

Household power profiles: Insights from demand data

Kiti Suomalainen

Michael Jack

David Evers

Kā Rakahau o Te Ao Tūroa

Centre for Sustainability



Agriculture • Food • Energy • Environment



Outline

GREEN Grid project

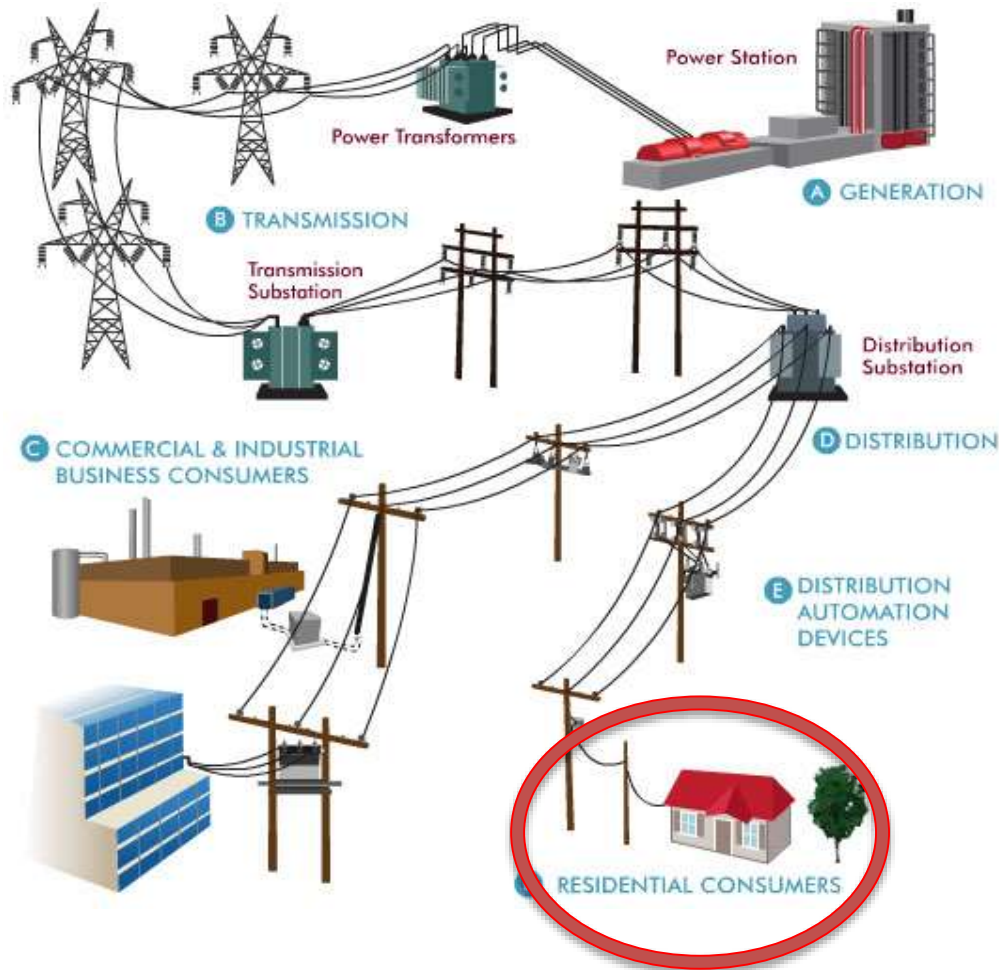
Electricity demand

Household electricity data

Some insights

Future research

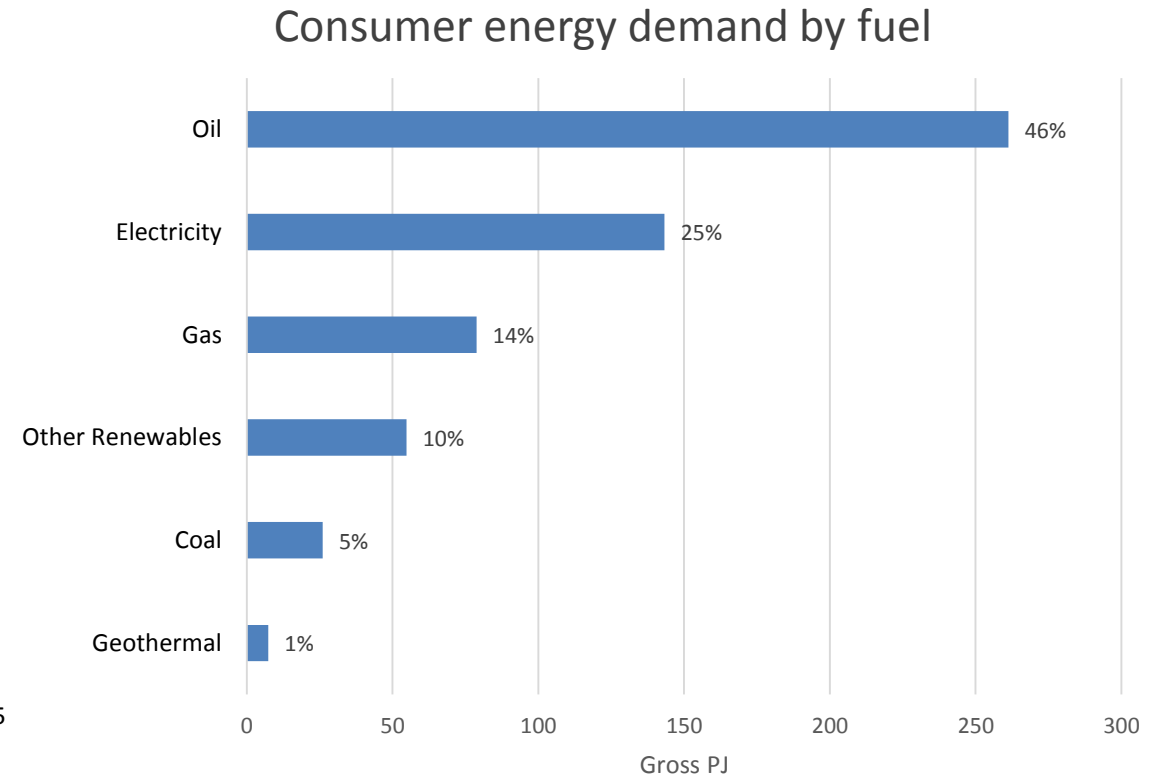
