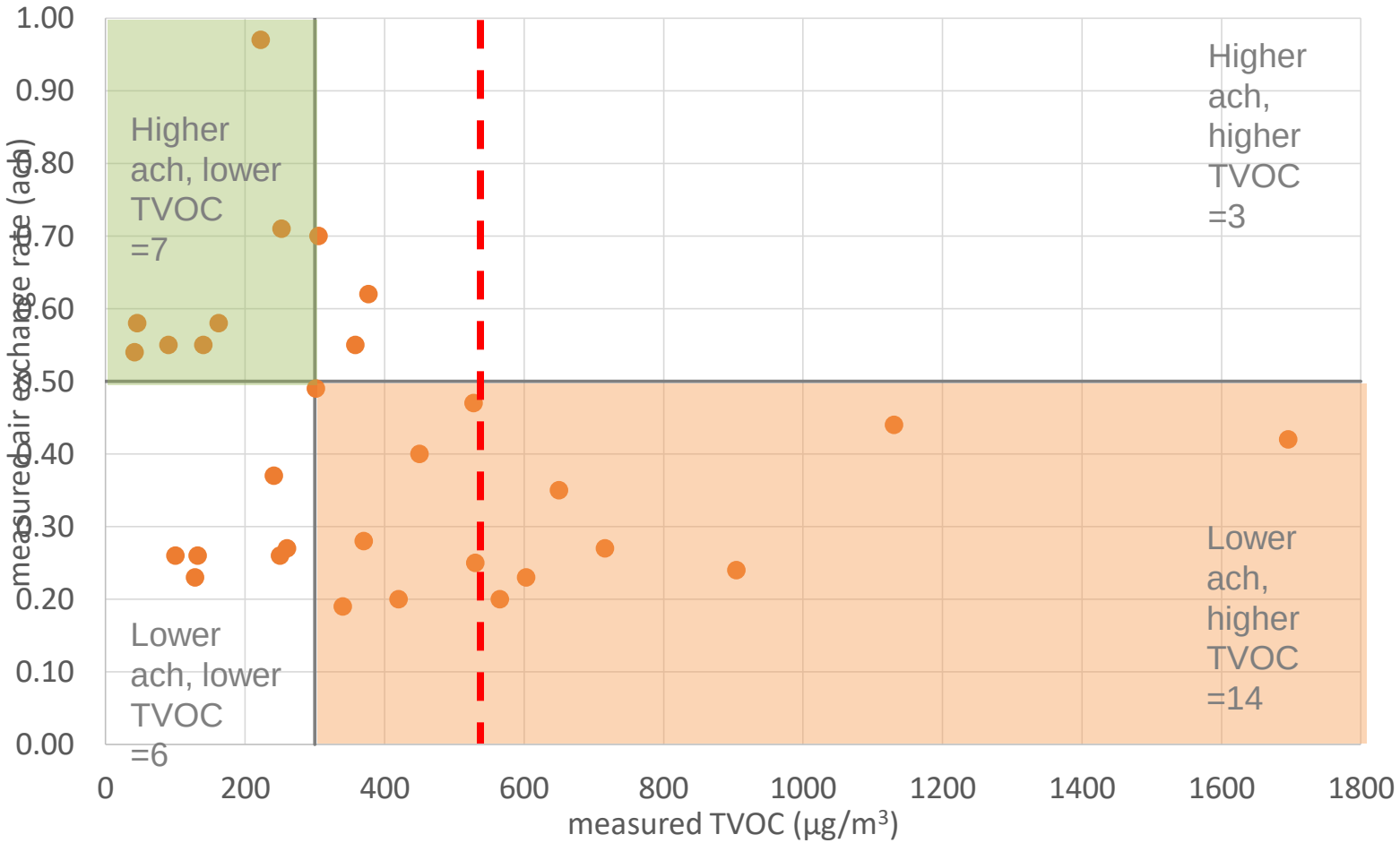

Overall map of radon Affected Areas in England and Wales (axis numbers are the 100-km coordinates of the national grid)

