Toiora Cohousing
High Performance Housing Energy Monitoring

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Introduction

- State-of-the-art ultra-efficient houses could provide significant **health, financial, and comfort benefits**

- Due to the small number (<50) of these buildings currently in New Zealand, there remains uncertainty about their **performance** in comparison to other building types

Aim: To collect and analyse indoor-air quality and energy use data from a first-of-its-kind medium density cluster of 20 ultra-efficient houses in the cold climate zone of Dunedin
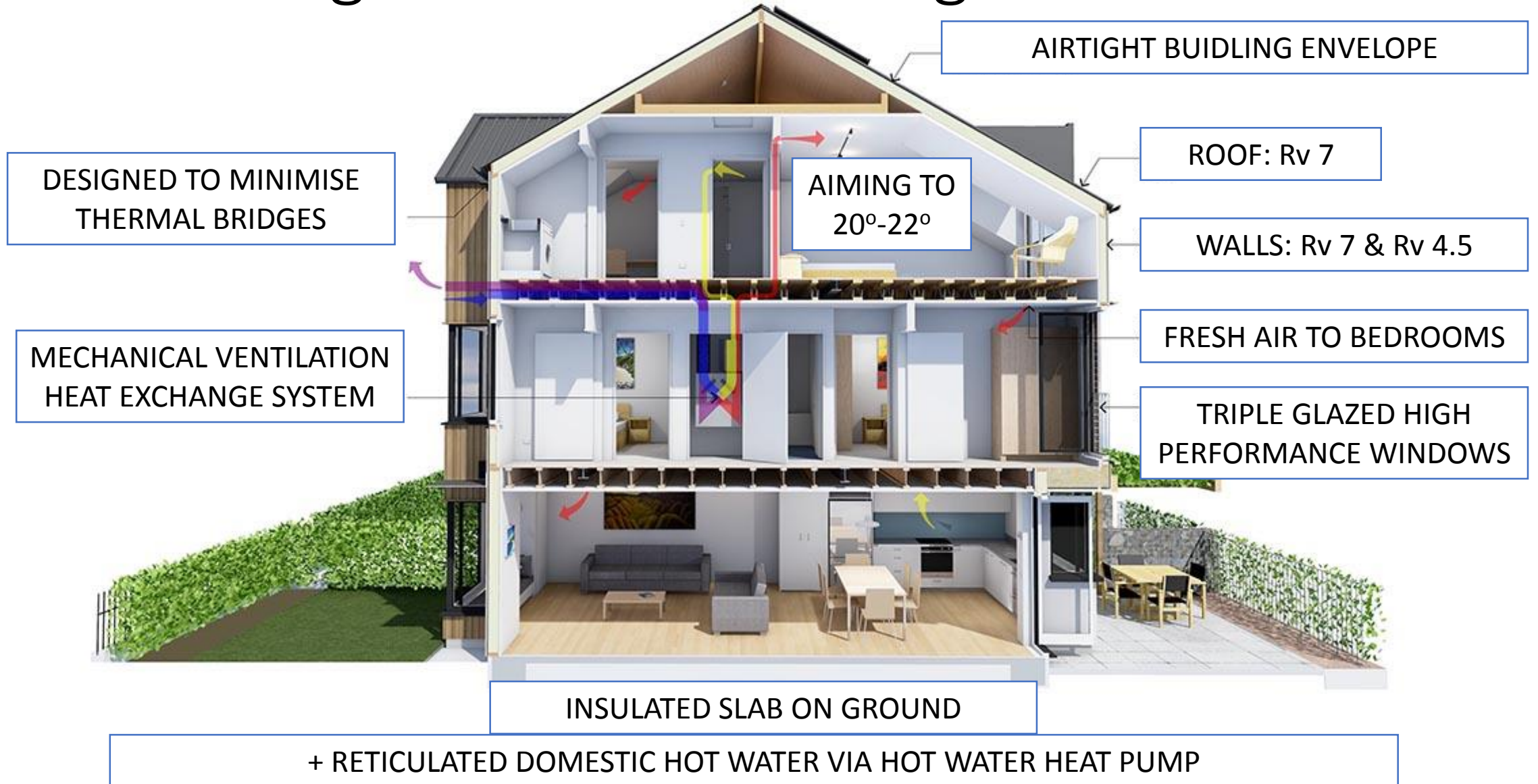
Toiora High Street Cohousing