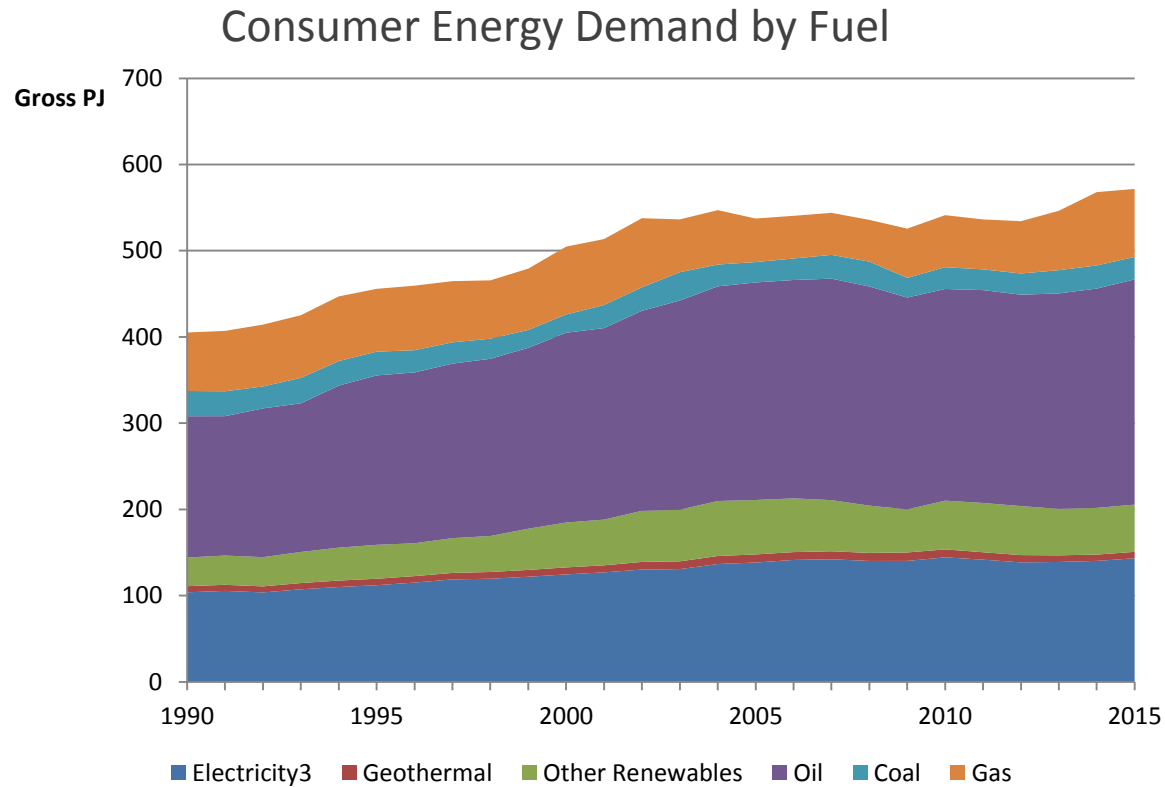
GREEN Grid project: 2012-2018



“Exploring the future of New Zealand’s electricity grid under conditions of higher levels of renewable and distributed generation, and changing demand profiles”

University of Canterbury: EPECentre
University of Auckland: Power Systems Group
University of Otago: Centre for Sustainability
-> Residential demand side management

