

# i-STUTE: WP1

Management Meeting #11 & Advisory Board #6

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# WP1's Work Packages

- ◎ **WP1.1: Review and synthesis of existing activities.**
  - A review of how economic, policy and behavioural factors influence the adoption of new technologies relevant to heating/cooling technologies.
- ◎ **WP1.2: Business model typology.**
  - What are the existing business models adopted by energy service providers in the UK? What are the new alternatives are under consideration? How do they match the requirements for successful introduction identified in our review?
- ◎ **WP1.3: Behavioural Insights – Case studies.**
  - Case studies analysis of where business models succeed or fail to build their understanding of customer needs and behaviours, develop relationships with those customers and provide propositions that customers adopt.
- ◎ **WP1.4: Behavioural Insights – Experiments and focus groups.**
  - Experiments & focus groups to provide converging evidence on a range of value propositions, zeroing in on features likely to lead to success or failure.

# WP1.1: Review and synthesis

- ◎ **WP Completed:** Dissemination Tasks as follows
- ◎ Review of behavioural vs economic influences on the adoption of new heating/cooling technologies relevant to i-Stute.
  - SUSTEM 2015 <http://research.ncl.ac.uk/sustem/sustem2015conference/proceedings/>
  - Biennial Conference on Environmental Psychology 2015
    - <http://bcep2015.nl/scientific-program/monday-poster-session/poster-session/> see #26
  - Pending: review submitted for publication in [Journal of Applied Behavioural Science](#)
- ◎ Business model side
  - Teaching Case Study about changes to E.On's business model
    - Now used with >450 international managers & students in UK, India & China
  - "Business Models in the Energy Industry" Review by Fred Dahlmann
    - Teaching syllabus for two MBA level programmes
  - MBA Dissertations: 6 on Business model topics (e.g. mCHP)

# WP1.1: Review and synthesis

- ⦿ **WP Completed**
- ⦿ Original intentions and timescale:
  - Activities completed to plan; business model work more applied given staff
- ⦿ Achievements to date & Outputs to date
  - See last slide and ongoing dissemination
  - Mix of academic dissemination and business (education) impact
- ⦿ Has the effort been justified?
  - Yes; essential “setting the scene”
- ⦿ Synergies with other WPs
  - Has provided framework to describe work to other WPs
- ⦿ Recommendations - is it worth continuing?
  - WP activities completed; ongoing dissemination

# WP1.2: Business model typology

## ◎ Concept

- What are the existing business models adopted by energy service providers in the UK? What are the new alternatives are under consideration? How do they match the requirements for successful introduction?

## ◎ Strategy

1. Explore the existence and application of business model thinking among key players in the UK home heating industry.
2. Investigate the changing nature of these business models over time.
3. Assess the validity and contribution of the business model concept to strategic thinking and industry evolution.

## ◎ Targets for 3rd Annual Report

- Start postponed: staff recruited allowed WP1.4 to start earlier.
- Present initial results from this stream as new since previous report

# WP1.2: Strategy & Progress

## ◎ Stage I – COMPLETED Feb 2016

- Desk-based website evaluation of existing businesses in the UK's domestic heating sector
  - 32 members of the UK's Heat Pump Association (HPA)
  - Characterised firms' existing business models along business model canvas categories
- Discussed with Tony Bowen to prepare for industry survey –
  - Key Participants AB proposed: Daikin, Worcester Bosch, Hitachi, Mitsubishi, MCS, NIBE
  - Only NIBE have confirmed interview 8/4/16

## ◎ Stage II – In Progress

- Prepared semi-structured interviews for industry participants
- Complete pilot interviews with initial participants
- Use pilot responses to prepare view of broader network participants

## ◎ Stage III – In Preparation

- Define broader network of participants and so pool of further interviews
- Revise interview structure; set up and conduct interviews across the broader pool
- Develop how business model canvas elements of network participants combine to offer overview of home heating products and services.

# WP1.2: Business Model Typology

## Stage 1 findings defined the traditional OEM-Distributor-Installer-Customer value chain

- HPA sample largely consists of OEMs, some installers, a couple of distributors and some firms related to heat pump manufacture
- **Key customers** depend on type of HP business, usually follows along the value chain
  - Heat pumps are normally offered as part of wider suite of products and services
  - Some regional & local specialisation
  - New-build, refurb or retrofit
  - Most only offer ASHP, few offer both ASHP & GSHP, no-one does GSHP only
- Some fairly advanced **marketing channels**
  - including use of types of social media, apps for technical support, but also “word-of-mouth”
  - pride in ethical approaches to marketing, no deposit needed
- Post-sale **customer relationship** highly dependent on support, maintenance, warranty, spare parts, etc.
- **Key partners** usually those (customers) needed further down the value chain but also external advisors
  - Close links between OEMs and installers, need for accreditation, training and support, thus often cannot offer from a range of OEM suppliers, must choose one.

