Post-Occupancy Performance Assessment of BASIX-Affected Dwellings in NSW, Australia

Lan Ding[1], Anir Upadhyay[1], Marini Samaratunga[1], Krishna Munsami[1], William Craft[1], Kate Bishop[1], Deo Prasad[2], Kevin Yee[3], Scott Wilson[3]

[1] UNSW Sydney, Australia
[2] CRC for Low Carbon Living, Australia
[3] NSW Department of Planning and Environment, Australia

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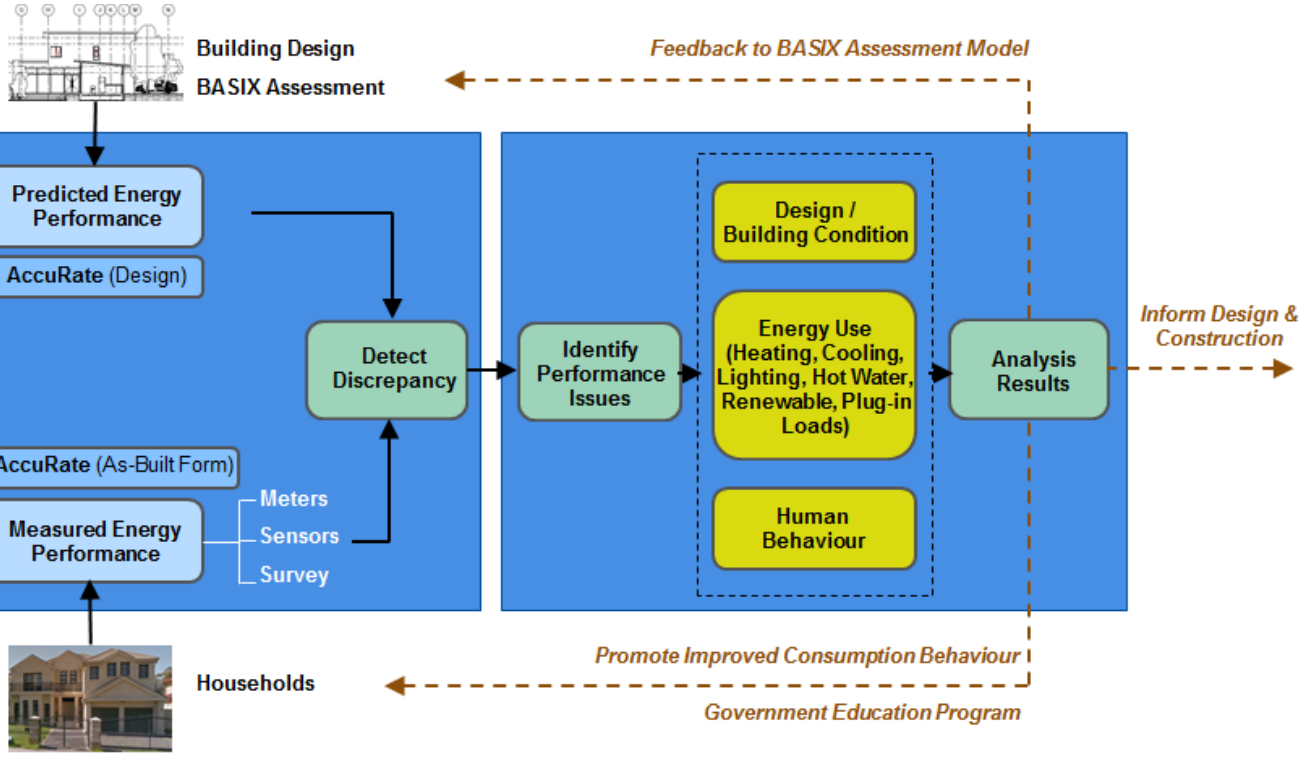
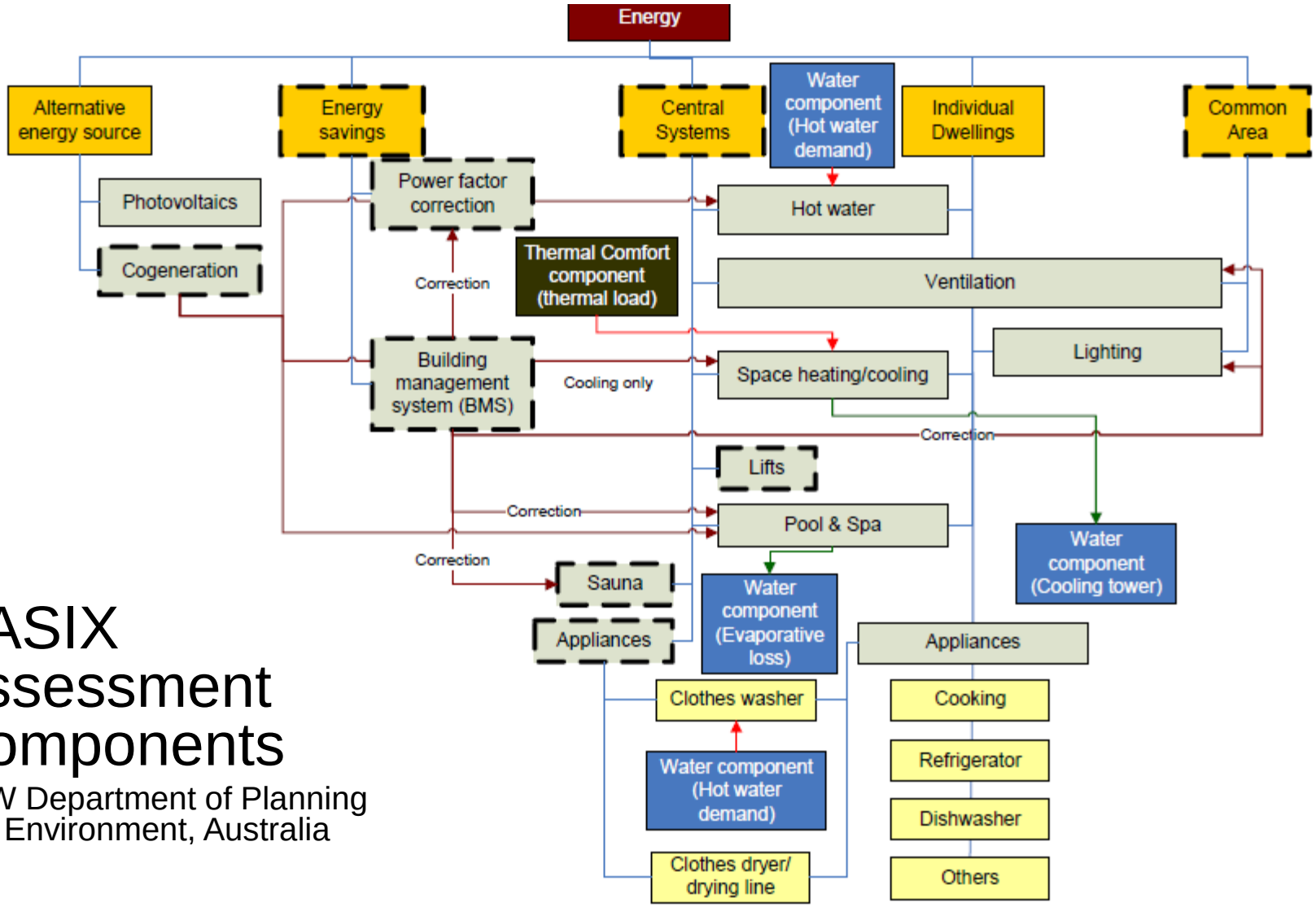
Overview

This research project carries out post-occupancy investigations of new residential buildings in NSW. It compares BASIX modelled results to monitoring data in real-life environments for each type of energy use in homes, and identifies performance issues in building condition, appliances and consumer behaviour.

The findings of this research will assist to identify areas for improvement of the BASIX assessment models, establish the links between government regulations, design options and post-occupancy behaviour and inform future sustainability strategies and policy.