- 24 units – built to passive house standard
- Medium density housing
- Units:
  - Levels: 1-3
  - Bedrooms: 1-4 + study
  - Occupants: 1-6
- Compact / functional houses
- Shared facilities
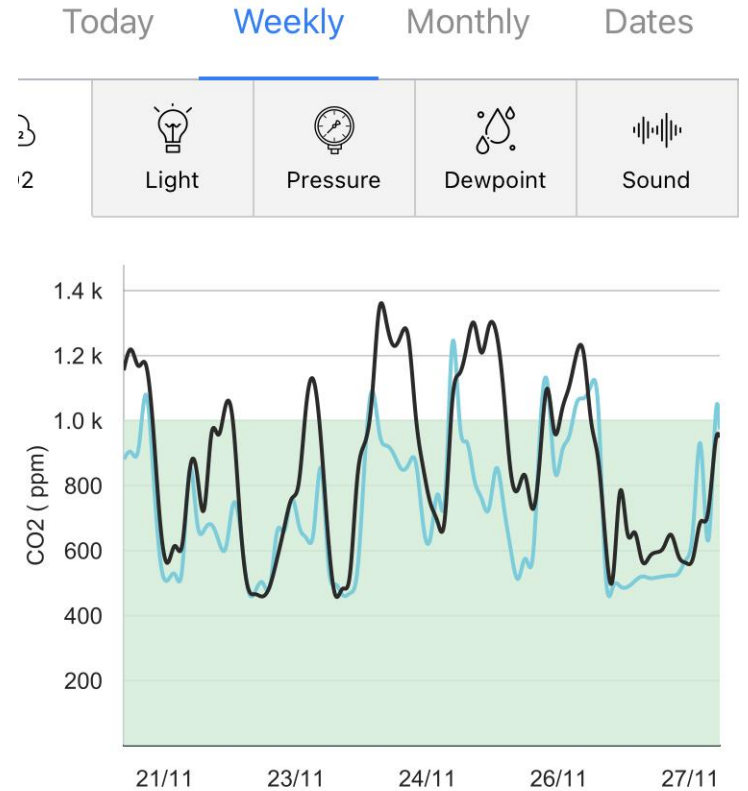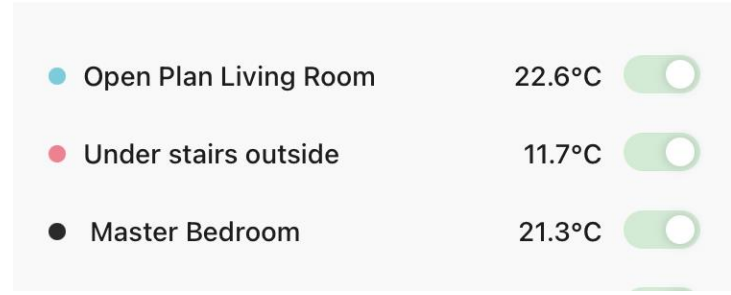- Designed for Dunedin Climate
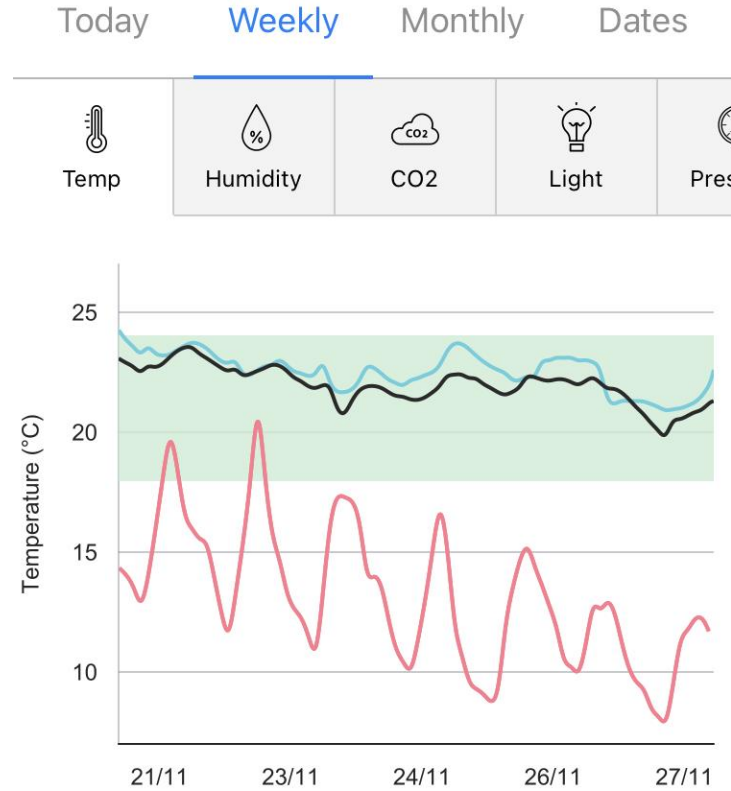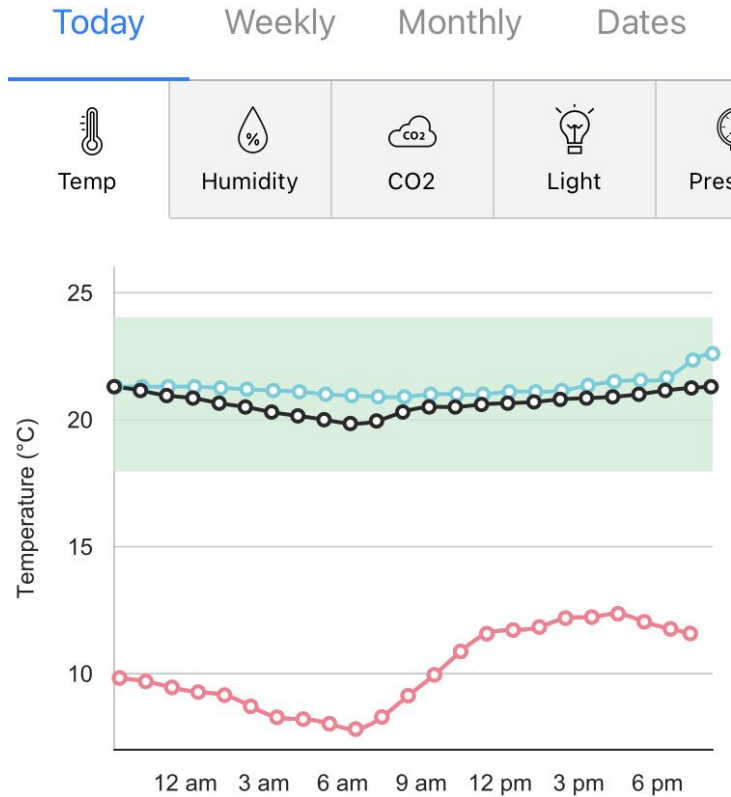
Toiora High Street Cohousing

