Keeping Warm and Healthy

Household Energy End-use Project (HEEP)

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Overview

- **Introduction**
  - Why look at temperatures?
- **Winter temperatures**
  - Too cold?
  - How do we heat?
  - Can we be warmer?
- **Summer temperatures**
  - Too hot?
  - Drivers of temperatures
  - Designing for the future
- **Conclusions**

Introduction

- **2 temperatures monitored in the living room**
- **1 in the bedroom**
- **External temperatures**
- **10 minute time interval**
- **11-12 months of the year**
- **Heating fuels monitored**
  - LPG, solid fuel, electric fixed systems, reticulated gas
  - 1/4 of houses at end-use level (including portable electric)

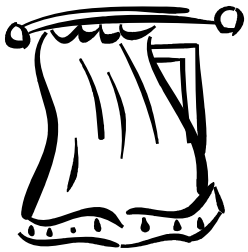
BRANZ logger

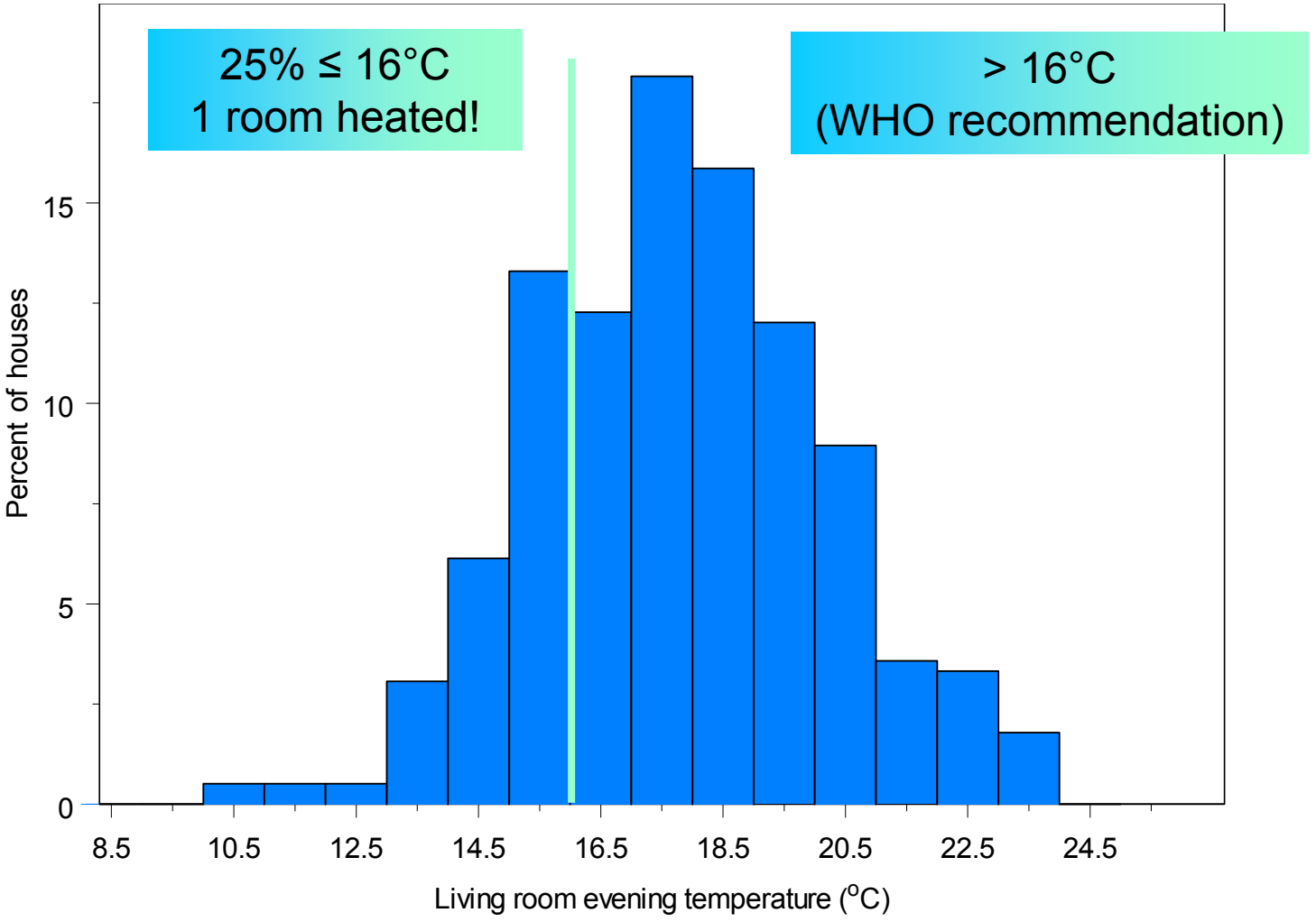
External temperature logger

Why look at temperatures?