# Air permeability trends: house age




Sources: BRE; Building Sciences (RSK); Leeds Beckett University; ATTMA

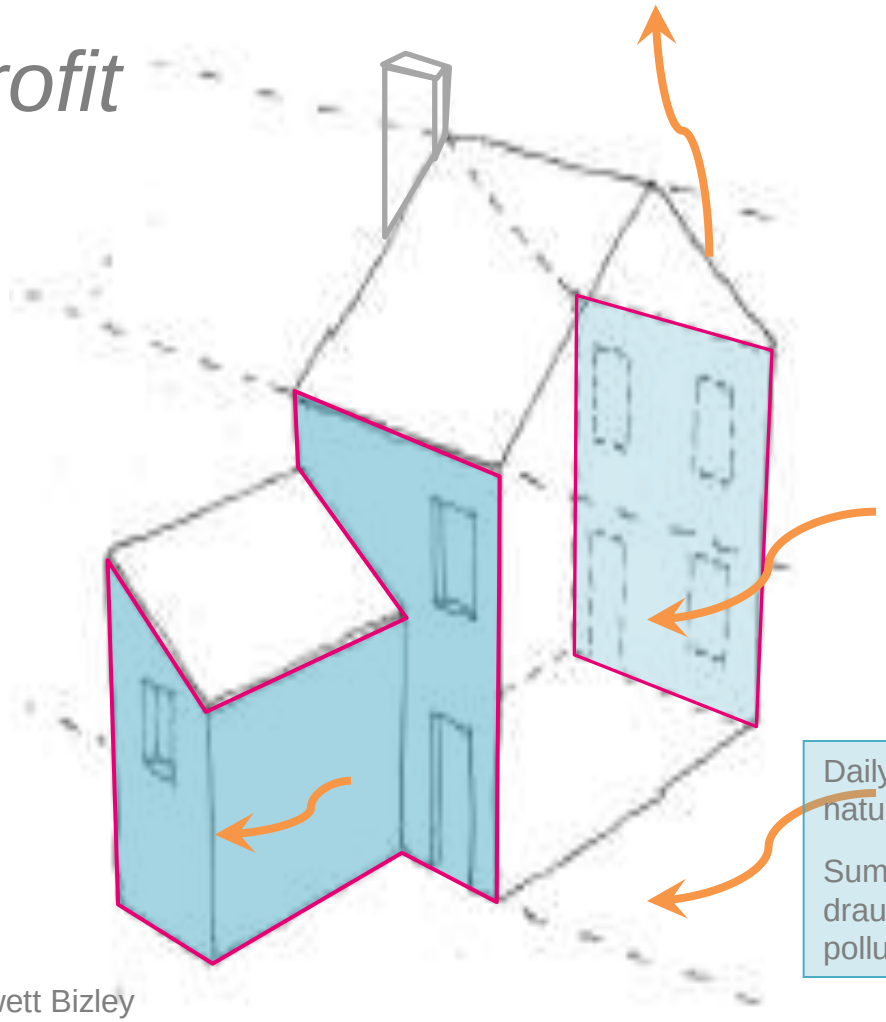
# Air exchange rates and TVOC concentrations in 30 bedrooms




Data collated from various studies

# Ventilation for moisture control

## *Pre-retrofit*



**Moisture landing zones**
Moisture vapour will condense on colder surfaces, e.g. uninsulated external walls and windows

**Wind-driven (adventitious) ventilation via original s.g. windows and chimneys**
May be significant enough to provide an air change of ≈ 1.5

Daily moisture generation managed through natural air movement.

Summary: may not be energy efficient, may be draughty. But moisture (and perhaps other pollutants) are managed