AIRTIGHT BUIDLING ENVELOPE

ROOF: Rv 7

DESIGNED TO MINIMISE THERMAL BRIDGES

AIMING TO 20º-22º

WALLS: Rv 7 & Rv 4.5

MECHANICAL VENTILATION HEAT EXCHANGE SYSTEM

FRESH AIR TO BEDROOMS

TRIPLE GLAZED HIGH PERFORMANCE WINDOWS

INSULATED SLAB ON GROUND

+ RETICULATED DOMESTIC HOT WATER VIA HOT WATER HEAT PUMP

The Study
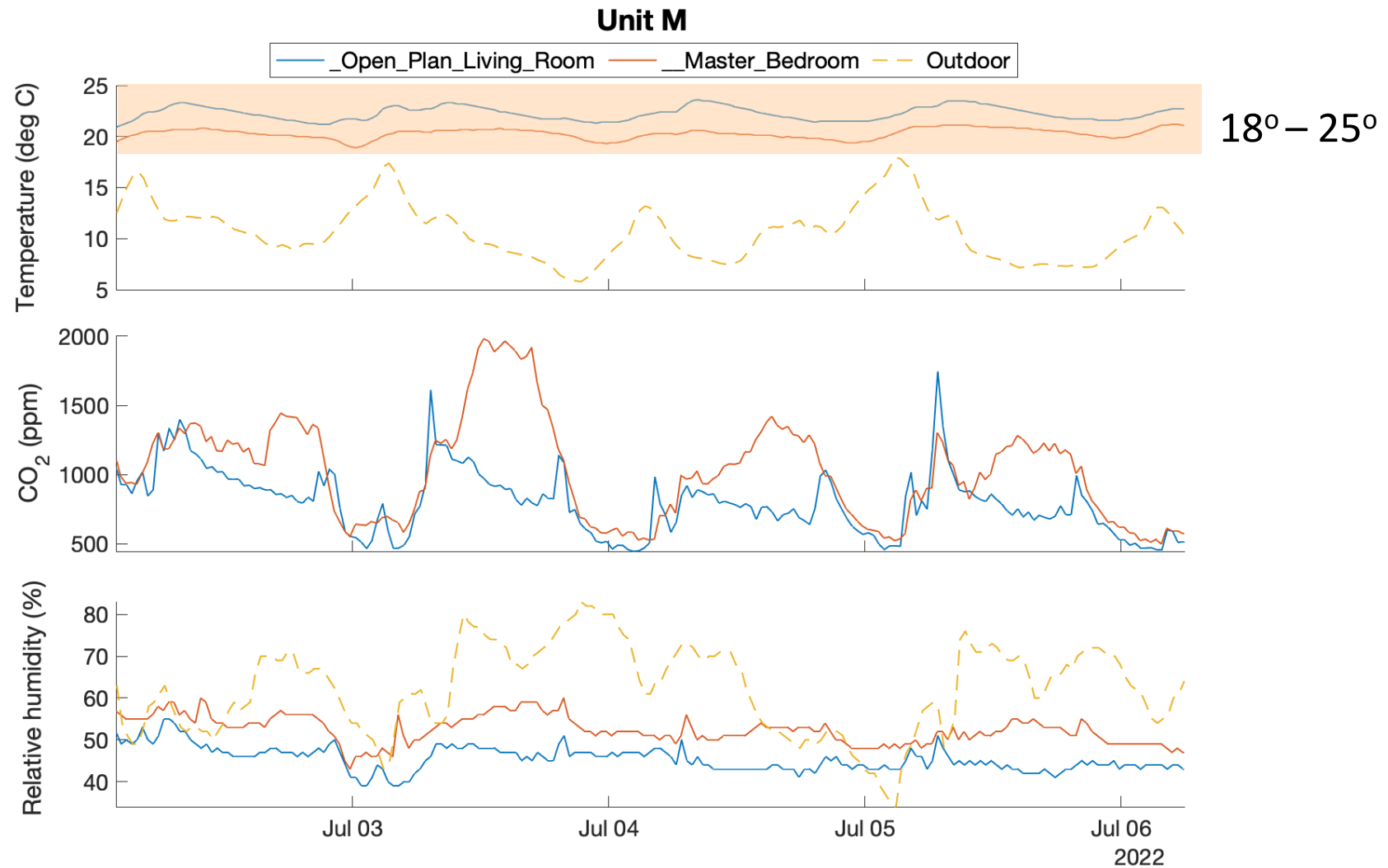
- 18 units participated in study - ~ 2 years

- Indoor **Air Quality** monitoring
  - Tether wireless monitoring devices (https://www.tether.co.nz) installed in bedrooms and living areas (37 monitors across 18 units).
  - Measure internal temperature, CO_2 concentration and relative humidity at 10-minute intervals for LIVINGROOM and BEDROOM
  - An outdoor monitor provides reference values.

