

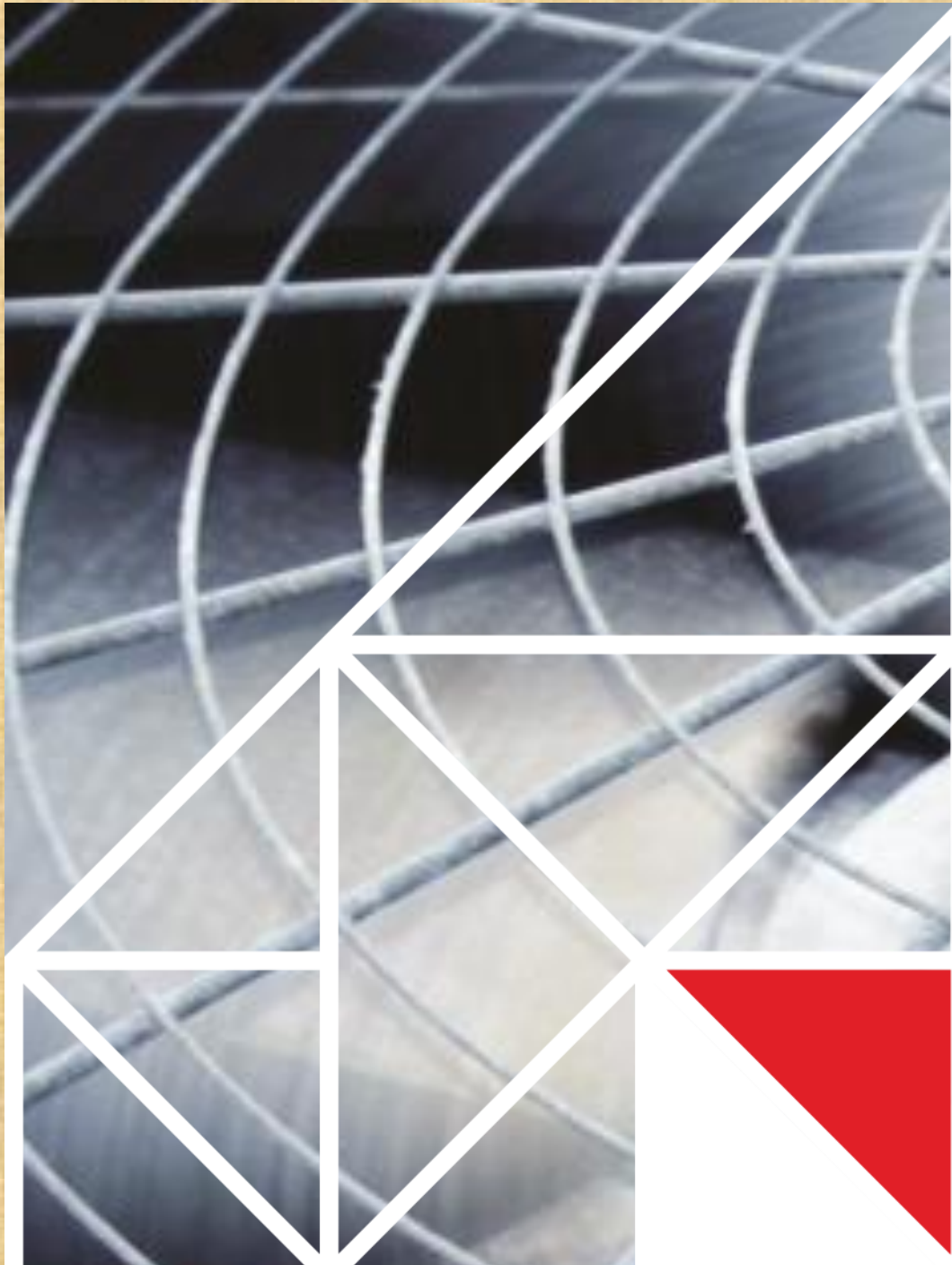


Dr Manfred Plagmann

BRANZ

**INDOOR CLIMATE AND
OCCUPANT BEHAVIOUR**

2:30 pm



Indoor Conditions and Occupant Behaviour

EDA Conference May 2017

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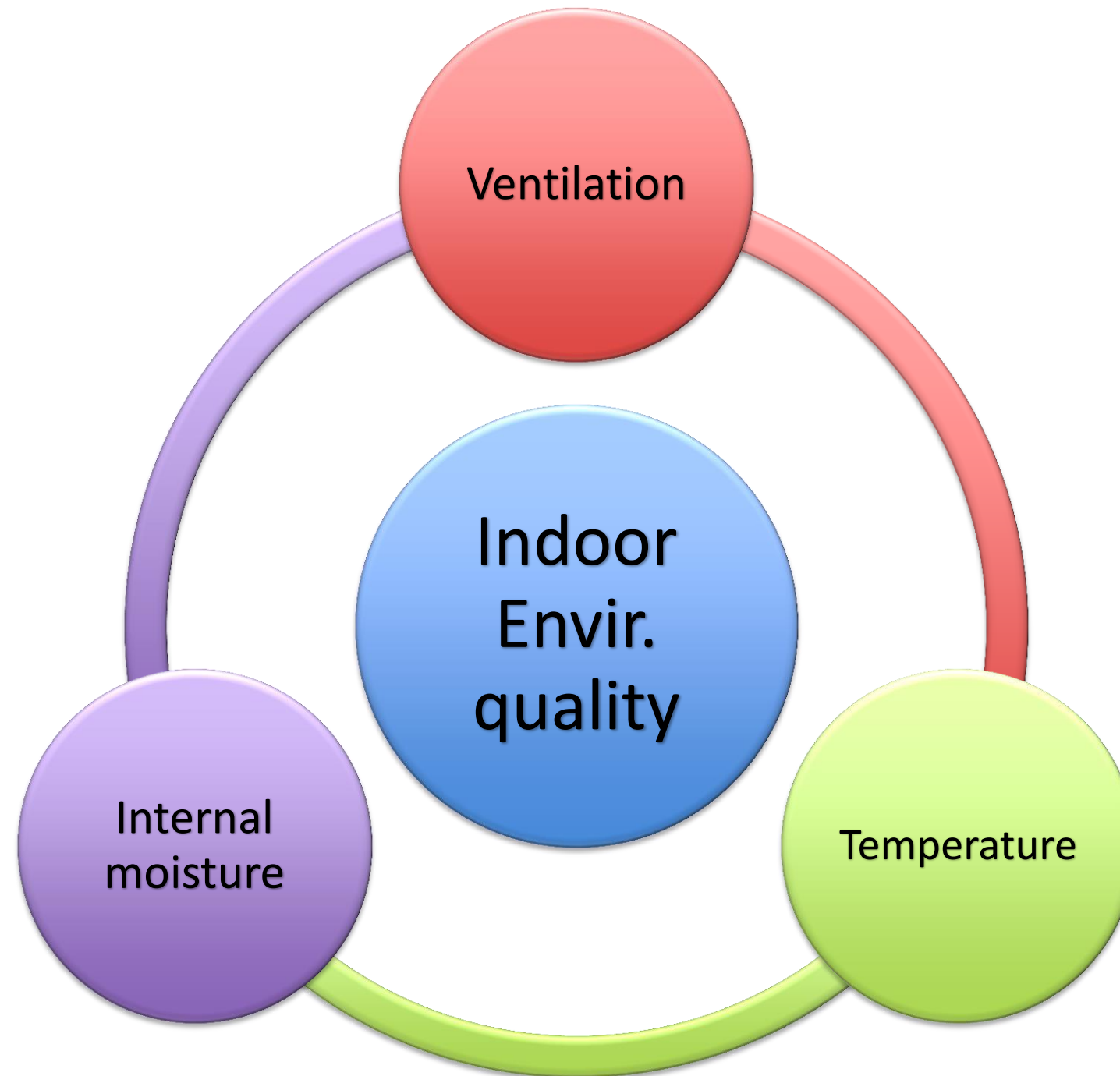
Structure

- Overview
- Performance of Window Ventilation
- Case Study: Return from the Moist
 - Bringing a building back to acceptable moisture levels
- Indoor conditions of NZ homes
- Window opening habits and ventilation perception

