Enhabit

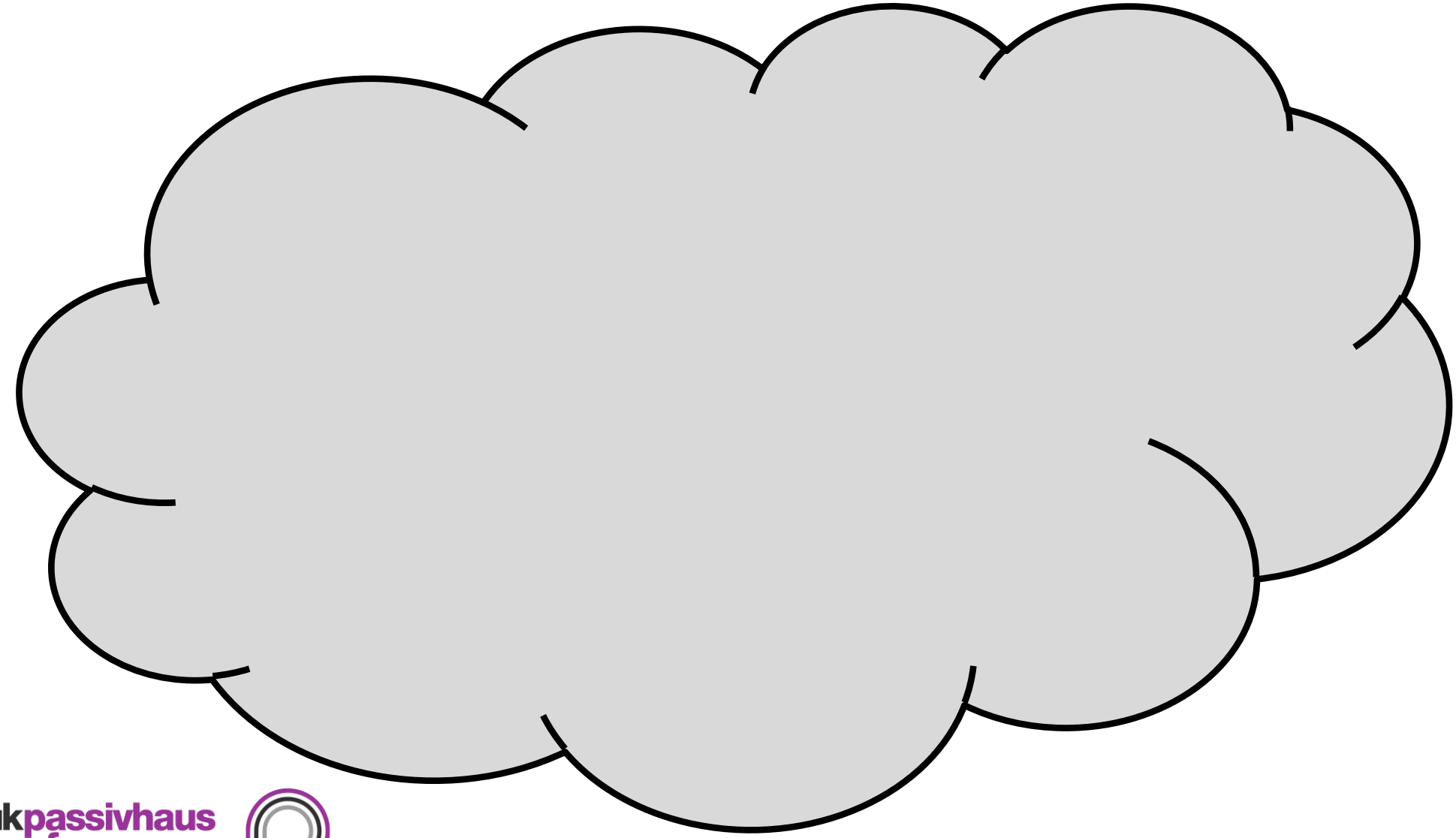
Indoor Air Quality …
What does it mean in practice?

PassivHaus Conference
24 Oct 2017

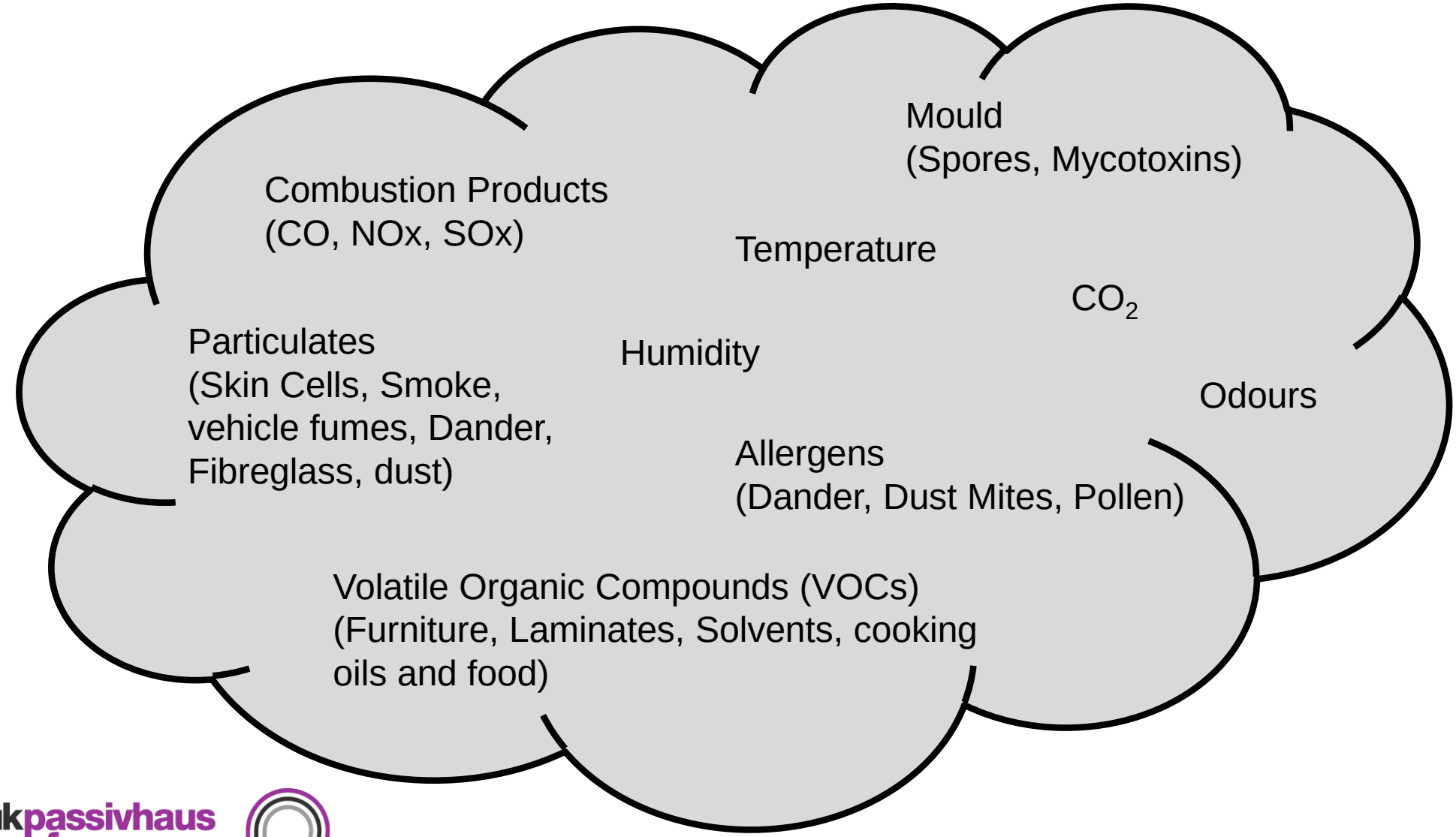
Agenda

- Defining Indoor Air Quality
- The Monitoring Process
- Case Study Buildings
- Results
- Conclusions

