

# Evaluating the Impact of the CVSC Project's Energy Efficiency Interventions: A Framework and Initial Findings

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# Background

- The Australian Government has invested \$100 million in Solar Cities programs designed to test *new & sustainable* models for electricity supply and use.
- It is being implemented in *seven* separate regions across Australia, including Central Victoria.
- Central Victoria Solar City (CVSC) program encourages residents to test the effectiveness of different energy efficiency and renewable energy products and services in reducing energy use & reliance on non-renewable energy.
- Managed by renewable energy company, Sustainable Regional Australia (SRA), located in Castlemaine, Victoria



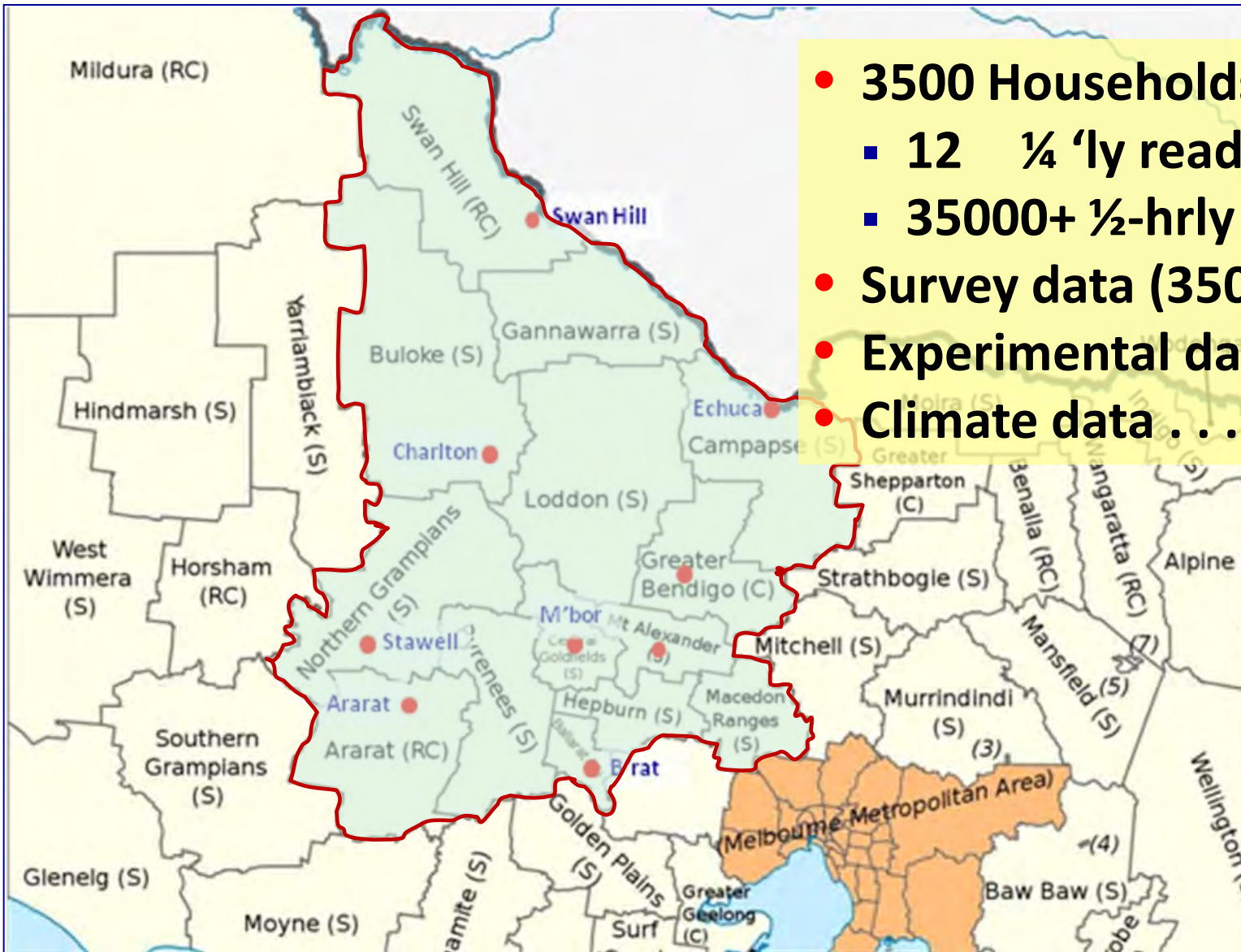
# Evaluation Design

- **The CVSC evaluation has been designed to:**
  - 1. monitor and evaluate the impact of the program;**
  - 2. identify the influence of non-program factors on energy consumption (e.g. attitudes, values, housing characteristics, climate) and adoption of energy efficiency technologies; and**
  - 3. inform public policy and future research.**
- **The Evaluation will:**
  - **Quantify the effects of CVSC packages on energy consumption;**
  - **Identify the drivers of efficient consumption and inform public policy by developing an energy-saving optimisation model;**
  - **Use the model to estimate future energy consumption and CO<sub>2</sub> savings in the Central Victoria region under various scenarios concerning social, economic, technological and environmental changes and developments.**



# Project Scope

7, 122, 43



- **3500 Households**
  - 12  $\frac{1}{4}$  'ly readings
  - 35000+  $\frac{1}{2}$ -hrly readings
- **Survey data (350+ vars)**
- **Experimental data**
- **Climate data . . .**