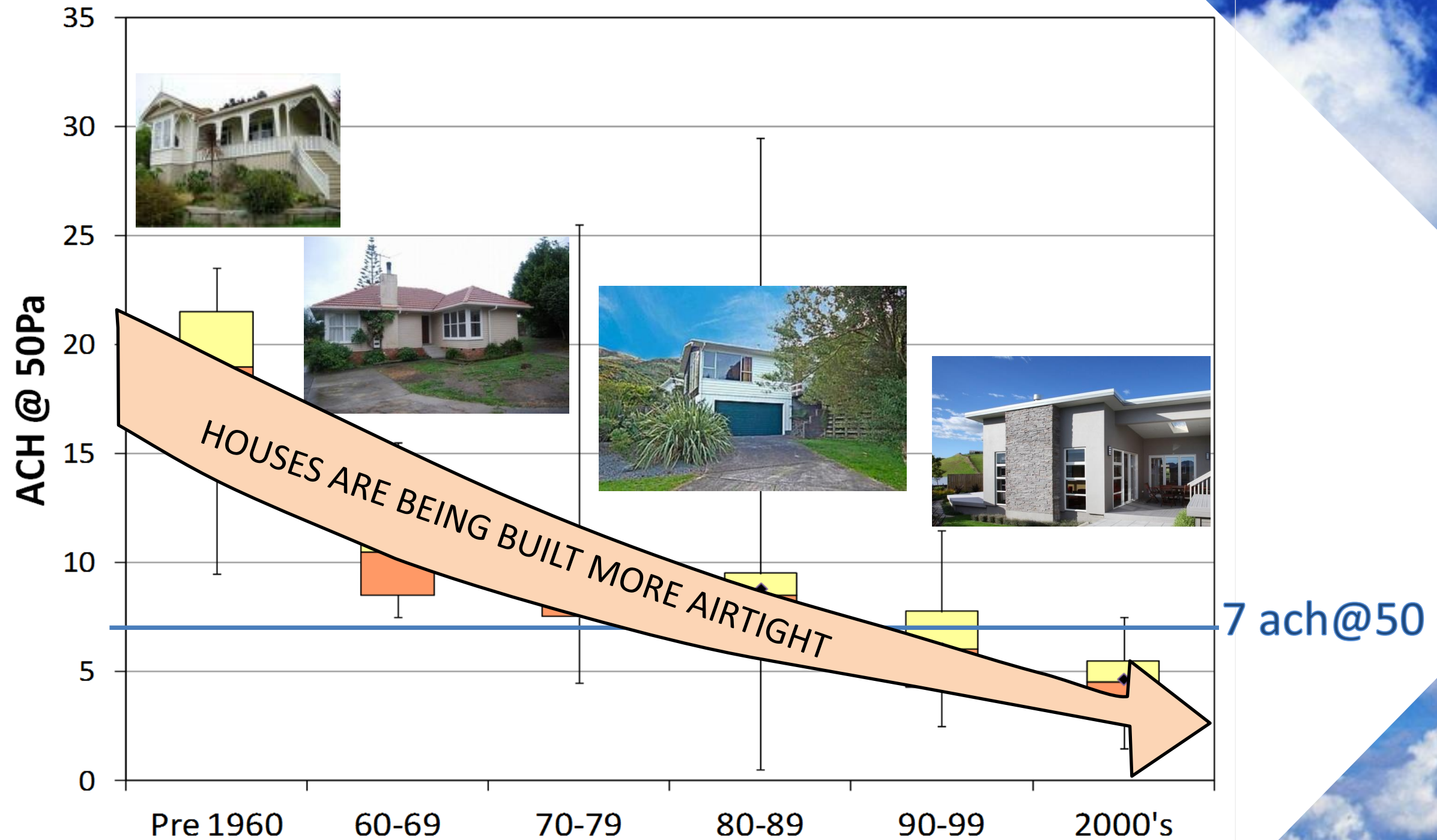


Ventilation overview

What are we talking about?



Where have we come from?



7 ach@50



Performance of Window Ventilation

Are Windows Enough?

Do windows need to be opened too often to be practical in newer homes?

What strategies work best?

- Opening windows on the security stays
- Opening windows wide to purge the home

E3 *Internal moisture*

- In practice, G4/AS1 implements the ventilation component of E3.3.1.

E3.3.1 *An adequate combination of thermal resistance, ventilation, and space temperature must be provided to all habitable spaces, bathrooms, laundries, and other spaces where moisture may be generated or may accumulate.*

G4/AS1 assumptions

- Most common route to meet G4/AS1 is providing openable windows equivalent to 5% of the floor area
- It assumes a degree of natural infiltration, which is becoming much less in modern homes
- Relies on occupants to open windows often

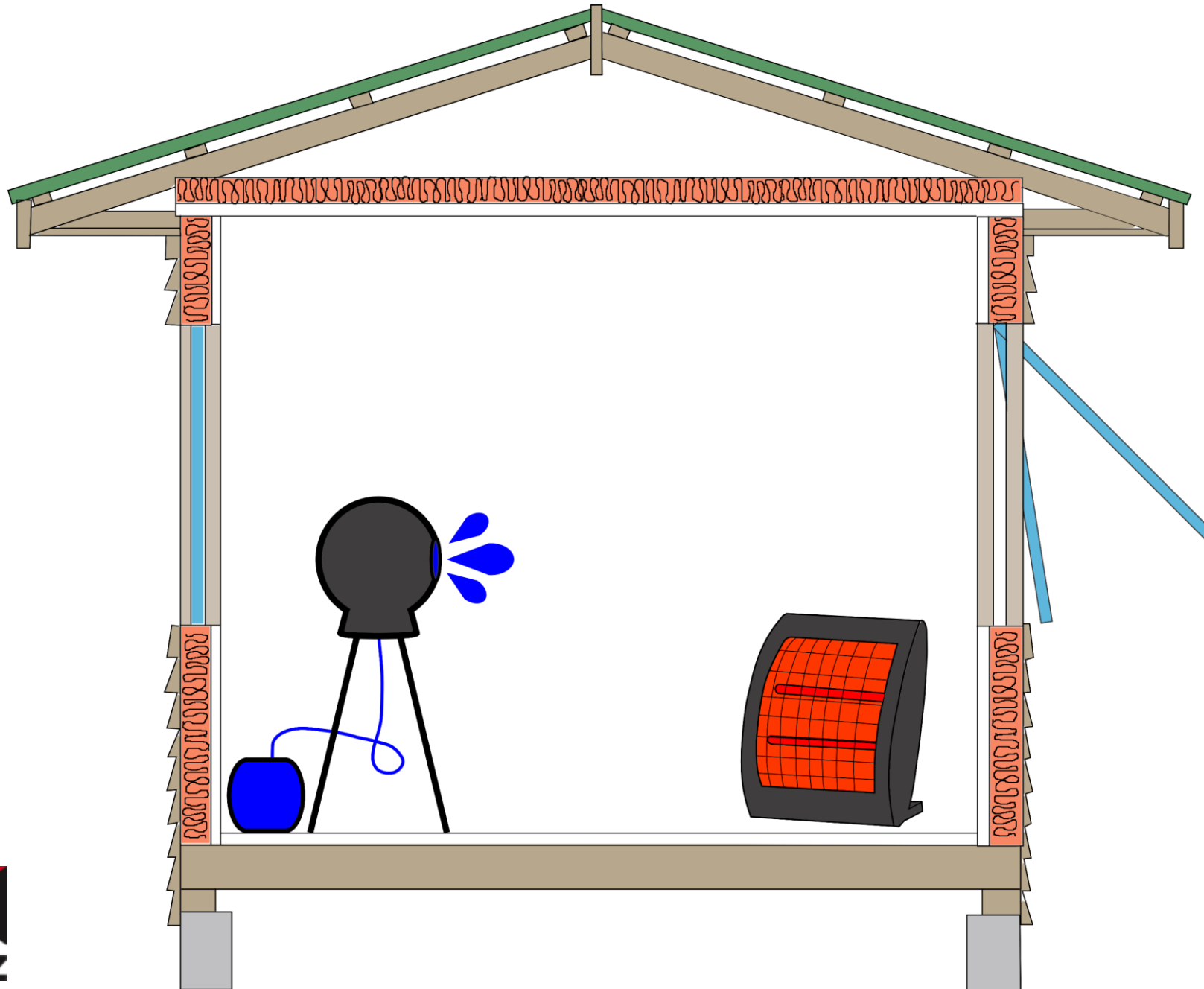
Window experiments – how effective are they?