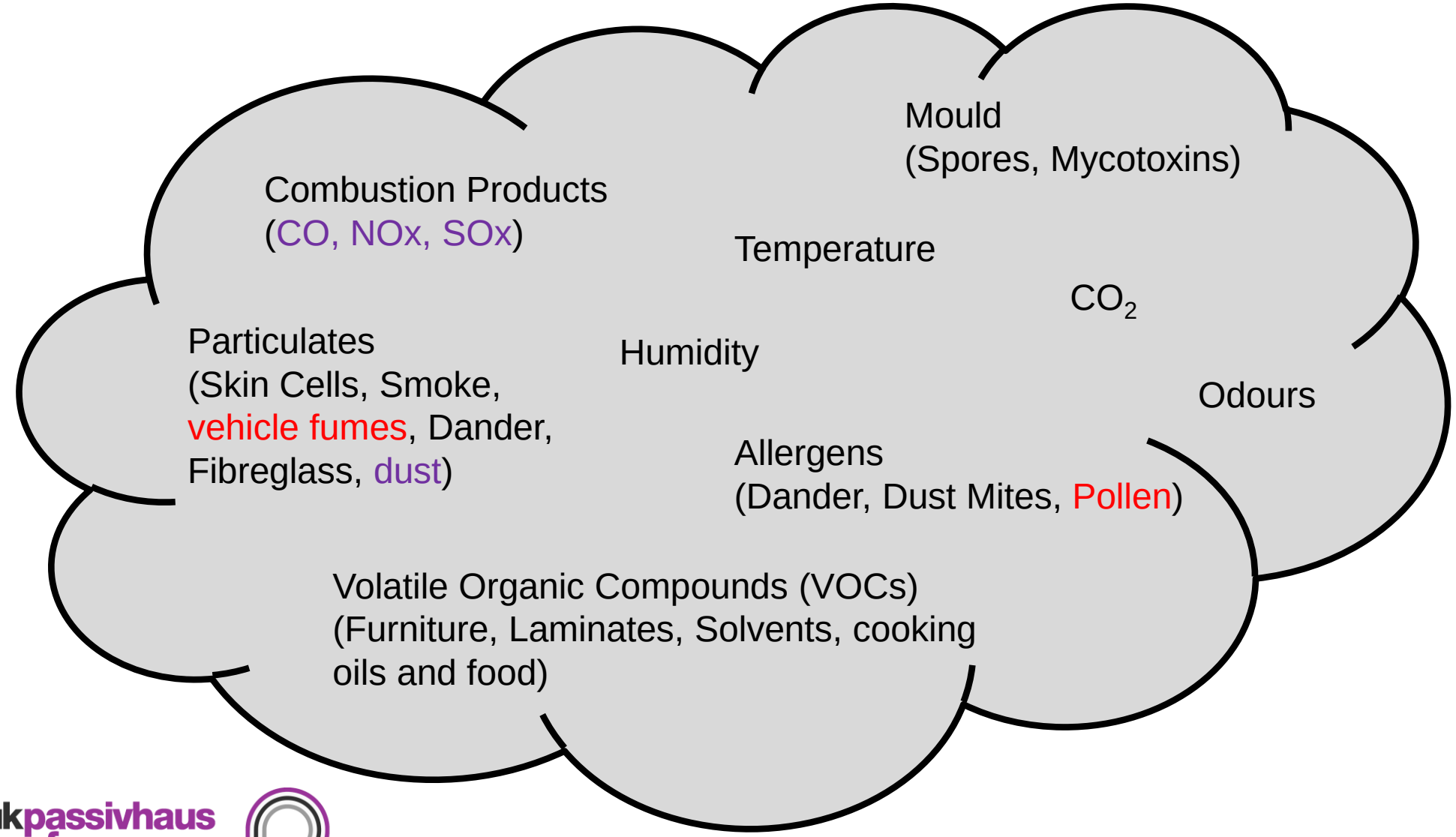
What defines your air quality?



What defines your air quality?



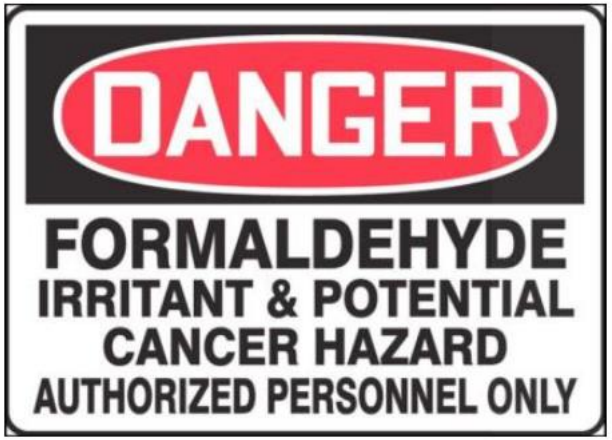
What defines your air quality?



Volatile Organic Compounds

- Very varied– any organic compound having an initial boiling point of less than 250ºC
- **Typical examples:** Propane, butane, methyl chloride, Formaldehyde, d-Limonene, toluene, acetone, ethanol (ethyl alcohol) 2-propanol (isopropyl alcohol), hexanal, Pesticides (DDT, chlordane, plasticizers (phthalates), fire retardants (PCBs, PBB))
- **Typical Sources:** Furniture, MDF, OSB, Plywood, laminate, solvents, cleaning products

- **Short Term Effects:** Eye, nose & throat irritation, headaches, nausea/vomiting, dizziness, asthma aggravation
- **Long Term Effects:** Cancer, Liver & kidney damage, Central nervous system damage