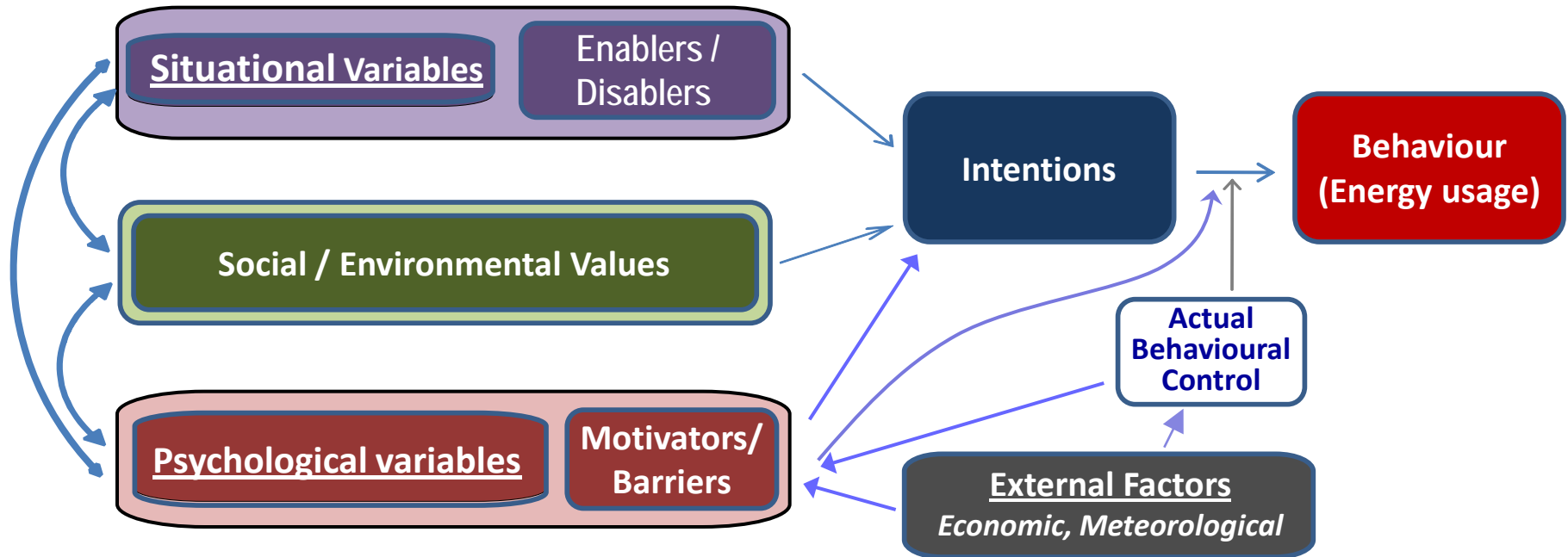
# Key Research Questions

- 1. What influence do technological, behavioural, social and economic factors have on energy consumption?**
- 2. What influence do these factors have on household adoption of solar energy technologies?**
- 3. How do demographic, geographic & attitudinal characteristics influence the use of CVSC packages and demand for energy?**
- 4. Which combinations of measures provide the most cost-effective and CO<sub>2</sub> efficient energy consumption?**
- 5. What are the characteristics of a predictive model that explain the impact of demand and supply management on future energy use and CO<sub>2</sub> emissions?**
- 6. How can results from such programs be effectively communicated to users?**



# Conceptual Framework

- To guide this investigation, UB has developed a conceptual framework based on key theories from the fields of behavioural studies



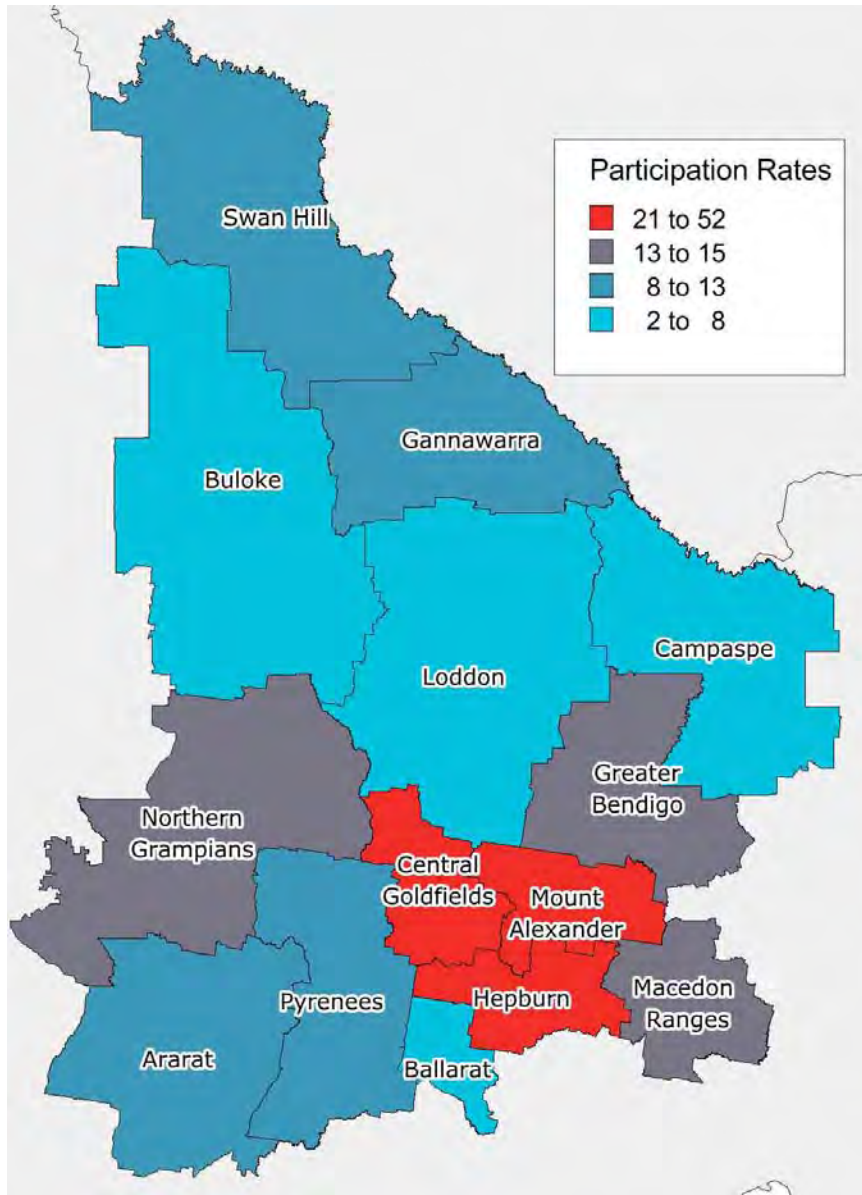
- clearly define appropriate study variables,
- guide a systematic approach to data analysis
- make comparisons with previous studies