Room conditioned to:
25°C, 70% RH

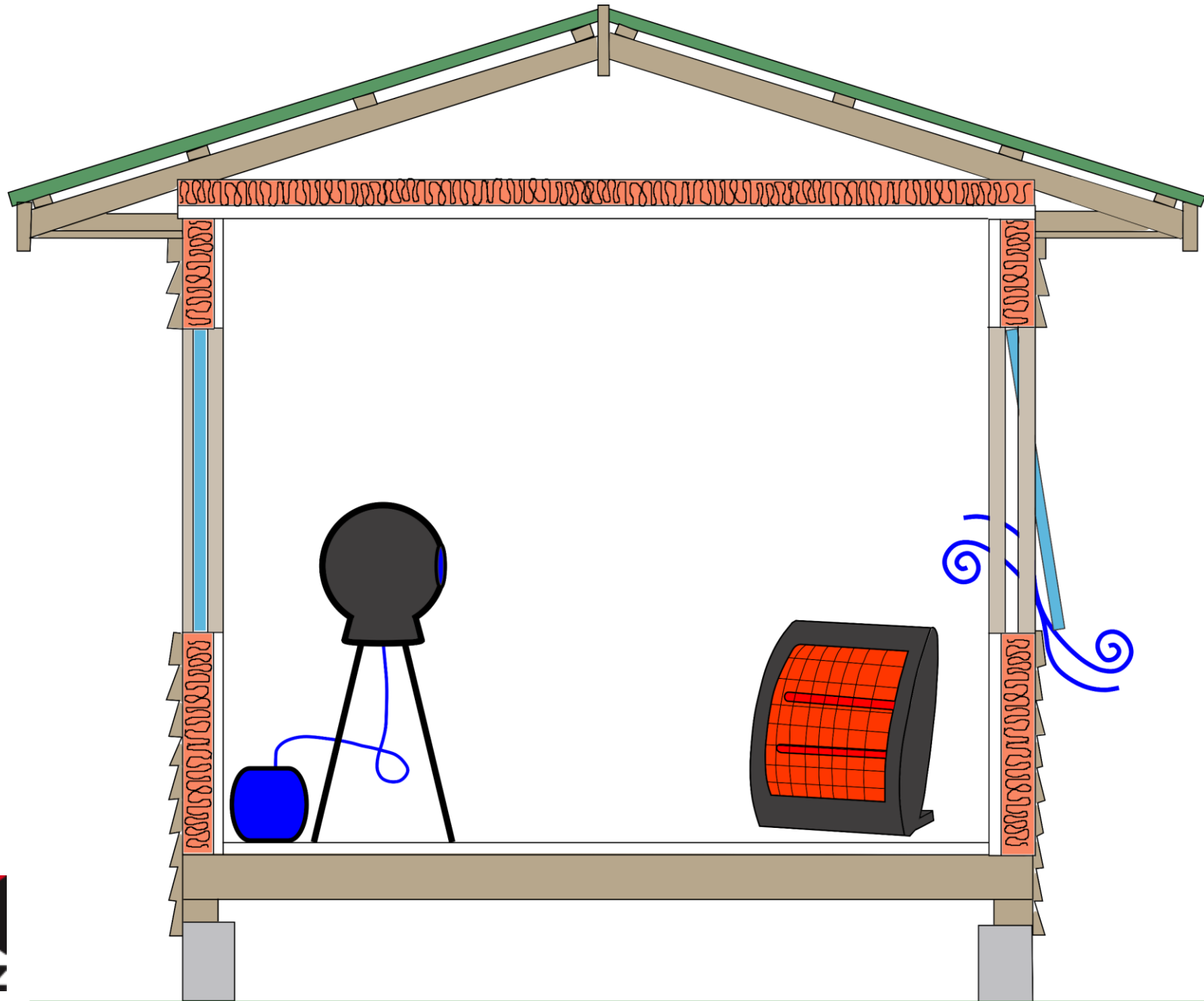
Airtightness 1 ach@50 Pa

Windows opened at 8am
every day for 3 months,
control turned off
at the same time

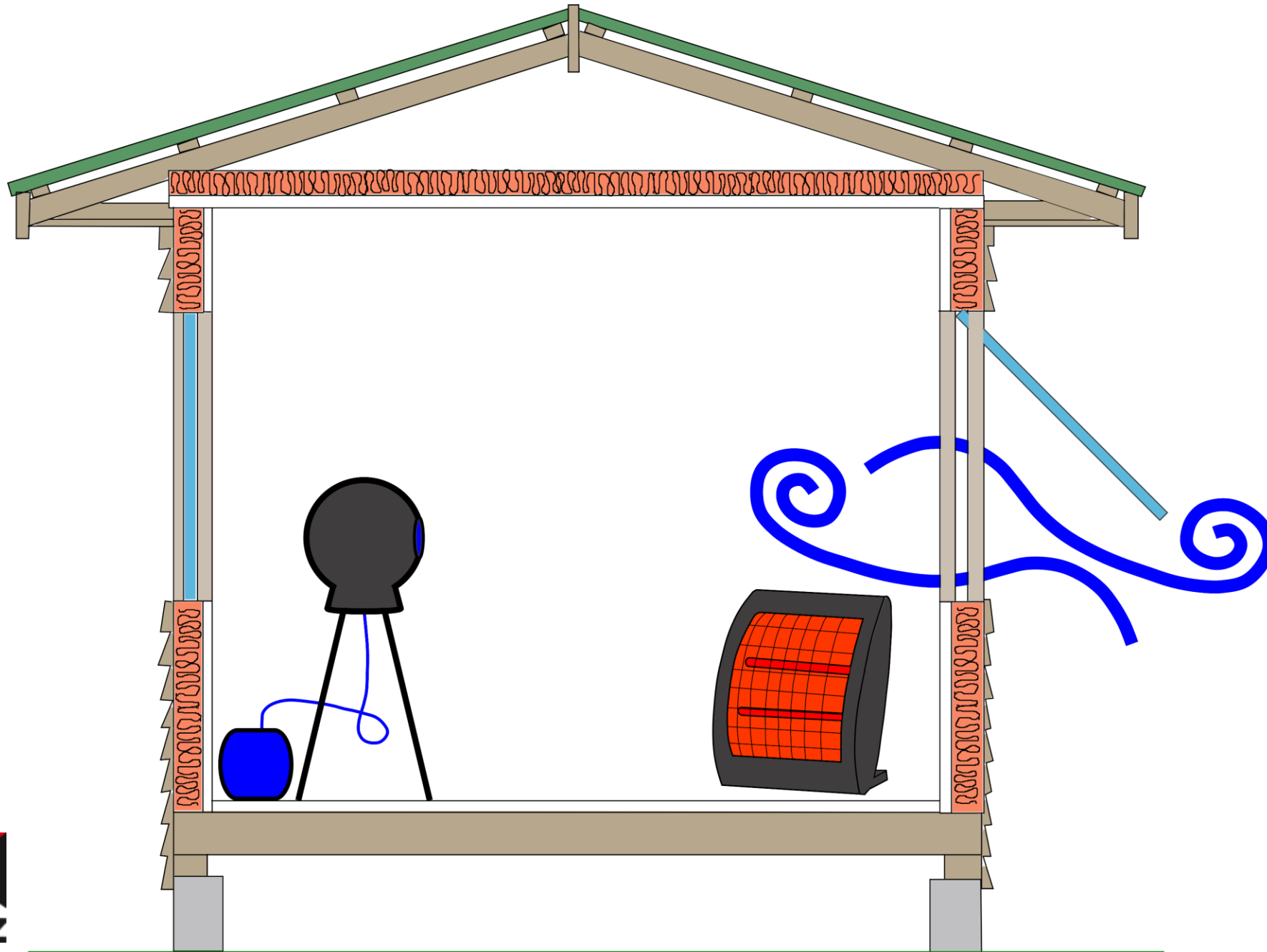
Range of wind conditions,
exterior temperature and RH



Window experiments – how effective are they?

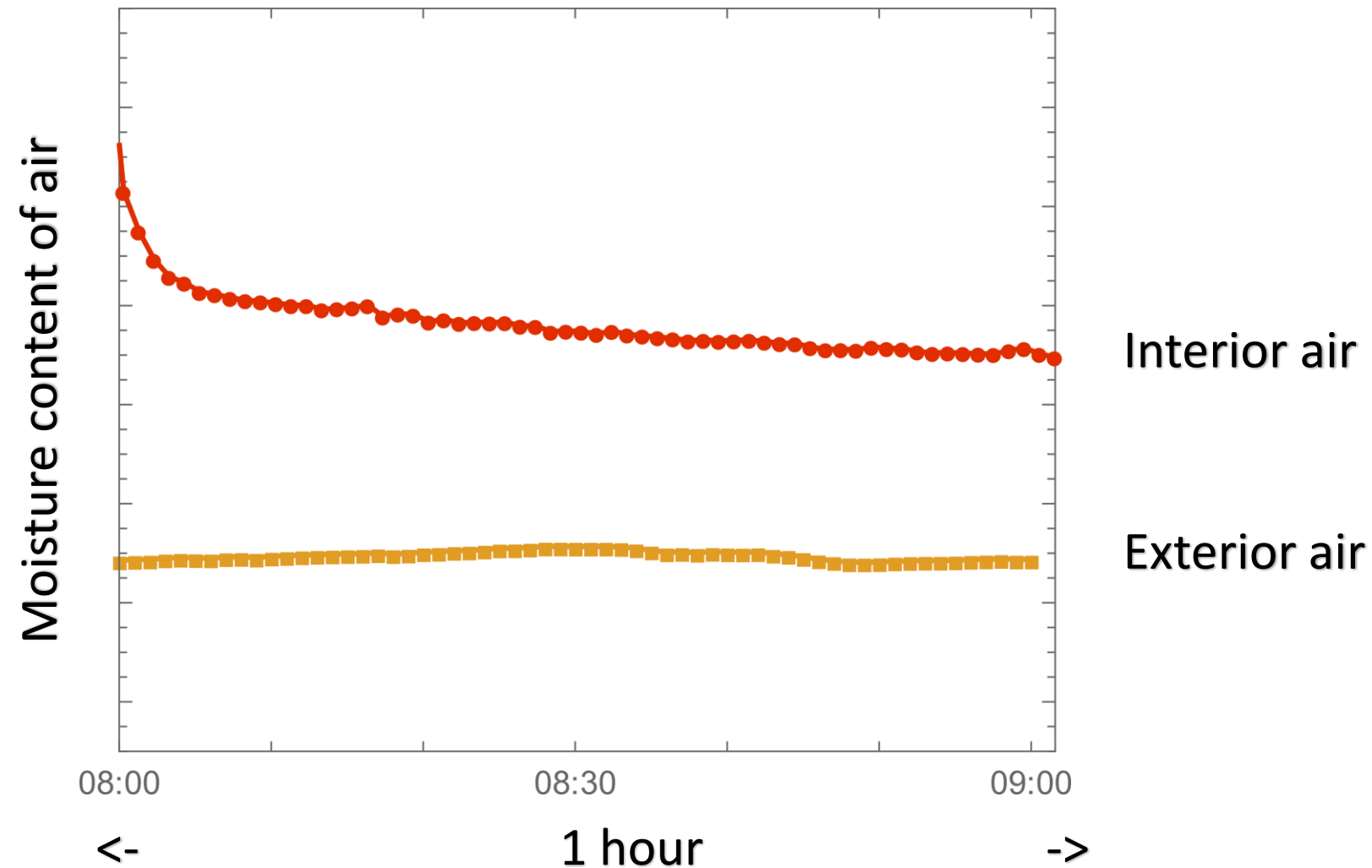


Window experiments – how effective are they?