- **Health**
- **Comfort**
- **Durability of the building**
- **Understand drivers of**
  - Cooling
  - Heating
- **Understand heating energy use**

Winter temperatures





Winter = June to August; 5 pm to 11 pm

Are New Zealand houses too cold?

- **Yes in winter**
  - Mean temperatures
    - Living room evening 17.9 °C
    - Bedroom night 13.6 °C
- **20 °C to 25 °C comfortable (international)**
- **18 °C to 24 °C optimum (WHO)**

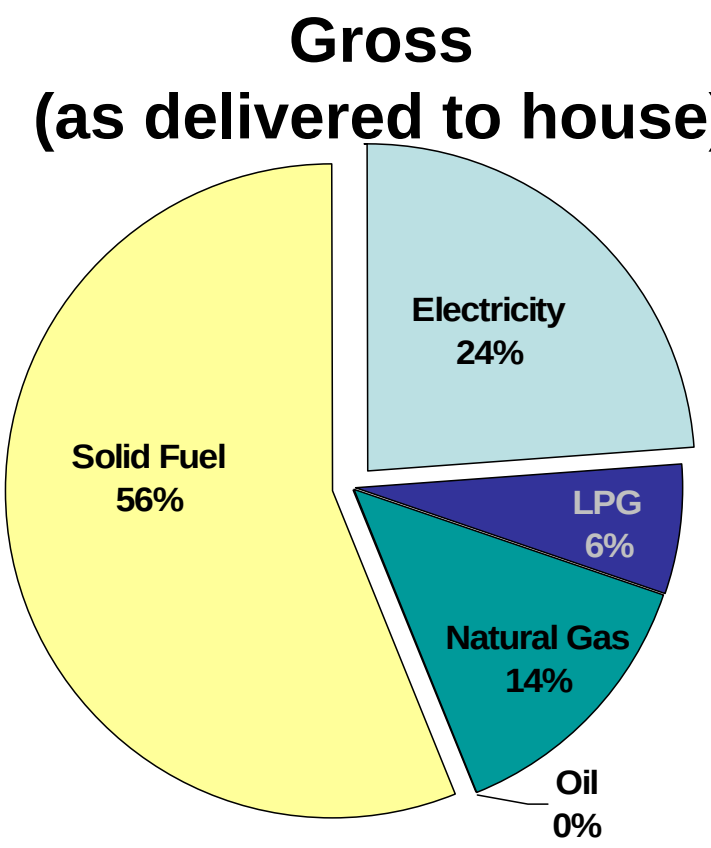
How do we heat?

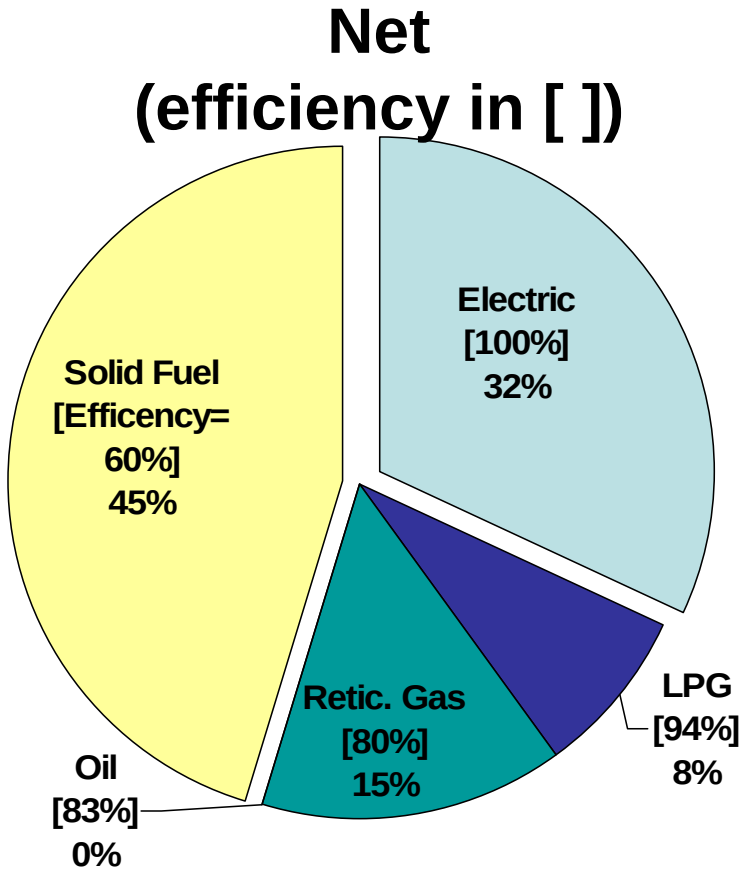
- **On Average**
  - 1 room
  - Evening heating
  - 5.5 to 8.5 months of the year
  - 1.7 fuel types

