

# How Energy Efficiency Programs influence Energy use: an application of the Theory of Planned Behaviour

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**Learn to succeed**

# Energy Efficiency Policy

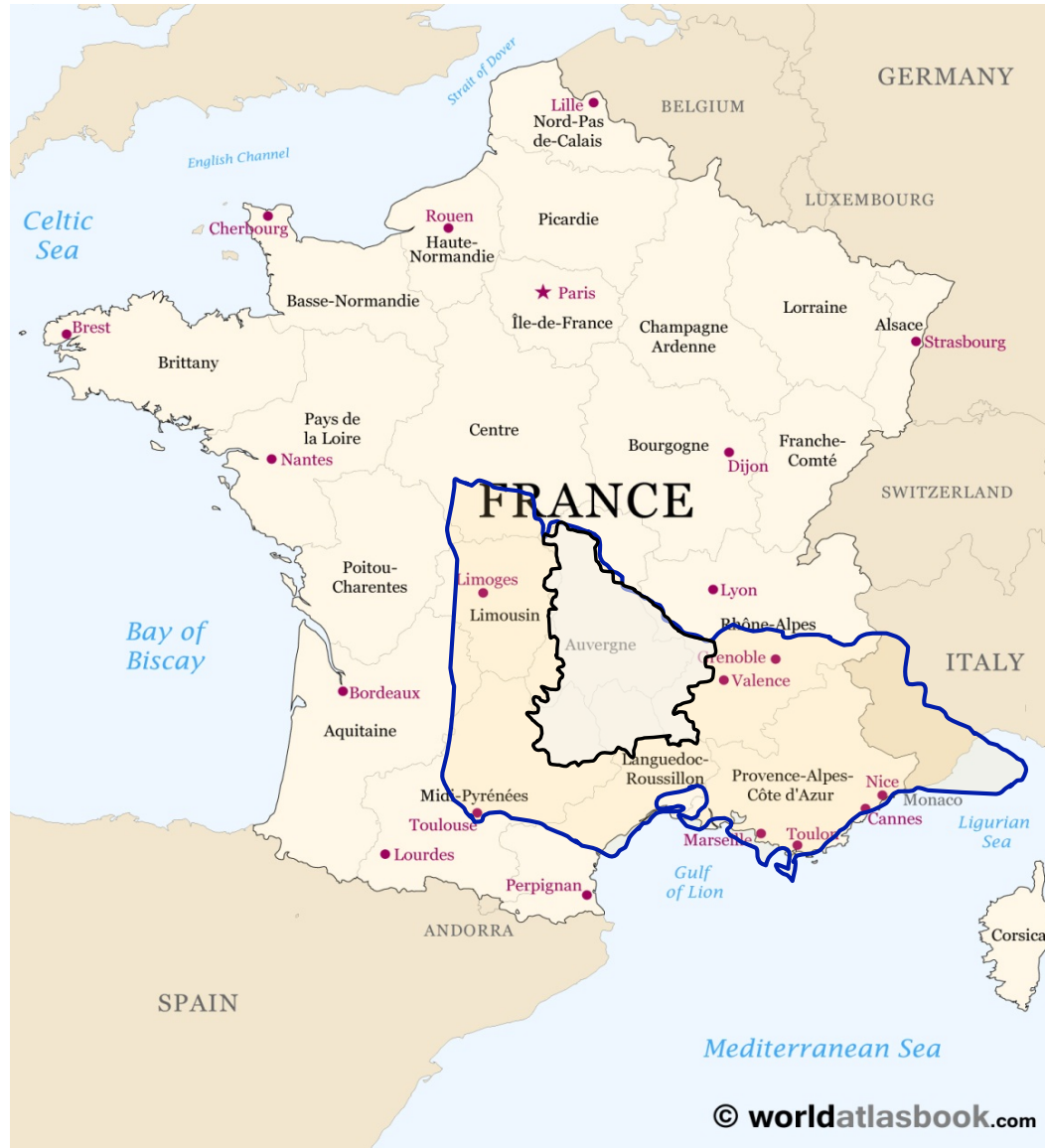
- Can government intervention correct investment inefficiencies?
- Encouraging households and industry to be more energy efficient has been a major challenge for policy makers.
- Energy Efficiency policies must be based on good research
  - not only about *if* policies work, but
  - extends to *how* they work and under what conditions.
- A lack of credible empirical research makes it difficult to assess the potential influence of both independent & complementary government policy measures  
(Allcott & Greenstone, 2012).