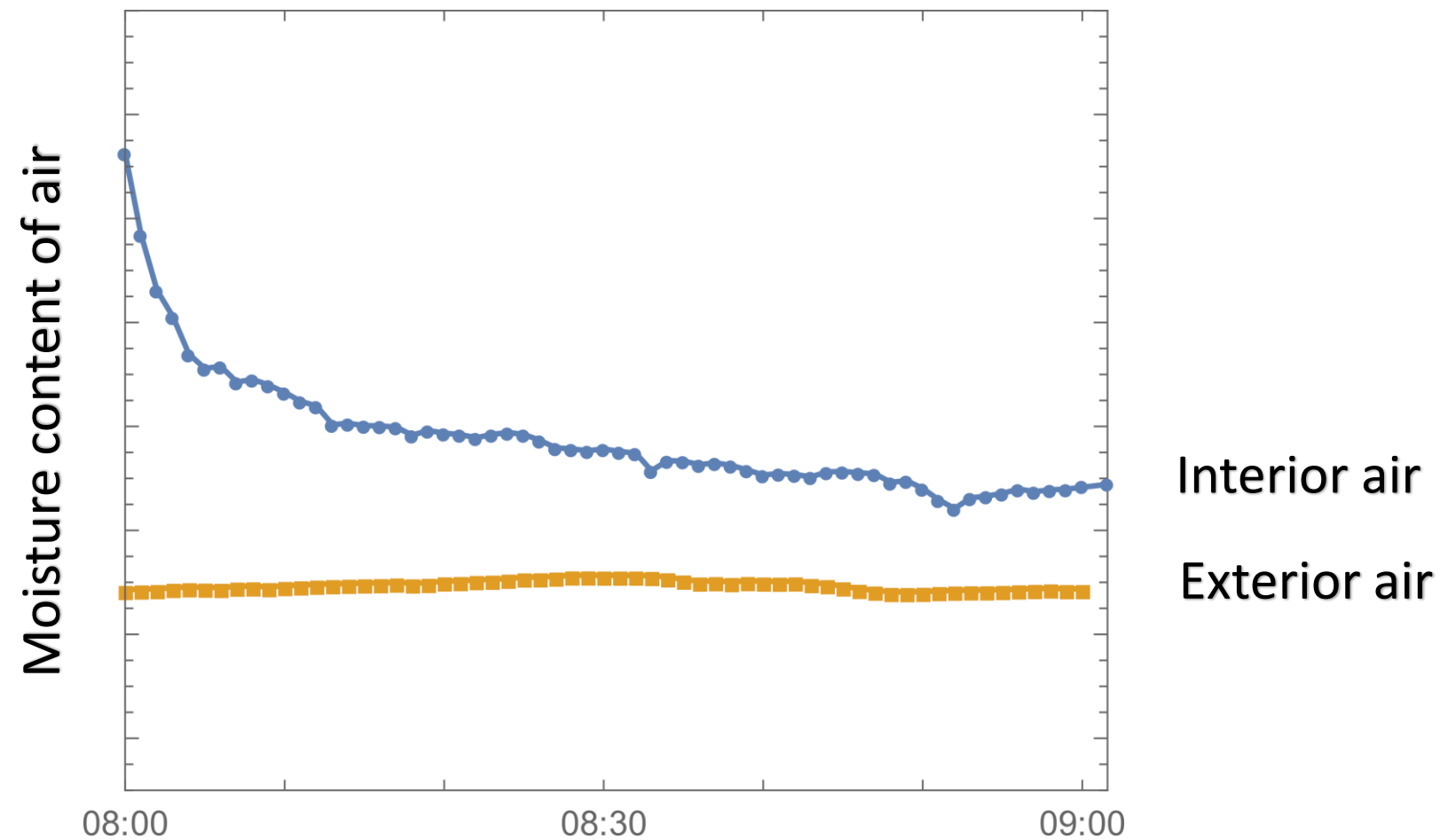
Results – trickle case

- Effective for background ventilation
- Not very effective during high production events (cooking, bathing) – need to increase ventilation at these times



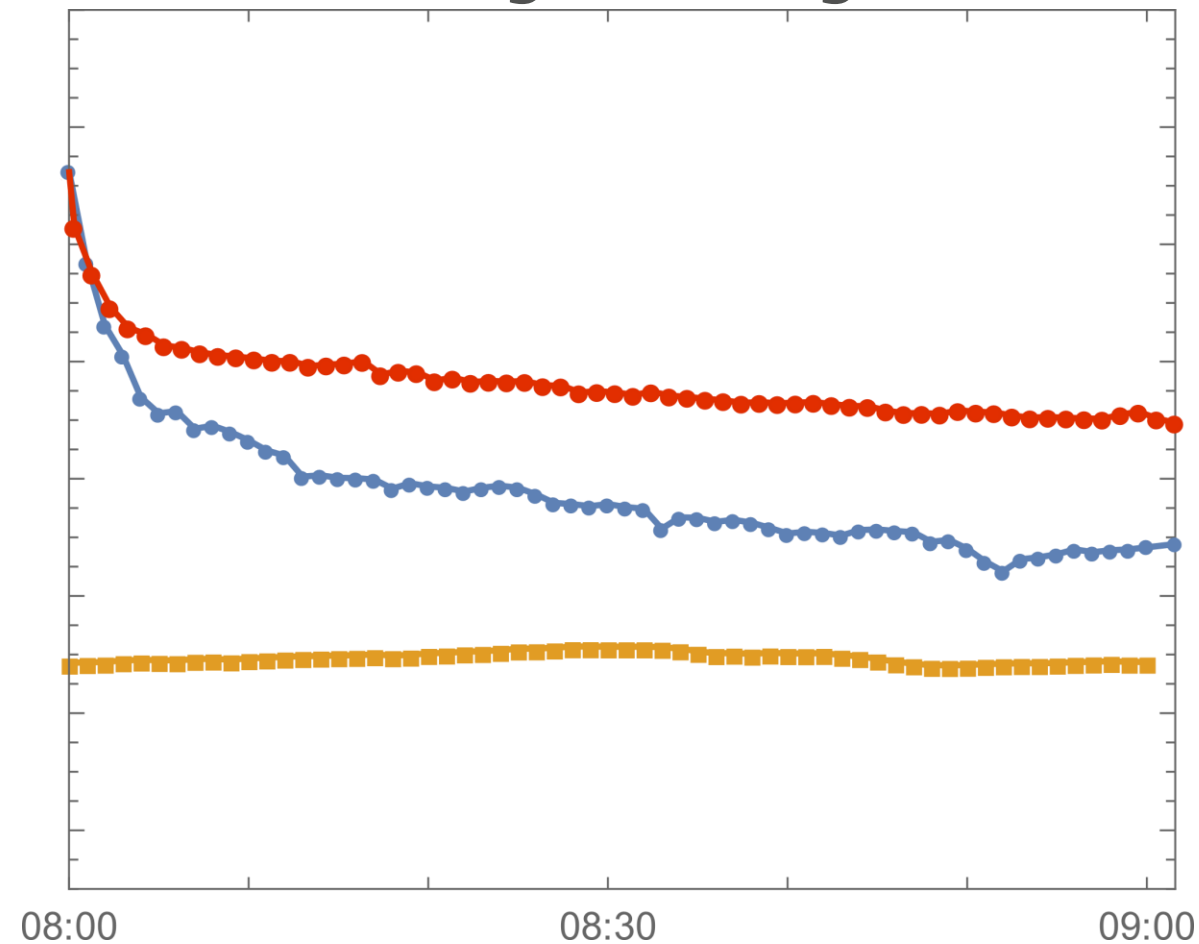
Results – window opening 300 mm wide

- Moisture content of air decayed quickly (10–15 minutes) with windows wide open



Comparison

- Much slower decay in trickle case
- Trickle vents should only be relied upon for background – not so great for dealing with high moisture loads



Great for airborne moisture ...