Main heater fuel used?

Main Heater Fuel used	Sample count	Percent of Sample
Solid Fuel	153	44%
Electric	105 (4 Heat pumps)	30%
LPG	54	15%
Reticulated Gas	36	10%
Oil	2	1%
Total	**350**	**100%**

Space heating energy





Most heating is done by the direct use of fuels

Fuel shift since HEEP completed monitoring

Heat pump uptake

- **Nearly 50% of new houses have heat pumps**
  - Up from 25% two years ago
- **Encouraged through councils, clean heating projects and marketing**

Replacing solid fuel with heat pumps

- **Replacing a direct use of fuel**
- **6% increase in electricity**
- **~60% increase in peak loads**
- **Currently heating in some areas is 80% solid fuel**
  - Generation, transmission and distribution issues

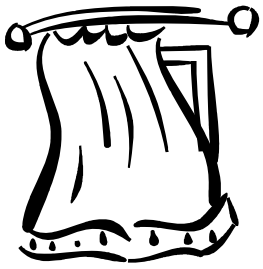
How can we be warmer?

- **Heat more**
  - Increase in cost
  - Financial issues
- **Use a more powerful heater**
  - Increase in cost dependant on heater efficiency
  - Not always an option - tenants, finance
- **Reduce heat losses from the house**
  - Not always an option - tenants, finance

Heater power

Coolest

Warmest



Main heater type	Temp (°C) ± 1 SD	Sample Count
Open fire (wood or coal)	**16.0 ± 0.5**	**12**
Portable Electric	**16.9 ± 0.3**	**83**
Portable LPG	**17.1 ± 0.2**	**54**
Fixed electric	**17.8 ± 0.3**	**19**
Gas	**18.0 ± 0.5**	**26**
Heat pump (elect)	**18.0 ± 0.4**	**4**
Central gas	**18.3 ± 0.7**	**7**
Enclosed solid fuel (wood)	**18.9 ± 0.2**	**138**

Winter = June to August; 5 pm to 11 pm

Resistance heaters to heat pumps

- **30% of HEEP houses have a main heater that is electric (16.9 °C)**
  - 1% use heat pumps as main heater