# Solar Cities Program

- Research trial designed to gain a better understanding of consumer response to the adoption of energy efficiency technologies and services.
- Australia's 7 Solar Cities are: Townsville, Adelaide, Alice Springs, Blacktown, **Central Victoria**, Moreland and Perth.



Source: Department of Climate Change and Energy Efficiency (2011)

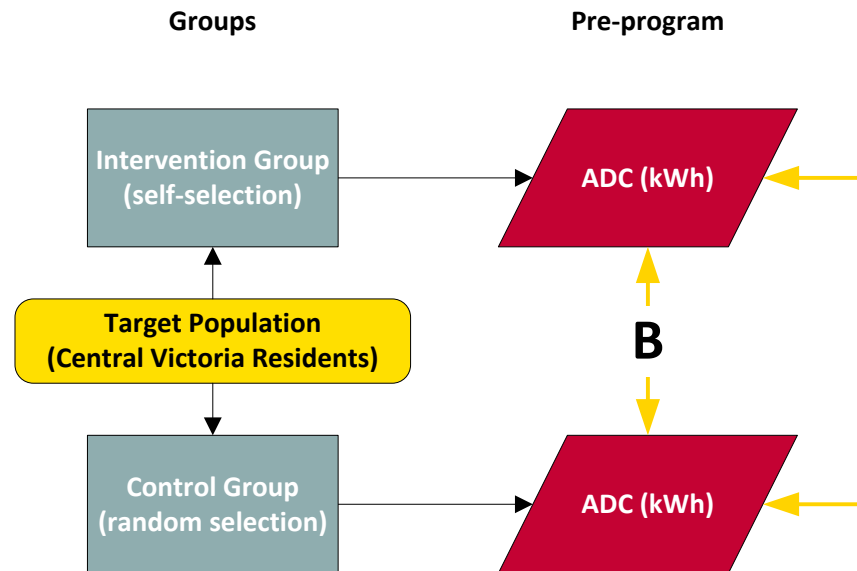


# Overview of CVSC Program: Residential Trial

- Administered by Sustainable Regional Australia
- Program involved the recruitment of 1,873 household research participants (intervention group) and a control group of 715.
- Each household in the intervention group received a free Home Energy Assessment (HEA)
- Eligible to take part in one or more additional program packages:
  - Retrofit rebate package (\$500 rebate on \$2,000+ energy efficiency investments)
  - Solar Hot Water
  - Household Solar Photovoltaics (1.5 Kw system)
  - In Home Energy Displays (IHDs)

# The Evaluation Design

- **Non-equivalent groups design**



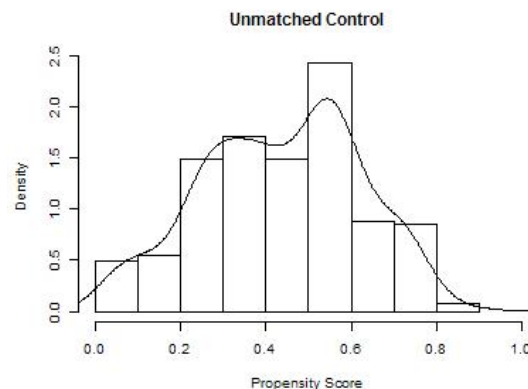
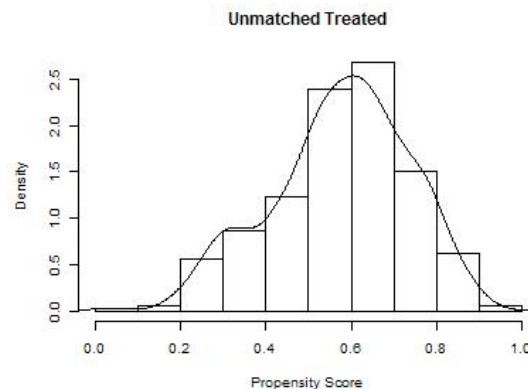
A and A1: Comparison of changes to both groups since the intervention