- Monthly **Electricity** consumption data
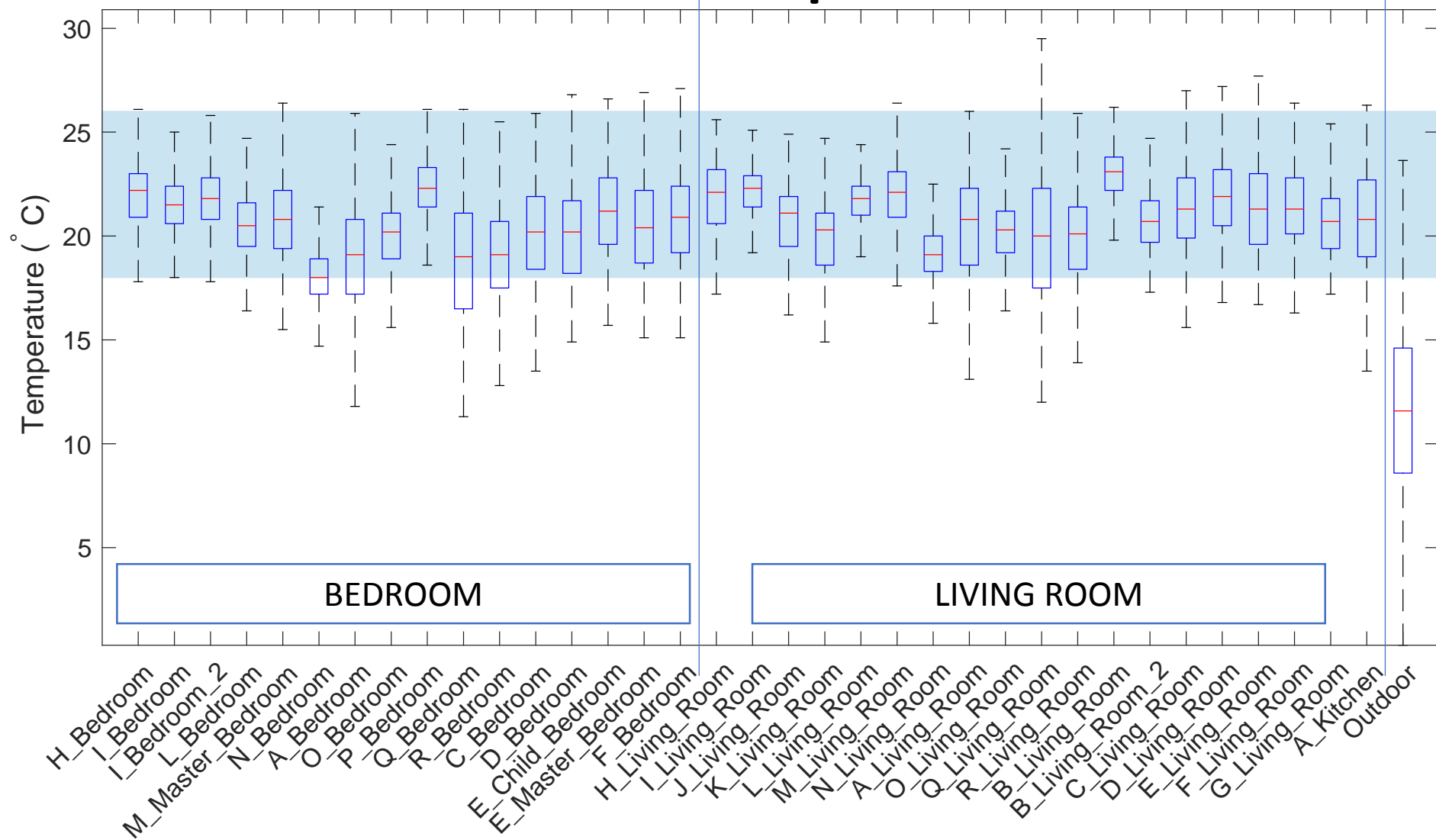