BASIX Assessment Components

NSW Department of Planning and Environment, Australia

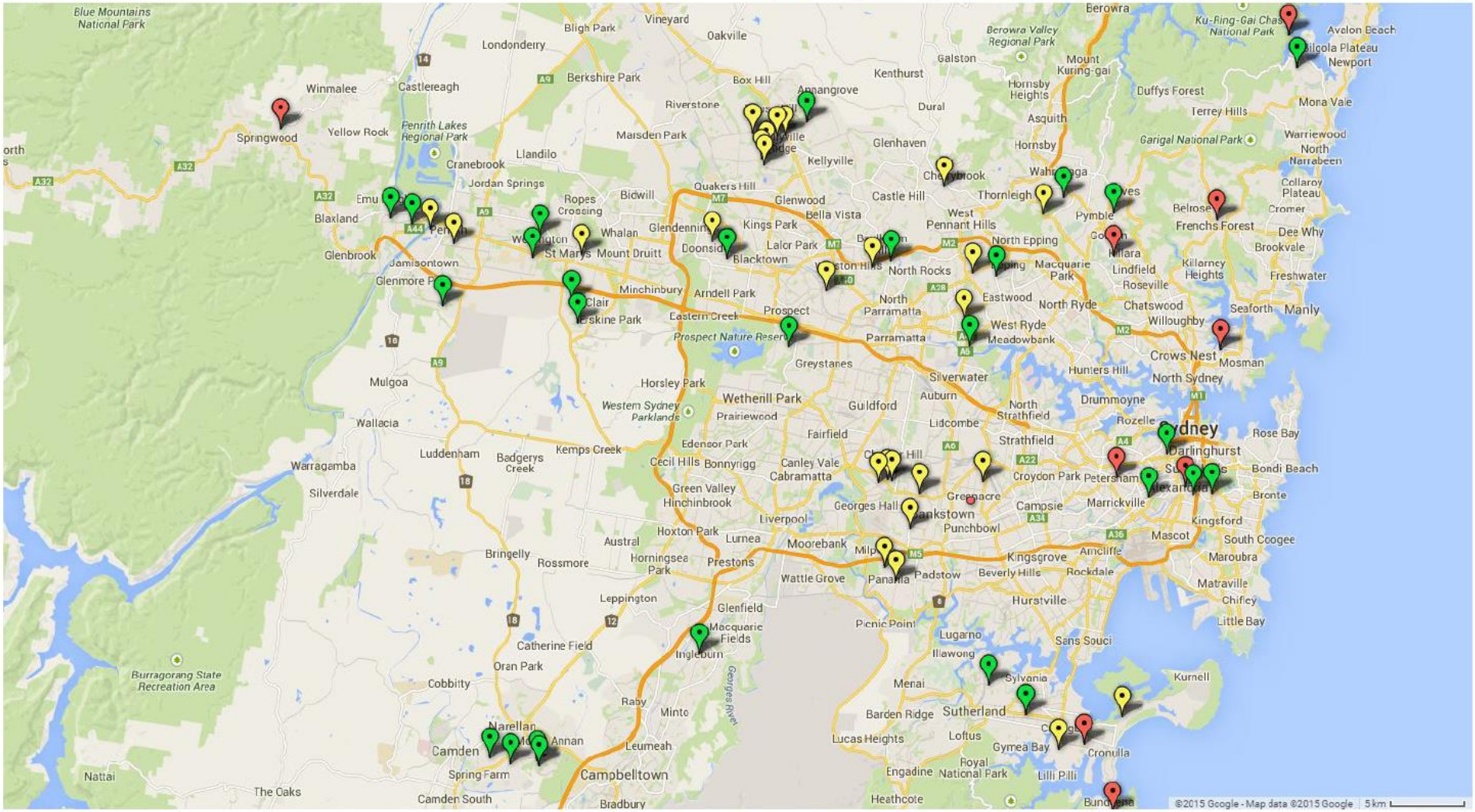
Building Type	Zone 1	Zone 2	Zone 3
Detached, semi-detached	40	35	25
3 storey units	35	30	20
4 and 5 storey units	30	25	15
6 storey units and higher	20	15	5

2002/2003 Benchmark: 3292 kg CO_2 emissions per person per year

Confirmed Stage 02 Dwellings vs Dwelling Age

0-5 years - 28 single dwellings.
5-10 years - 23 single dwellings, 3 multi-unit dwellings.
20+ years - 10 single dwellings, 1 multi-unit dwelling.

Map shows 63 out of 65 confirmed dwellings

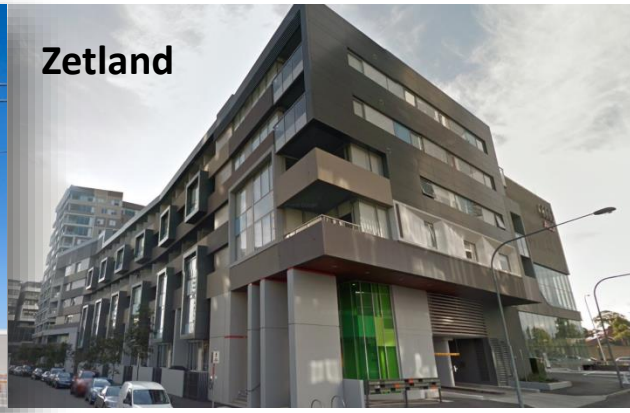


Organisers:

International Co-owners:


Rhodes


Redfern


Zetland

BASIX Estimation
(Energy, Water & Thermal)

Electricity & Gas
- Cooling
- Heating
- Lighting
- Ventilation
- Hot water
- Pool & spa
- Alternative energy supply
- Others (cooking, fridge, dishwasher, clothes washer, clothes dryer, other internal use)
- Common space services at multi-unit dwellings

Building Design

Behaviour Assumption

Measured Performance
(Energy)

Electricity & Gas
- Cooling
- Heating
- Lighting (& ceiling fans)
- Hot water
- Pool & spa
- Alternative energy supply
- Others (aggregate)

Building Implementation
- Building changes
- Insulation, etc

Building Diagnostics
- Air leakage
- Building envelope thermal performance, etc

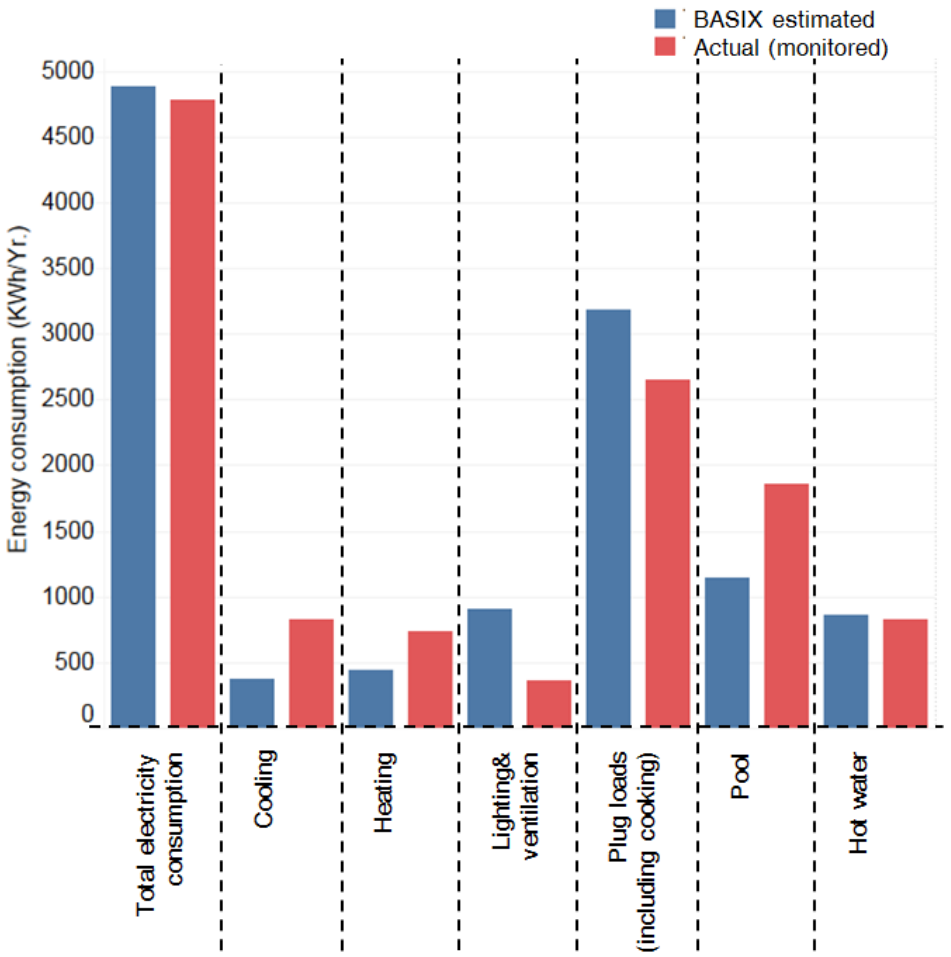
Human Behaviour
(Occupants)

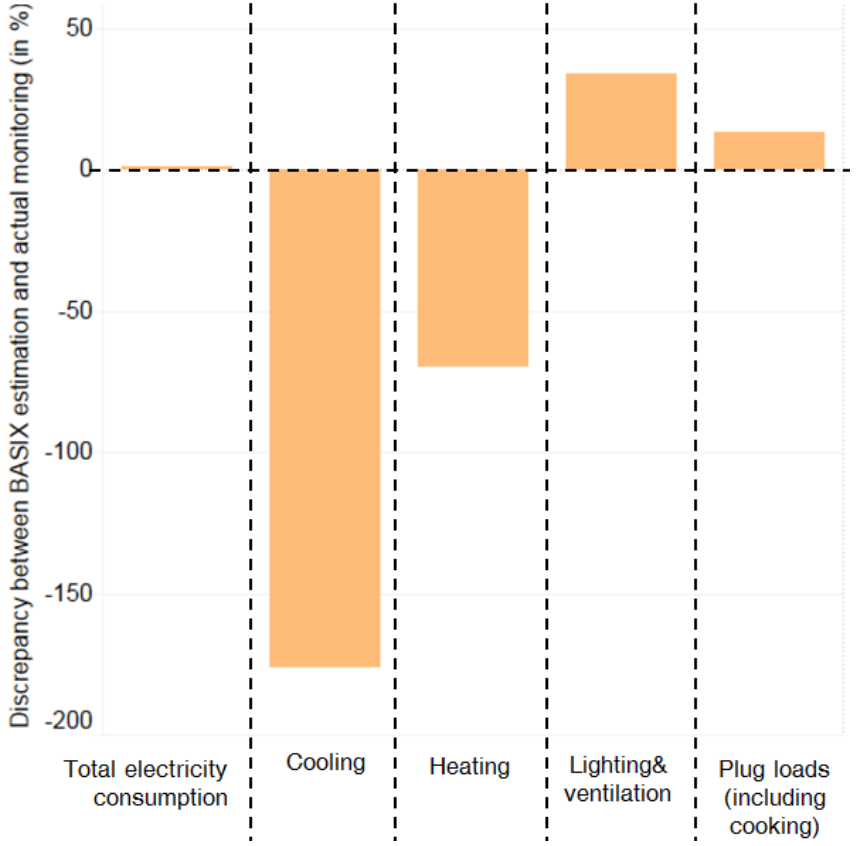
Socio-Demographics
- Occupancy
- Age, income, employment, etc