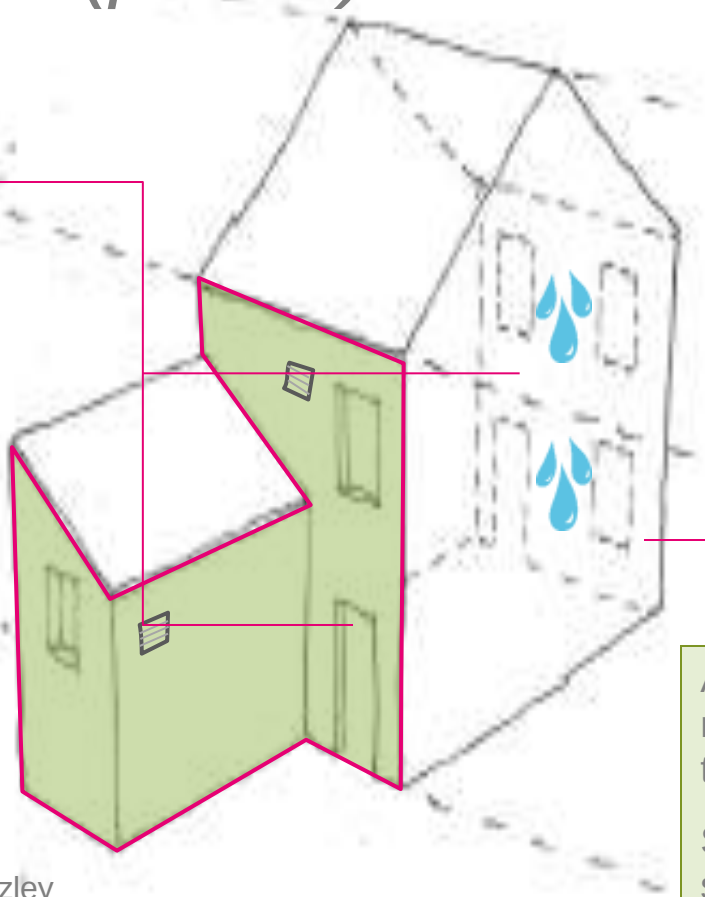
House sketch by Prewett Bizley Architects

# Ventilation for moisture control

## *Post-retrofit (partial)*

**Ventilation considered**
as part of retrofit strategy

**But budget constraints meant it didn't go in!**



**Feature facade**
EWI possibly inappropriate; funding didn't include IWI measures.

**Windows replaced**
and chimney ~~capped~~

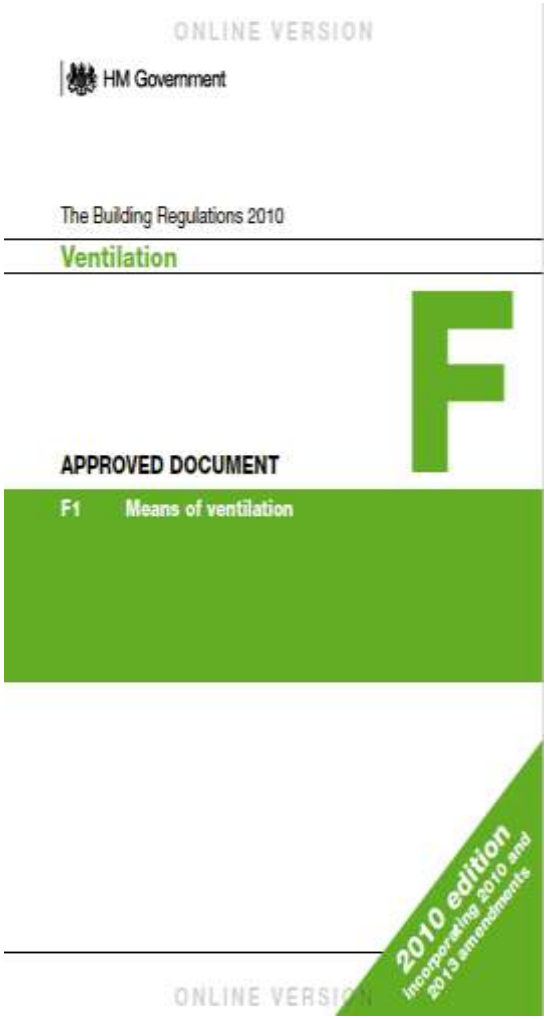
**EWI added to rear**
~~and single-storey~~ extension

Air permeability reduction through these measures
typically between 35 and 50%

Same moisture generation as pre-retrofit state. Greater propensity for problem condensation on uninsulated elements