# What are we measuring?

- The three key measures of the evaluation relate to gross savings, net savings and estimates of avoided emissions.
  - **Gross energy savings** involve measuring changes in electricity consumption that occur after program participation (e.g. receiving an energy assessment, installing solar technologies).
  - **Net savings** involve savings that are attributable directly to the program
    - Net savings = gross savings – free riders + participant spillover + market effects.
  - **CO<sub>2</sub> emissions avoided** due to the program

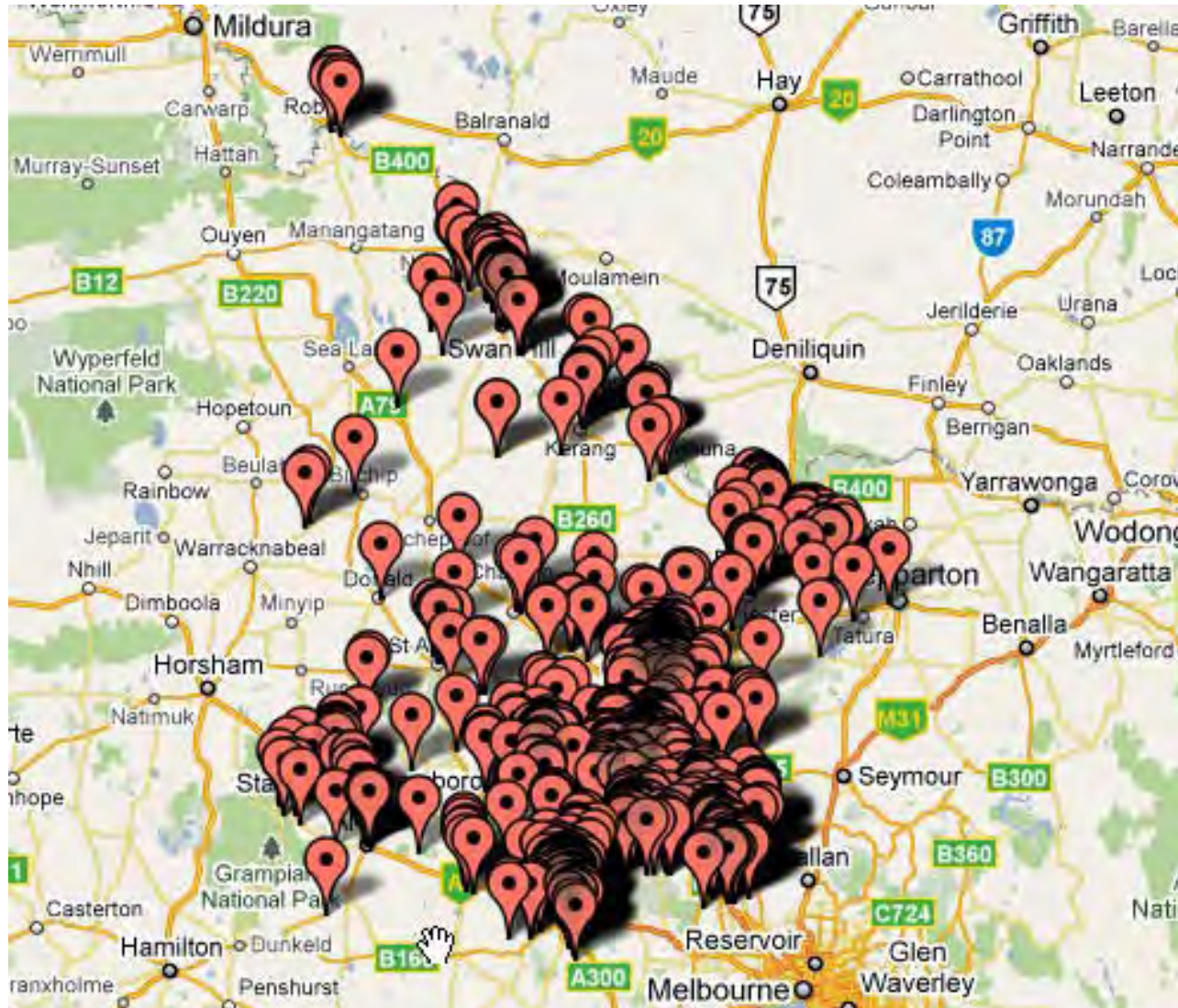


# Participation Rates

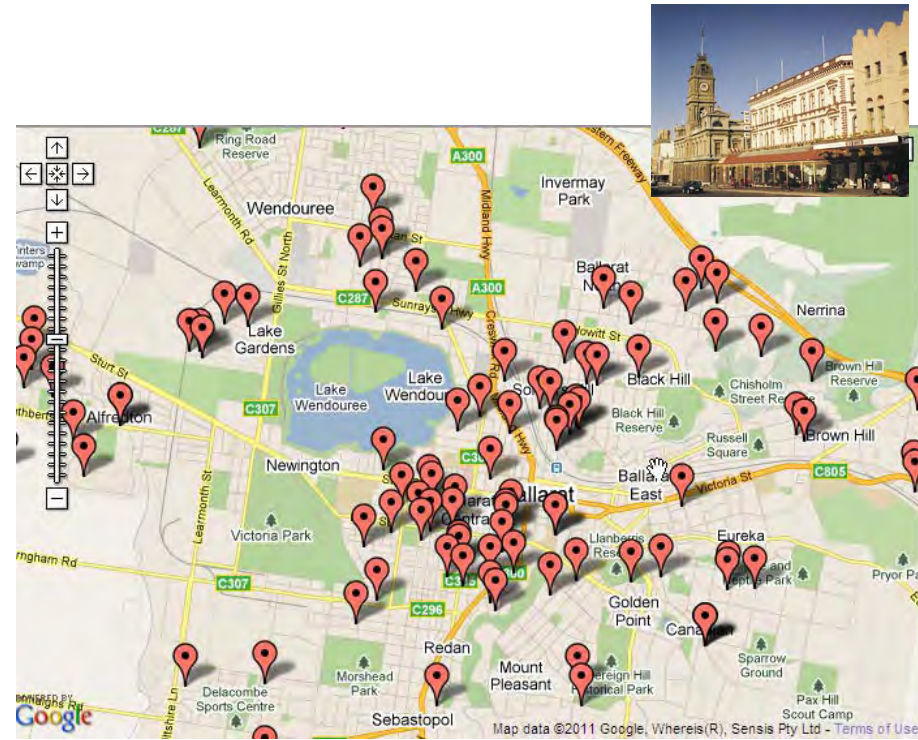
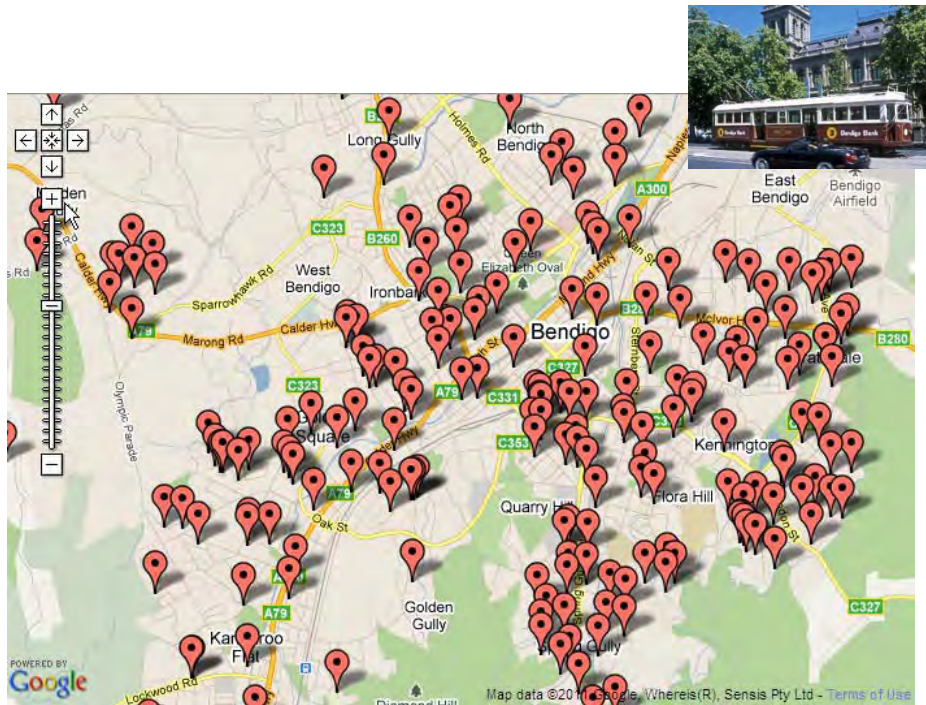


- **Participation rates for the CVSC Project to date:**
  - Intervention households per 1000 households