# WP1.2: Business Model Typology

- ⊙ Original intentions and timescale:
  - Start postponed, activities now underway and progress as described
- ⊙ Achievements to date & Outputs to date
  - Research underway; first stage completed
  - Need to secure further company participation than achieved so far
- ⊙ Has the effort been justified?
  - Yes, given late start
- ⊙ Synergies with other WPs
  - Provides business impact channel for WP1.4 findings as they arise
- ⊙ Recommendations - is it worth continuing?
  - Yes; early stage.



# WP1.3: Behavioural Insights - Case studies

## ◎ Concept

- Case studies analysis of where technologies & business models succeed or fail to build an understanding of customer needs and behaviours, develop relationships with customers and provide propositions that customers adopt

## ◎ Strategy

- Case Study approach
- Four case studies ongoing, one shelved.

## ◎ Targets for 3rd Annual Report

- Showcase those reaching impact stage
  - Perception Gap work
  - User requirements for domestic thermal storage

# WP1.3: Behavioural Insights - Case studies.

- ◎ Work package started September 2014, as scheduled
- ◎ Case Studies:
  - 1.3.1 Thermal stores (LU)
    - Determination of user requirements for domestic thermal stores
  - 1.3.2 Heat emitters (LU)
    - Review of human factors surrounding heating emitters for heat pumps
  - 1.3.3 Smart displays & Control (WBS, leveraging Innovate UK funded work)
    - Understanding planned behaviour & norm activation in design of display choices
      - Work with Lightwave RF and WMG shelved – project didn't focus on display changes
    - Effect of temporal distance on future thinking about domestic temp. control
      - Crowd design study prepared
  - 1.3.4 Perception Gaps (WBS, leveraging Innovate UK funded work)
    - Presentation of Peterborough Council and University of Warwick Studies completed
    - Next study now confirmed by Honeywell – Schools in Peterborough

# WP1.3.1: Case Studies - Thermal Stores

- ⦿ Determining user requirements for domestic thermal stores
  - Hypothesis: Thermal stores have the potential to supplement the delivery of heat from heat pumps, but householders need better information about their status/use

Work completed to date:

- 35 in-depth interviews with householders (combi-, conventional and solar systems)
- Exploring use of hot water storage as a proxy for future thermal stores
- Focusing on interaction between householders, the hot water system and how it is planned/controlled
- Exploration of current and future use in homes, including:
  - Understanding whether people check or consider how much hot water they have available
  - How do people ensure the system meets their requirements for hot water?
  - When the system doesn't meet their requirements, what do they do? (e.g. wait, boil a kettle etc)

Next steps:

- Interviews complete, analysis in progress. Insights so far....
  - People implicitly or intuitively manage hot water with little formal feedback
  - People are risk averse and would be concerned about “external” use of “their” hot water
  - Paper in preparation for Energy Research and Social Science

## WP1.3.2: Case studies – Heat Emitters

- ◎ Consideration of the human factors relating to heat emitters for retrofitted domestic heat pump systems
  - Hypothesis: Low temperature heat pump systems require changes to heat emitters to deliver the required thermal performance in homes, but these changes may not be acceptable to householders.
  - Work completed to date:
    - Review of heat emitters and identification of relevant human factors, e.g. noise levels, power requirements
    - Review of the 'Heat emitter guide for domestic heat pumps'
    - On-line survey about heat emitter use (n=290)
  - *Tentative* insights so far.... Practicalities and preferences represent barriers to retrofitting fan-assisted radiators

### Next steps

- Wider distribution of the survey, planned for Winter 2016-17
- Interviews and home walk-throughs, planned for Winter 2016-17