Energy Use Behaviour
- Energy use
- Adaptive behaviour
- Investment behaviour

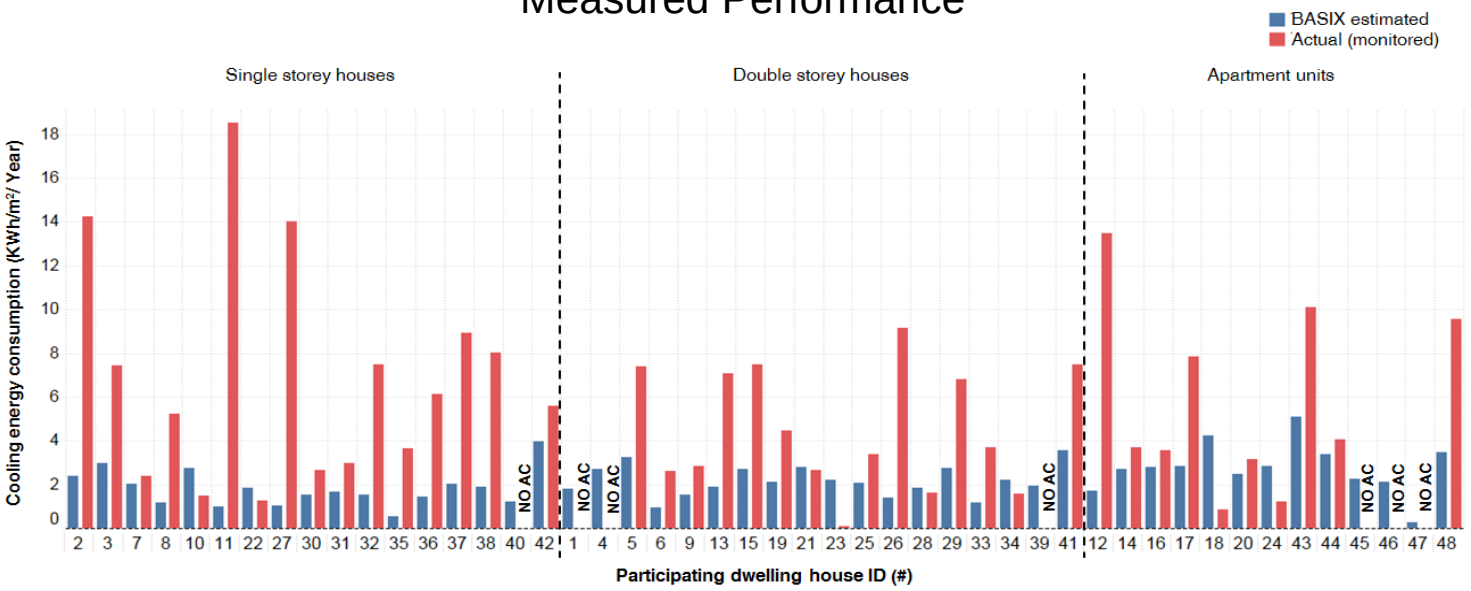
Influential Factors
- Thermal perception
- Attitudes, preferences, etc
- Cost
- Knowledge, government education program, etc

Comparison of Energy Use between BASIX Estimation and Measured Performance

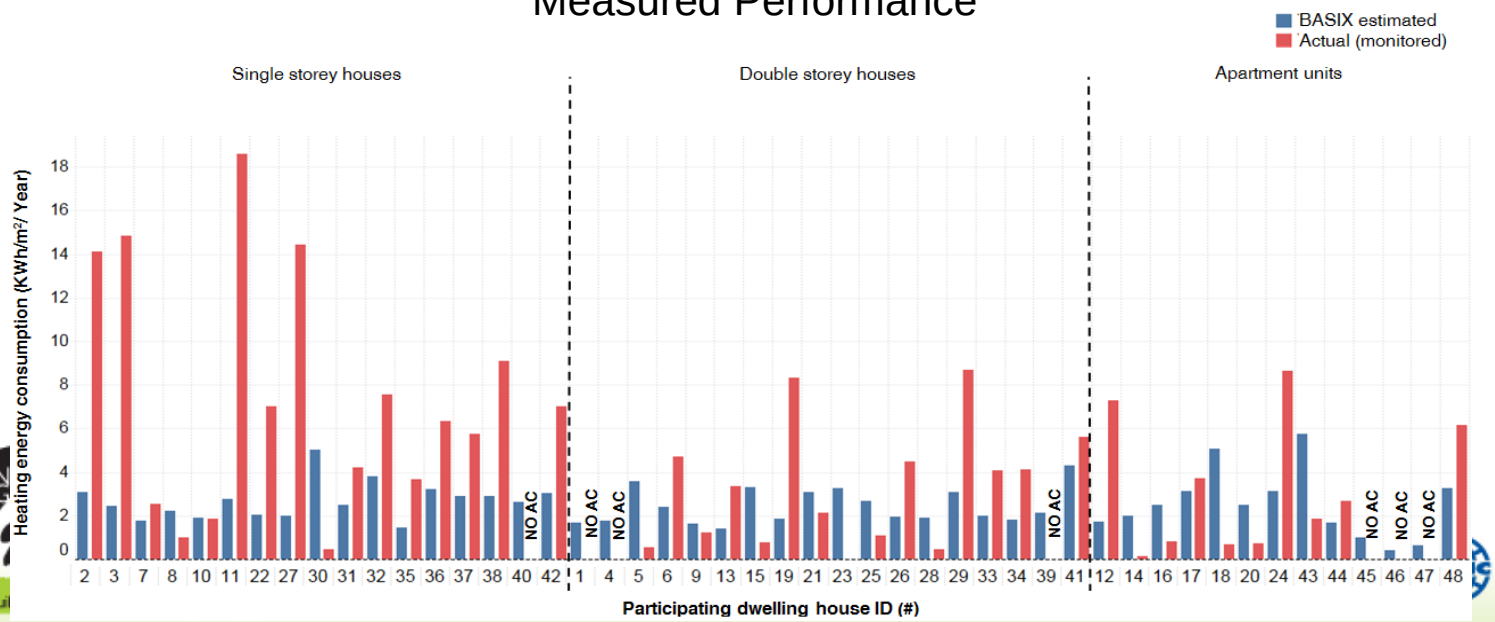




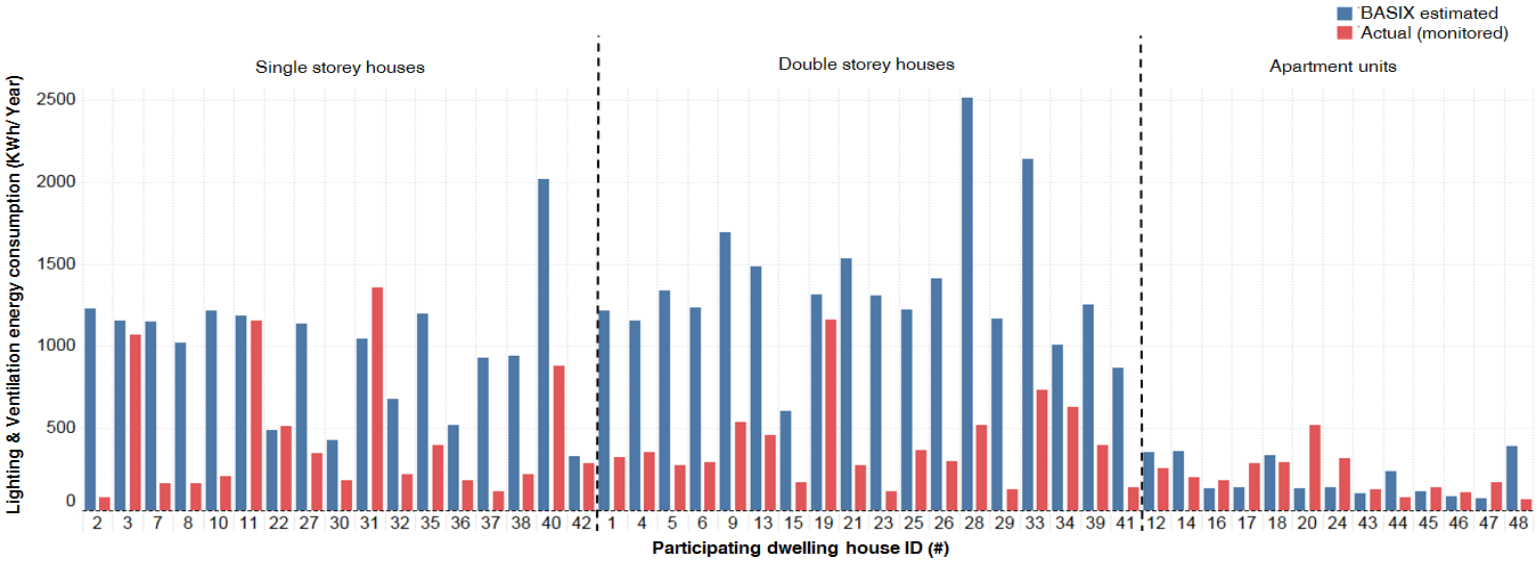
Comparison of **Cooling** Energy Use between BASIX Estimation and Measured Performance