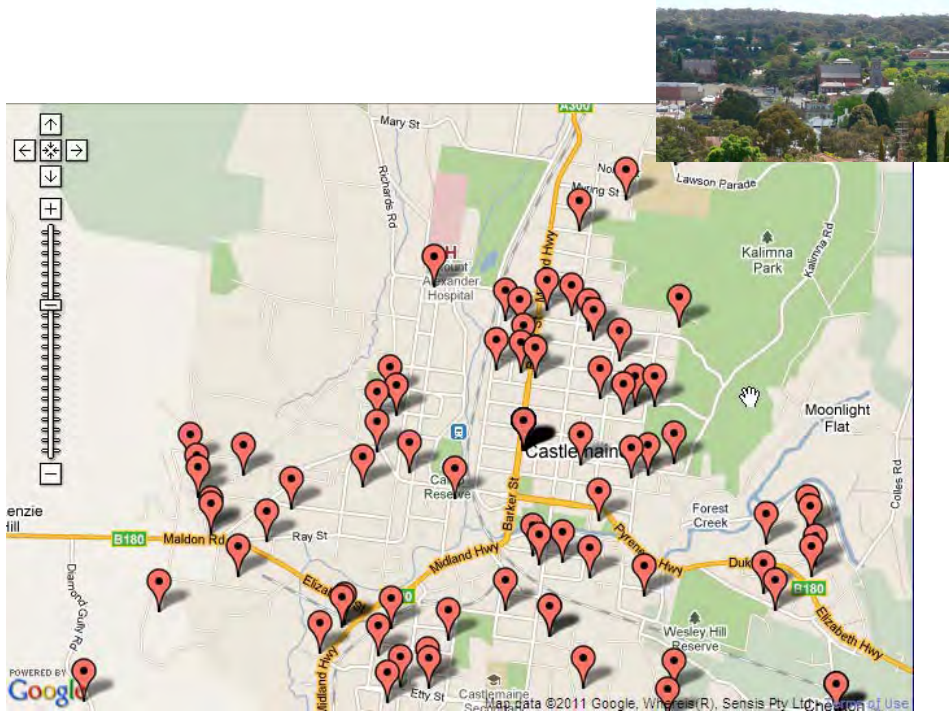
# HEAT Assessments



# HEAT Assessments: Bendigo & Ballarat



# HEAT Assessments: Castlemaine & Newstead



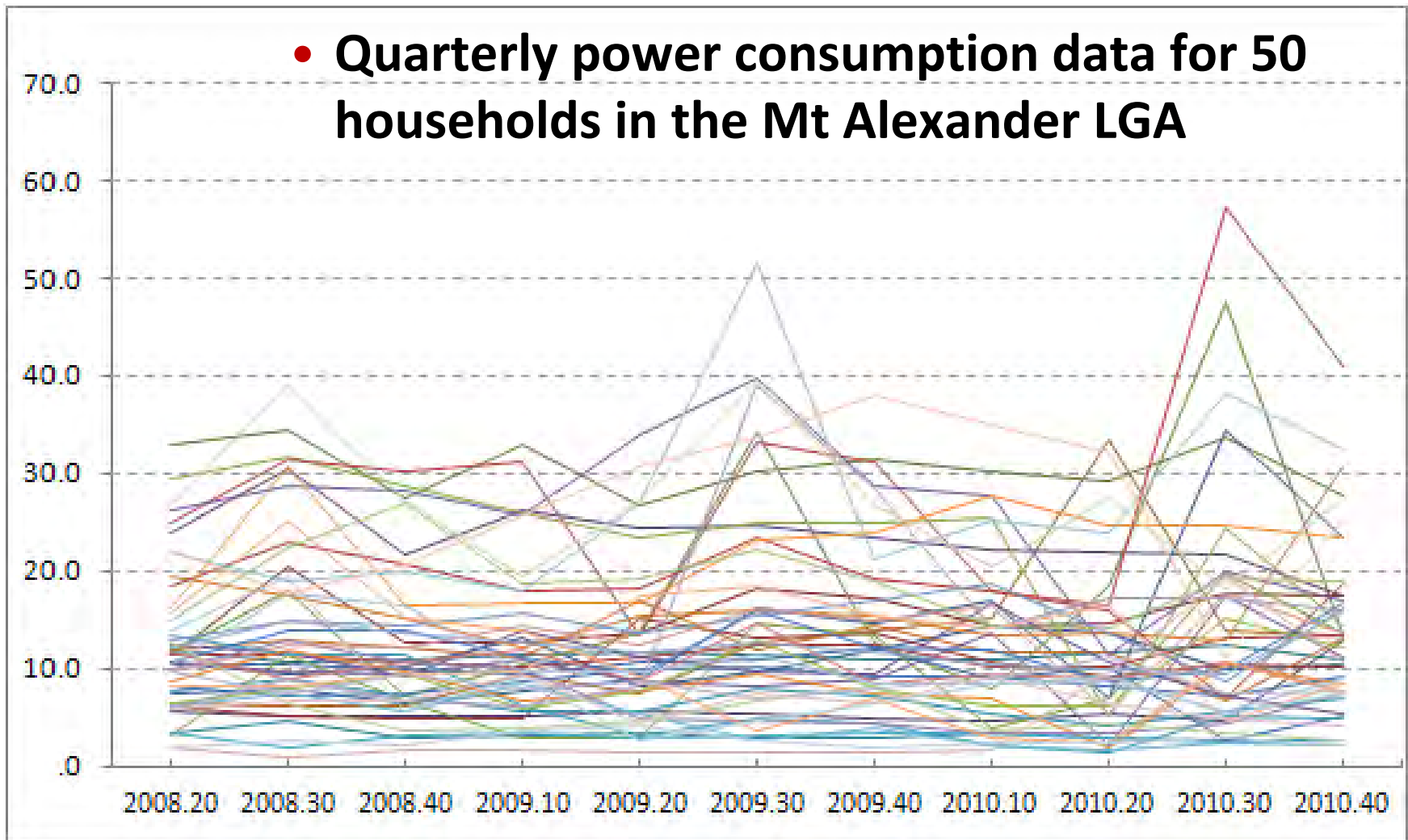
# HEAT Recommendations

- **Appliances - standby off (73%)**
- **Draft stripping (66%)**
- **Cooling – behaviour (66%)**
- **Heating - behaviour (64%)**
- **Curtains / pelmets (63%)**
- **Turn off lights (61%)**
- **Appliances - service (56%)**
- **Cold water wash (56%)**
- **External shading (55%)**
- **Heating - equipment (54%)**
- **Replace standard globes (54%)**