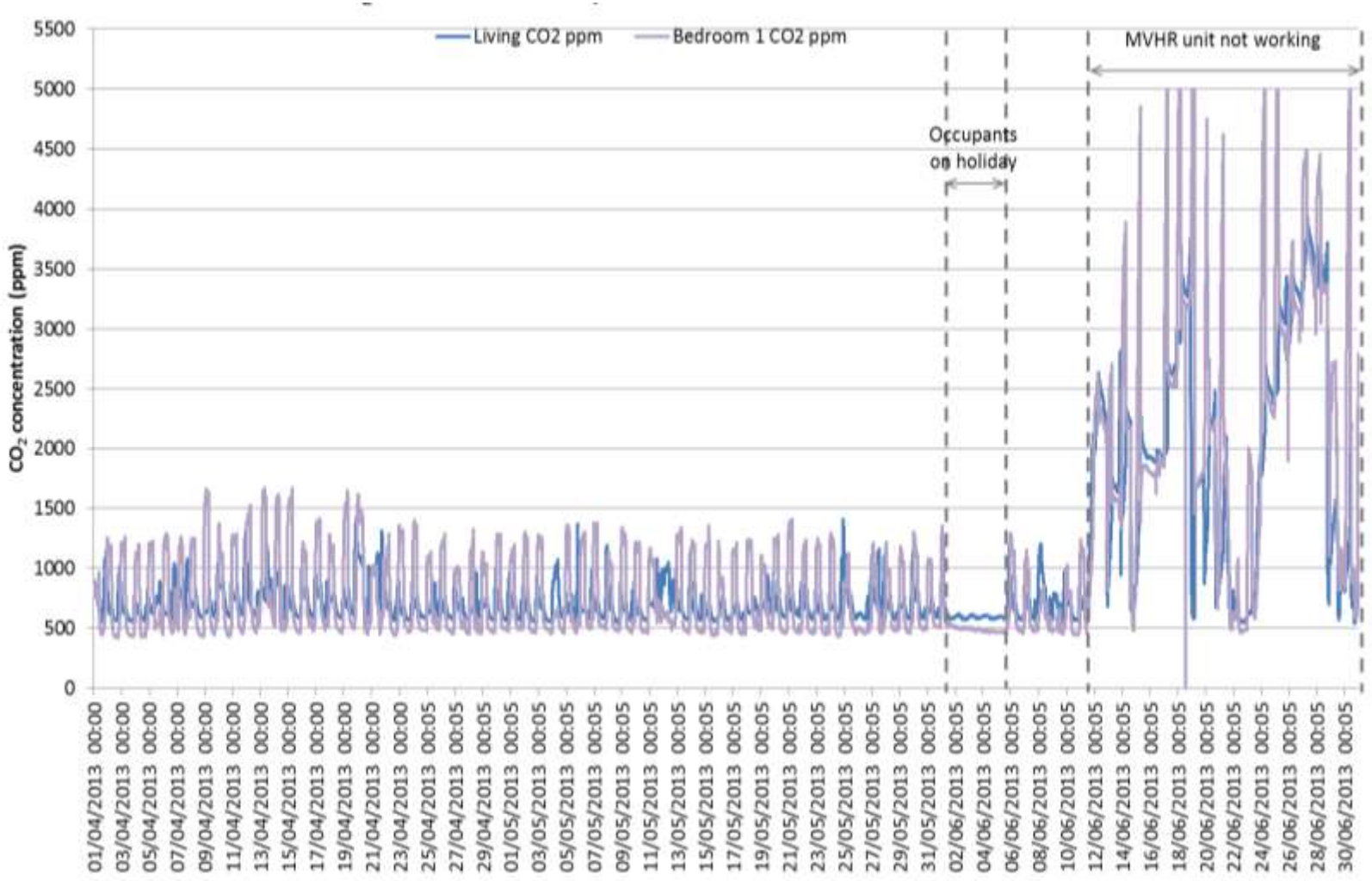
House sketch by Prewett Bizley Architects

# Regulations and performance standards – Part F




- Sets *minimum* background air flow rates for control of bio-effluents, and increased rates for moisture control – both considered to be the key pollutants in dwellings.
- Approved Document F – Ventilation (AD F), 2010 revision introduced key Part F change: ventilation in homes now a *notifiable service*
- But **96%** of new dwellings fail to meet these *minimum* performance specifications
(study of 80 homes carried out for DCLG 2016)

# What happens when the system fails?




Source: Innovate UK BPE Pro

Thank you for listening