B: Comparison between the two groups before the intervention (matched to control for biases)

C: Comparison between the two groups after the intervention

# Matched Pairs

- To increase comparability between the intervention and control groups a matched pairs design was used.
- Propensity score matching based on a composite of background variables.



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- **socio-demographic and property characteristics**
    - gas hot water more prevalent in the control group (46% vs. 33%)
  - **psychological & behavioural factors aligned with the TPB**
    - The only significant difference noted for the TPB variables was for *intentions*
    - financial and environmental attitudes and perceived behavioural control were high for both groups,
    - subjective norms were relatively low.
  - **opportunity for energy efficiency interventions to target perceptions of social pressure to reduce energy use.**

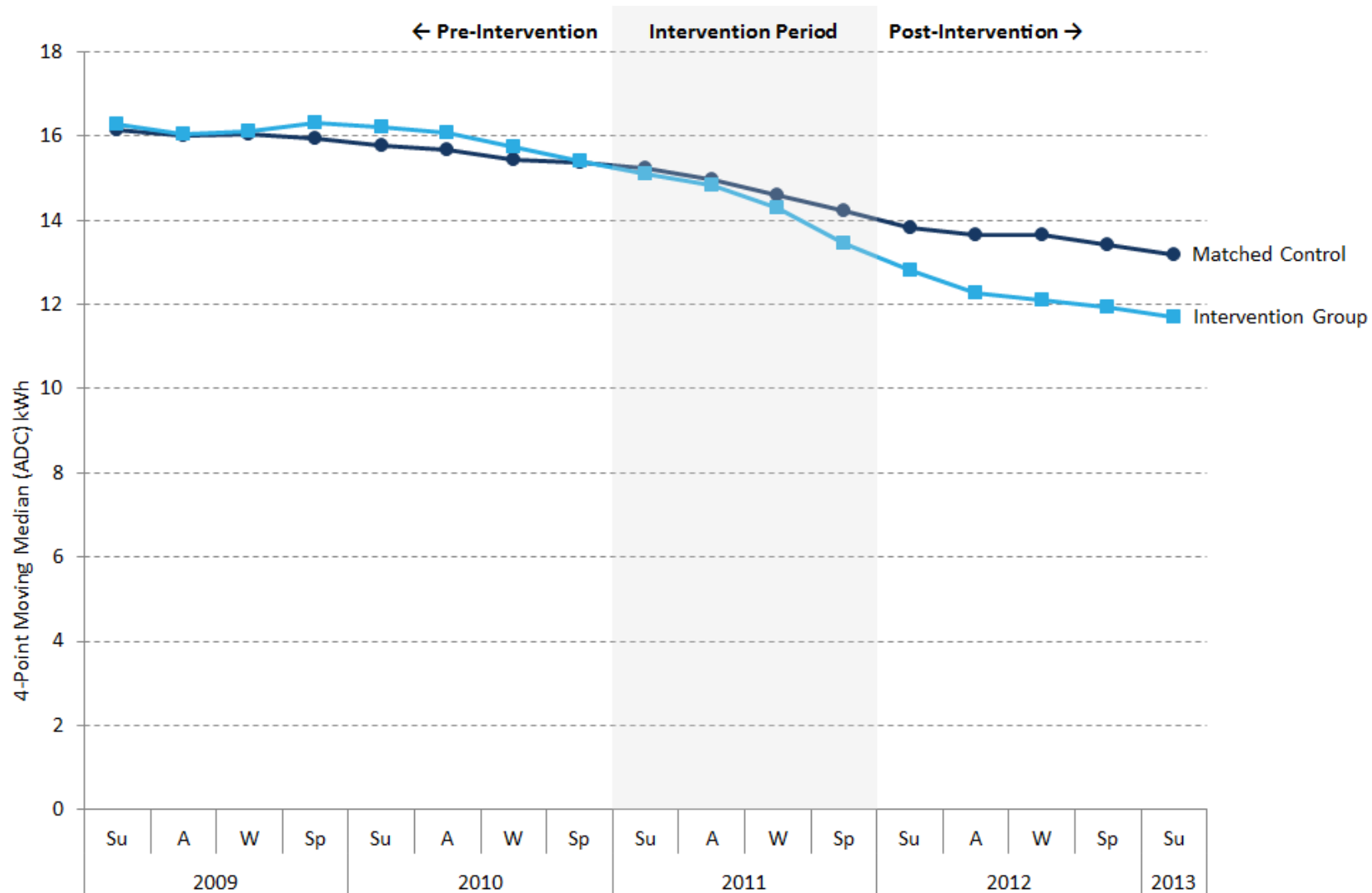