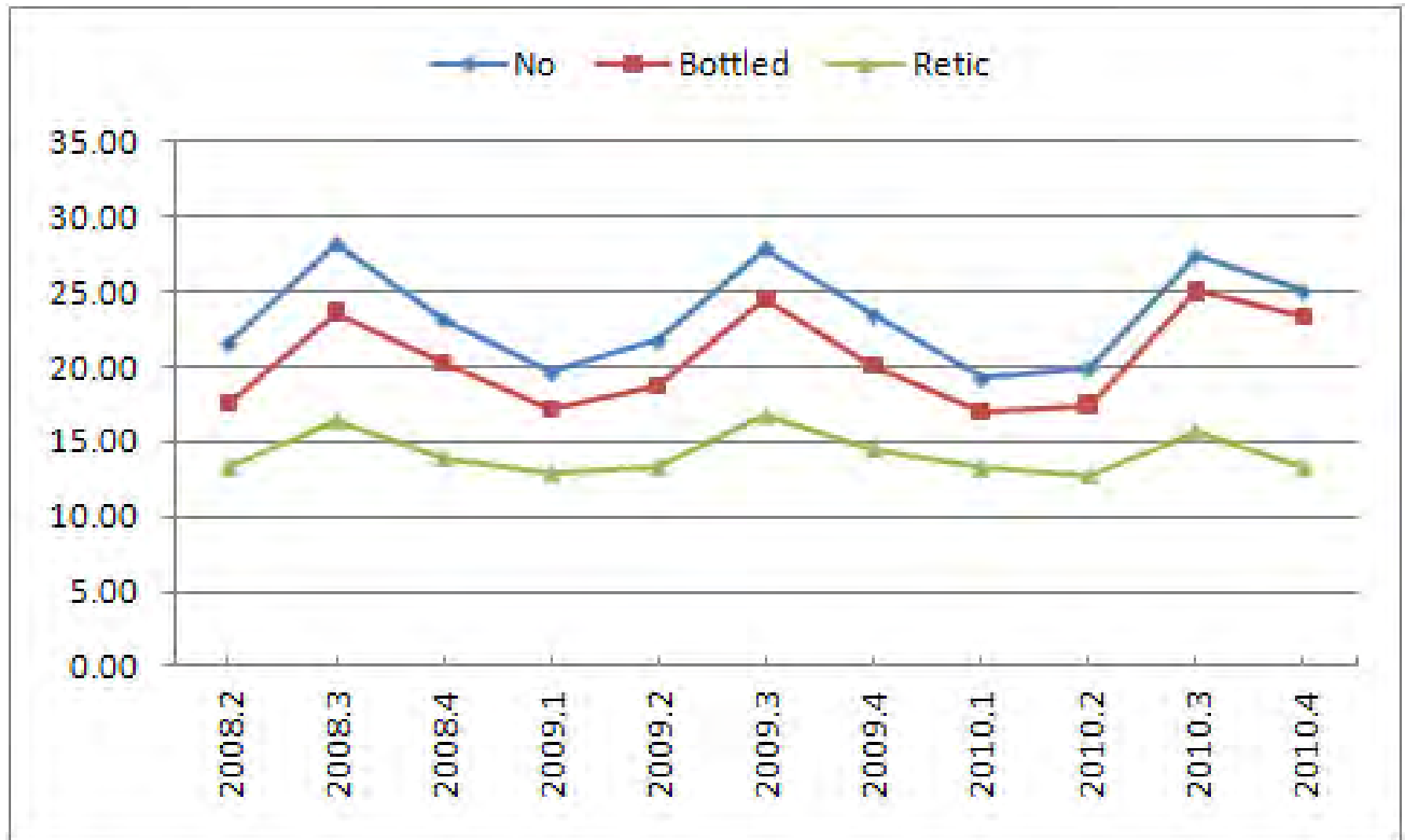


# Household Power Consumption

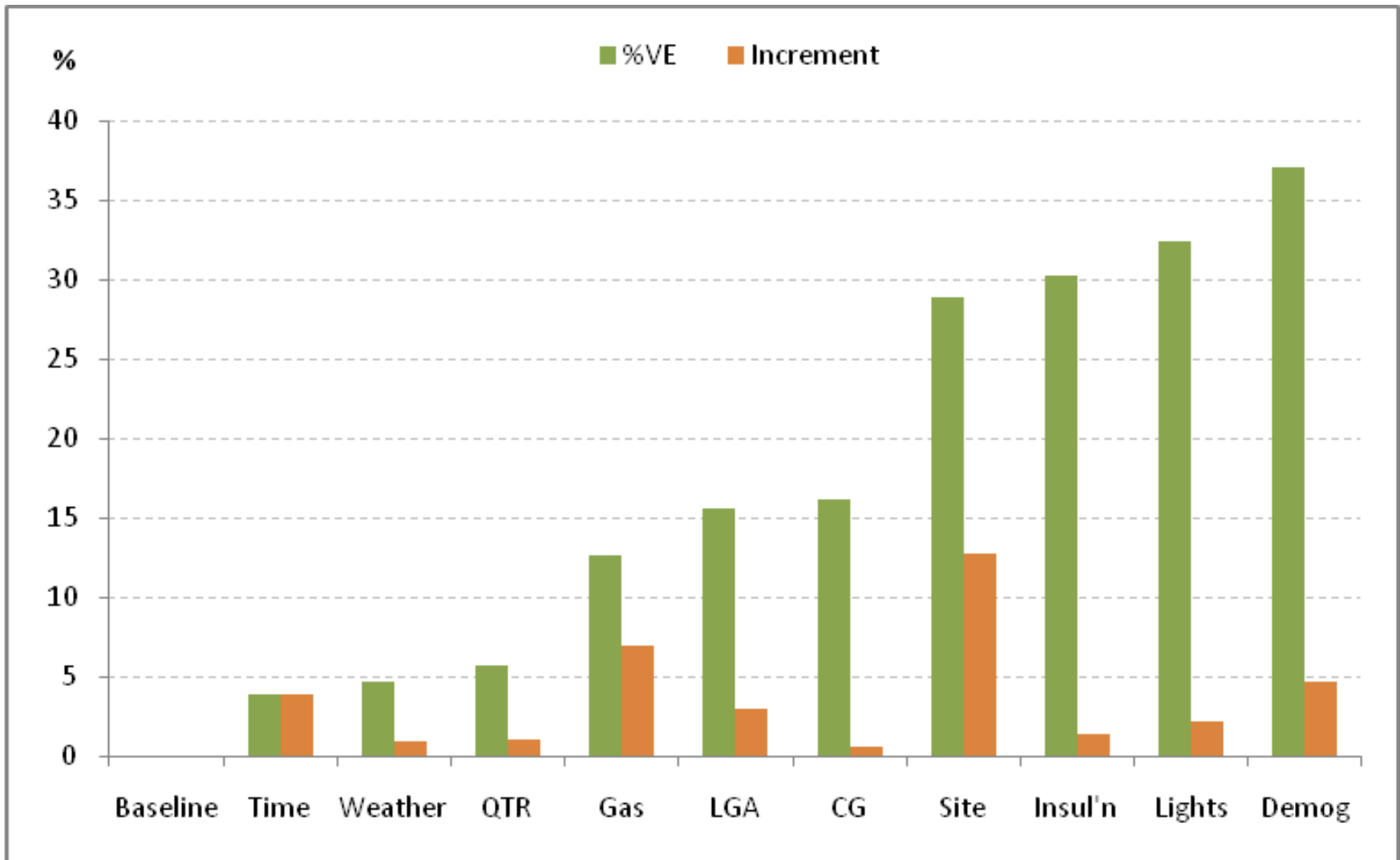
- Quarterly power consumption data for 50 households in the Mt Alexander LGA



# Historical Consumption Patterns



# Building The Model



# Early Findings: Diff's Between Households

- **Significant factors re electricity consumption:**
  - climate (*time of year and temperature*)
  - gas connection
  - house size and type
  - physical characteristics (*floor type, number of floors*)
  - number of occupants
  - some insulation measures (*floor and window awnings*)
  - income and lighting.
- **Some factors identified as not significant:**
  - housing material type;
  - building age;
  - roof colour and type; and
  - several insulation measures (*e.g. wall insulation, double-glazing, window tinting, draft stoppers and skylights*).