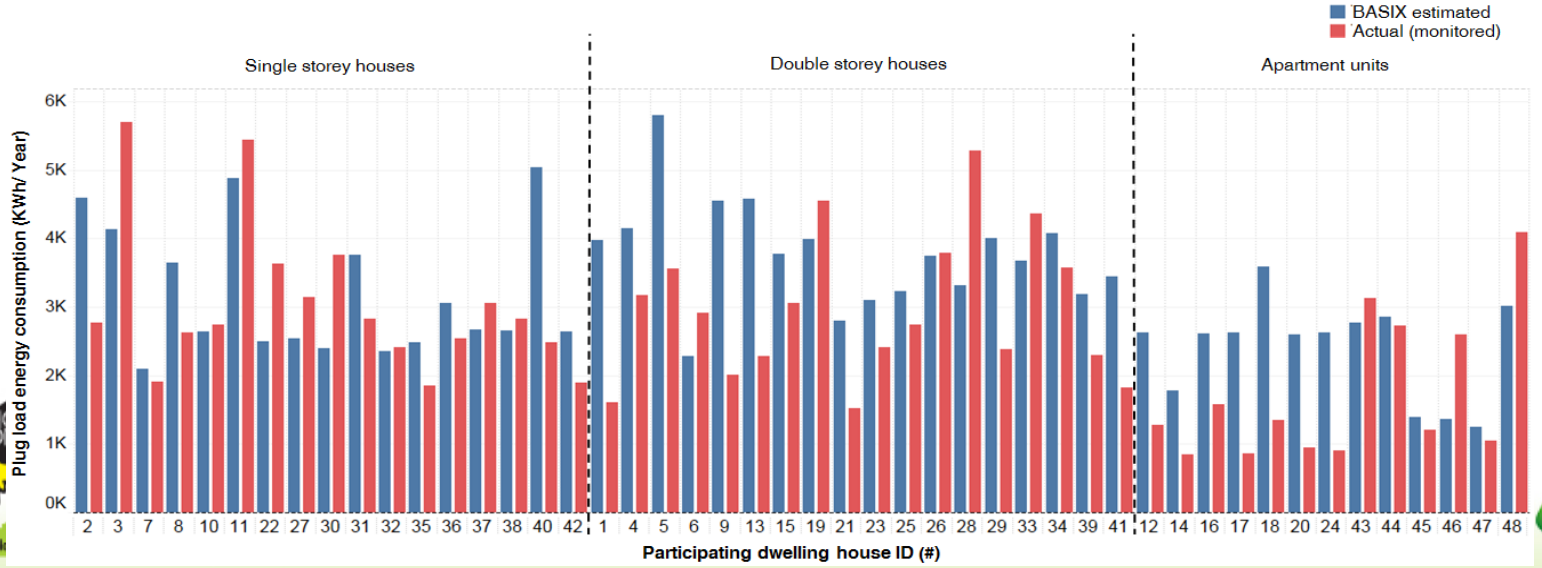
Comparison of **Heating** Energy Use between BASIX Estimation and Measured Performance



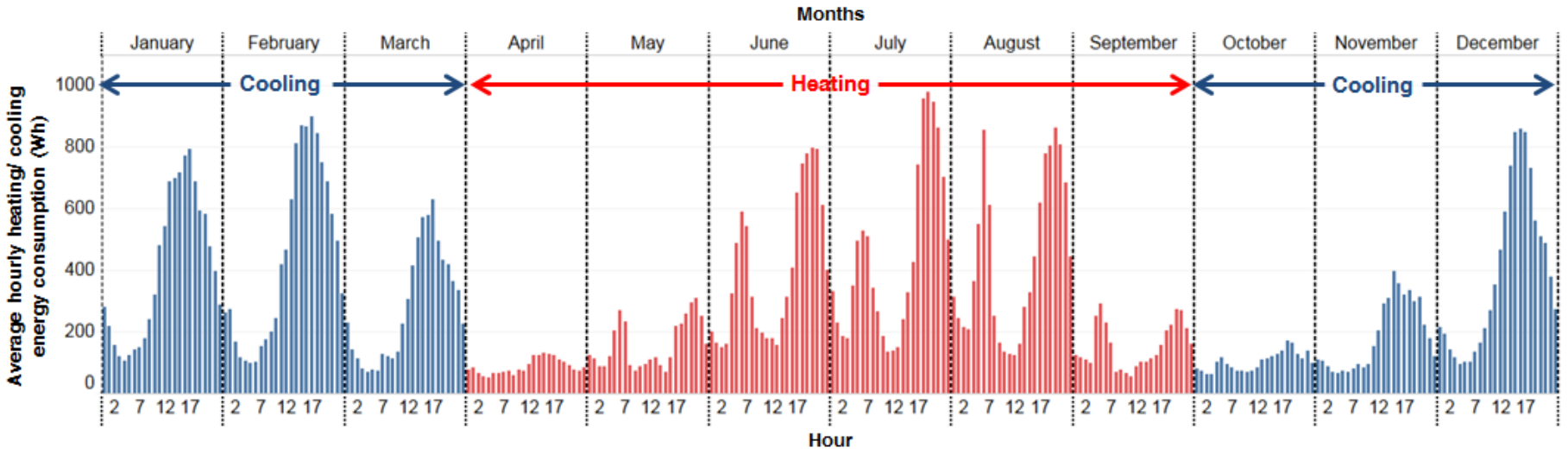
Comparison of **Lighting** (& fan) Energy Use between BASIX Estimation and Measured Performance



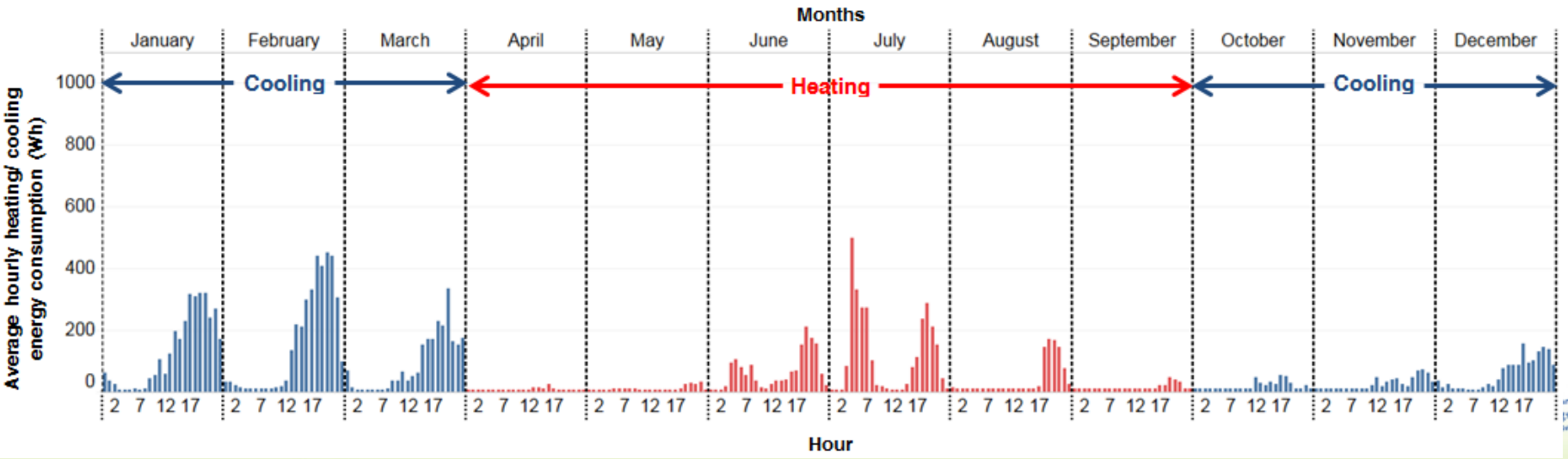
Comparison of **Plug-in Appliances** Energy Use between BASIX Estimation and Measured Performance



High Cooling and Heating Energy Use (Compared to BASIX Estimation)

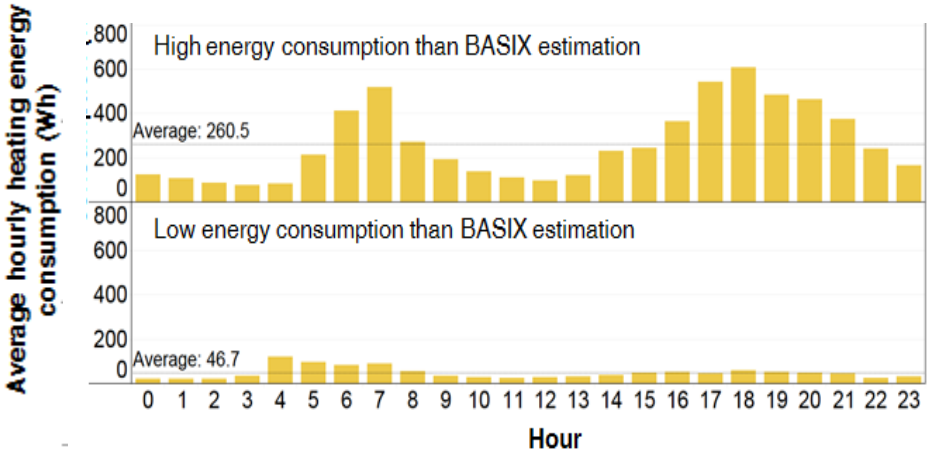


Low Cooling and Heating Energy Use (Compared to BASIX Estimation)

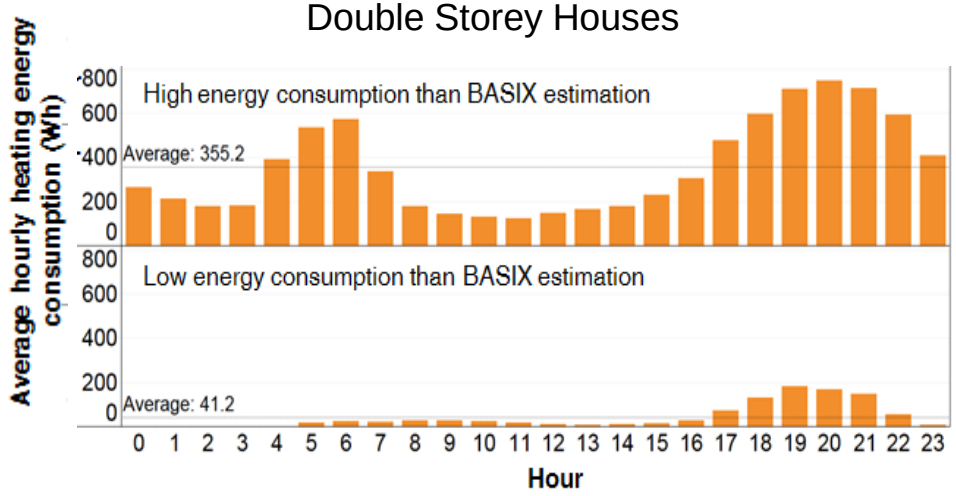


Heating Energy Use (Daily)