Replacing resistance heaters with heat pump

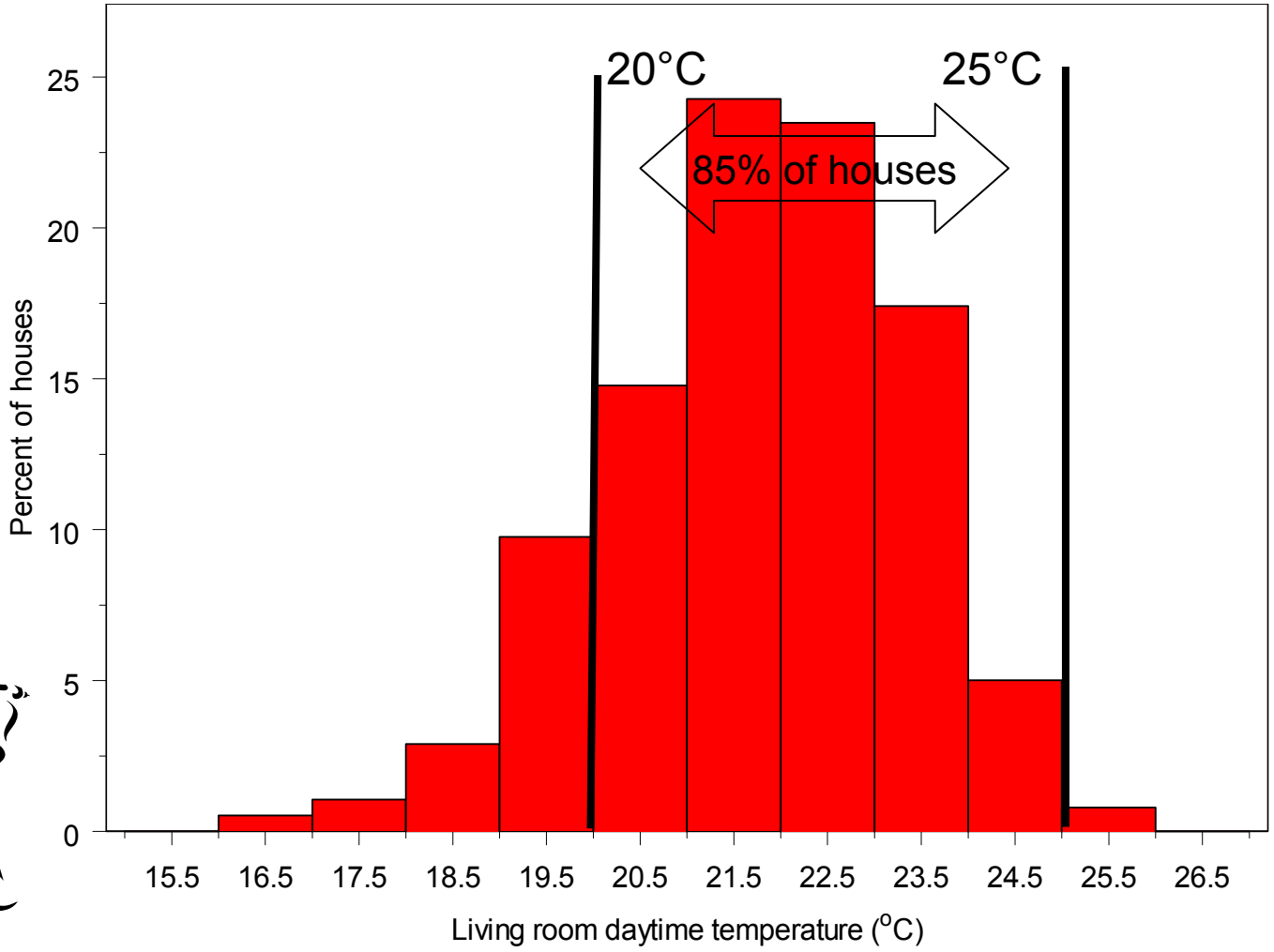
- **Heat pumps are more efficient**
  - The houses are able to heat to solid fuel temperatures (18.9 °C) without using more electricity IF
    - The heating schedule is the same
    - The rooms heated are the same

Pre and Post 1978 Houses

Insulation	Overnight Bedroom	Evening Living Room	Heating Energy (net) (kWh/year)
No requirement (Pre-1978)	13.2°C ± 0.1	17.6°C ± 0.1	3,180
Mandatory (Post-1978)	14.5°C ± 0.2	18.6°C ± 0.2	2,410

- **Post 1978 houses have larger floor areas and warmer temperatures**

Summer Temperatures



Summer daytime = December to February, 9 am to 5 pm

Too hot?

- **Nearly 80% of houses spend more than ½ of the daytime between 20°C and 25°C**

- **20% spend more than 2 hours above 25°C**
- **1% spend over ½ of the day above 25°C**