# WP1.3.3: Case studies - Smart Display & Control

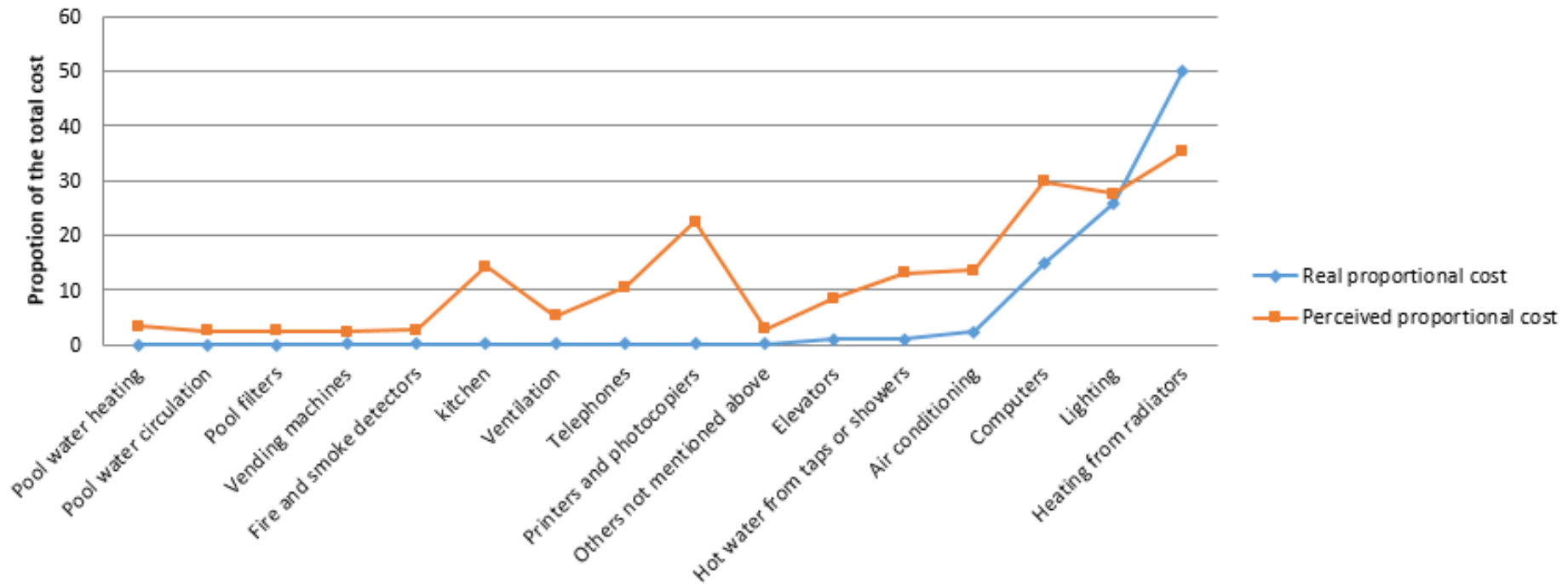
- ◎ Effect of temporal distance on creativity in domestic energy control design (broader than just display units)
  - Hypothesis: *Priming* to set temporal distance increases creativity and consumer engagement in designing how energy might be controlled in the future
    - Consumer-led design approach with elements of crowd sourcing and crowd evaluation
  - Study 1: Online experiment
    - Impact of priming (tomorrow vs. 1yr) before commencing task
    - Hypothesis is that where primed for a longer term, people think more of higher level goals and develop solutions that are more creative and engaging, as evaluated by expert judges
    - Online Survey prepared; final review 4/4/16 with launch after; 2wks data collection, 2wks analysis
  - Study 2: Lab experiment version of Study 1 using the priming effects seen as significant in Study 1
    - Evaluation of designs compared between experts, peer participants & crowd
    - Design underway; Experimental work planned for May
  - Study 3: Evaluate other elements of construal level theory
    - From temporal distance to social distance (for self or others), geographical distance (your home vs other buildings), uncertainty (probability of implementation)