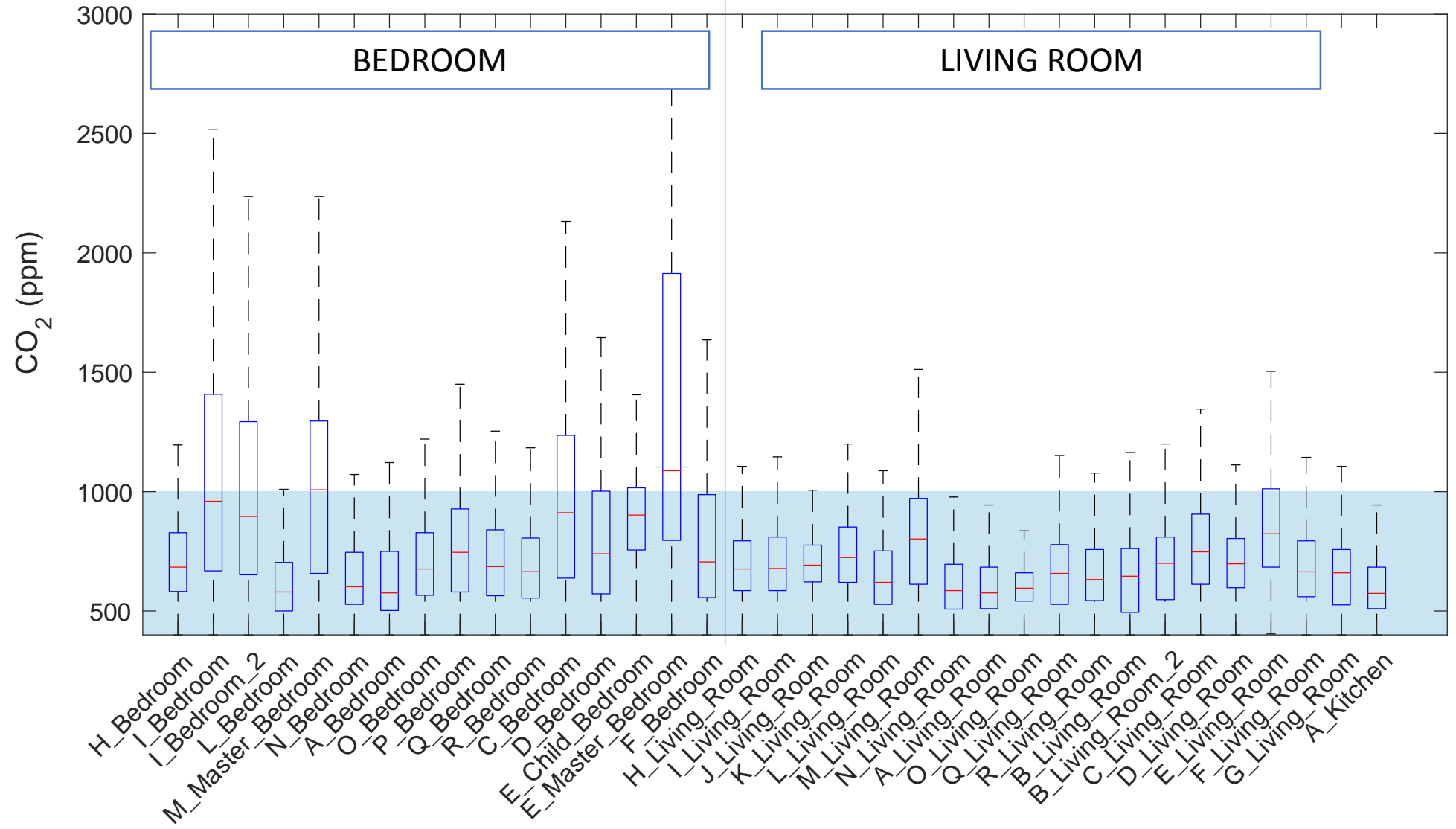- **Survey** of participants behaviour