Single Storey Houses

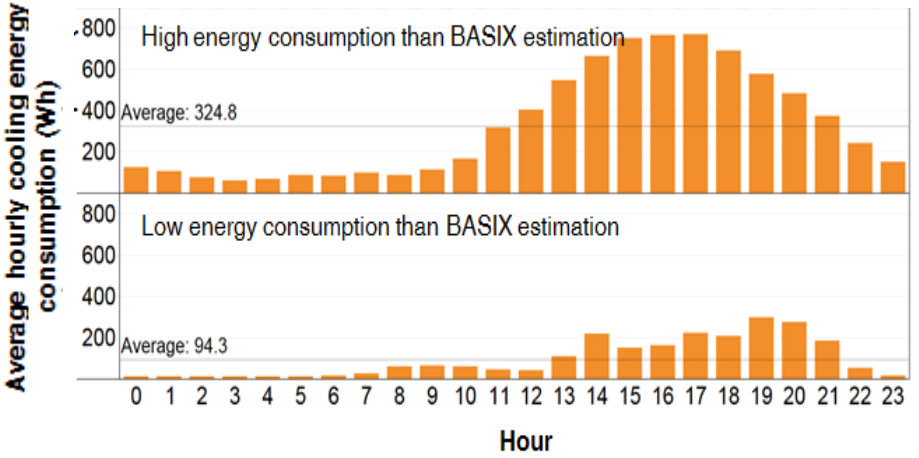


Double Storey Houses

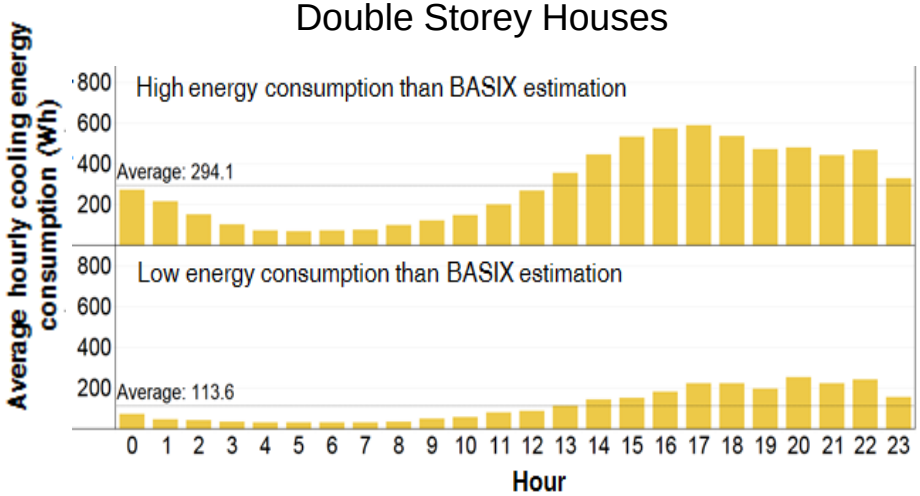


Cooling Energy Use (Daily)