## WP1.3.3: Case studies: Perception Gap

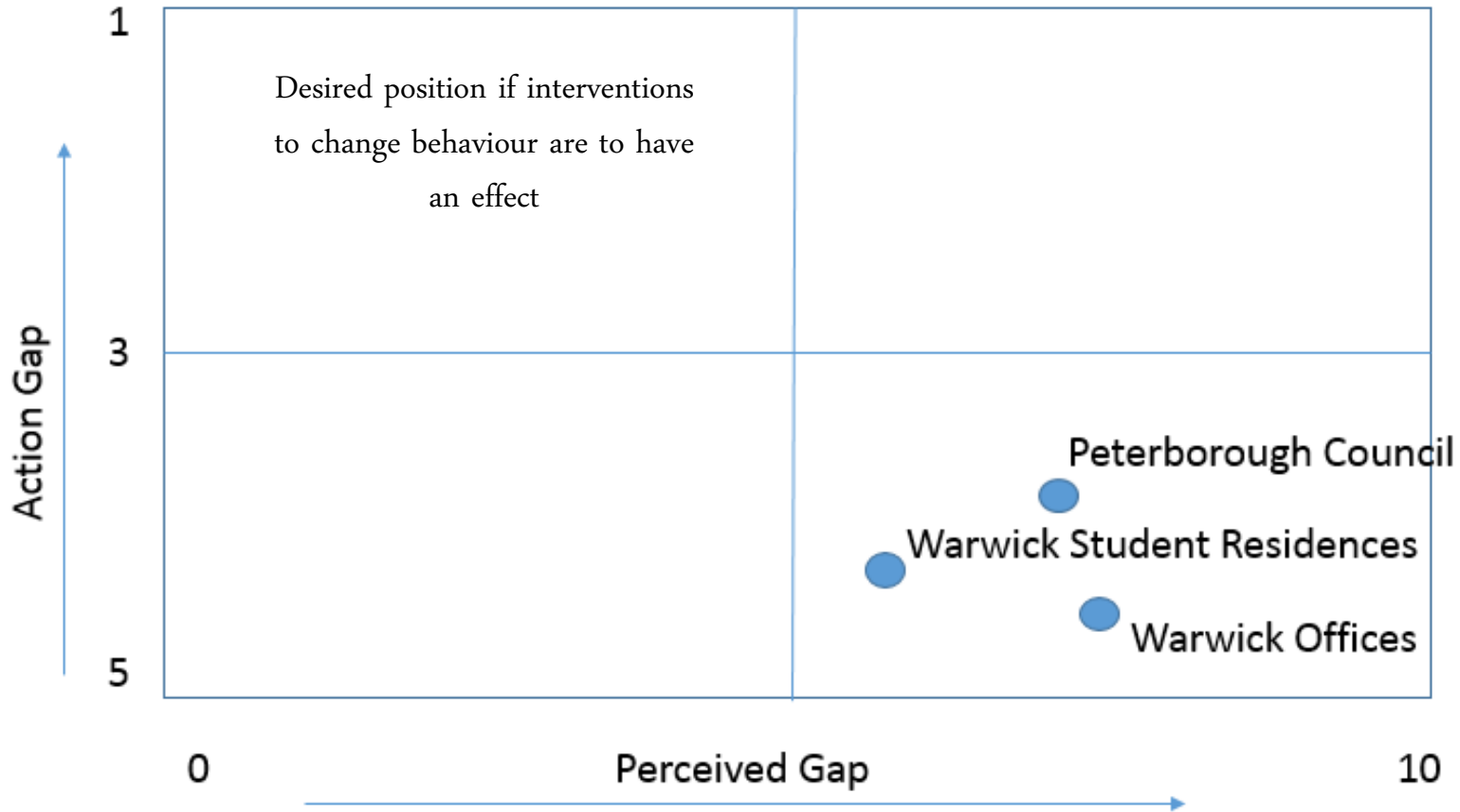
- ⦿ Work on behavioural factors influencing energy saving actions in situations where economic incentives are not at play.
- ⦿ Developed with Honeywell as a two stage, interview + survey process to include in their Energy Management contracting
  - The initial interviews (15-20 selected staff) characterised the estate, indicated the main energy consuming activities and so guided the subsequent survey.
  - The subsequent survey (250-350 respondents) measured what people know about the energy consumption of the buildings they work or live in and their views on energy saving interventions they could take
- ⦿ Assessment and analysis completed & prepared as presentation for:
  - Peterborough Council Estate
  - University of Warwick Estate, separating out...
  - University of Warwick Student Residences
- ⦿ Preparation for next example underway – Peterborough Schools

# Example of the perception gap

Real proportional cost and perceived proportional cost of each type of energy user in the Town Hall



# Considering both the perception gap and the action gap





# WP1.4: Behavioural Insights – Case Studies

- ⦿ Original intentions and timescale:
  - Activities commenced according to plan and progress as described
- ⦿ Achievements to date & Outputs to date
  - The mix of start, progress, add & stop intended
  - Market oriented research involving companies and consumers
  - Proposed new business process on trial at Honeywell
- ⦿ Has the effort been justified?
  - Yes; includes mixes academic research with near-to-market opportunities
- ⦿ Synergies with other WPs
  - Shared activity with WP3.
- ⦿ Recommendations - is it worth continuing?
  - Yes

# WP1.4: Behavioural Insights: Experiments

## ◎ Concept

- “To provide converging evidence on a full range of possible business propositions, and provide vital data for zeroing in on precisely which proposition features are likely to lead to success or failure”

## ◎ Strategy

- A structured series of experiments to systematically address the behavioural challenges identified in the WP1.1 review
- Sequence and content determined by a mix of the review insights and experimental outcomes.