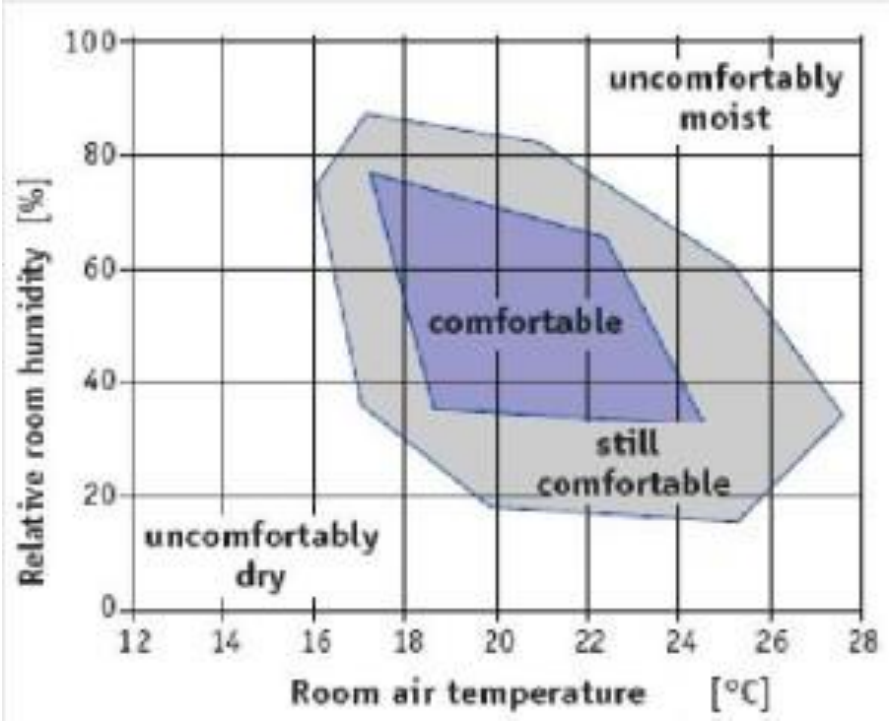


Air Quality – CO_2

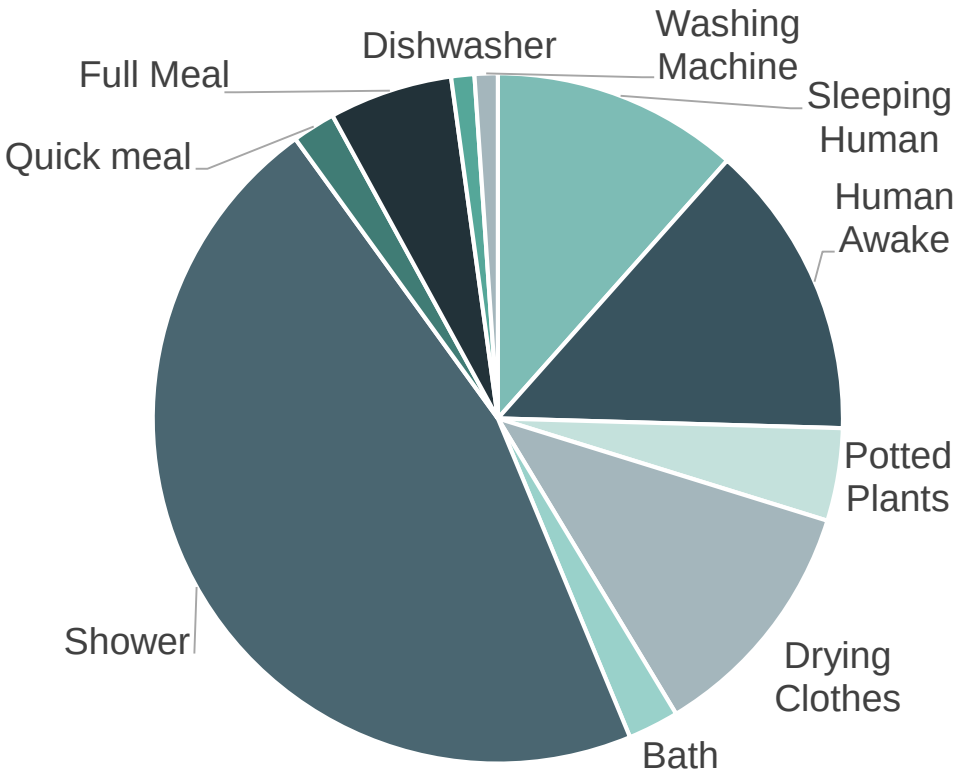
Concentration (ppm)	Effects
250 - 350	Normal background concentration in outdoor ambient air
350 – 1,000	Concentrations typical of occupied indoor spaces with good air exchange
1,000 – 2,000	Complaints of drowsiness and poor air
2,000 – 5,000	Headaches, sleepiness and stagnant, stale stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may also be present
5,000	Workplace exposure limit
>40,000	Exposure may lead to serious oxygen deprivation resulting in permanent brain damage, coma, even death

Air Quality - Humidity

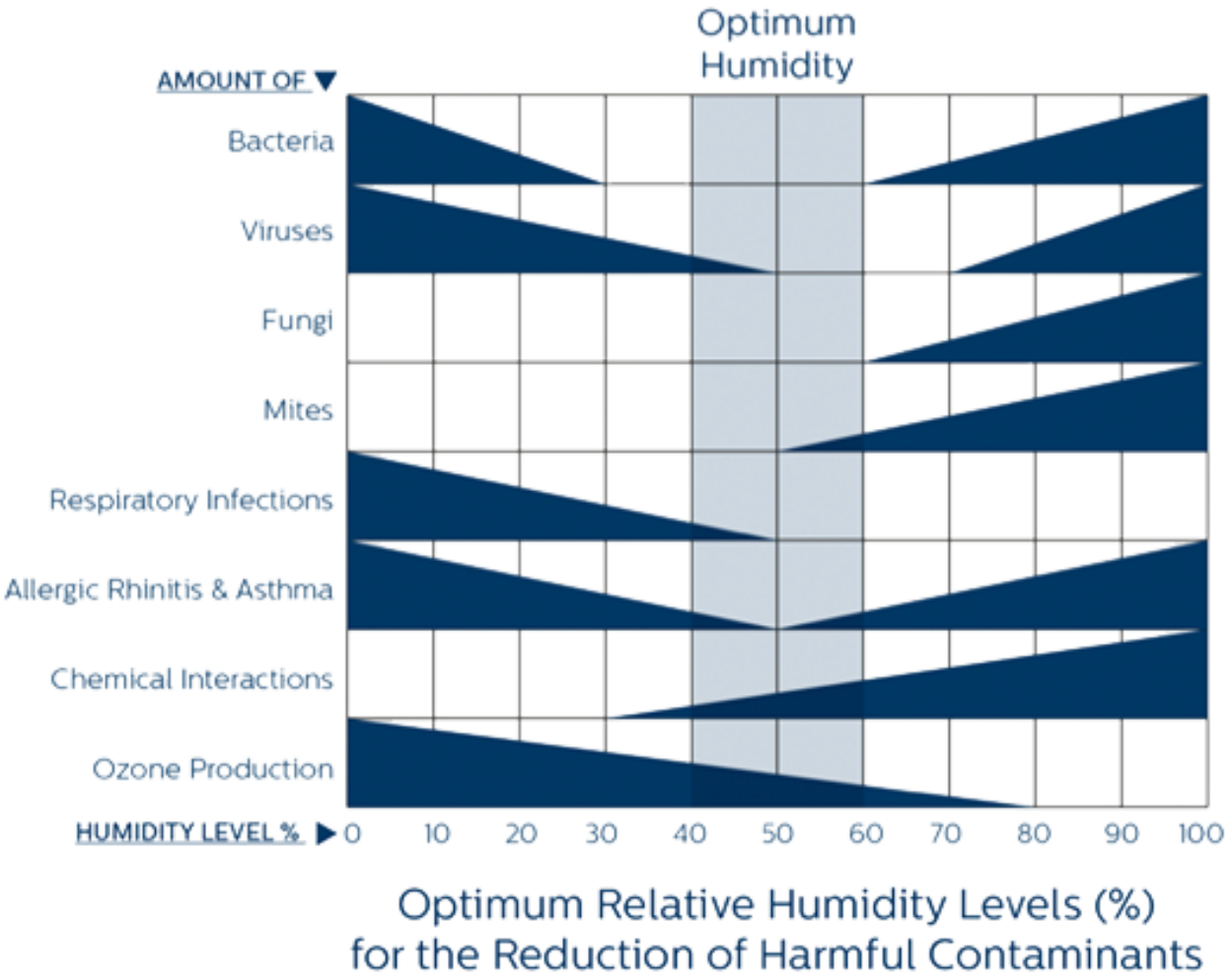
- Family of four over 24 hours produces:
  - over 9 litres of water vapour



Sources of humidity



Air Quality - Humidity



Optimum Relative Humidity Levels (%) for the Reduction of Harmful Contaminants

"There are strong associations between indoor fungi and initiation, promotion and exacerbation of allergic respiratory disease" *Indoor Fungal Exposure and Allergic Respiratory Disease. N J Osborne et al 2015*

Severe asthma with fungal sensitisation is estimated to affect between 3.25 and 13 million adults worldwide and contributes to the 100,000 annual asthma deaths

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  - Why Monitor?
- Case Study Buildings
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Introducing Foobot …

- Particulates (PM25)
- VOCs
- Equivalent CO2
- Temperature
- Humidity
- Global Pollution Index

Why these results need to be treated with caution ….

- Occupancy habits
  - Cooking
  - Washing
  - Opening windows
  - Use of MVHR boost mode
- Different times of year
- Not a full year
- Foobot accuracy?
- Particulate types?
- VOC types?