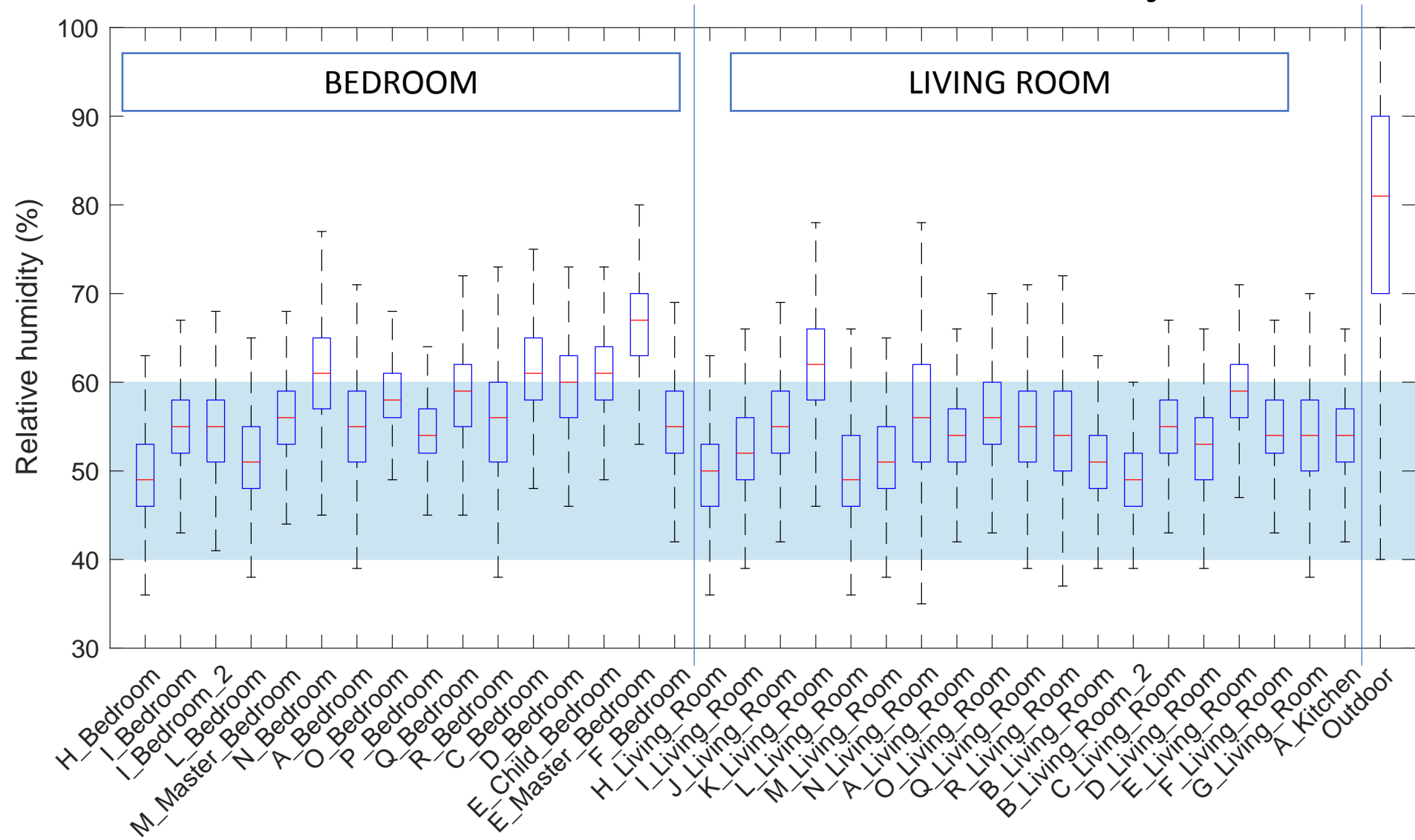# Sample
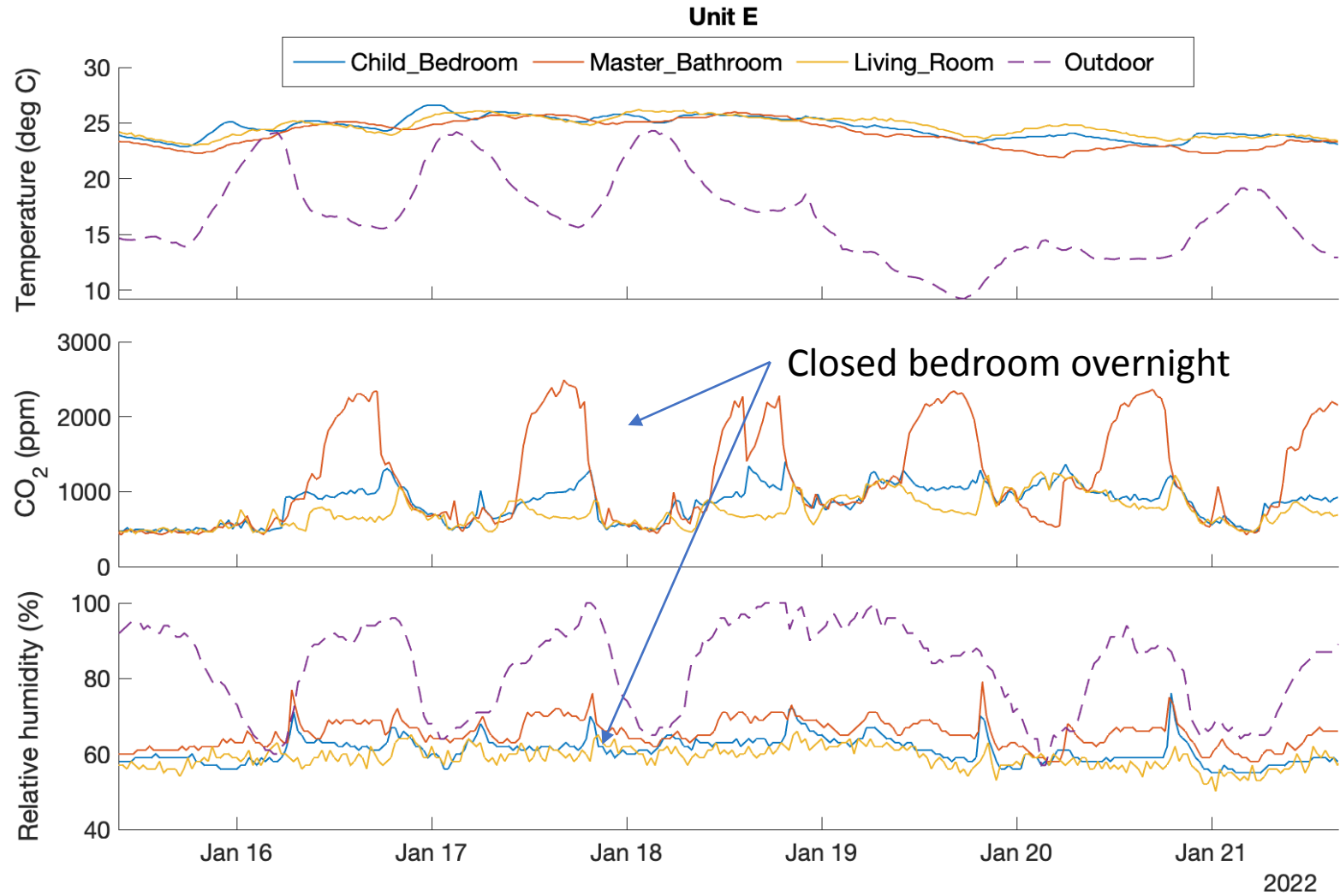
Example Dataset