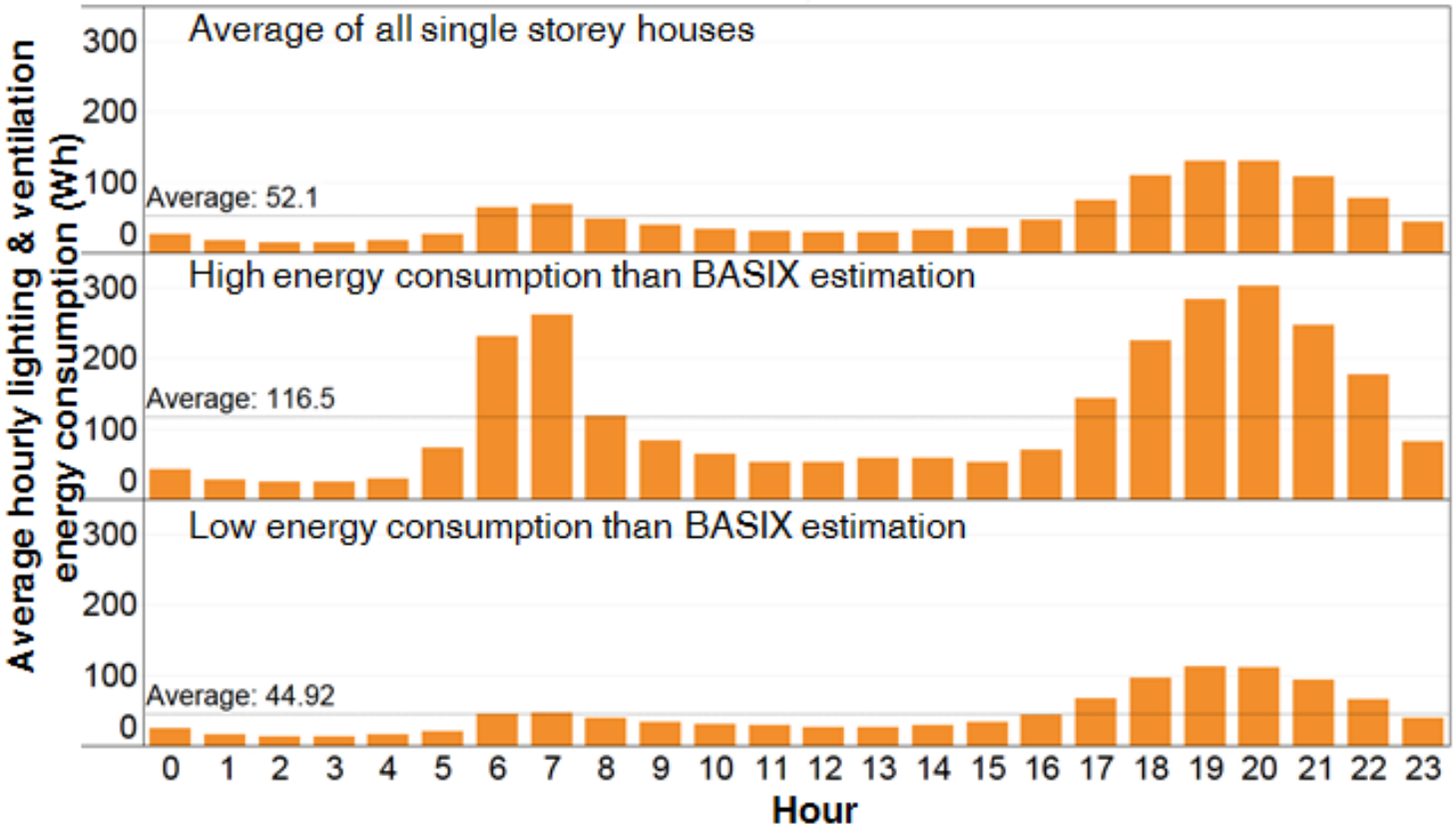
Single Storey Houses



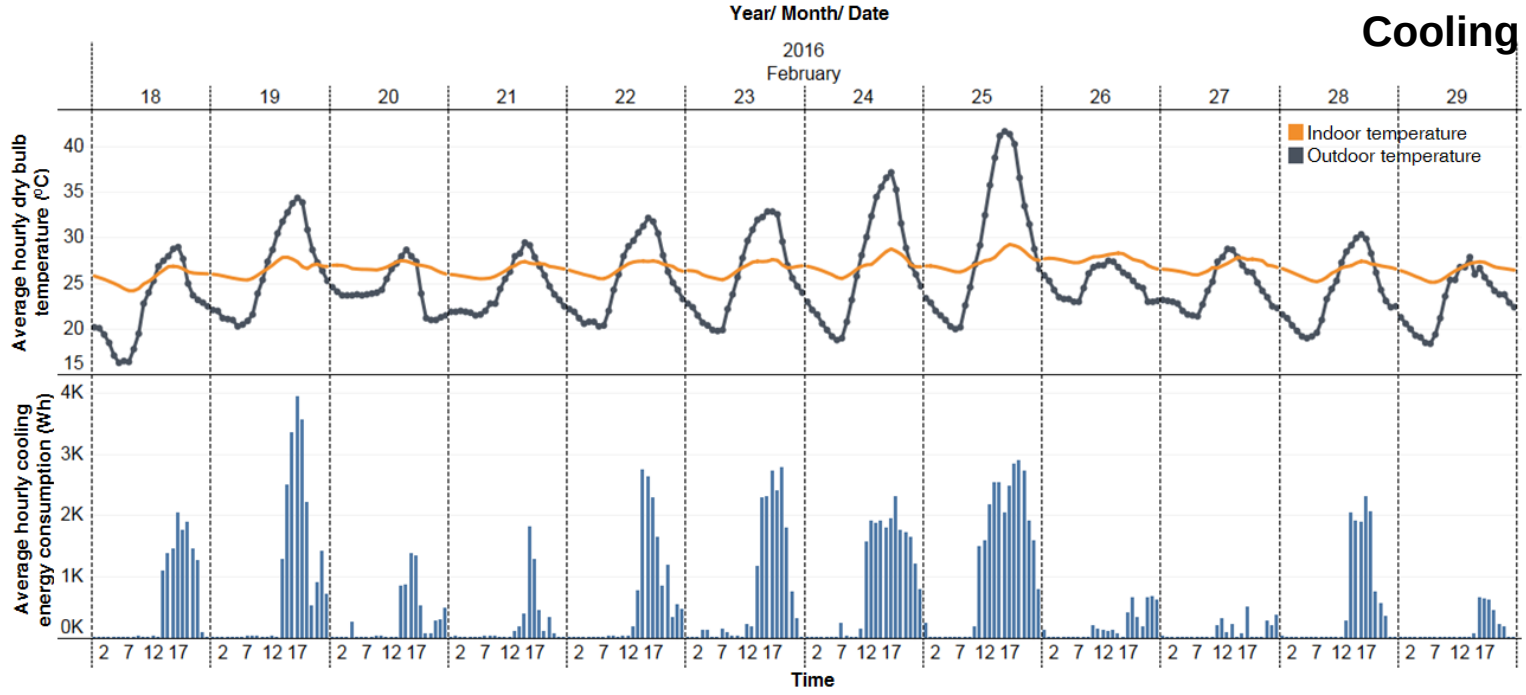
Double Storey Houses



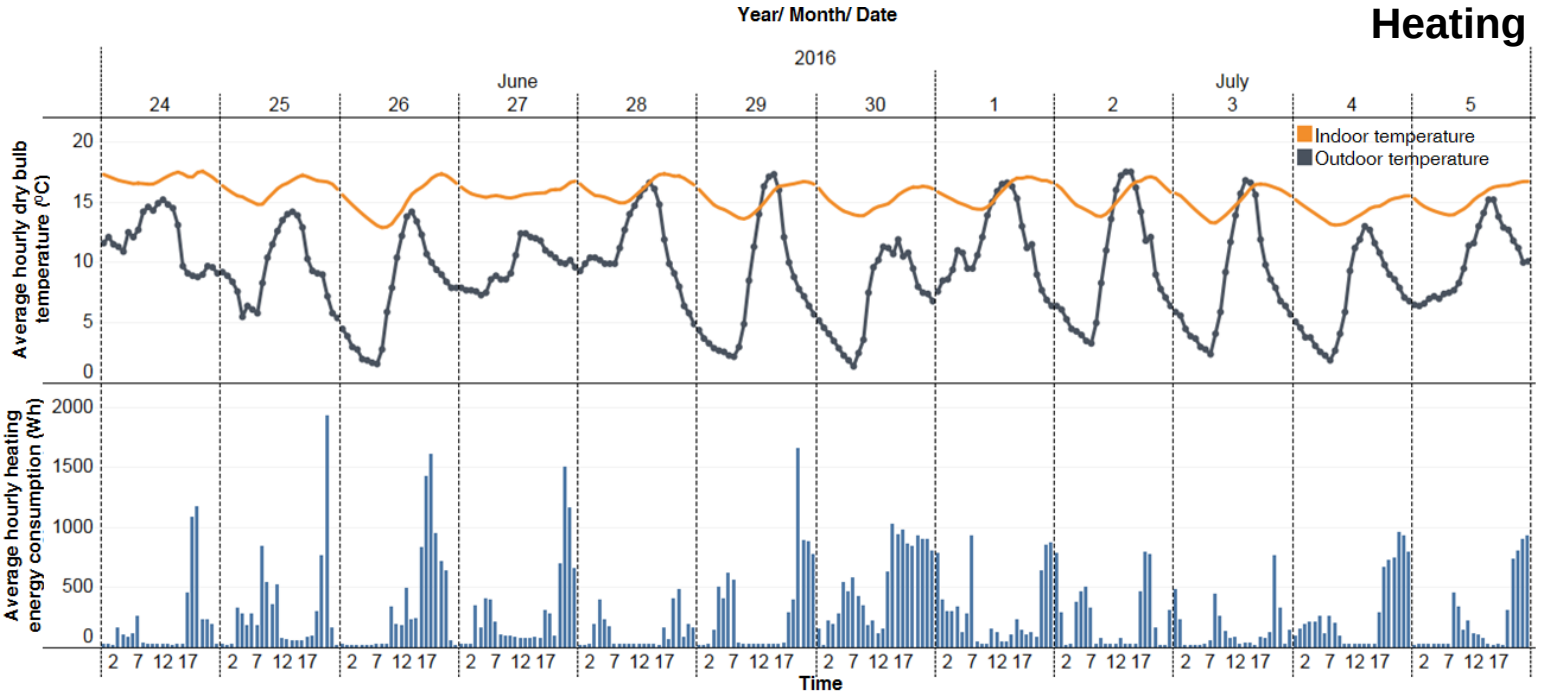
Lighting (& Fan) Energy Use (Daily)