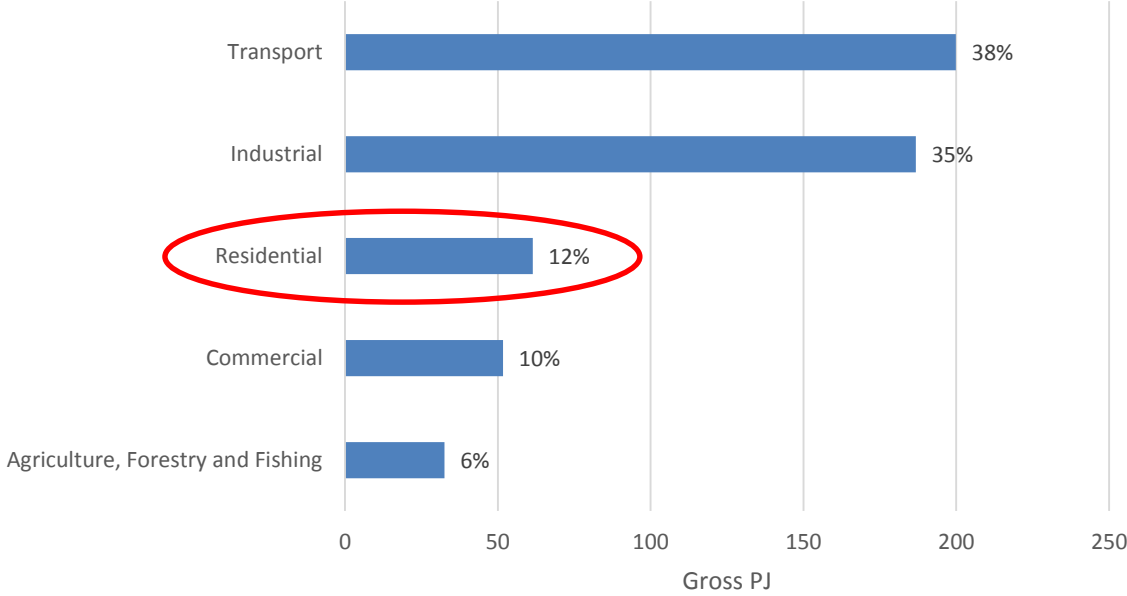
Energy in New Zealand, 2015



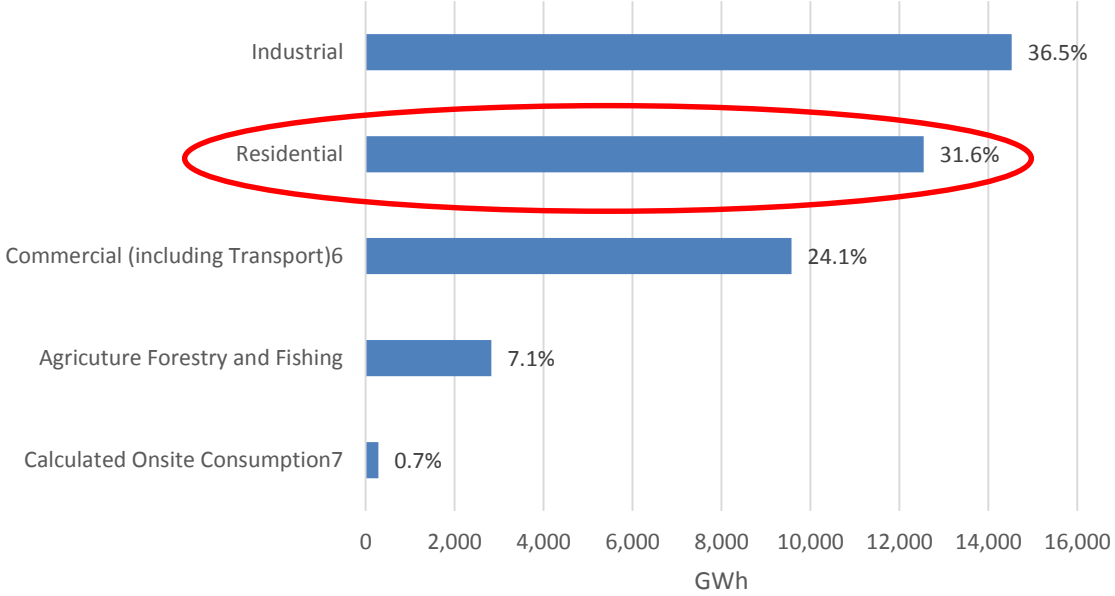
Source: MBIE, 2016

Energy demand by sector

Consumer energy demand by sector



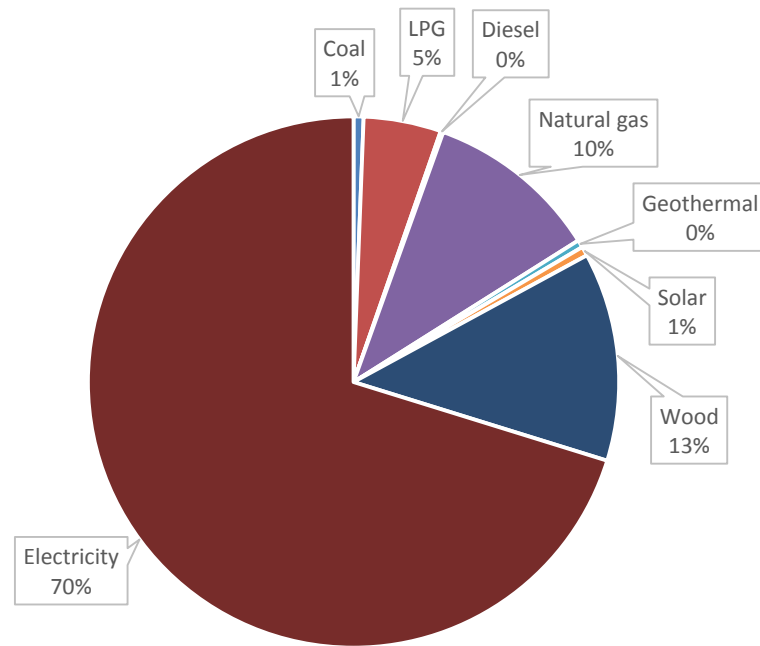
Electricity consumption by sector