Unit M

Indoor Temperatures

Indoor CO$_2$ levels

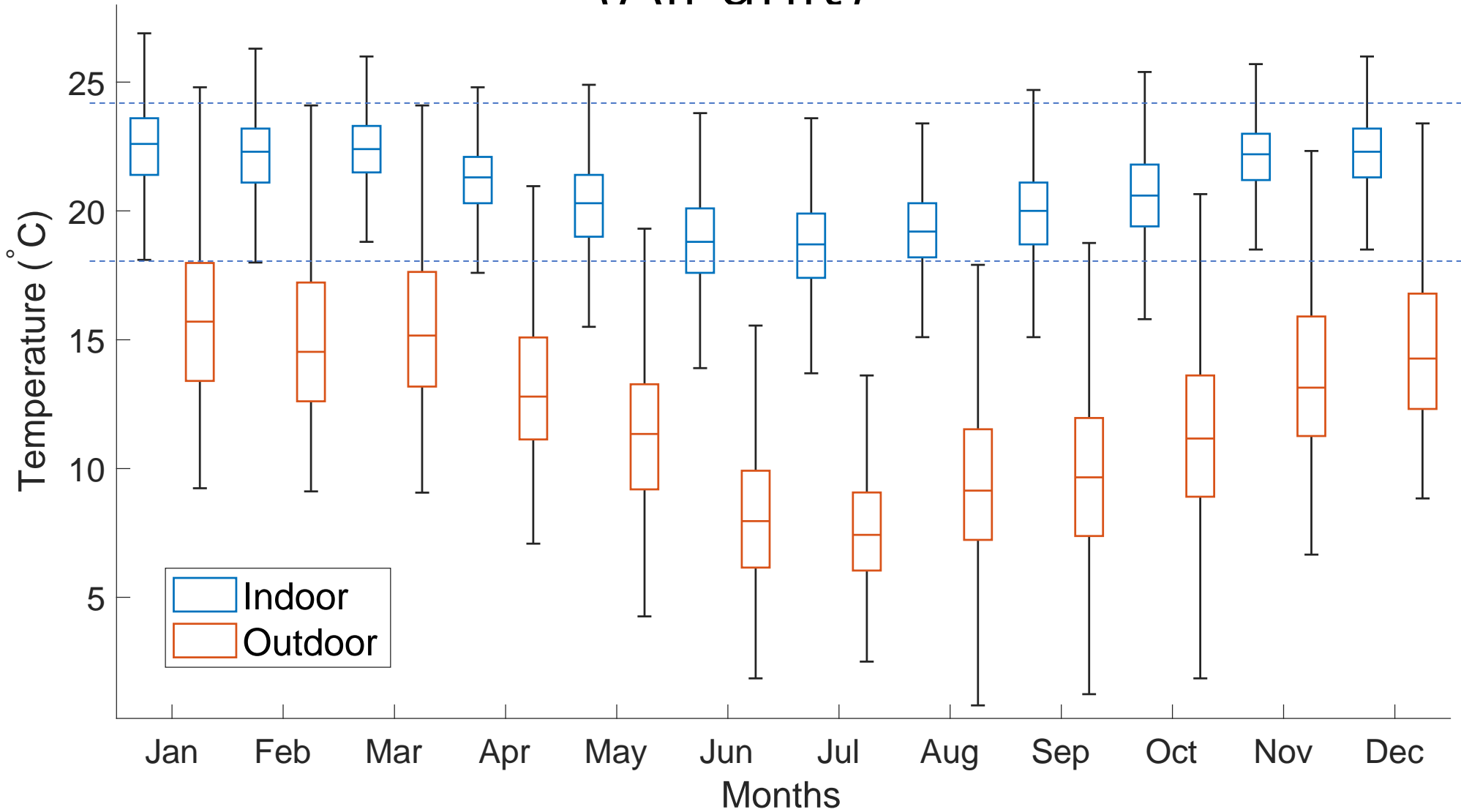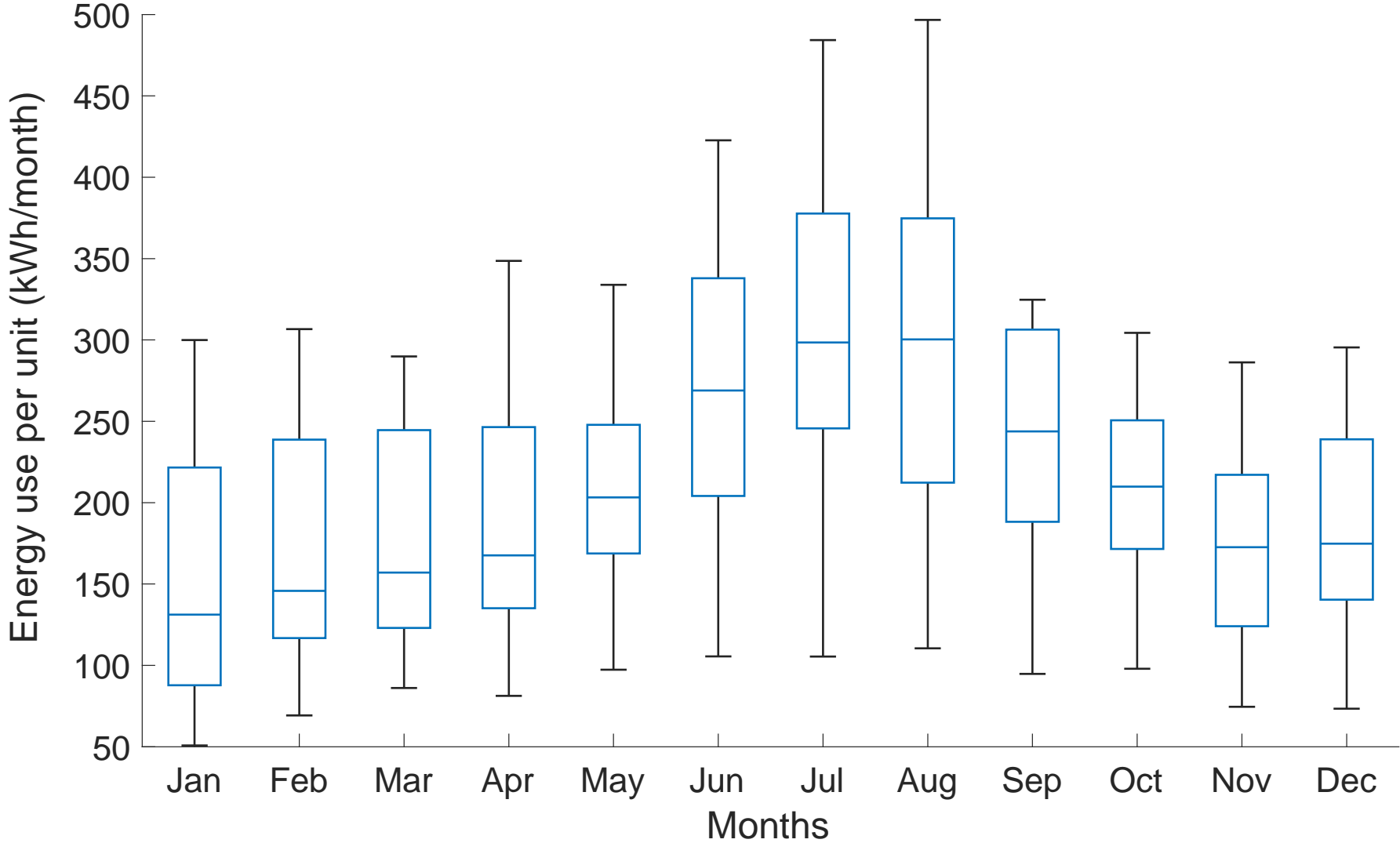# Relative Humidity

What is happening with Unit E?