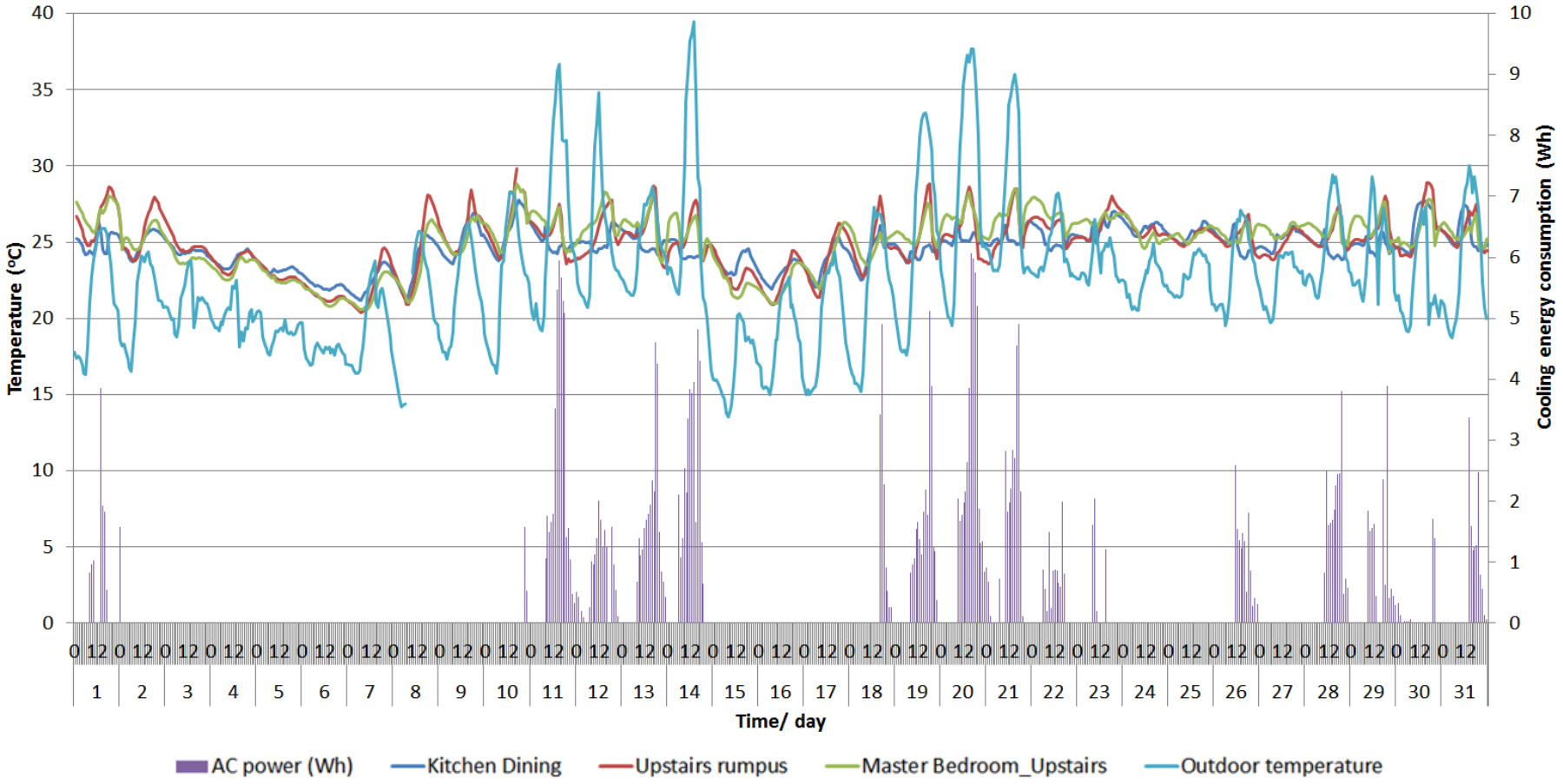
Cooling

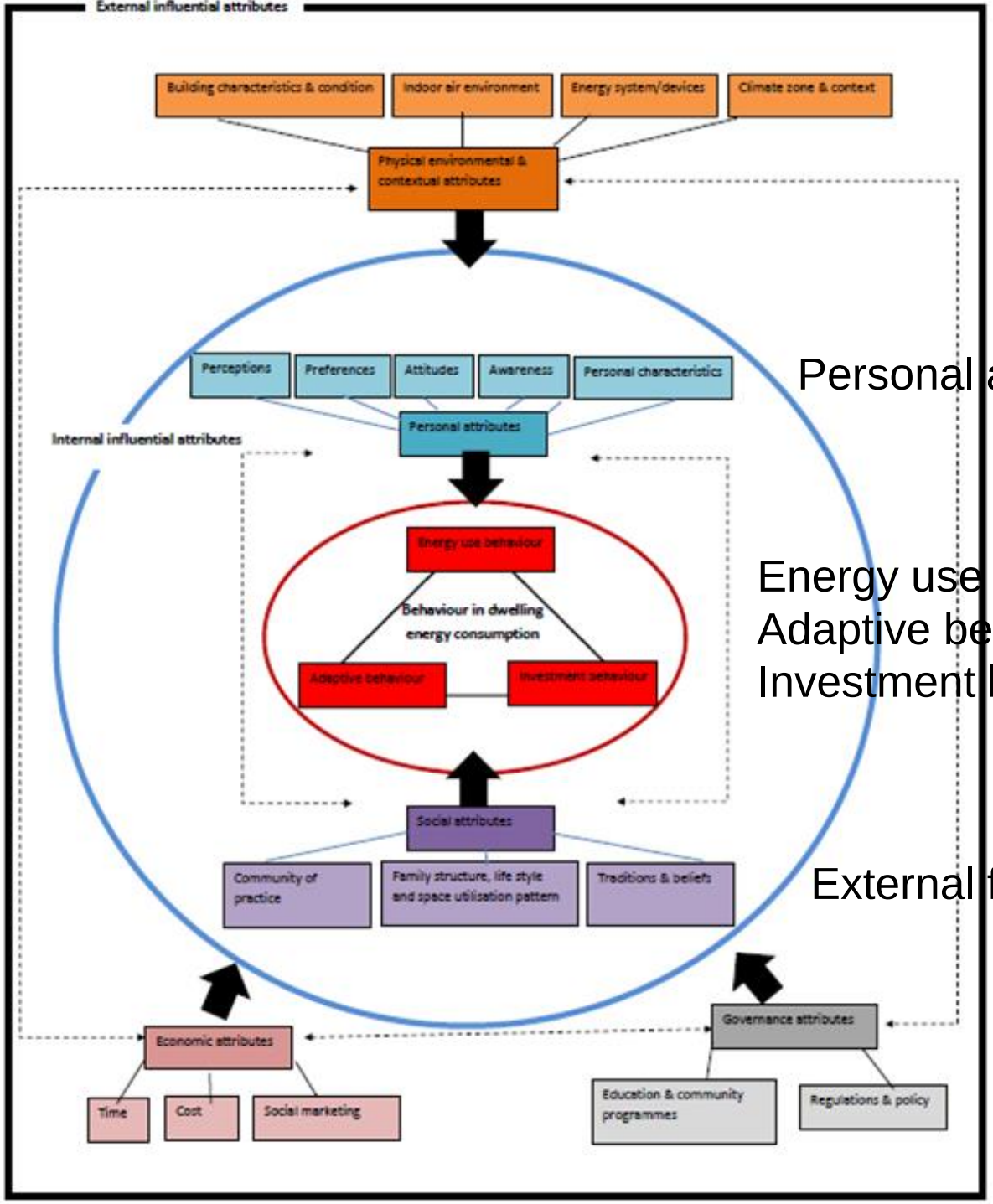


Heating



Outdoor/Indoor temperature and cooling energy usage (in January 2016) in a double storey house (#15)





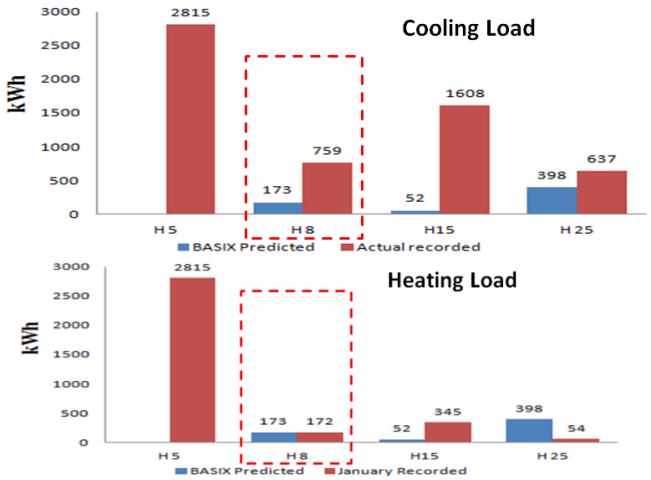
Personal attributes

Energy use behaviour
Adaptive behaviour
Investment behaviour

External factors

Case example: House ID #8

Dwelling ID	Number of occupants	Children	Elderly over 65	Home office	Single/double storied	Total floor area (m²)	Orientation	BASIX estimate kWh/yr.	Actual energy consumption kWh/yr.
8	4	2	0	yes	single	148	West facing Living: South	6603.83	7613



Energy use behaviour in space cooling

- Use air conditioner for cooling over 10 hours during weekends and 3-5 hours on weekday afternoons
- Turn on the air conditioner to cool air before it gets too hot
- Often use two operational zones of the air conditioner covering master bedroom and living/dining space for cooling

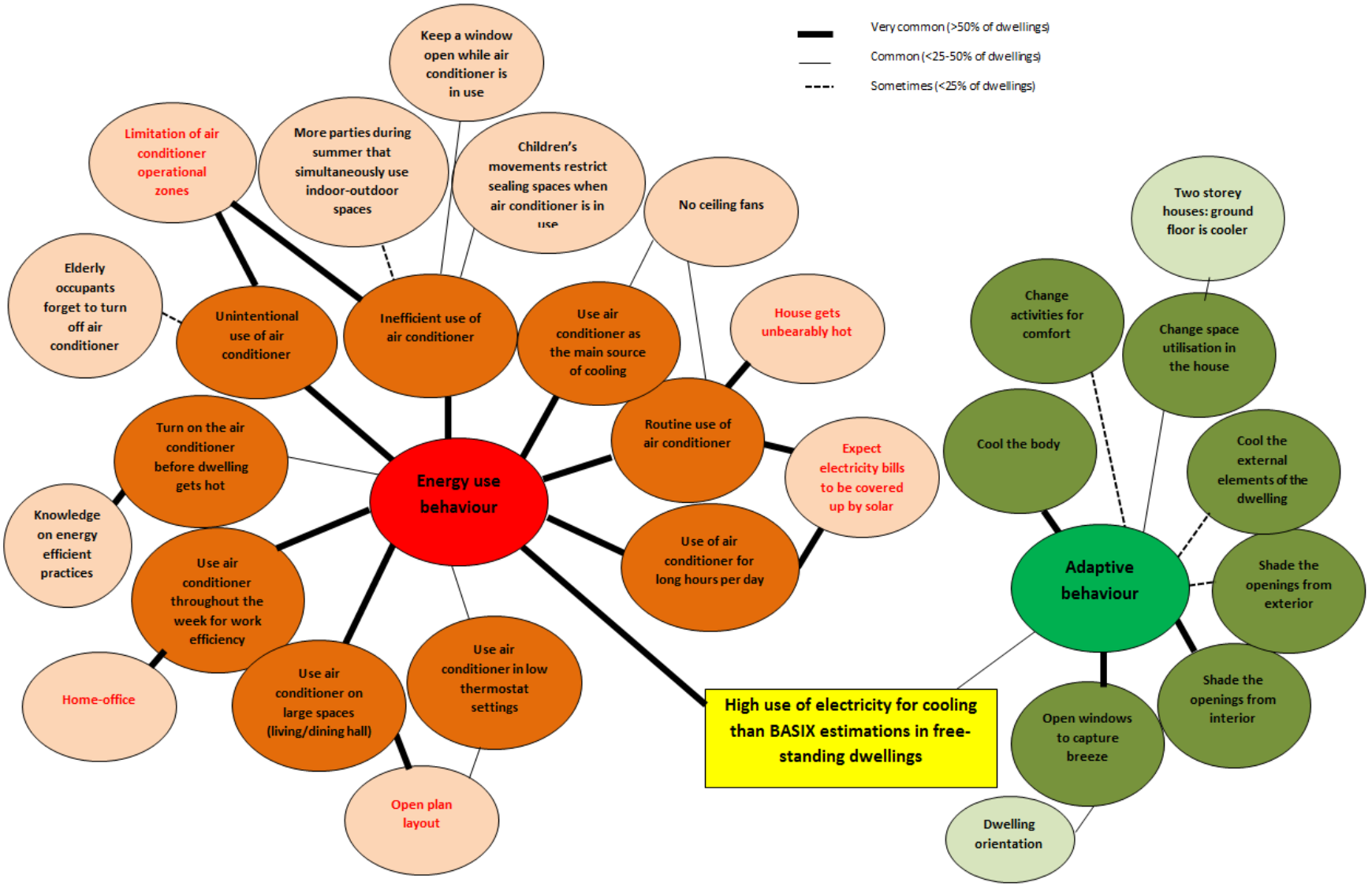
Adaptive behaviour in space cooling

- Close window blinds in the master bedroom facing west
- Use water sprinkler to cool alfresco area

Influential attributes

- Personal – Residents are heat sensitive and prefer cool environment
- Social- Due to the home office and young children age below five, house is occupied for at least 5 days per week
- Physical environmental- Master bedroom gets too warm due to the western orientation

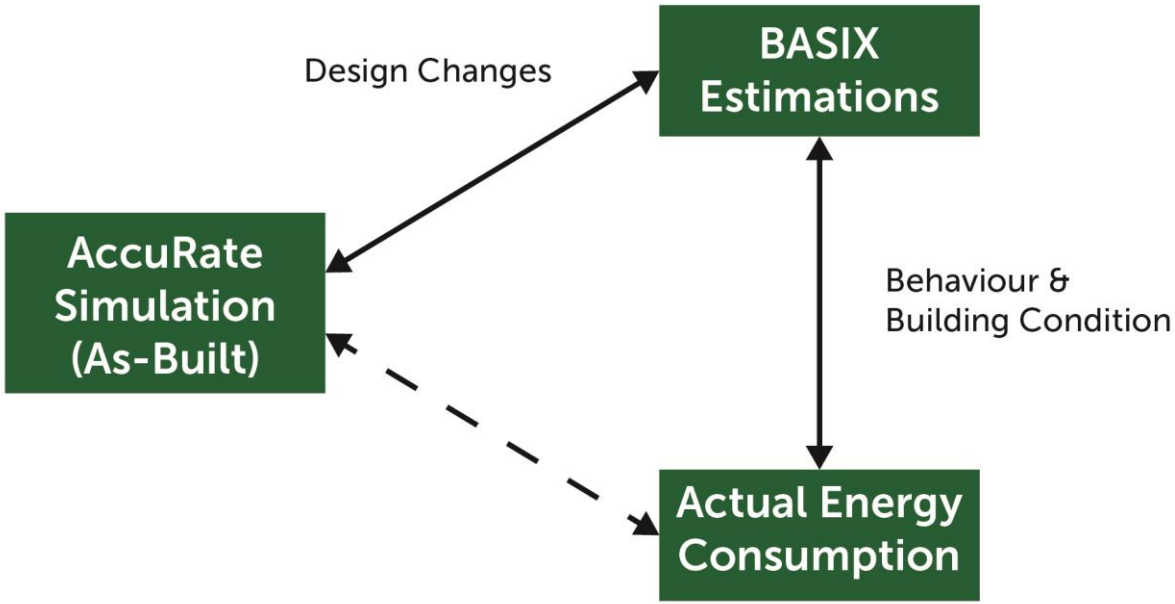
Findings on Occupant Behaviour
from Dwellings with High Cooling Energy Use (Compared with BASIX Estimations)