Source: MBIE, 2016

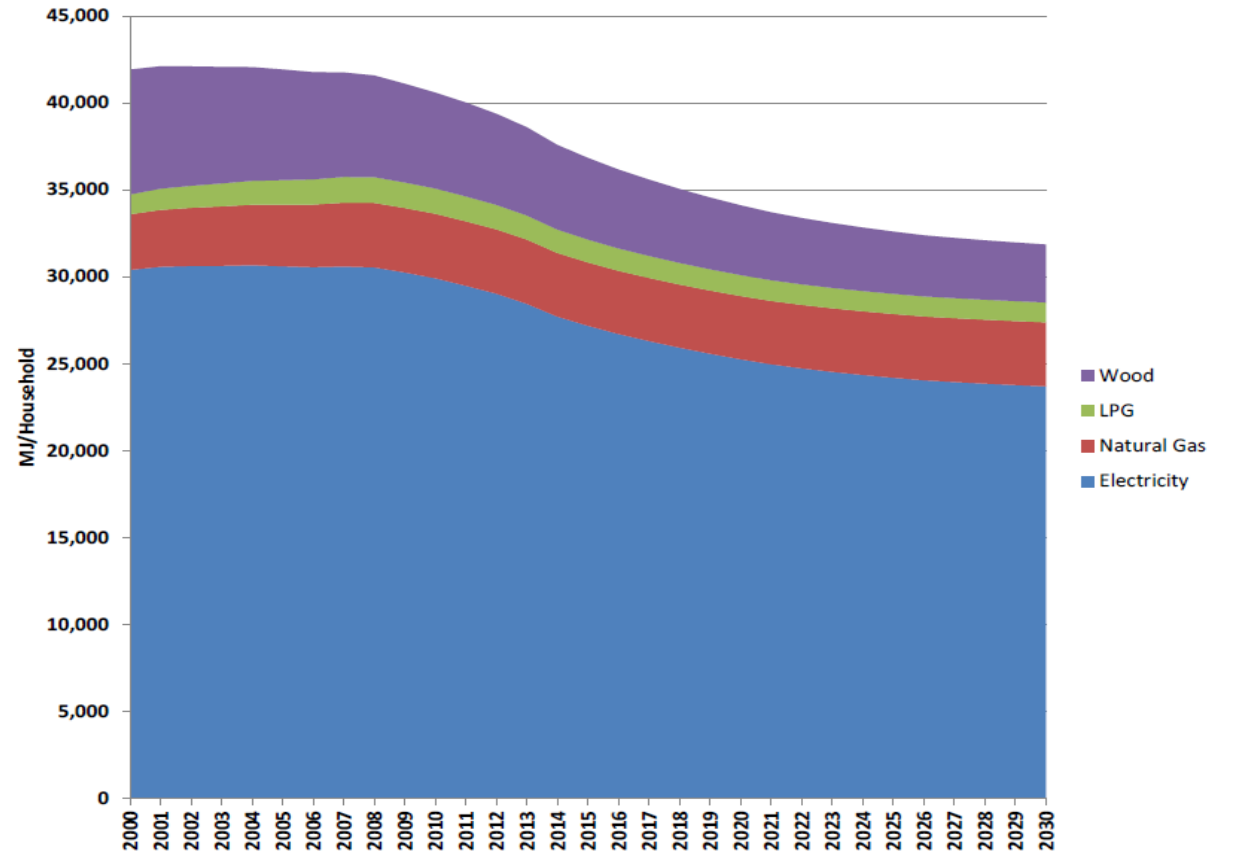
Energy in the residential sector

Residential consumer energy demand by fuel



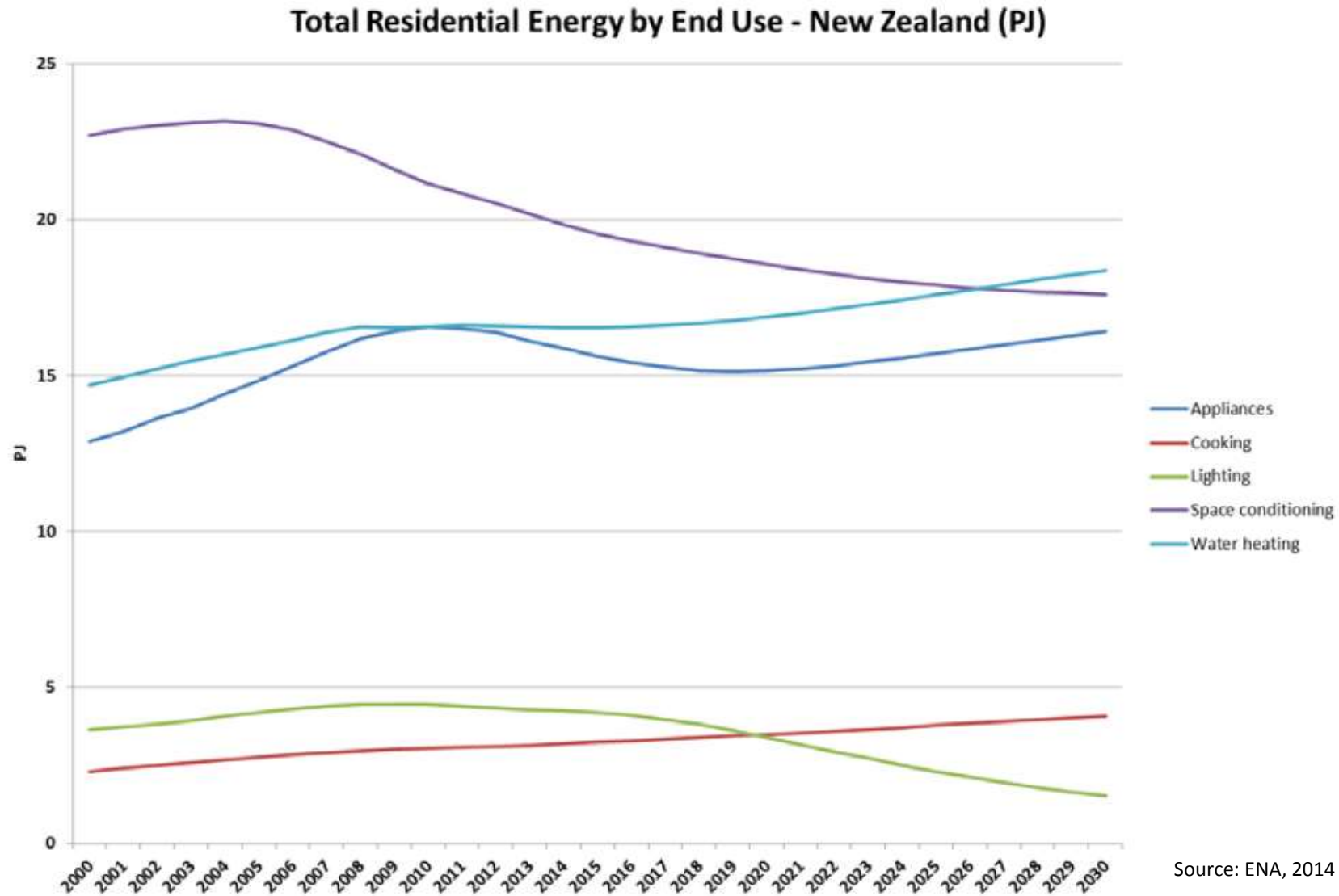
Source: MBIE, 2016

Total Energy per Dwelling by Fuel - New Zealand (MJ)