# Other Elements

- **Appliance data, and environmental and psychological variables will be included in future models**
- **With further recruitment of intervention participants and interval data becoming available during the next 12 months, analysis will be undertaken to compare the influence of CVSC program interventions**

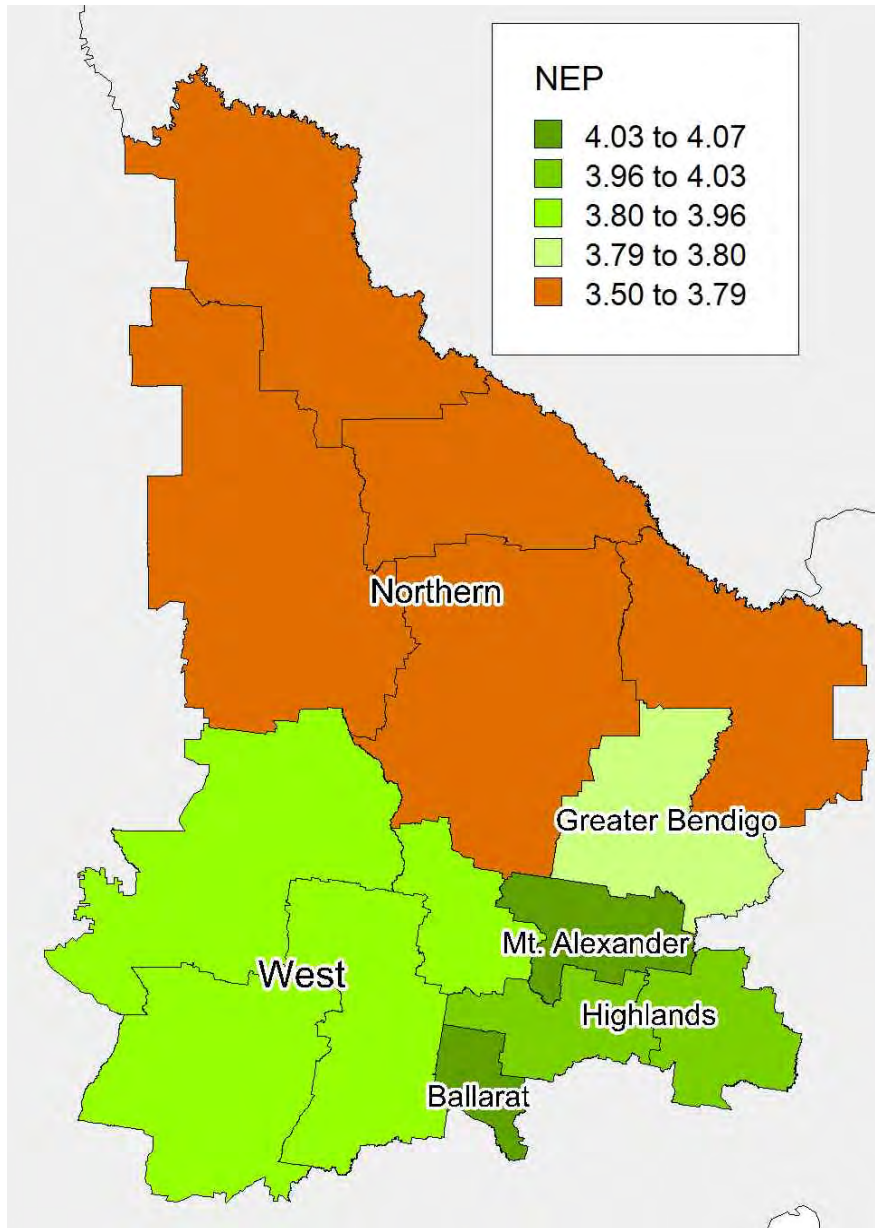


# New Ecological Paradigm

- **Key part of conceptual framework: environmental values**
- **Dunlap and Van Liere's (1978) New Ecological Paradigm (NEP) was created to measure the degree to which people view humans as a part of nature rather than separate from nature (ecological worldview)**
- **High scores indicate complete acceptance of the NEP**