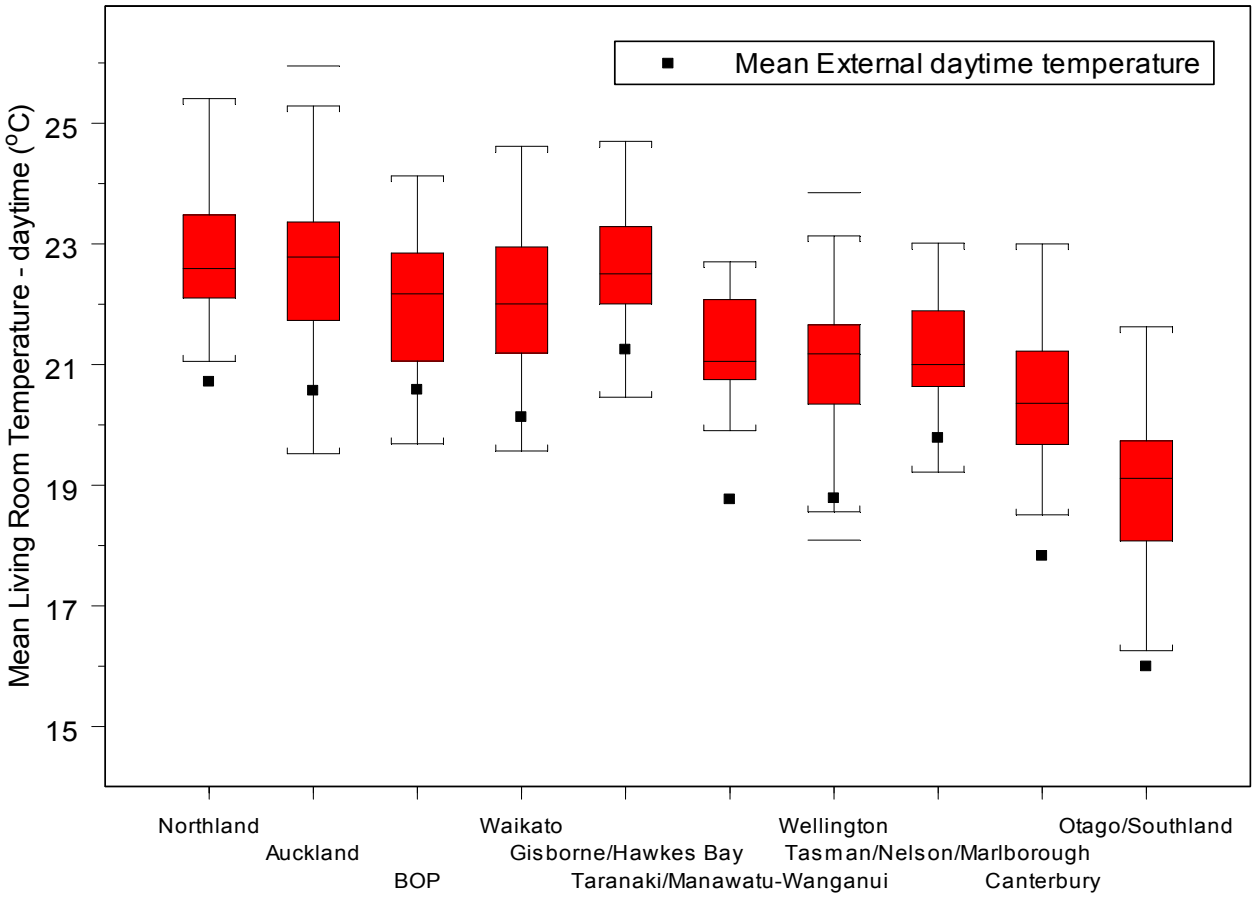
- **Average maximum temperature reached at 5.40pm** (regional range 5pm-6.40pm)

- **3% HEEP houses heat all year**
- **4% HEEP houses have heat pumps (reverse cycle a/c)**

Drivers of temperatures

- **Climate**
  - Houses are passive
  - 4% have the ability to cool
- **House age**
  - Heat losses
  - Heat gains