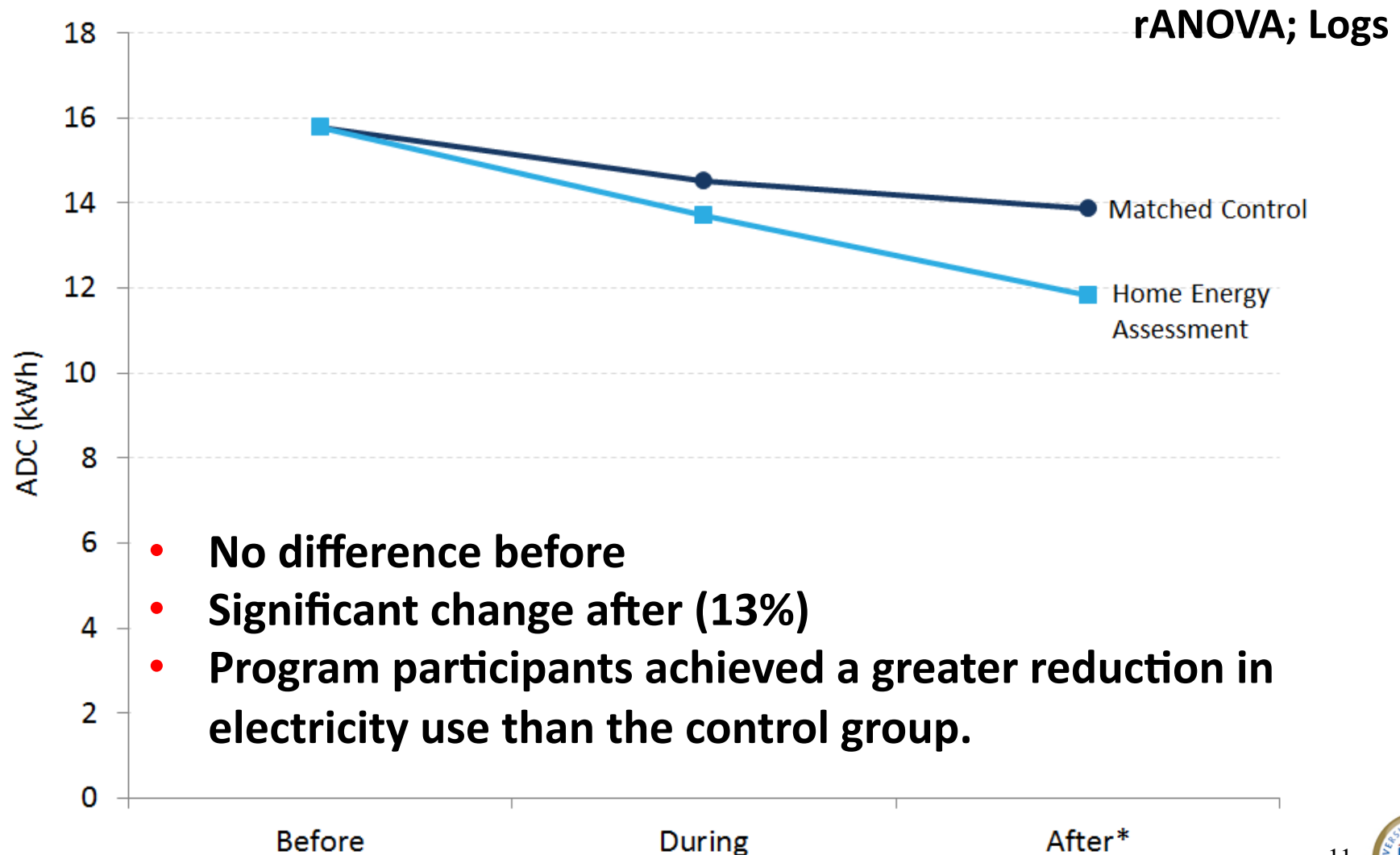
# Matching Process



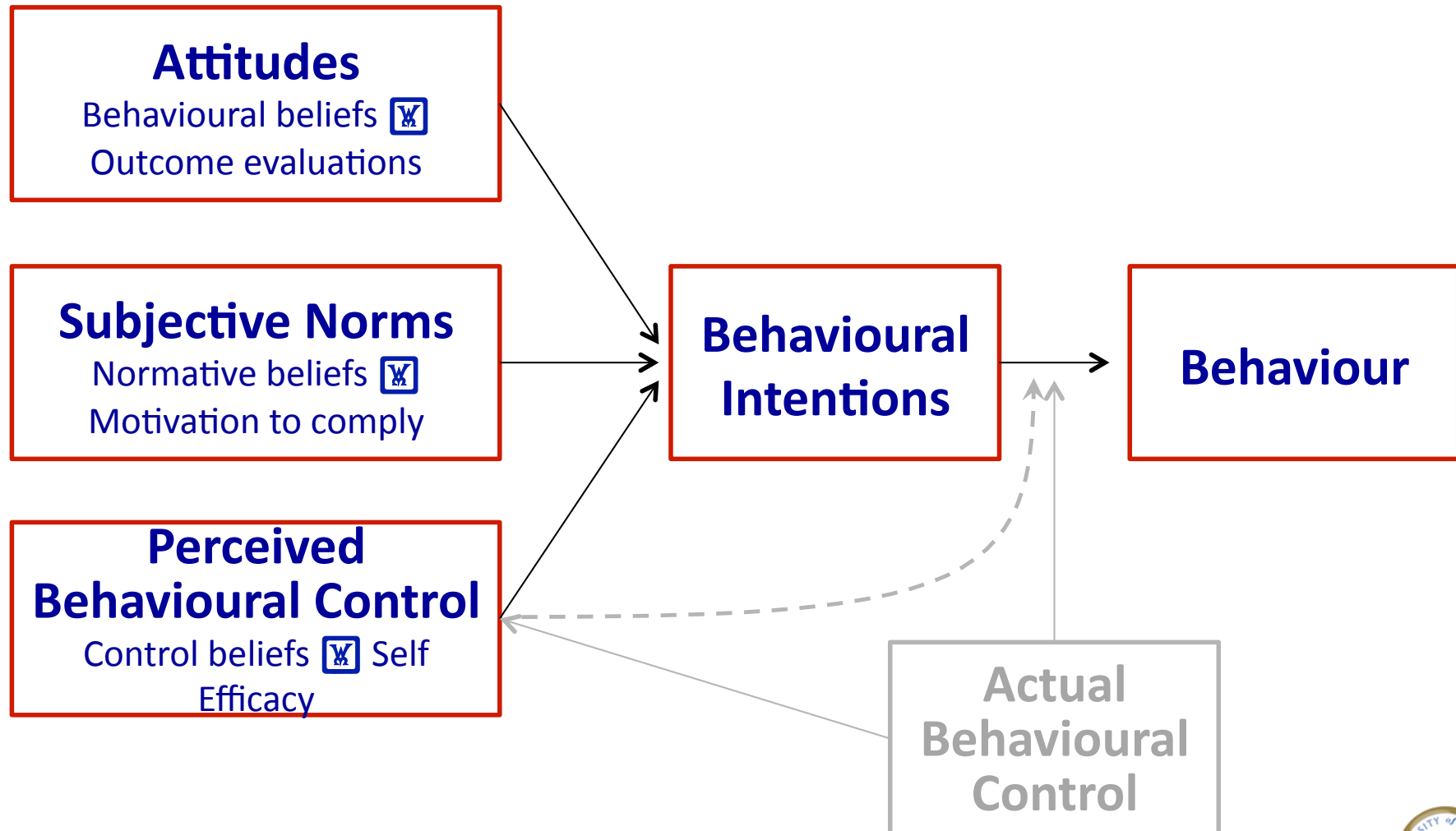
# ADC: Pre- Post Intervention



# Pre-post Changes



# Conceptual Framework: Theory of Planned Behaviour



# The *Good* The *Bad* & The *Snuggly*

**Validity &  
Reliability**

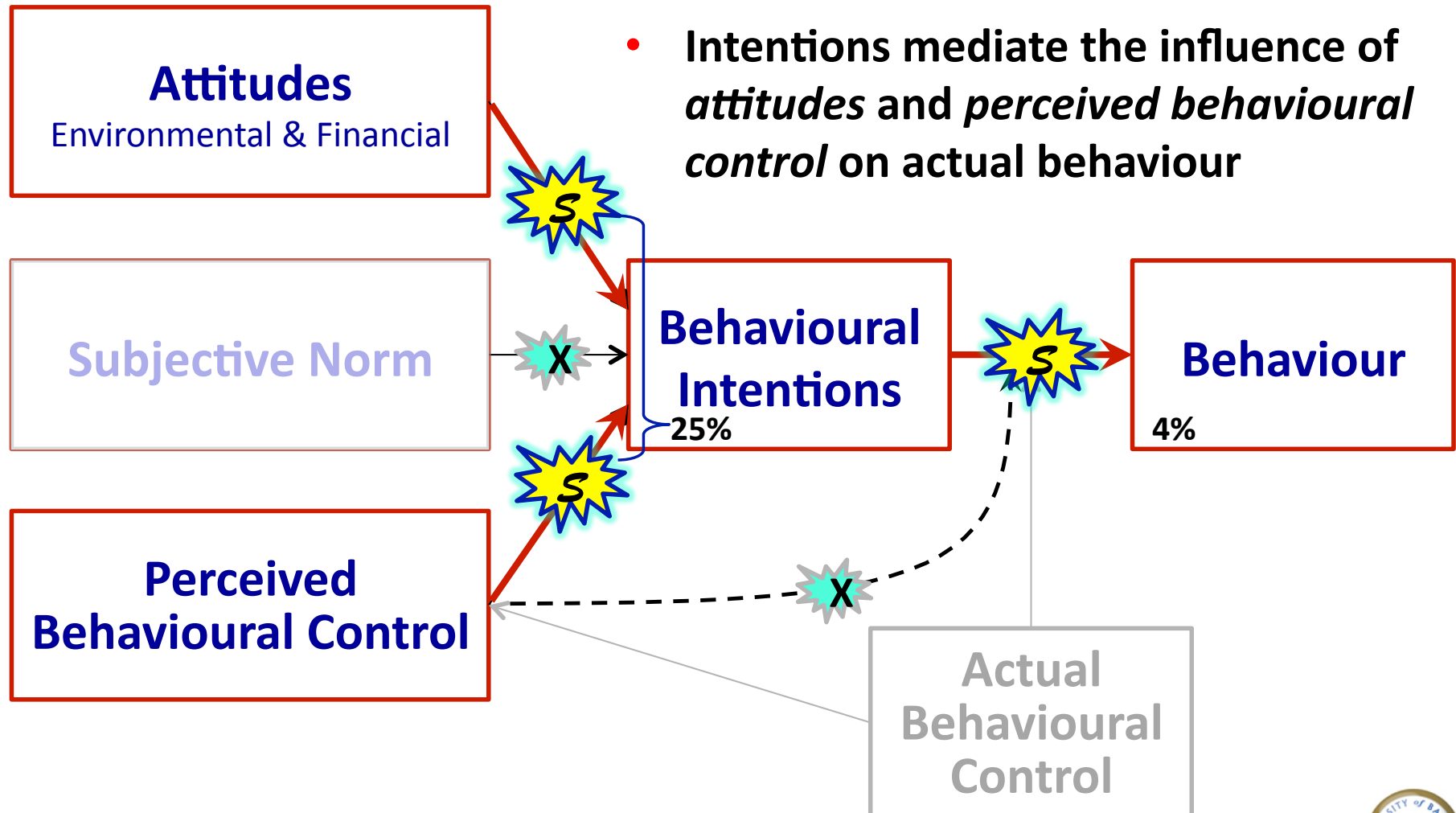
**Fit b/w TPB model  
and the data**

**Moderation  
effects of program  
participation**

- Polychoric correlations and CFA with WLS;
- Initially not a good fit due to low reliability for the 2 indicators for *attitudes: outcome evaluation*;
- Excellent fit when removed (CFI > 0.99, RMSEA = 0.05);
- Outcome evaluations relating to environmental & financial benefits of reducing energy were not a uni-dimensional construct;
- Composite scores computed to get measurement errors for indicators;
- Separate composites calculated for financial & environmental attitudes;



# Explaining Energy Use, Intentions & Behaviour



# Moderation – Group Differences

- TPB variables - good fit for both groups;