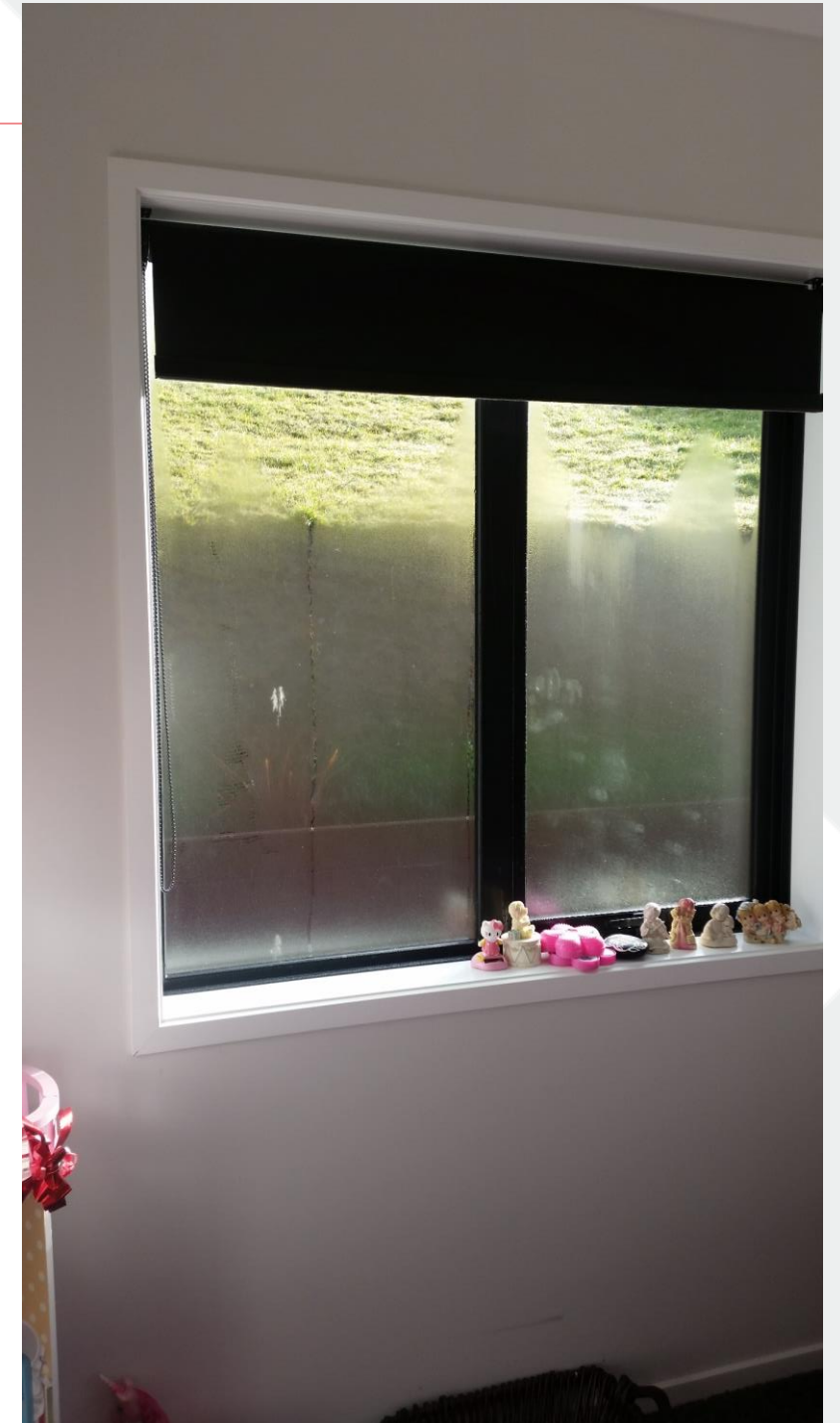
- 10–15 minutes of open windows will only get rid of airborne moisture
- Removing condensed water is an ongoing process, which requires regular heating and ventilation
- Condensation on glass can be up to 80 g/m²
- Furnishings, linings, clothing also retain significant moisture



Drying out a damp home
G4 in action

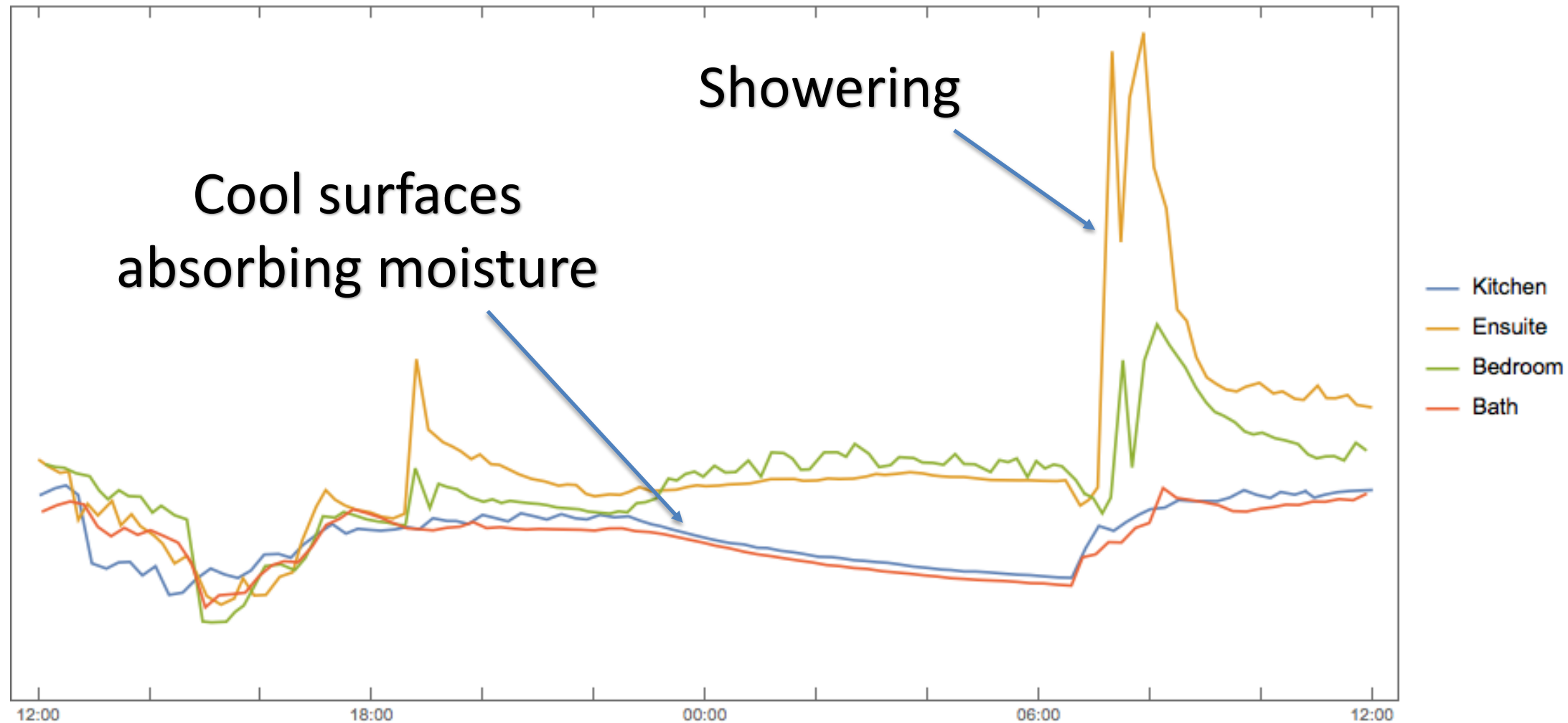
Case study

- Modern home, double glazing, centrally heated
- Consistent with many new builds, airtightness of 3.5 ach@50 Pa
- 2 years old, construction moisture not an issue
- Moisture build-up noticed, even condensation on double-glazed windows
- Trickle ventilation