Source: ENA, Trends in Residential Electricity Consumption, 2014

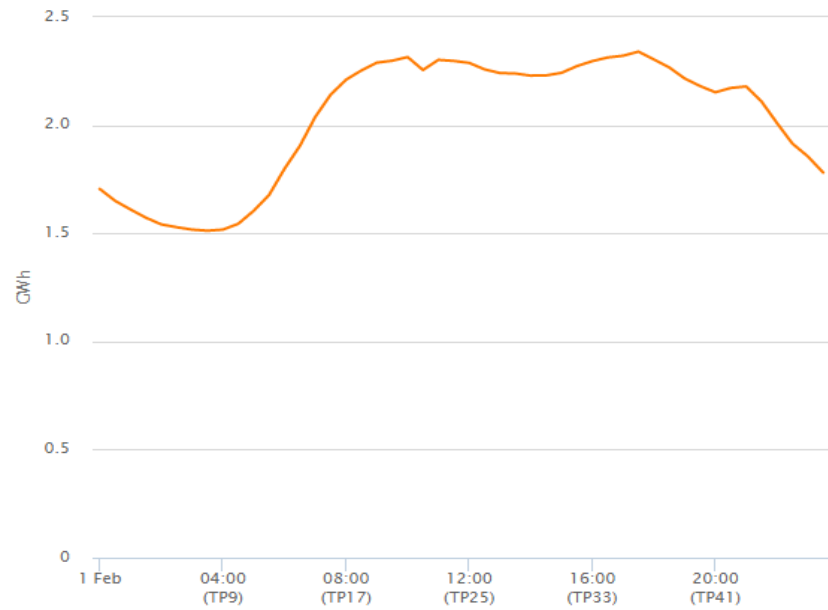
Energy trends in the residential sector



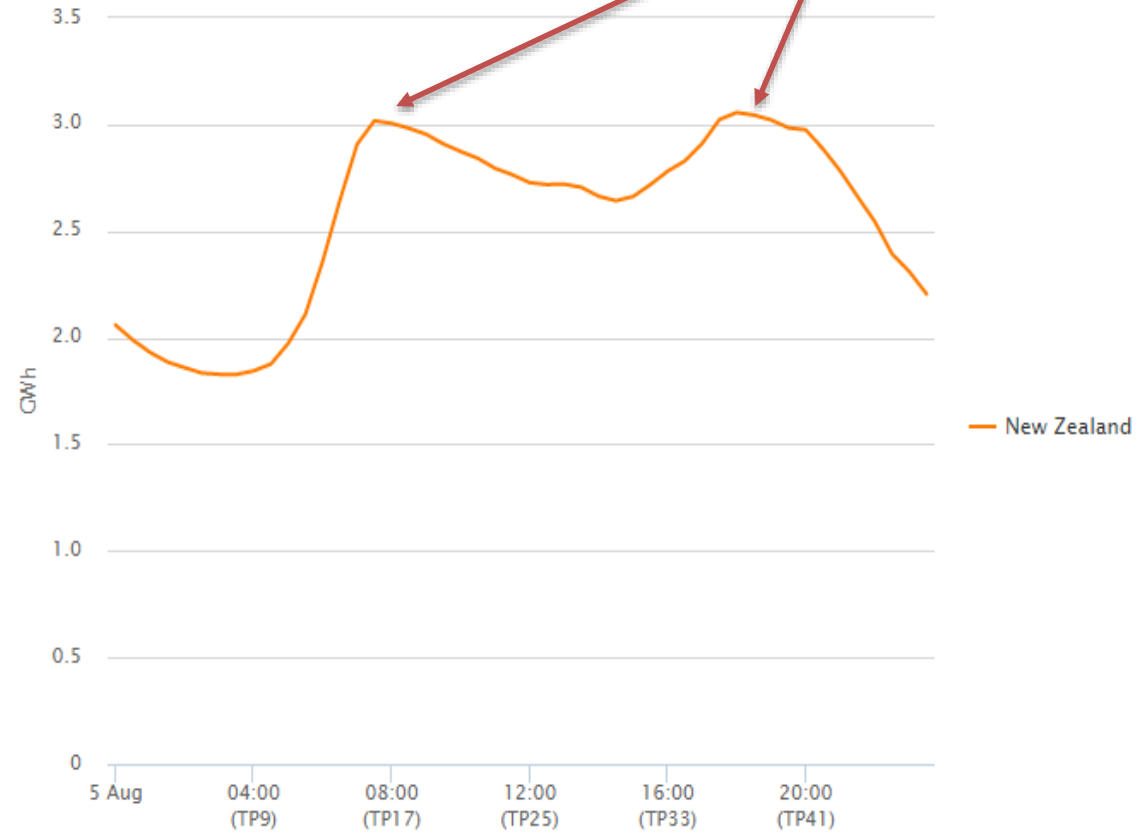
Source: ENA, 2014

Variable demand

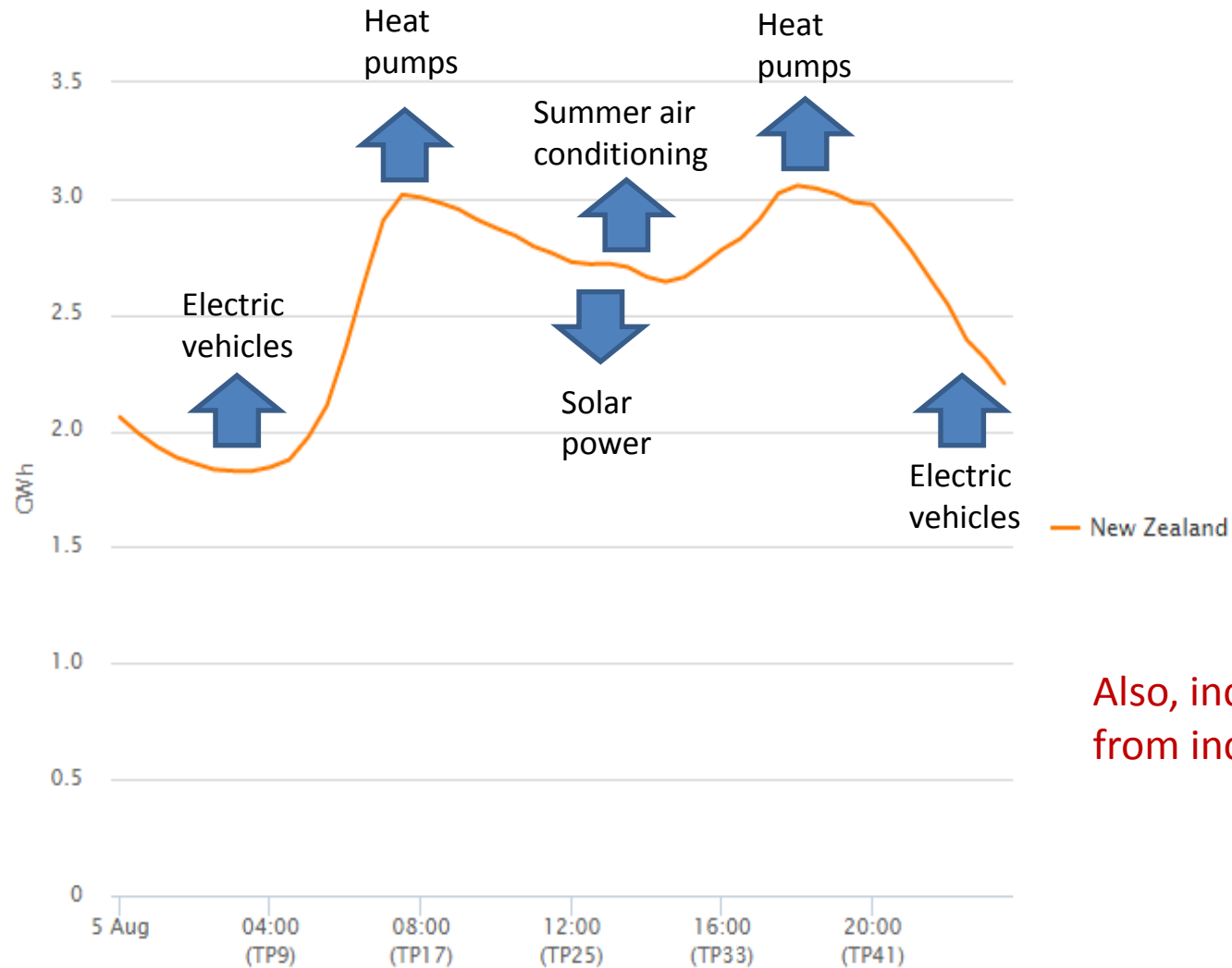
2 February 2016



5 August 2016



Increasingly variable demand



Also, increasing variability in supply from increased wind & solar