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Buildings Monitored …

Victorian End of Terrace

- 2 adults, 2 children
- Double Glazing
- Natural Ventilation
- Estimated airtightness of 10 to 15 ACH
- South facing rear elevation
- Cavity Wall Insulation
- TFA of 90m2
- Space heating demand of 141 kWh/m2.yr
- Hampshire

Contemporary Natural Ventilation with MVHR

- 2 adults
- Double Glazing
- Carefully designed Natural Ventilation with background MVHR
- Measured airtightness of 12 ACH
- Some SE windows, primary glazing NW
- Good u-values
- TFA of 225m2
- Space heating demand of 70 kWh/m2.yr
- London

EnerPHit Semi-detached

- 2 adults, 2 children
- Triple Glazing
- Paul MVHR
- Measured airtightness of 0.65 ACH
- South facing rear elevation
- Excellent u-values
- TFA of 198m2
- Space heating demand of 20 kWh/m2.yr
- London

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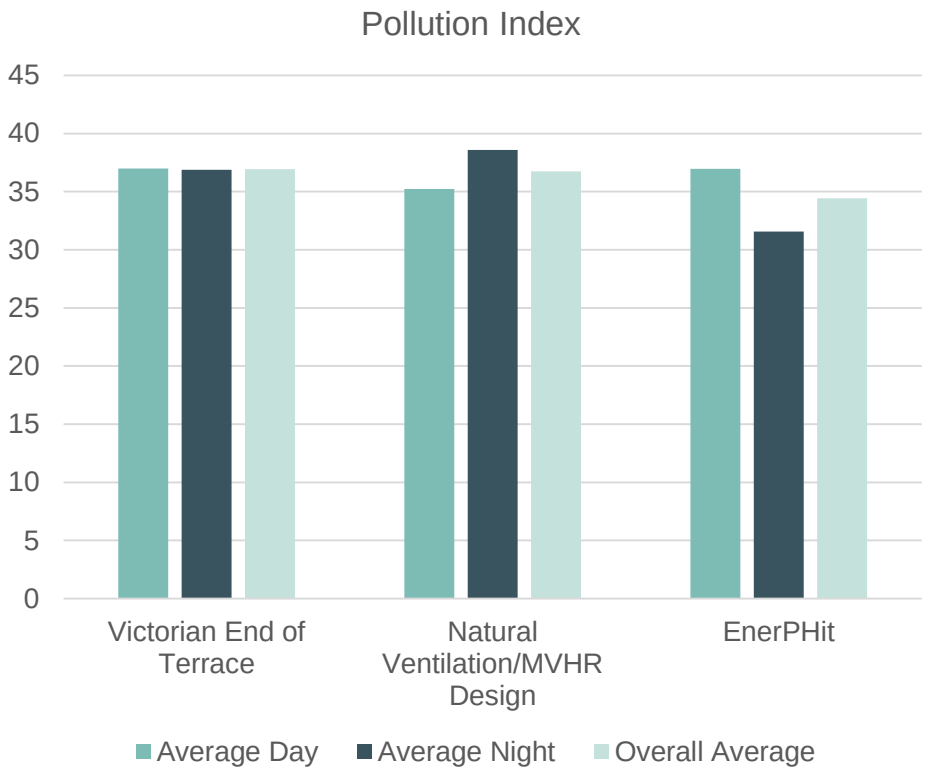
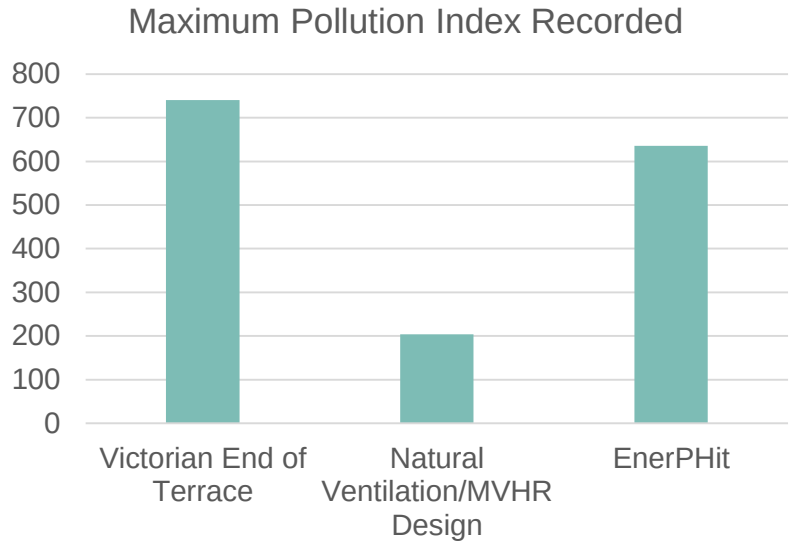
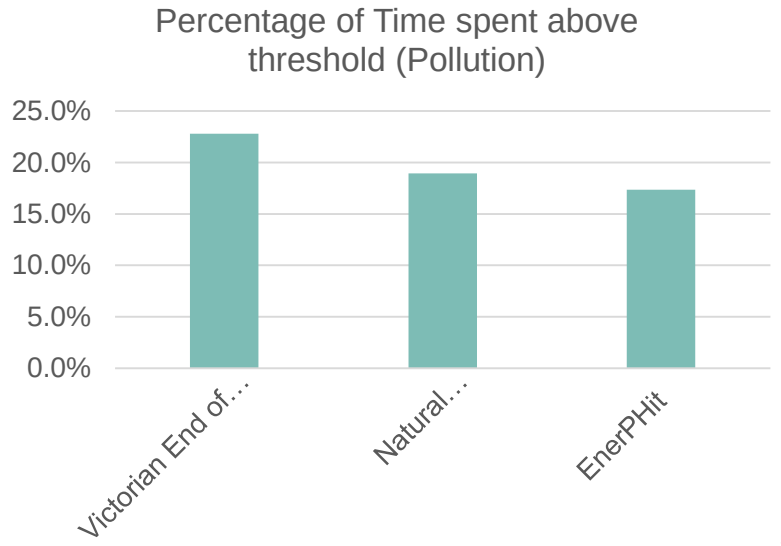
Results – Global Pollution Index