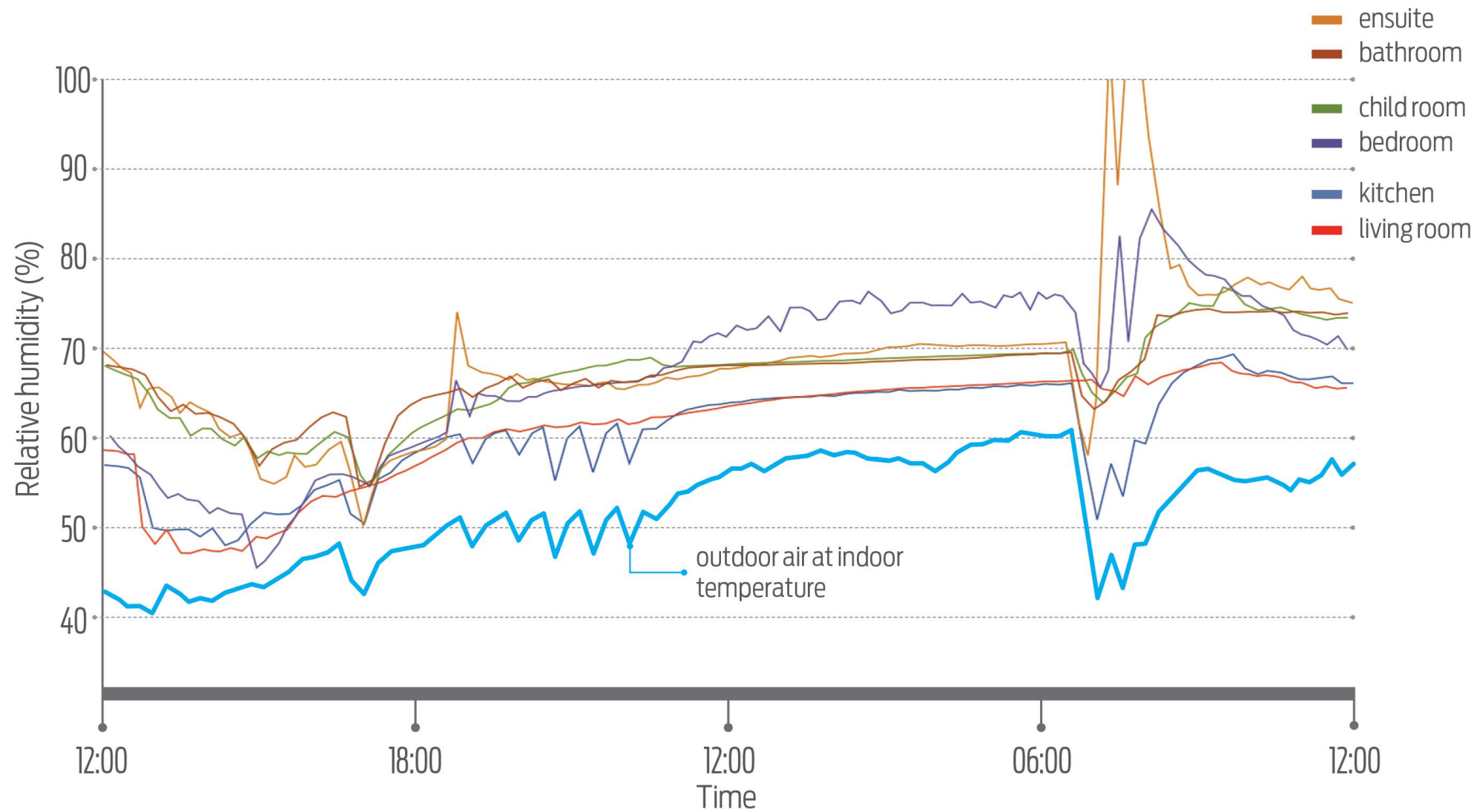


Instrumentation

- Temperature and RH at 15-minute intervals
- Measured for 2 months



Demonstration of drying potential



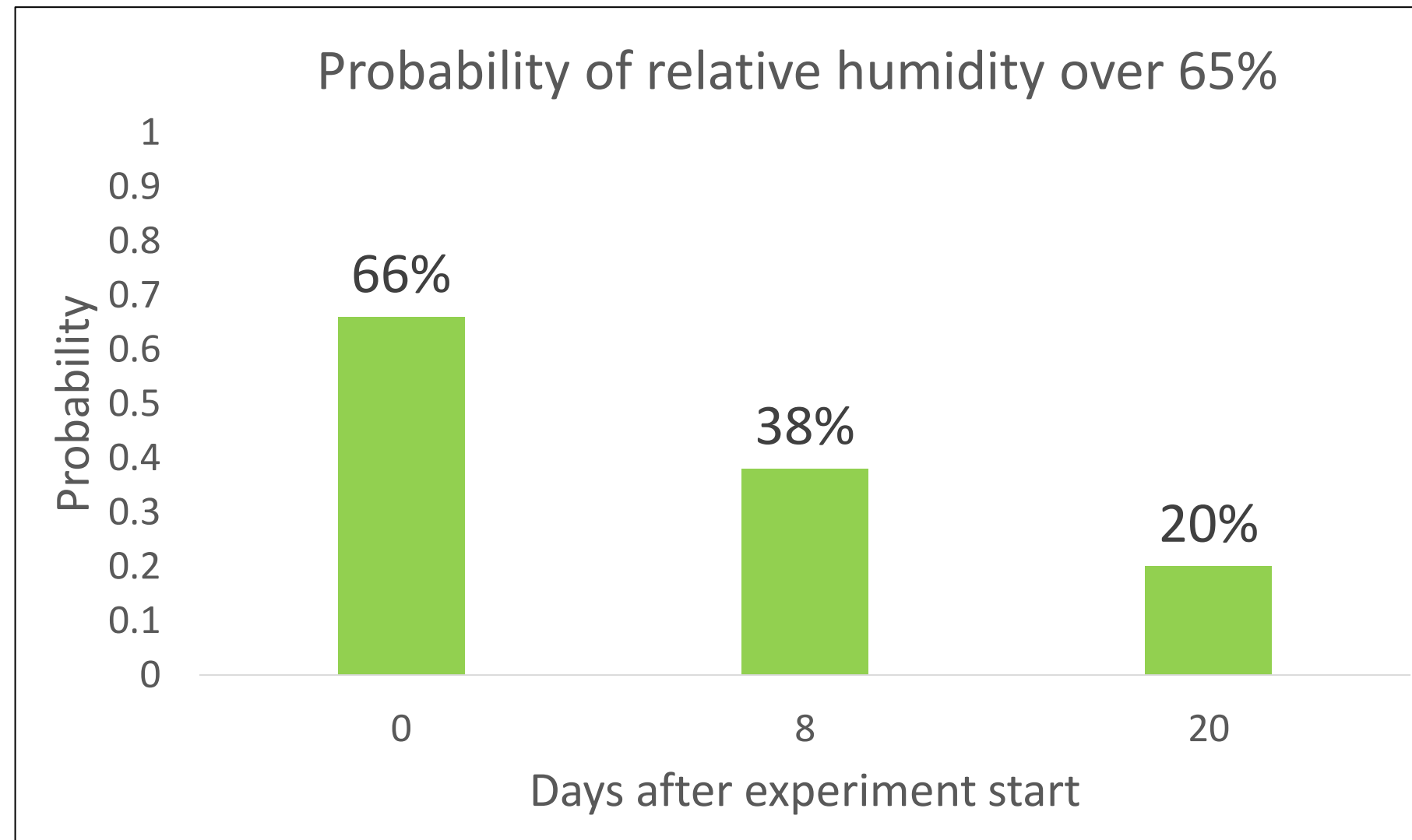
Case study

Recommendations

- Closing internal doors, opening window and using extractor when bathing
- Regular use of rangehood when cooking
- Regular opening of windows in the morning for at least 10–15 minutes
- Alternate ventilation and heating

Case study

- Behavioural change impact



Key messages

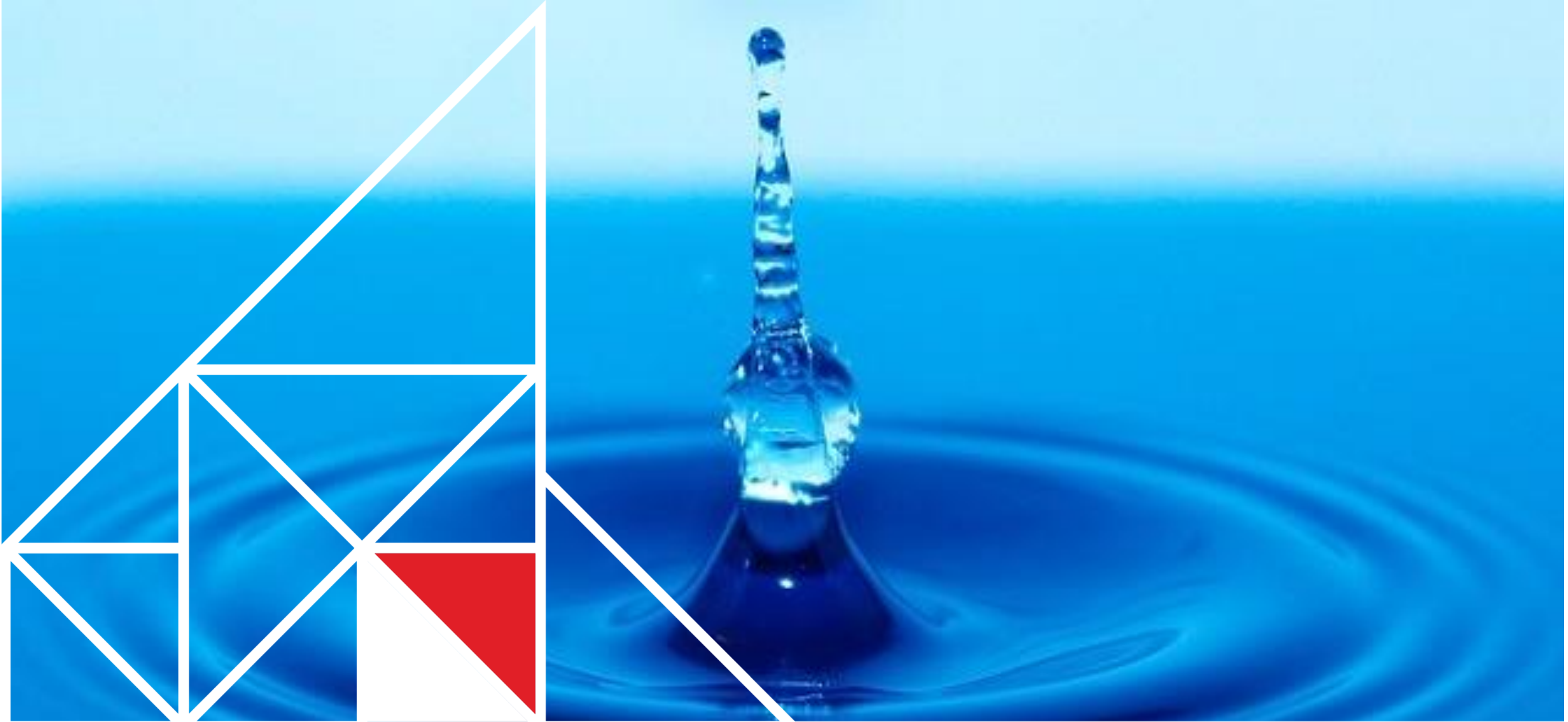
- Old habits incompatible with new home
- Regular ventilation is key
- Heating very important
- Not a quick fix, requires concerted effort