Unit E

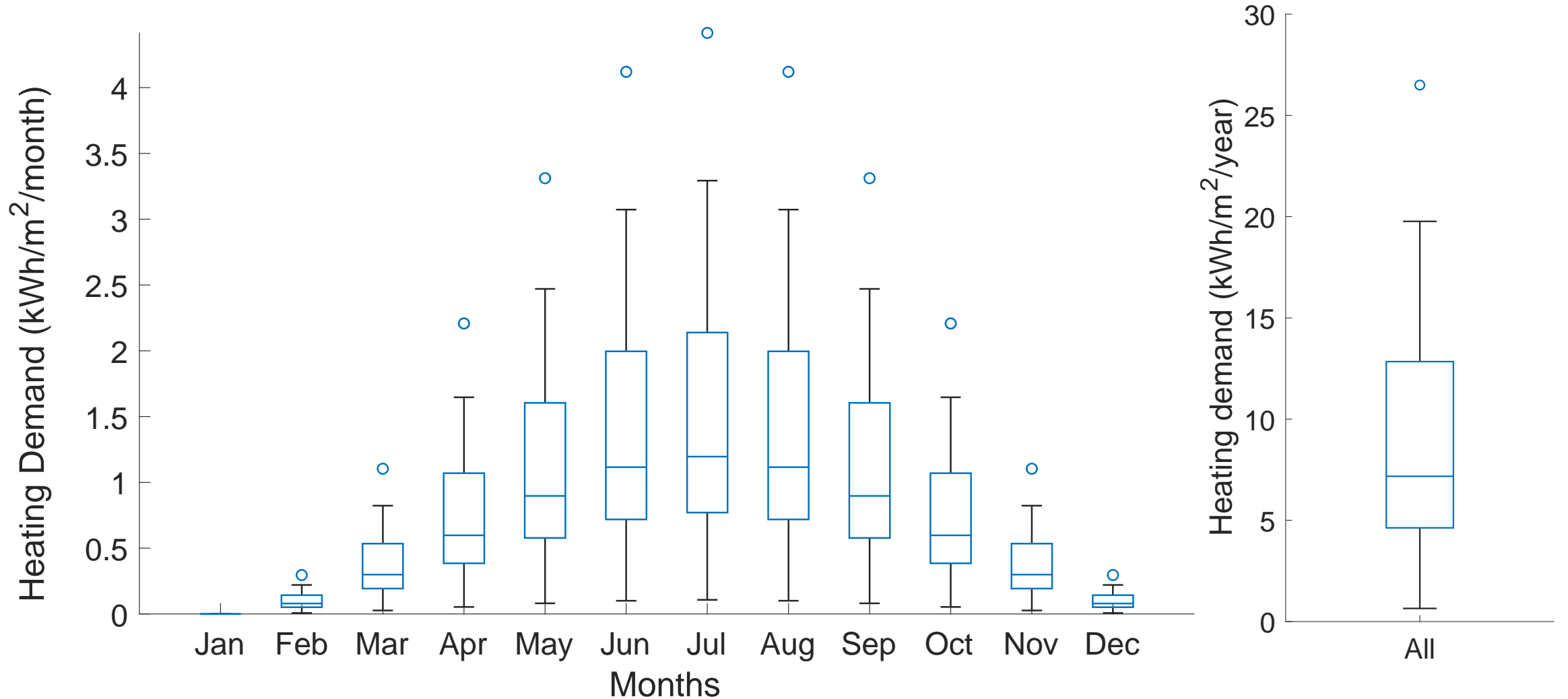Child_Bedroom — Master_Bathroom — Living_Room – – Outdoor

Closed bedroom overnight

Internal Temperatures – Seasonal Variation (All unit)

Energy use per unit – Seasonal Variation

Estimated Heating Demand (kWh/m²)

Survey

- Comfort
  - Householders reported living in **comfort conditions** throughout the year.
  - Some householders chose to **open their windows** once a day. This did not have a significant impact on temperature variations.
  - Most householders reported using **very little or no heating during winter.**
  - Most householders did not change the setting of their **heat exchanger** and was kept on "**Medium air flow**"

Preliminary Findings

- Temperatures
  - Ranged between 18°-25° most of the time
  - Slightly higher for livingrooms than for bedrooms
- CO2 Levels
  - Higher levels were found in houses with high levels of occupancy
  - Some spikes in bedrooms with doors closed overnight
  - Some spikes when high levels of occupancy and heat exchange at "medium"
- Energy use
  - Very low

Key messages

- Temperatures largely within healthy range through out year.

- Small temperature variation between different units.

- Relative humidity largely within healthy range, but some above 60%.

- CO_2 levels largely within health range in living rooms.

- Some correlation between high levels of CO_2 and:
  - Doors closed (bedrooms overnight)
  - high levels of occupancy,
  - poor management of ventilation system.

- Very low electricity bills.

- Further work:
  - Compare with NZ averages (BRANZ-HEEP2 study)
  - Develop recommendations for using the ventilation system

Thank you

- Members of Toiora Cohousing (For allowing us to monitor their units!)
- Decarbonised Energy Solutions (Hot Water Heat Pump Design/Data)