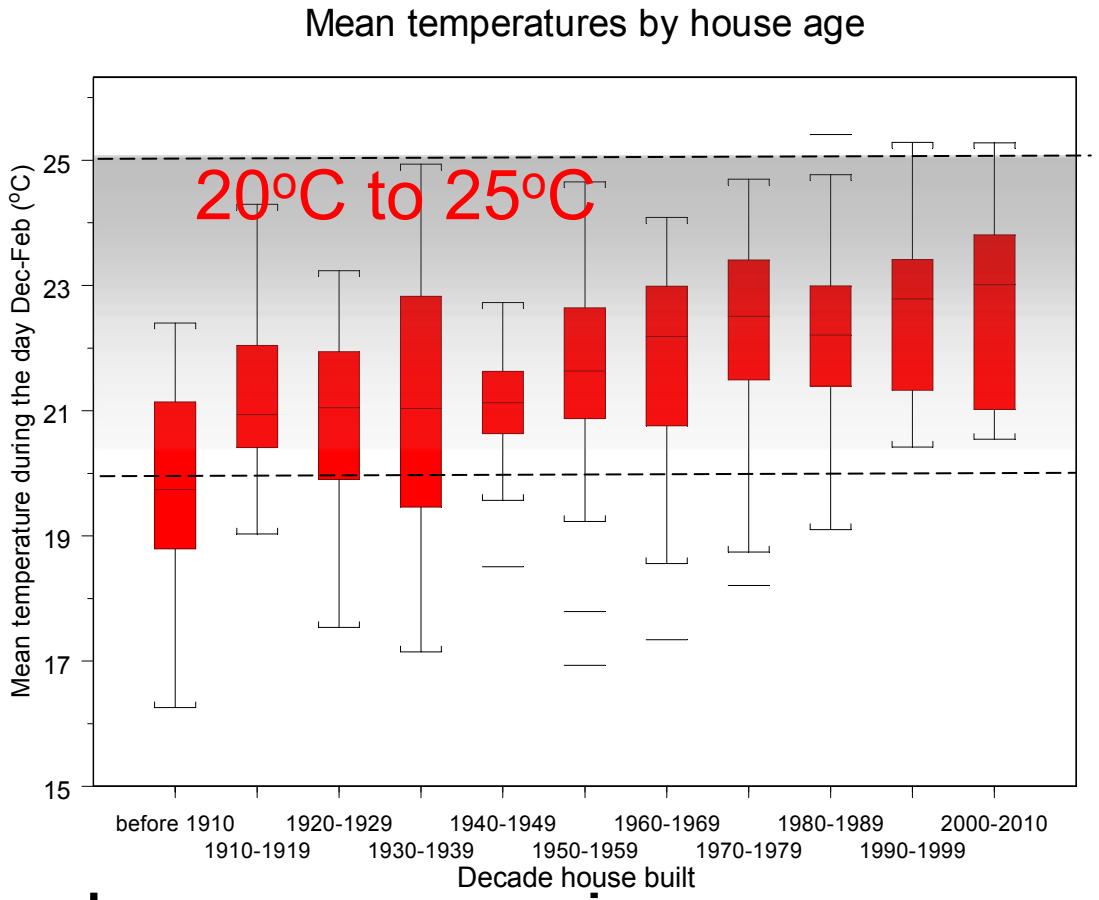
Climate



A 2-3°C external temperature rise will make many houses uncomfortable

December, January & February – 9am to 5pm

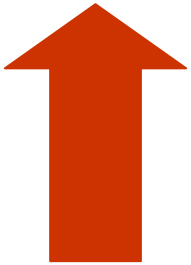
House age



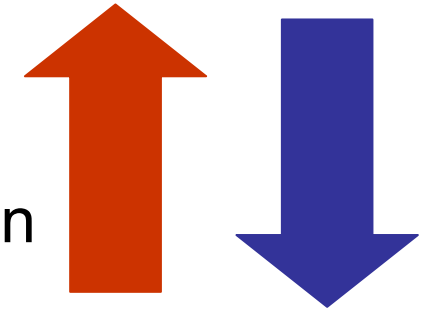
- **Newer houses are warmer in summer**
- **0.25°C increase per decade of construction (Linear models)**
- **Climate and age explain 69% of the variance in temperature**

Causes of temperature change

- **HEEP**
  - Insulation
  - Airtightness
  - Eaves



- **Modelling**
  - Larger windows
  - Reducing ventilation
  - Removing eaves
  - Increasing insulation

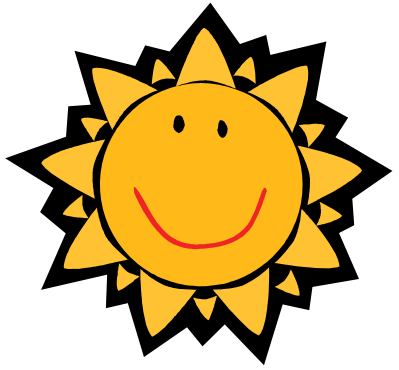


- Smaller windows
- Increasing usable mass

Good design required

To prevent reliance on air conditioning in Summer

- **Suitable amount of windows**
- **Opening windows on both sides of the house**
  - Practical
  - Security
  - Noise (a/c also noisy)
- **Shading**
- **Mass**



Winter conclusions

- **About half of NZ heating energy is solid fuel**
- **Heat Pump may have electricity load issues**
  - Increase in peak loads when replacing solid fuel
- **25% of NZ houses are below 16ºC**
- **Be warmer - heat more, bigger heater & insulate**
  - NZ houses are spot heated
  - Solid fuel burners warmest
  - Post 1978 houses are 1 °C warmer than pre 1978
    - Similar energy use

Summer Conclusions

- **Most houses are considered comfortable**
- **Drivers of temperatures**
  - New houses are warmer (0.25^{o}C per decade)
  - Climate (climate change)
- **Good design could prevent reliance on air conditioning for comfort**