Avoid:

- Drying clothes indoors
- Unvented dryers
- Unflued gas

Cost of Purge Ventilation

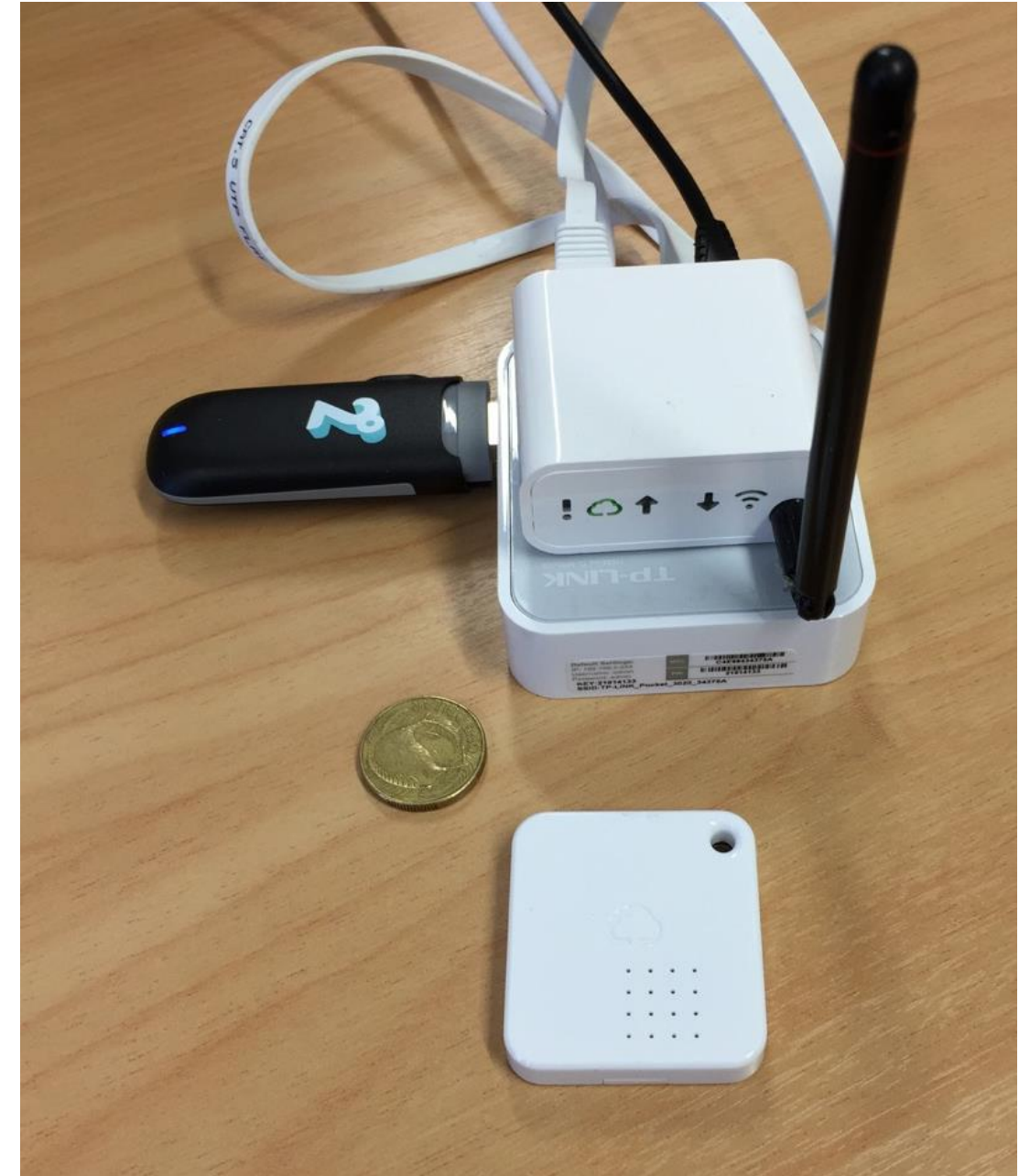
- Consider a home of 100 m²
- Volume 240 m³
- Assume temperature difference 20 indoors – 10 outdoors
- Cost per kWh NZ\$ 0.30
- Estimated cost for a purge ventilation: NZ\$ 0.25
- Cost per Month: NZ\$ 7.50



Indoor Conditions

Instrumentation

- Using small sensor packs
- Online all the time
- They report T/RH every 15 minutes
- Report window/door motion event as they occur

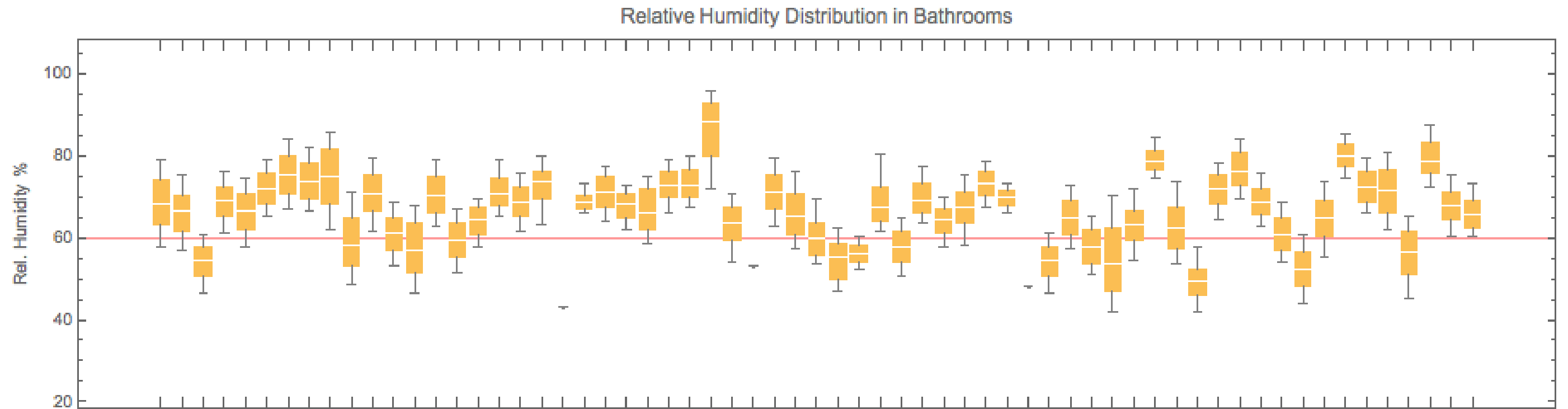


Behaviour study

- More 70 homes across New Zealand
- Measured relative humidity and temperature in 4 location in the house
- 600 sensors in operation
- 12 million temperature and rel. humidity data points
- 2.2 million window and door events recorded