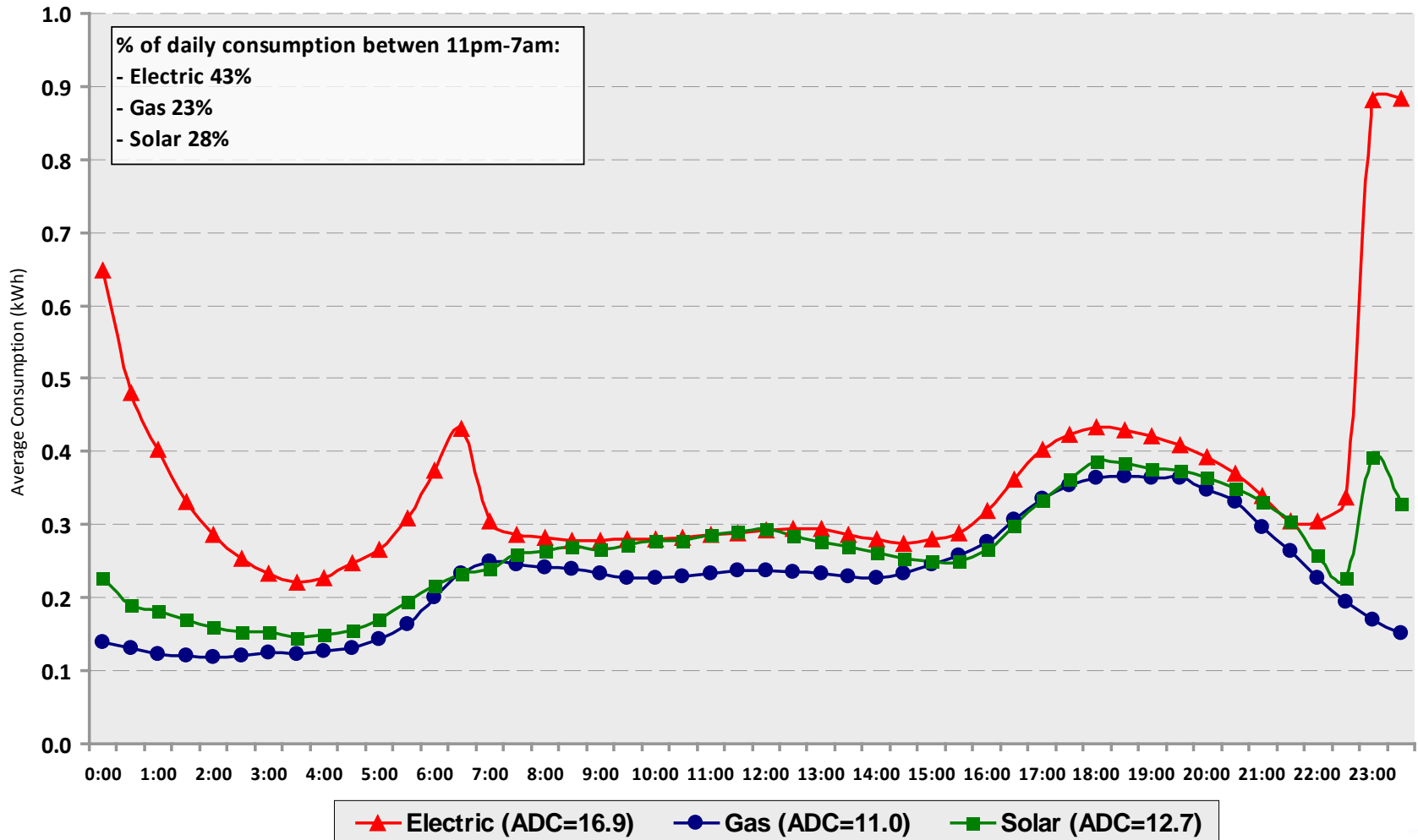


# Measures of Greenness

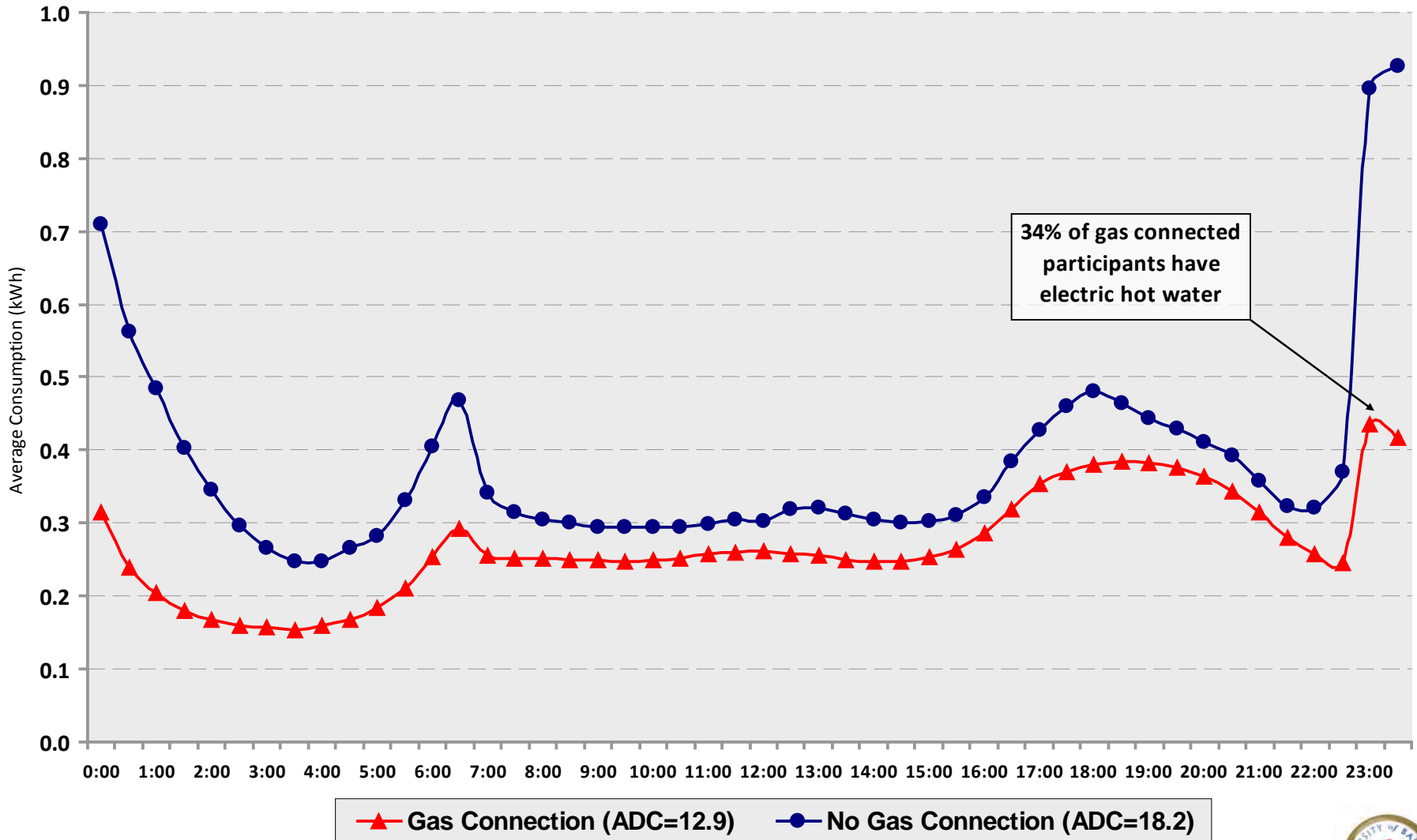


- **Average NEP Scores by Region (intervention group)**
- **In all areas (except H'lands) Intervention Gp NEP scores were greater than those for the Control Gp.**

# ½ Hourly Consumption by Hot Water Type



# ½ Hourly Consumption by Gas Connection



# Conclusions

- **Preliminary analysis suggested a need to account for the hierarchical nature of the data in this study;**
- **Hierarchical models (eg Linear Mixed Models) allow for the dependencies often found in longitudinal data;**
- **An initial baseline model identified the four most influential factors affecting household energy consumption to be site details, location, gas connection and household demographics (i.e. income, number of occupants);**
- **With further recruitment of intervention participants, and interval data becoming available during the next 12 months, more detailed analyses will be undertaken to compare the influence of program interventions in the context of other determinants of energy use;**
- **Self-selection bias, Free-rider and Spill-over effects will be considered as the analysis progresses to attribute energy savings to program participation;**
- **Energy program evaluation research needs to use appropriate methods to be credible and to get most accurate results for translation into practice.**



# Acknowledgements



Australian Government  
Solar Cities



Sustainability  
Fund



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