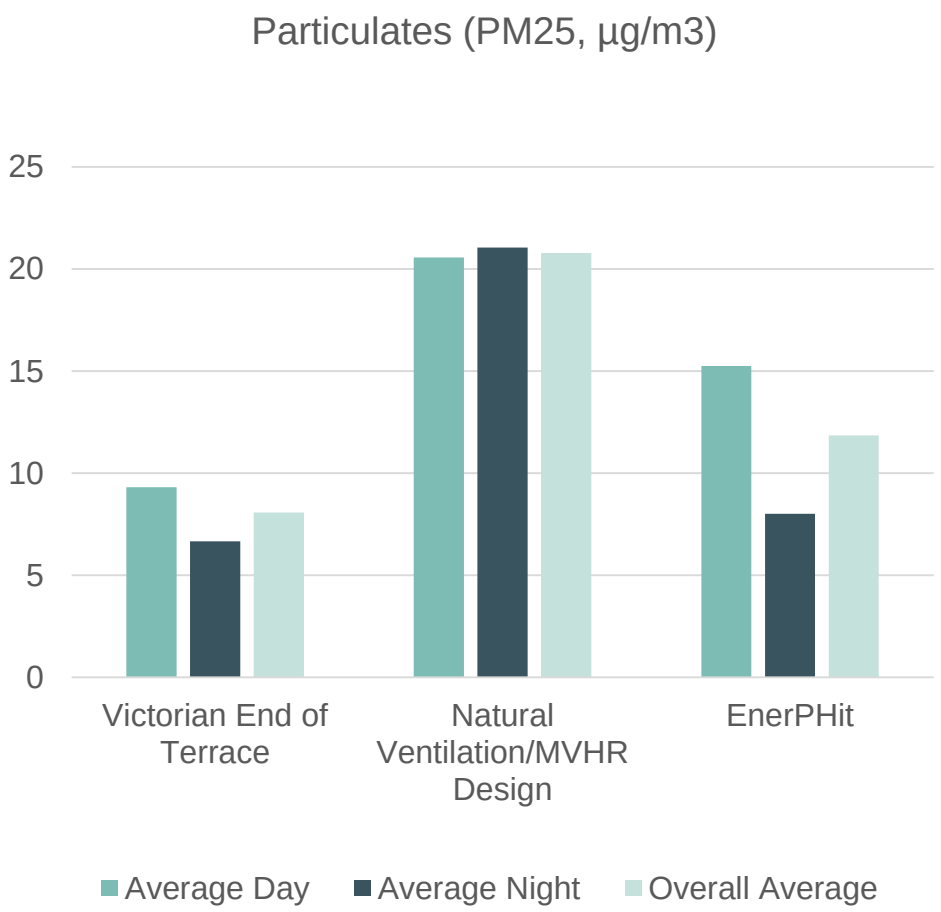


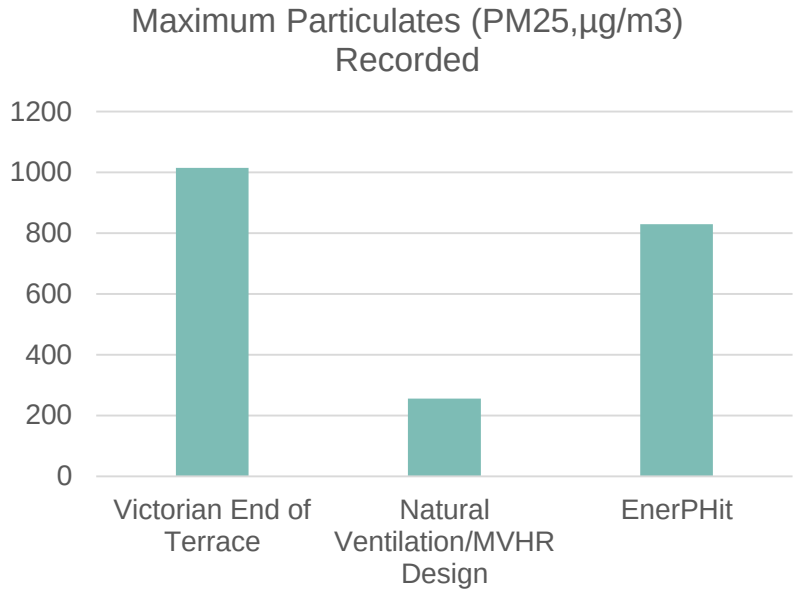


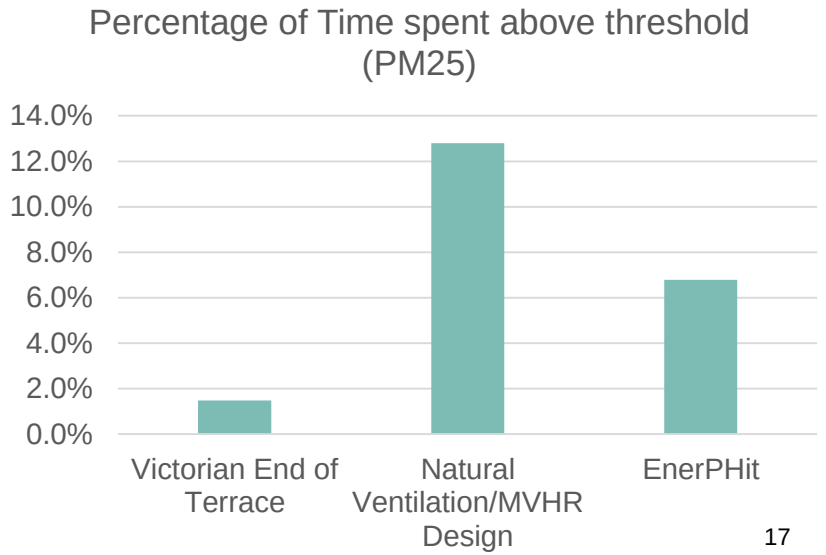


Threshold = 50

Results – Particulates (PM25)