Findings on Changes of Dwelling #8 after Implementation

House ID #8

Emu Plains, 2750



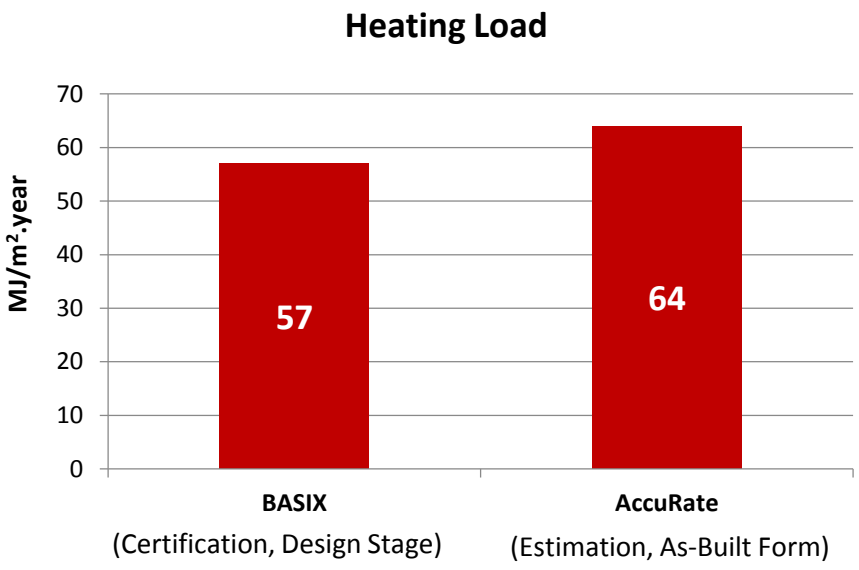
As-Built Design Changes from BASIX Estimations

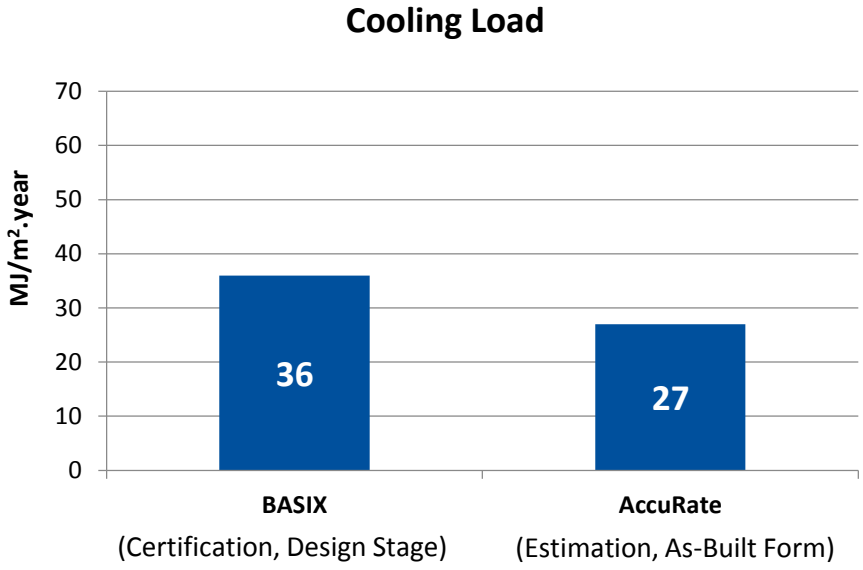
Sept 2010

July 2016

- Patio added to East side of the house early 2011 – BASIX Certificate in 2009.
- Heating and cooling systems added to the house – BASIX estimations did not include any heating or cooling systems.

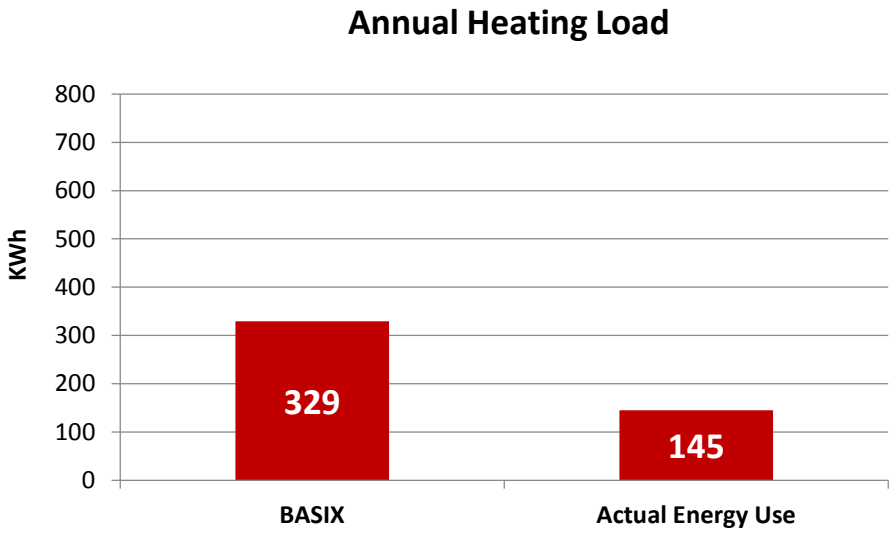
AccuRate As-Built Simulation

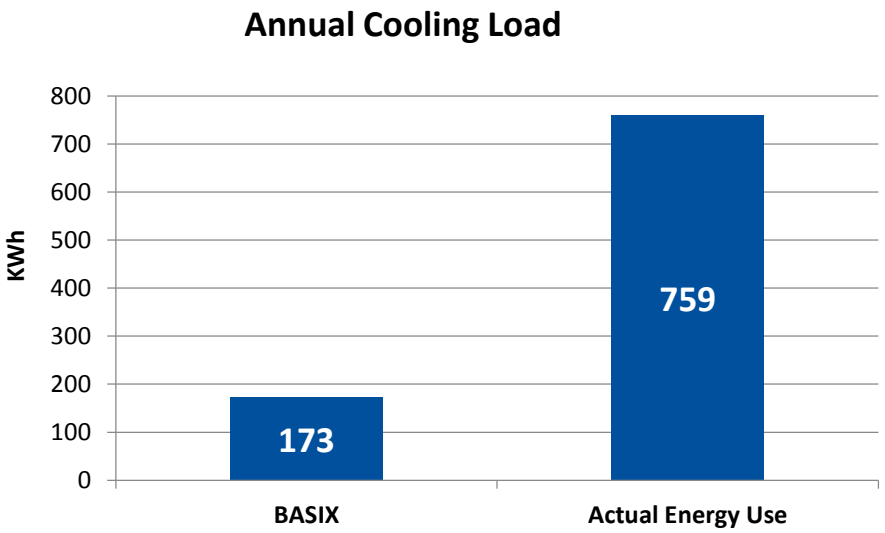




Discrepancies between BASIX and AccuRate data (as-built form) are a result of design changes made to the house after the BASIX Certification was completed.

Actual Building Energy Consumption

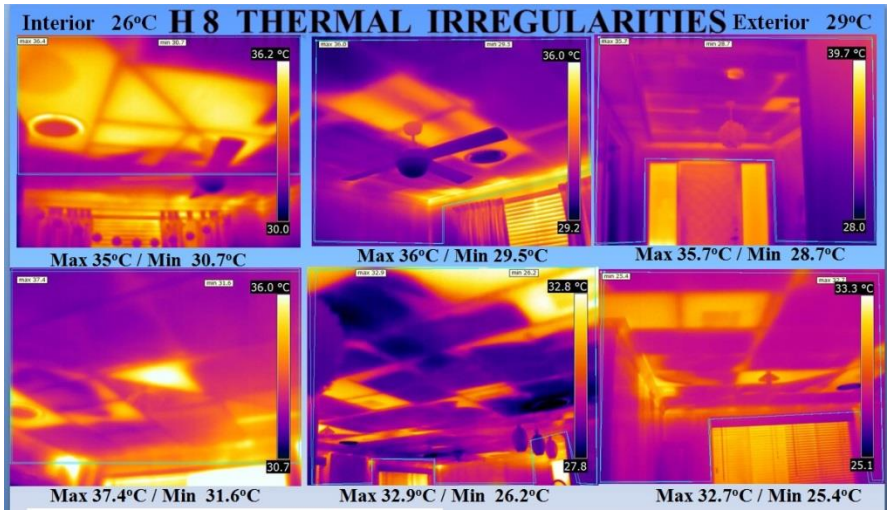




Discrepancies between BASIX and actual building energy use data are impacted by building condition and behavioural factors.

Factors Influencing Actual Building Energy Consumption

- Building condition:
  - Thermal irregularities due to insulation performance/installation.
  - Inflitration/Exfiltration – 8.76ACH @ 50Pa.



- Behaviour:
  - 4 people living in house - two adults and two small children (< 5yrs).
  - Home office and always someone at home to look after the children.
  - Occupants are heat sensitive and prefer cool environments.
  - Master bedroom gets too warm due to the western orientation.
  - Often use air conditioner for cooling over 10 hours during weekends and 3 - 5 hours on weekday afternoons.
  - Often use two operational zones covering master bedroom and living/dining space for cooling

Thank you

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Soo Kim, Australian Government Department of the Environment and Energy

Contact: Dr Lan Ding, Project Leader, Lan.Ding@unsw.edu.au