- No evidence moderation

## Intervention

## Control

### Intentions

- Attitudes (environ)
- Attitudes ( financial)
- Subj Norm
- PBC
- *Intercept\**

### Results:

- No significant difference
- No significant difference
- No significant difference
- No significant difference
- *Significant: Intervention > Control*

### Behaviour – $\Delta$ ADC %

- Intentions
- PBC
- Intercept

### Results:

- No significant difference
- No significant difference
- No significant difference



# Change in Energy Use & TPB

- A multi-group path analysis suggests that participation in the program does not affect the direction and/or strength of the relationship between the model's independent and response variables.
- Average intentions for the intervention group are higher than the control group, even after controlling for attitudes, subjective norm and perceived behavioural control.
- Exogenous factors to the TPB are influencing the intervention's group predisposition to have stronger intentions to reduce energy use.



# Conclusions

- Provides a framework for evaluating energy efficiency programs (*if* and *how* they work)
- 13% of the electricity use reductions can be attributed to participation in the CVSC program. This finding suggests that the program was successful in encouraging participants to change their energy use behaviour.
- TPB is a plausible model to explain household energy use intentions and behaviour
- Intentions to reduce energy use were influenced by environmental and financial attitudes towards reducing consumption and perceived control over such behaviour.

# Conclusions

- **Social pressure did not appear to be an important determinant of energy use intentions & behaviour in the context of other attitudes and beliefs**
- **Changes in intentions and behaviour may be driven by programs fostering more favourable attitudes and beliefs towards energy use rather than by strengthening the relationships between these constructs.**
- **Is reducing energy use harder than people think?**
  - **Possibly due to cognitive difficulties in considering peripheral internal and external factors (barriers/enablers) likely to influence such behaviour.**



# Future Research

- **Participant outcomes may have varied depending on participant characteristics and adoption of the program's additional packages: retrofit rebate; household solar electricity; solar hot water; and in home energy displays**
- **Determinants of attitudes and perceived barriers towards reducing energy use**
- **Developments in behavioural economics concerning biases in decision-making may provide a useful theoretical framework to explain discrepancies between perceived and actual control over energy consumption**
- **To test the generalisability of this study, it is recommended that these findings are tested in other regions and for different types of energy efficiency programs or policies.**