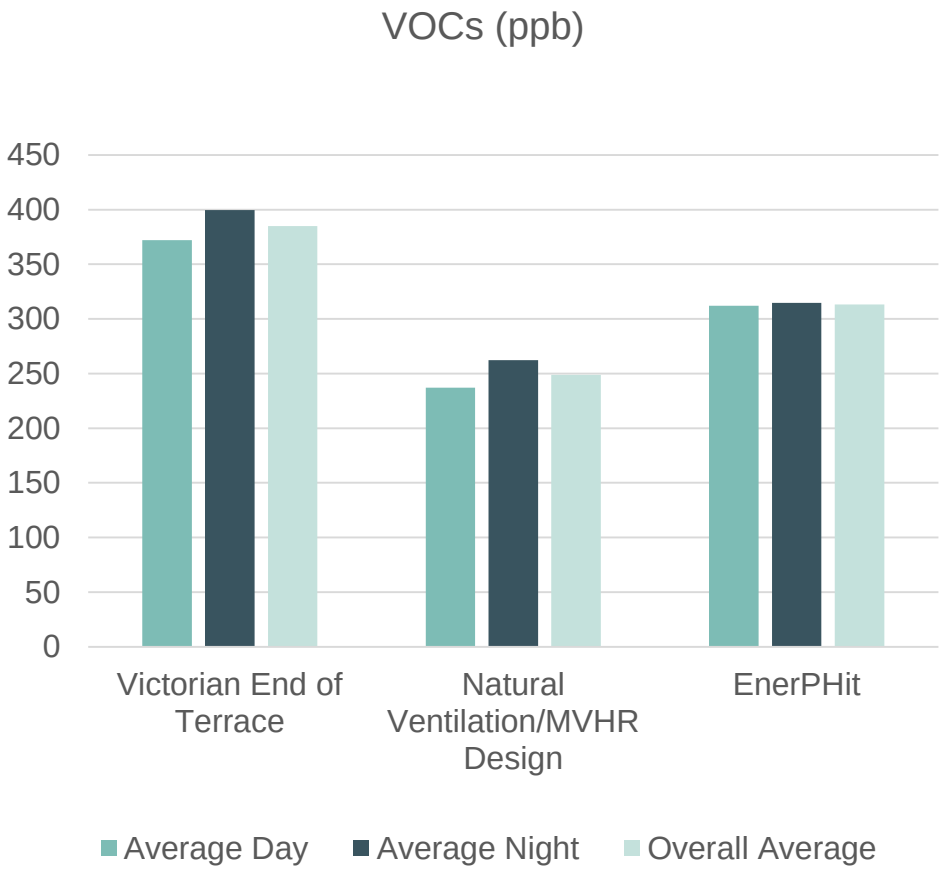


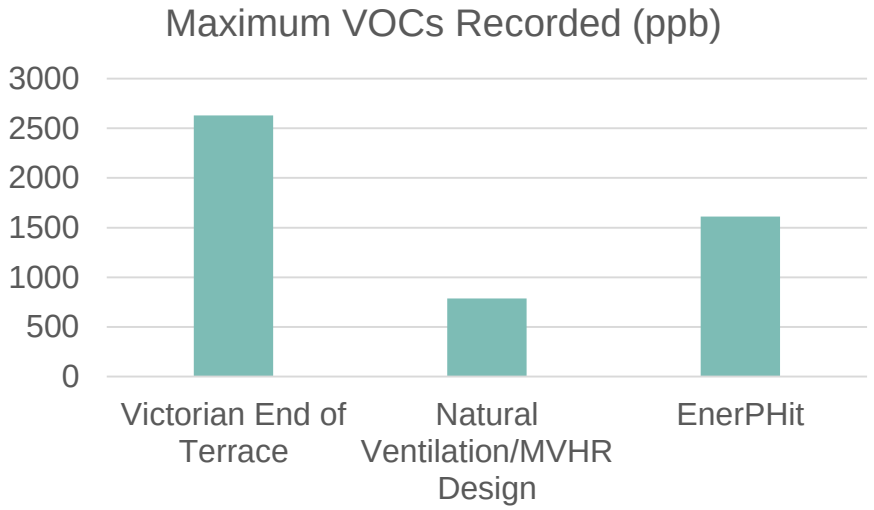


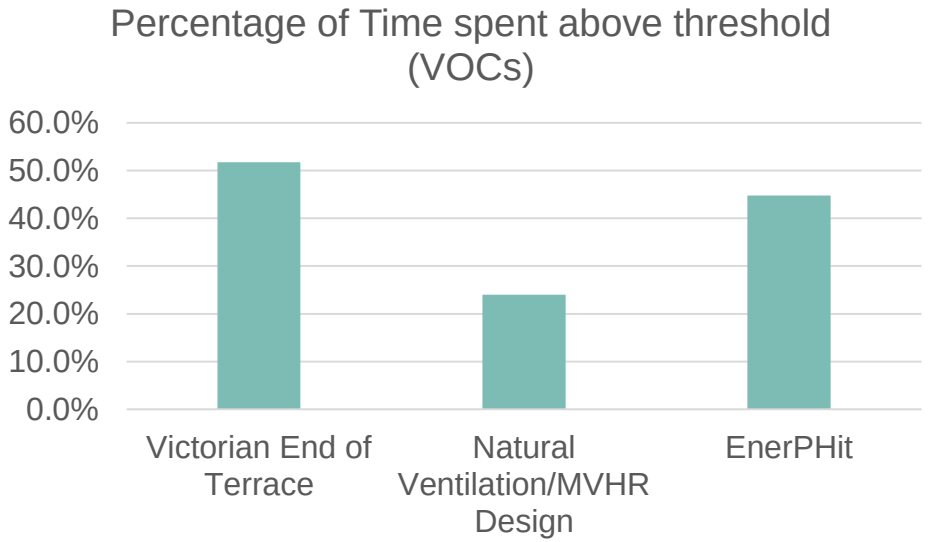


Threshold = 25 µg/m3

Results – VOCs

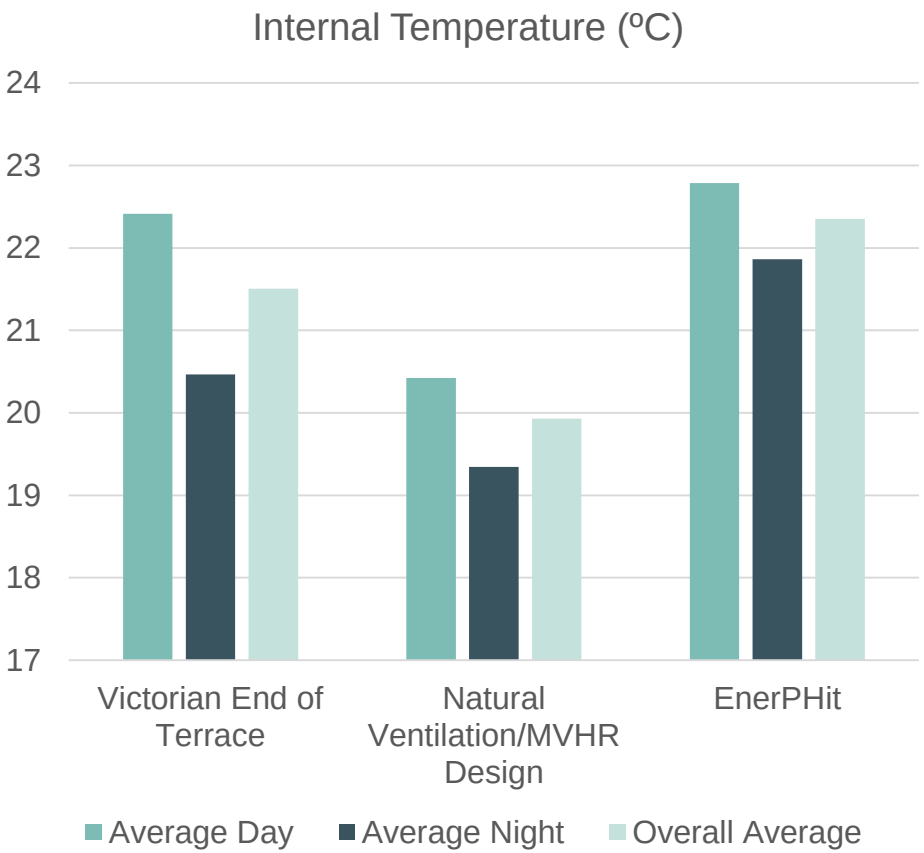


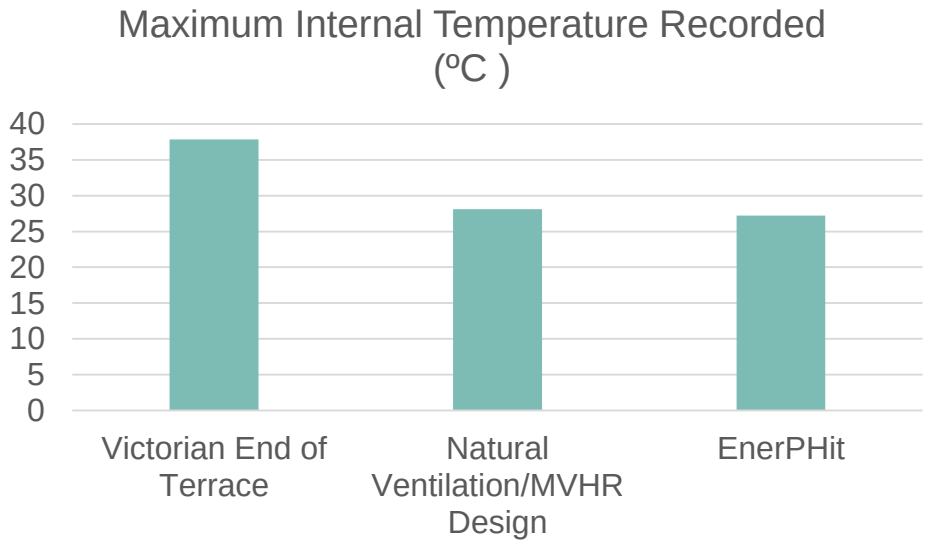


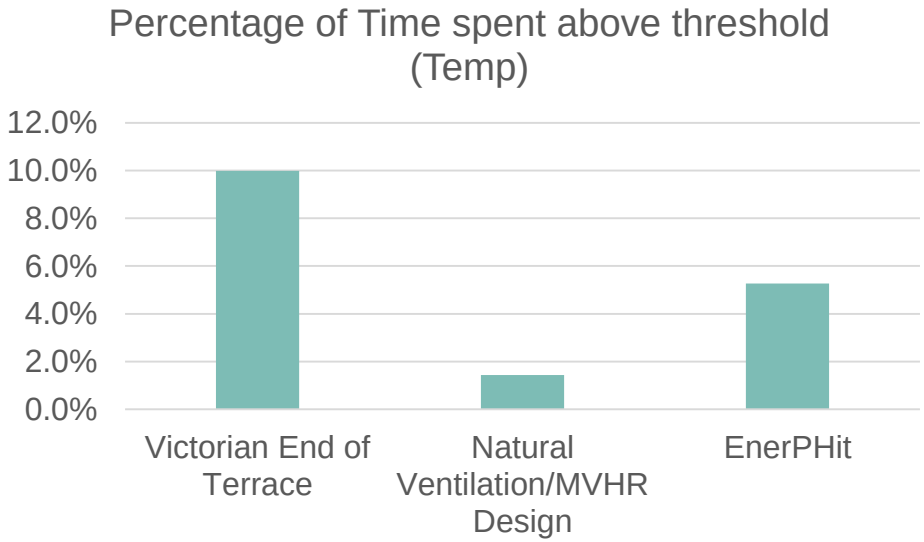


Threshold = 300 ppb

Results – Internal Temperature

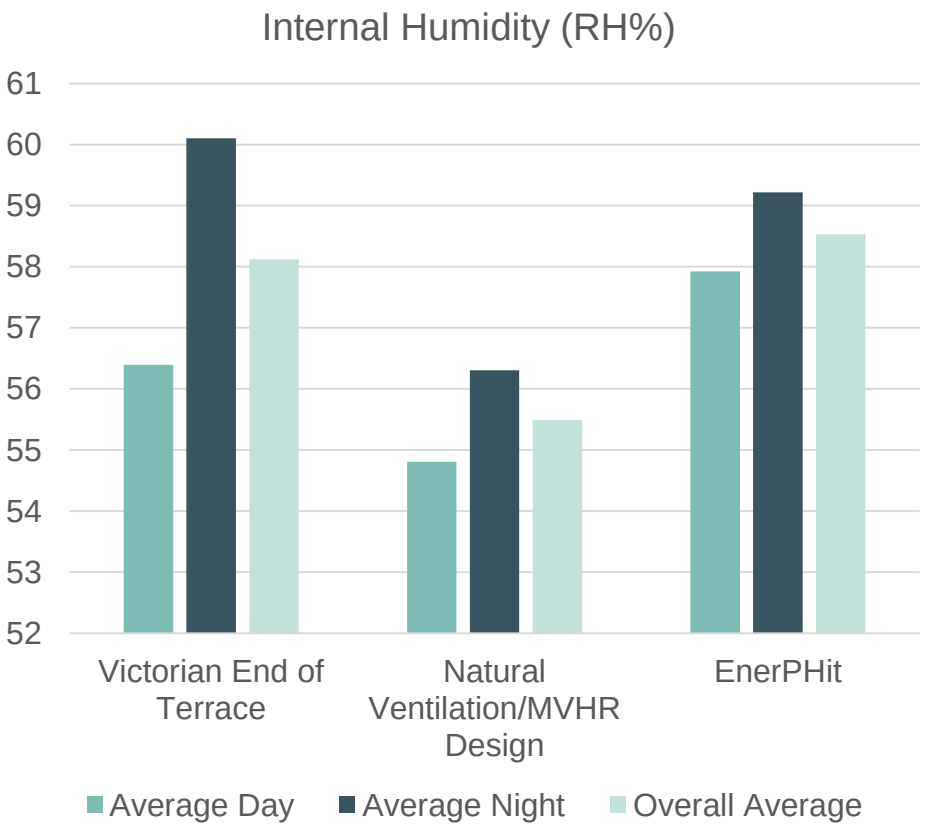


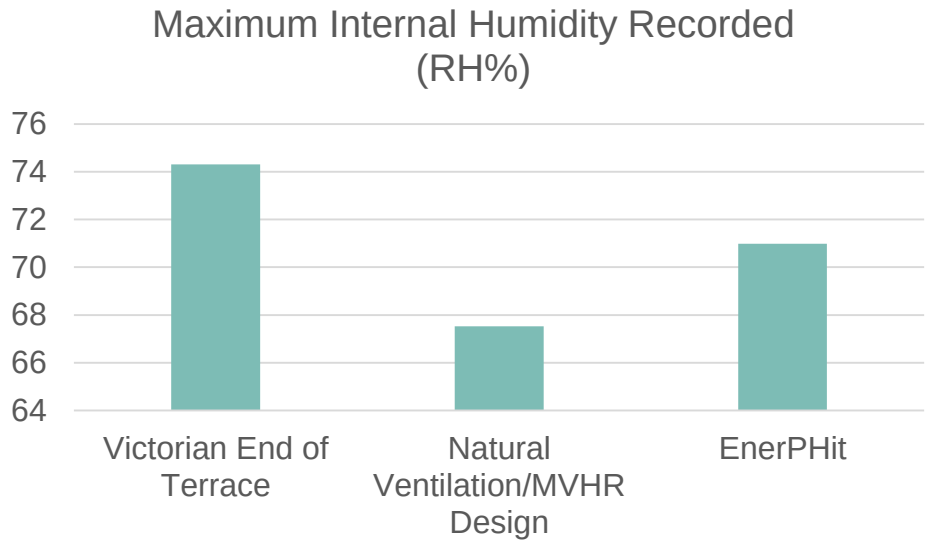