Research questions

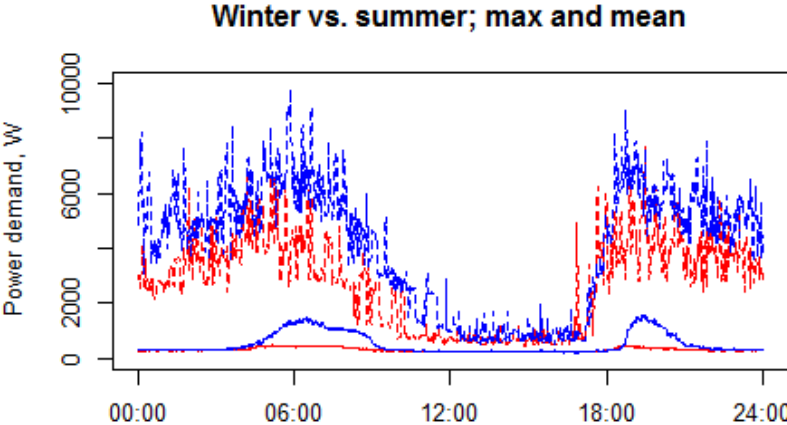
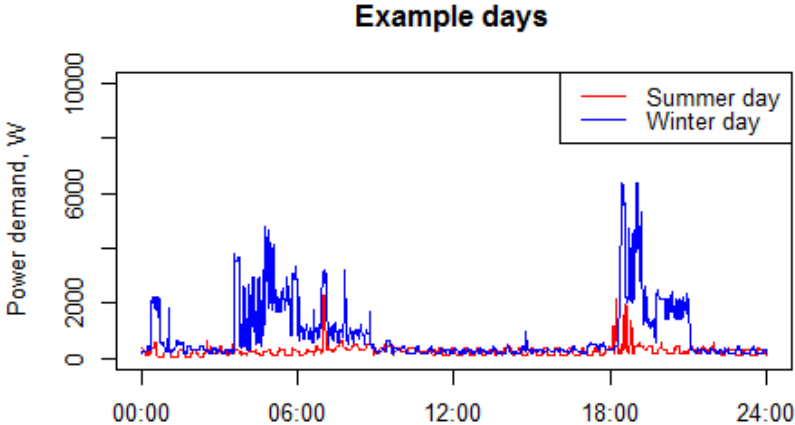
- How variable is household demand?
 - Within houses & between houses
- Do household peaks coincide with network peaks?
- What appliances contribute to household peak demand?
- What opportunities exist for managing residential peak demand?