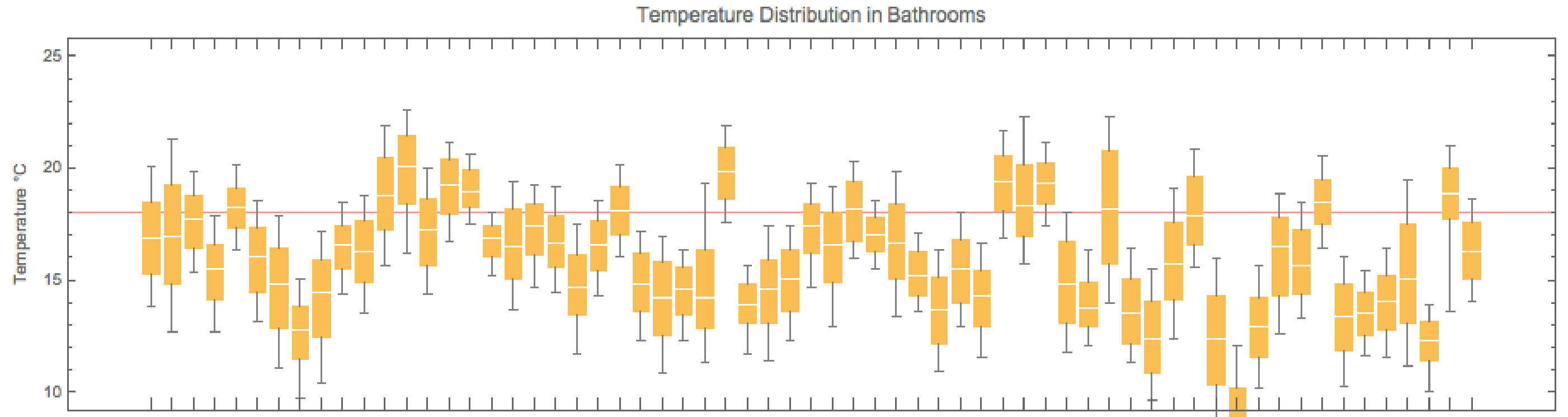
Indoor climate 1

- Relative humidity in bathrooms



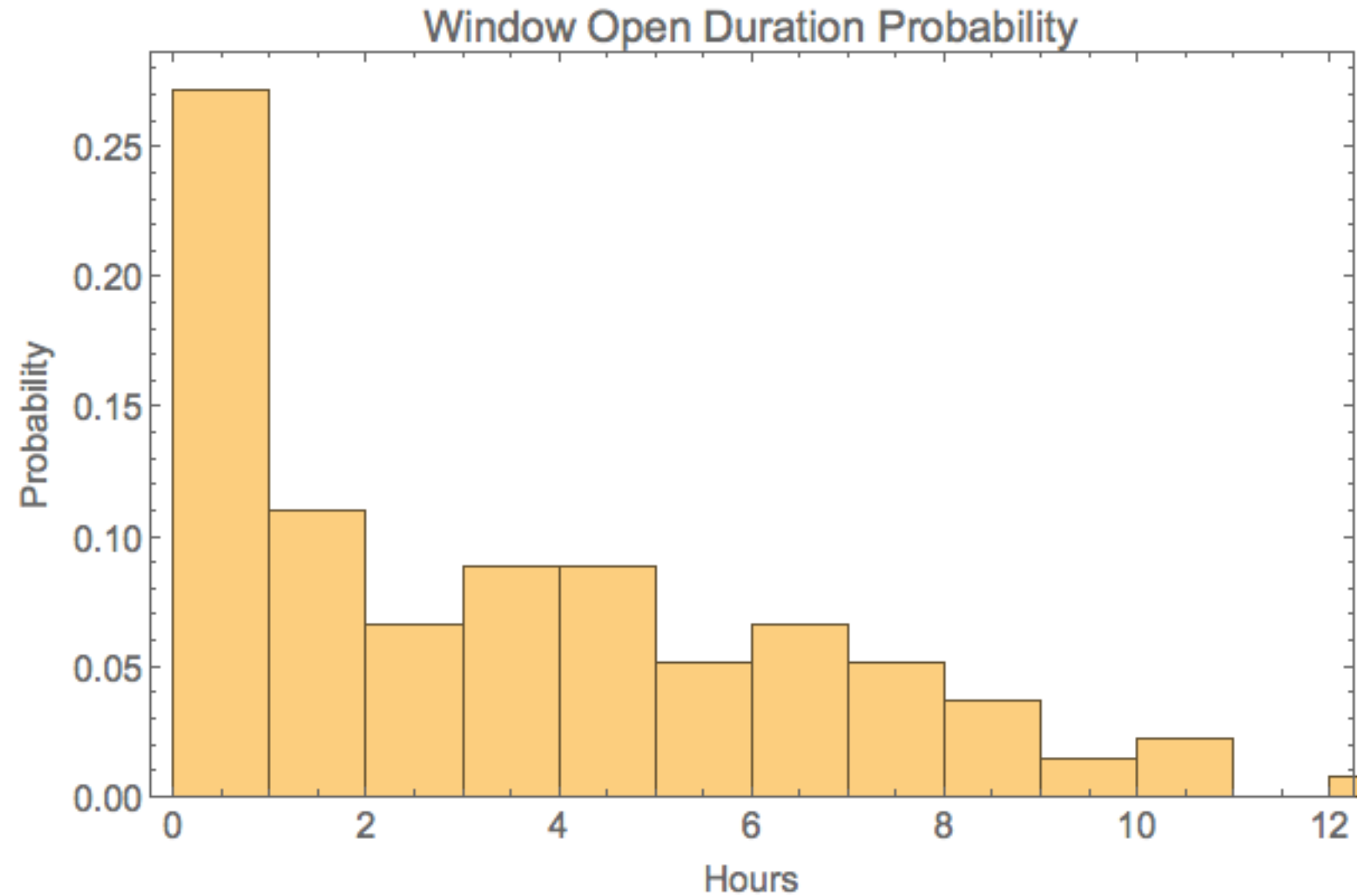
Indoor climate 2

- Bathroom Temperature



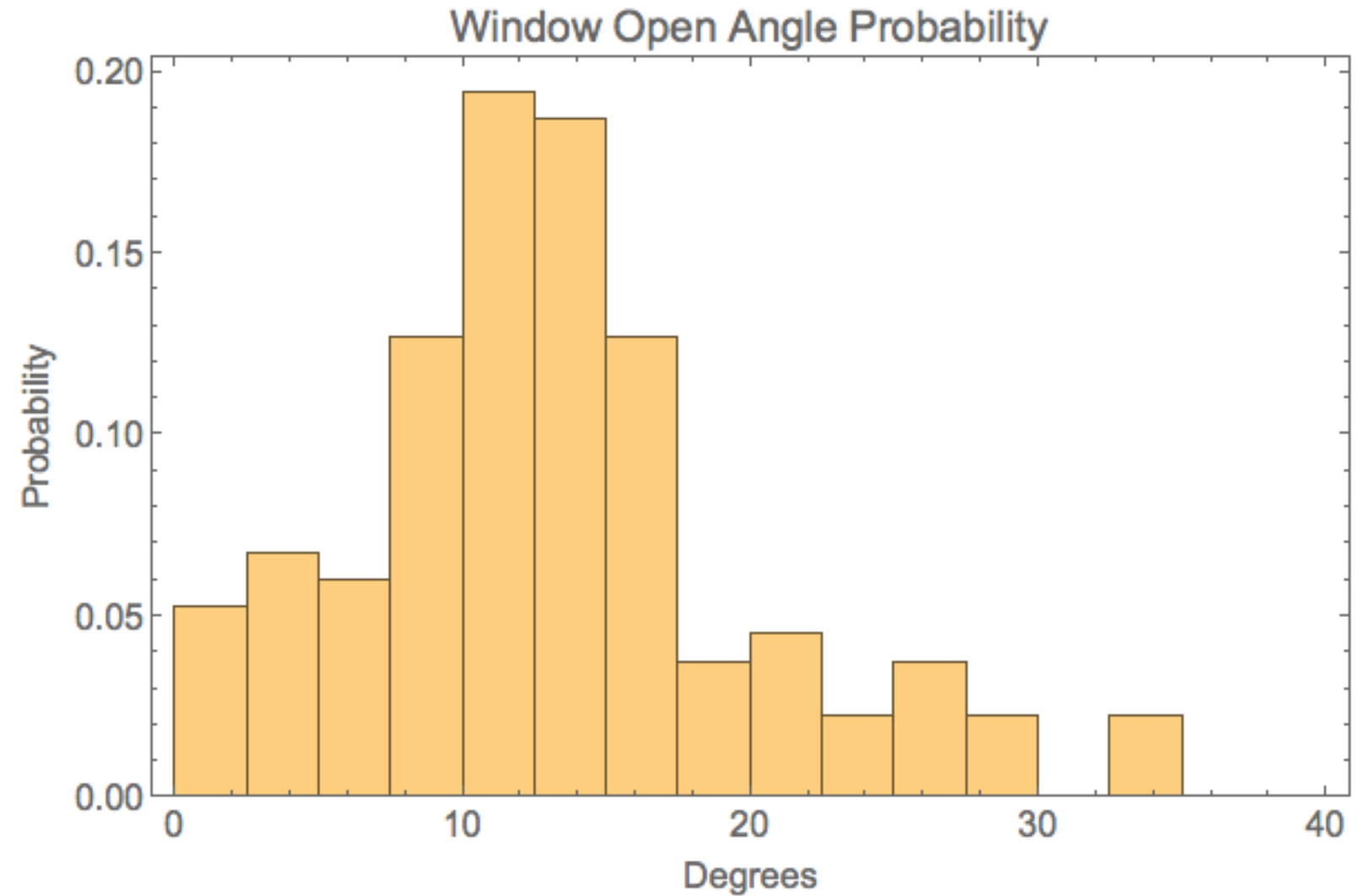
Window data analysis

- Probability of finding an open window at any given moment is 0.03.



Window data analysis

- How wide is the window open?



Bathroom Windows

- The probability of opening the bathroom window before a high moisture release is 0.2
- How long are the windows open for?
 - Predominantly for 10-15 minutes
- How wide are the windows open?
 - Usually around 12 degrees

Occupant Action <-> Building Reaction

- Occupants do open windows or use fans in their bathrooms
- Occupants have the impression that they are doing the right thing to combat moisture.
- However, the measurements show that it is not enough
- Particularly heating of the rooms is lacking with its negative effect on indoor rel. humidity
- Windows are opened too late. Often not long or wide enough.
- Bathroom doors left open

Word cloud of "thank you" in various languages including: danke, 謝謝, ngiyabonga, teşekkür ederim, tapadh leat, gracias, thank you, maiguruu, mochchakkeram, go raibh maith agat, sukriya, kop khun krap, arigato, takk, dakujem, obrigado, dziekuje, hvala, maiguruu, sagolun, sukriya, terima kasih, 감사합니다, merci, danke, 謝謝, ngiyabonga, teşekkür ederim, tapadh leat, gracias, thank you, maiguruu, mochchakkeram, go raibh maith agat, sukriya, kop khun krap, arigato, takk, dakujem, obrigado, dziekuje, hvala, maiguruu, sagolun, sukriya, terima kasih, 감사합니다, merci.