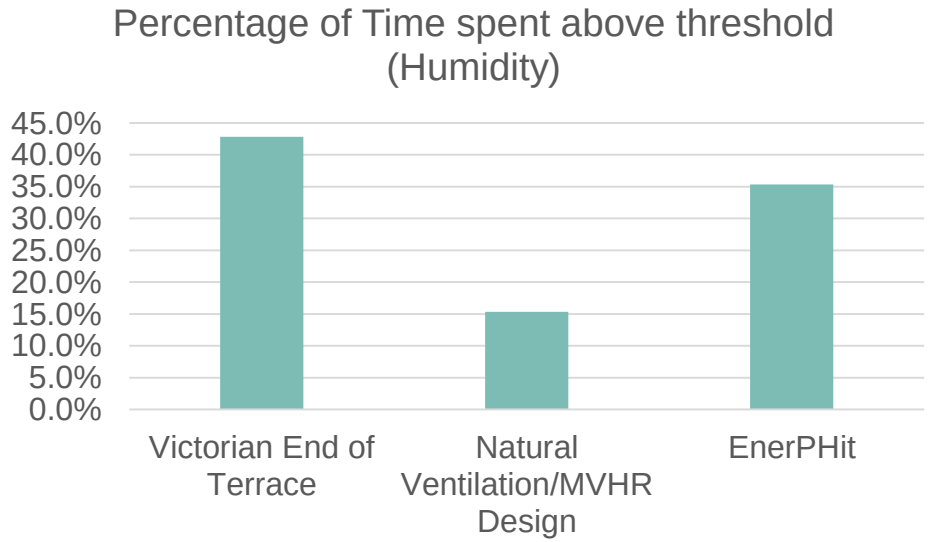


Threshold = 25ºC

Results – Internal Humidity

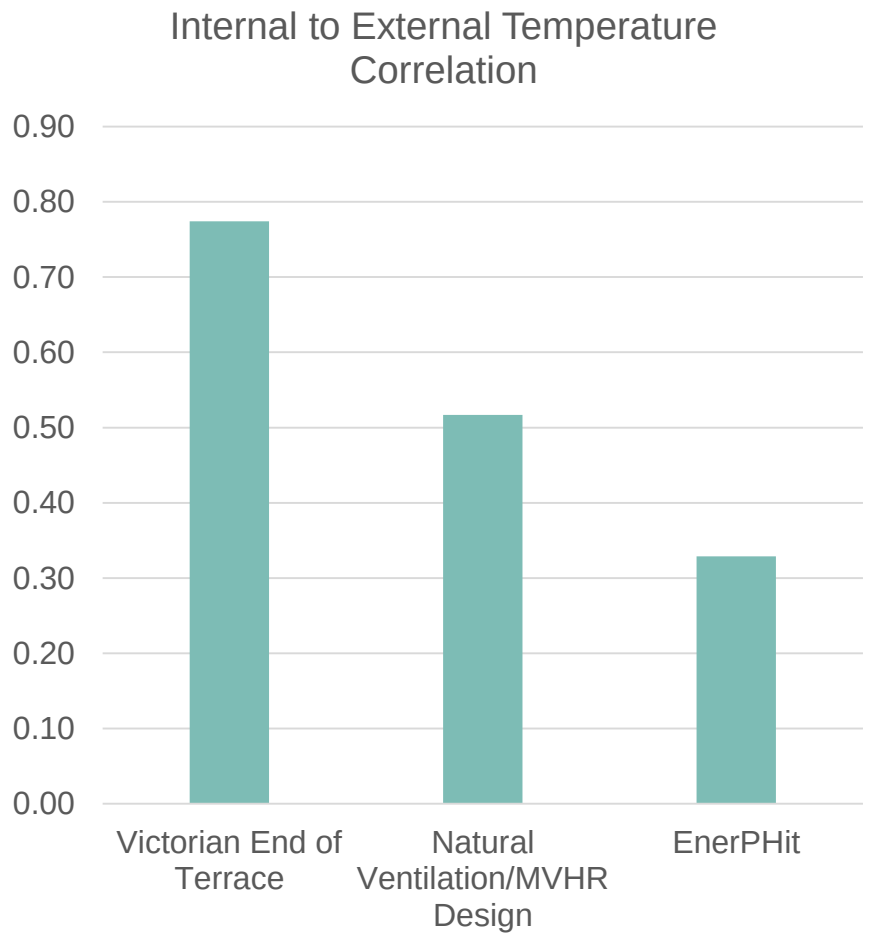


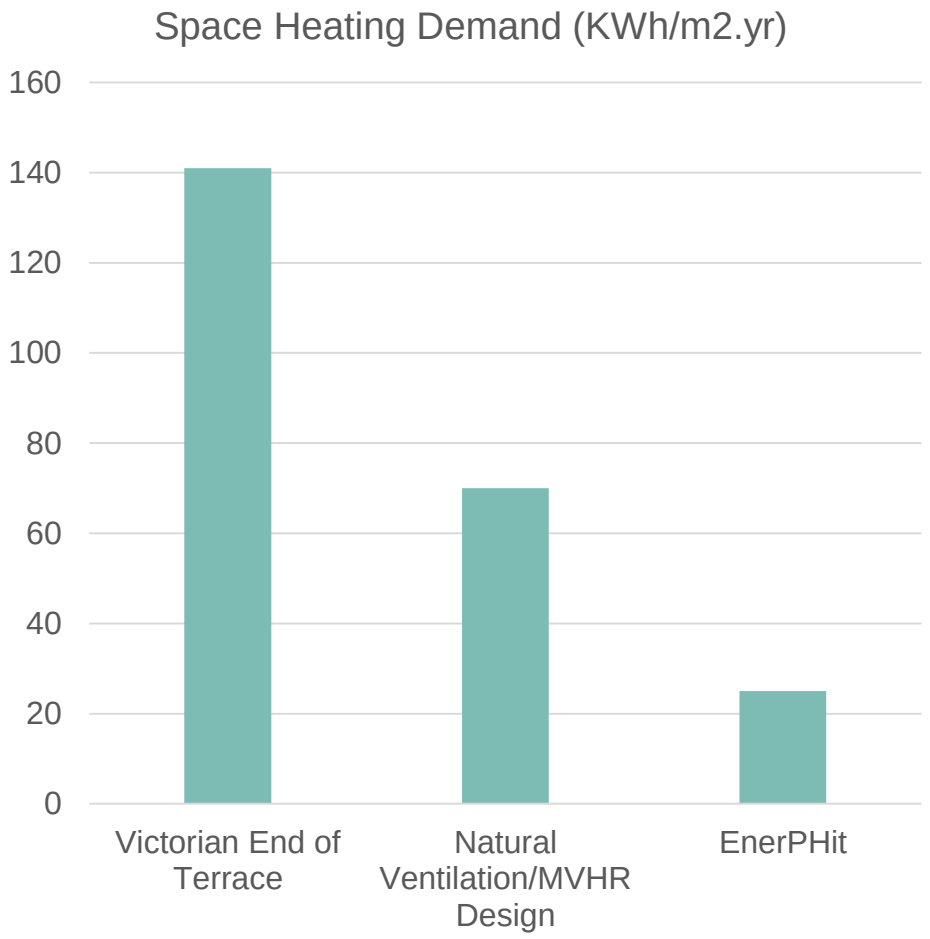




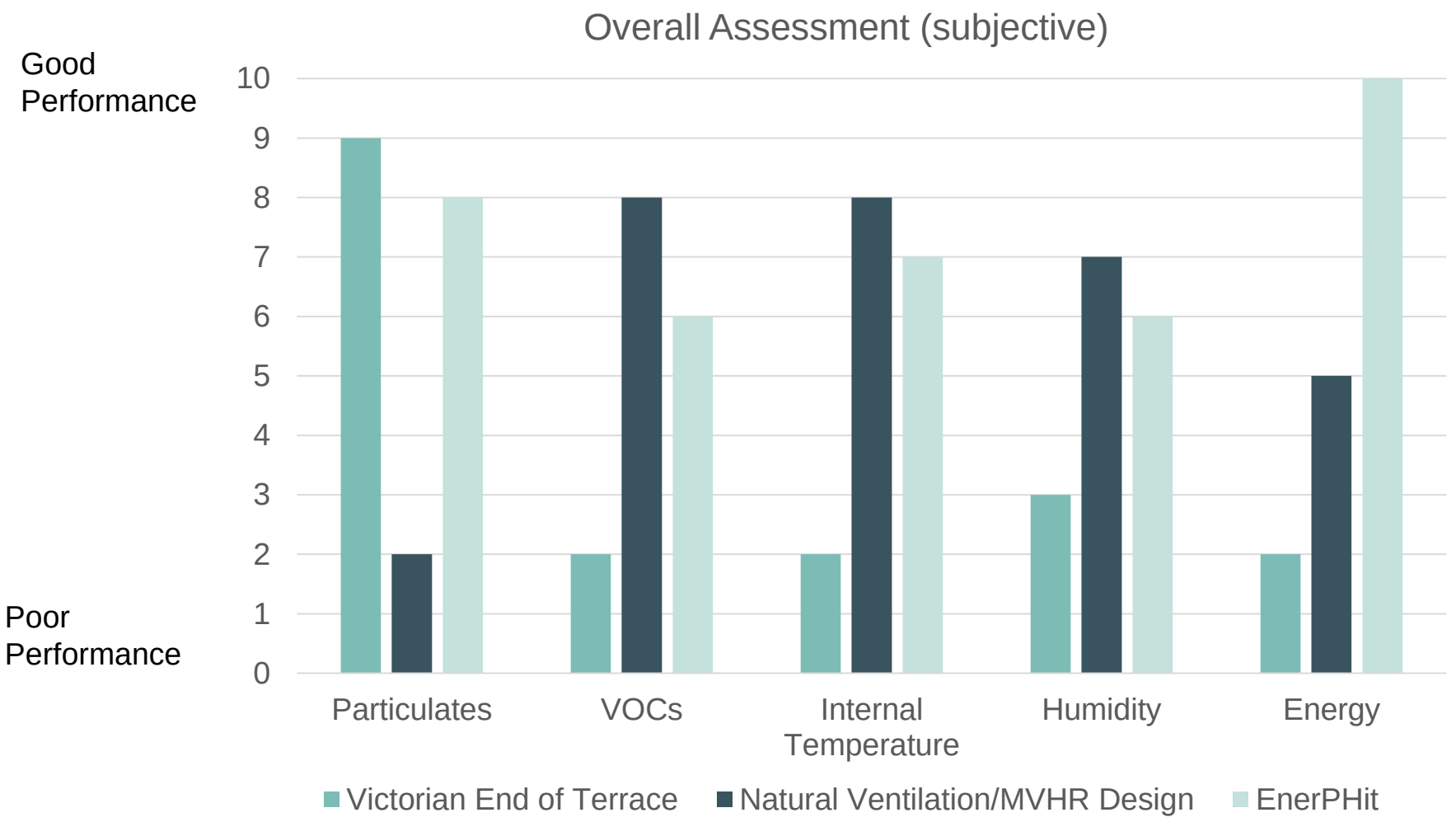
Threshold = 60% RH

Results – Internal to External Temperature Correlation





Results – Overall Assessment of performance



Conclusions

- EnerPHit significantly out performs a traditional house in terms of temperature, humidity and VOCs – whilst using a seventh of the energy
- EnerPHit is a new-build – elevated VOCs from construction?
- Particulates are noticeably higher in both London properties
- The naturally ventilated property performs well against the EnerPhit, but:
  - Has fewer occupants in a larger volume
  - Still uses more than three times as much energy
  - Has very few south facing windows
- Further work to develop and refine analysis
- All round performance … EnerPHit

Enhabit

Questions?