Data from households

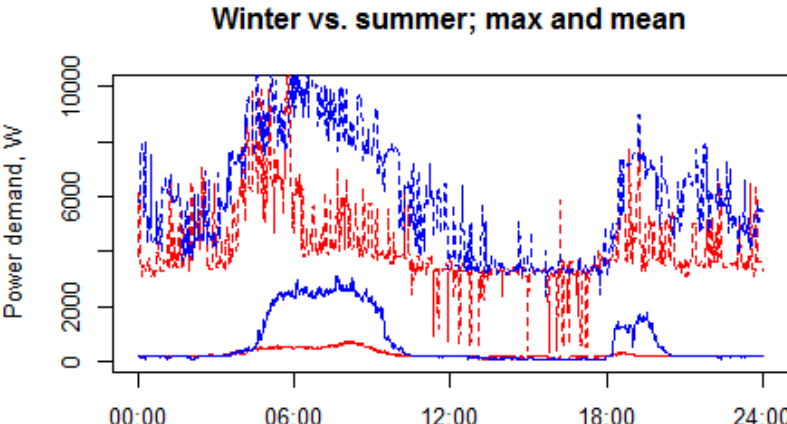
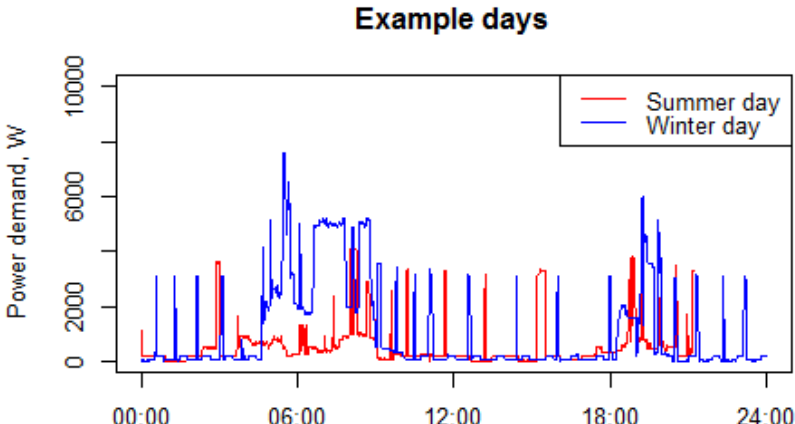
- GridSpy data:
 - Circuit level monitoring
(e.g. hot water cylinder, heat pump, kitchen appliances)
 - 1 minute time resolution
 - 40+ households
- Household surveys
 - Demographics
 - Time-use diaries

Insights: Variability

House 1:
- 3 occupants



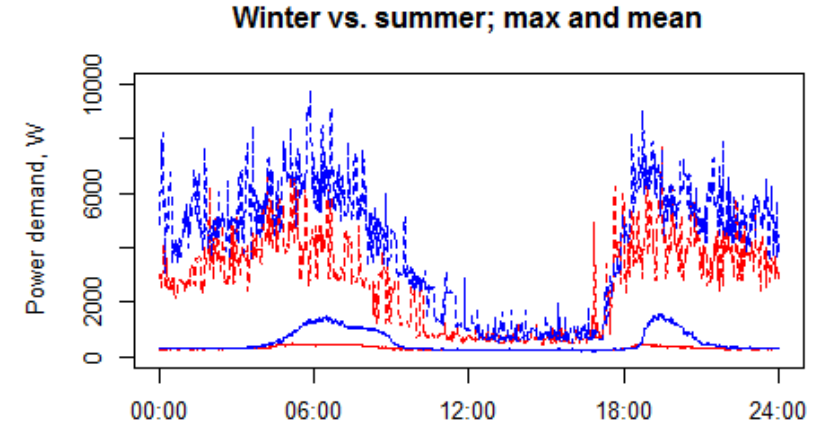
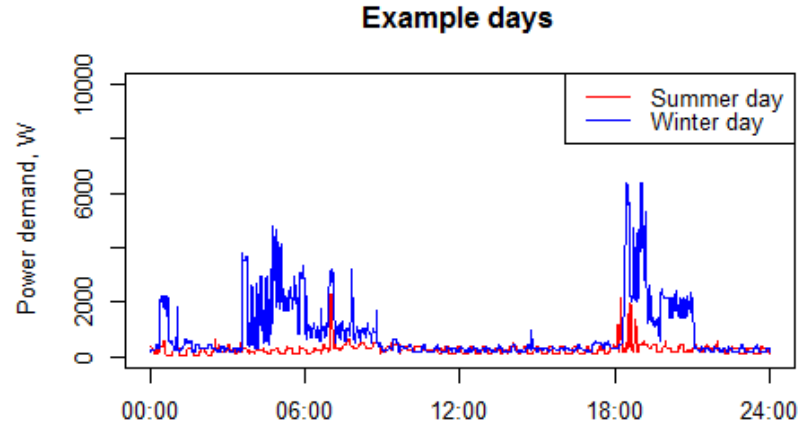
House 2:
- 3 occupants



Insights: Role of technology

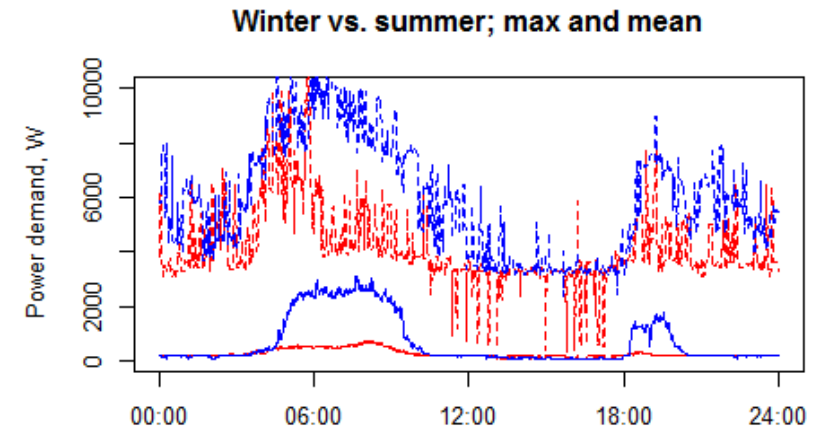
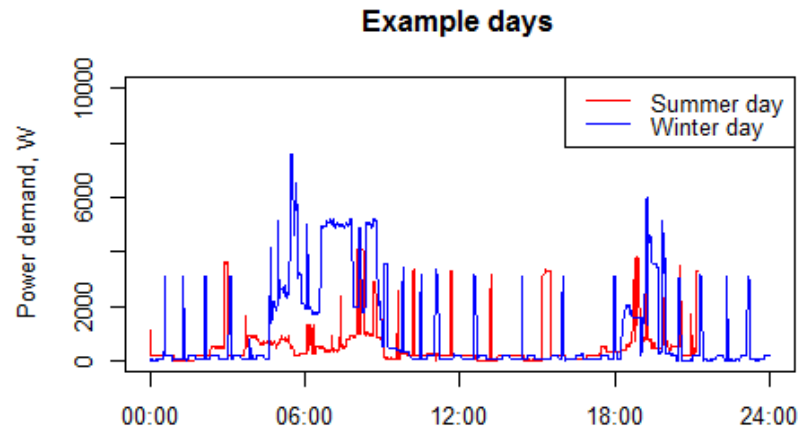
House 1:

- 3 occupants
- No electric hot water



House 2:

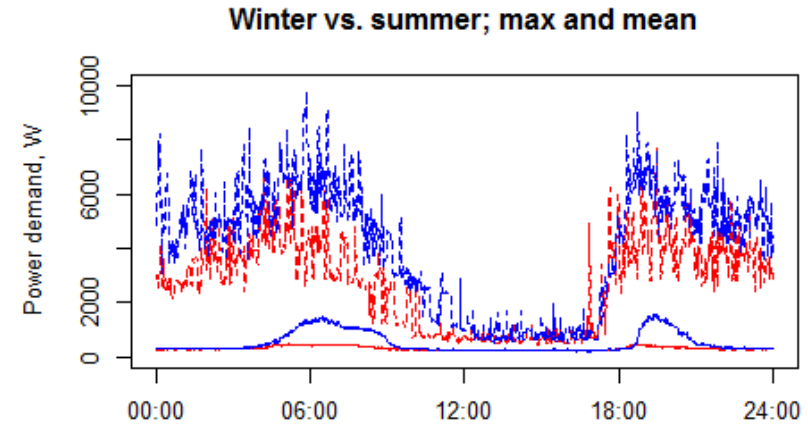
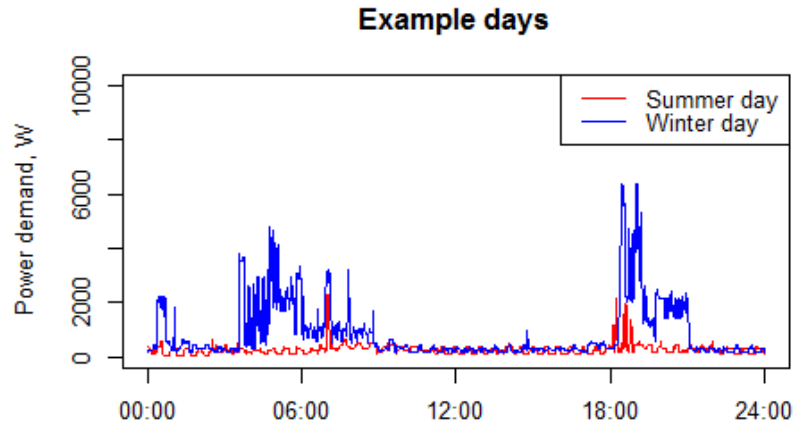
- 3 occupants
- Electric hot water
- Spa pool



Insights: Occupancy

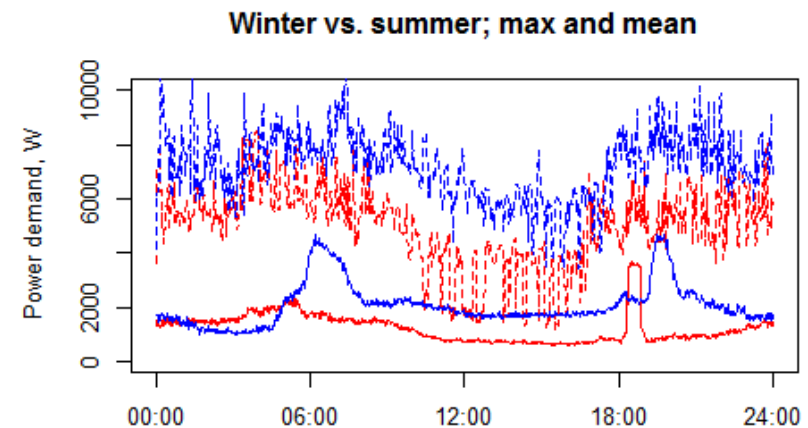
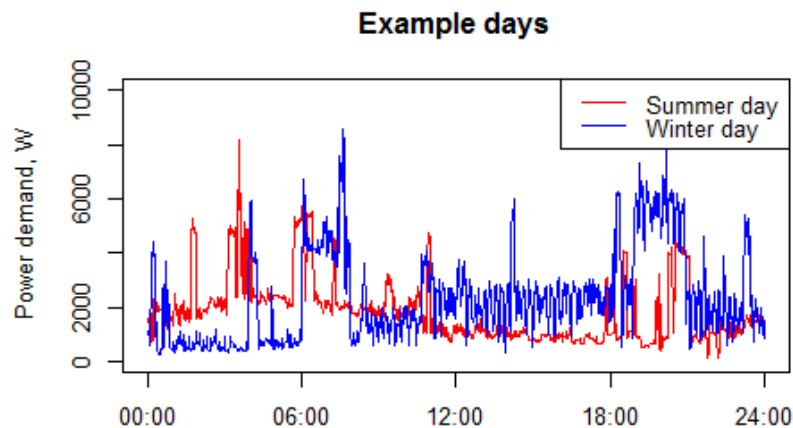
House 1:

- 3 occupants:
34(F),33(M),3(M)
- No electric hot water



House 3:

- 3 occupants:
33(M), 34(F), 1(M)
- Electric hot water



Future research opportunities

- Social change:
 - Understanding behaviour around energy choices
- Technological change:
 - Battery storage
 - Solar power, electric vehicles
- Optimal residential peak demand management

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Thank you!

Contact: kiti.suomalainen@otago.ac.nz