## ◎ Targets for 3rd Annual Report

- Present the programme of experimental work, which had only just commenced in Y2
- Highlight areas of confirmation, contradiction & insight
  - Some results are contradicting more general studies & need confirmation

# WP1.4: Behavioural Insights – Experiments

Progress since last MC meeting in **Red**:

- ⦿ Experiment 1.4.1a – Aligned versus non-aligned information
  - Status and output: Complete and written up as white paper
- ⦿ Experiment 1.4.1b – Follow-up on Alignability effects
  - Status: **Design complete, testing to commence in the next two weeks**
  - Output: Aim to publish as two study paper (with 1.4.1a)
- ⦿ Experiment 1.4.1c - Eye-tracking insight into aligned versus non-aligned information
  - Status: On hold/low priority as primarily repeating 1.4.1a&b
- ⦿ Experiment 1.4.2a – Temporal Discounting
  - Status: **Initial pilot study now complete, and written up as white paper**
- ⦿ Experiment 1.4.2b – Follow-up on Temporal Discounting effects
  - Status: **Design complete, testing to commence shortly**
- ⦿ Experiment 1.4.3 – Norms and Action Inertia
  - Status: **Design complete, pilot testing to commence shortly**
- ⦿ Experiment 1.4.4 – Messenger Effects
  - Status: **Design discussions underway**

# WP1.4: Behavioural Insights - Experiments

## Experiment 1.4.1a – Boiler/Heat Pump Choice (Alignability effects)

- ⦿ **Aligning effects** occur when you present side by side comparisons of product features and people place more weight on aligned features when products are similar or presented as similar
- ⦿ Key findings from our study presenting boiler and heat pump choices in both aligned and unaligned comparisons
  - Evidence for an increased probability of selecting superior alignable options when products were similar
  - An increased tendency to copy non-aligned information over when options are presented as similar.
  - No effects of alignability found for differing products – leading to rationale for Experiment 1.4.1b
  - Insight: Presenting alternative heating technologies in ways that encourage alignability effects risks “copy over” and a focus on the attributes
  - Opportunity: How can people be encouraged to think beyond the details?
    - High construal level thinking vs low construal level theory

# WP1.4: Behavioural Insights - Experiments

## Experiment 1.4.1b – Follow-up on Alignability Effects by adding Priming

- ◎ The shift in focus away from alignable features when technologies differ may be explained by shift in construal levels
- ◎ **How can people be *primed* to focus more on higher-order goals** than on maximizing output in the immediate situation?
  - ◎ Primed by being asked to consider actions tomorrow or next year before presented aligned and non-aligned options for boilers and heat pumps
- ◎ Predict there will be an increased probability of making a green versus non-green choice when higher-level construals are activated. Further, that there will be an interaction between construal level and alignability – with non-aligned information and high-level construals providing the conditions under which ‘green’ choice will be most viable
- ◎ Status: **Design complete, testing to commence in the next two weeks**
- ◎ Implications: Informs the type of information structure and processing strategy most likely to lead to desired behaviour

# WP1.4: Behavioural Insights - Experiments

## Experiment 1.4.2a – Temporal Discounting

- ⦿ Temporal Discounting: the value of a reward decreases as the time delay until its receipt increases.
- ⦿ Experiment's Aim: **To exploring methods for overcoming temporal discounting effects in field of domestic heating technologies**
- ⦿ Compare choice of standard versus energy efficient technologies according to
  1. **Framing the benefits** in different ways. Benefits presented as....
    - Bill reduction
    - Spend monthly with examples
    - Extra to spend monthly or yearly
    - Save monthly or yearly
    - Earn monthly or yearly
  2. **Understanding Patience effects** (assess the willingness to wait of the participants)
- ⦿ **Status:** Pilot study complete (403 participants), and written up as white paper

# WP1.4: Behavioural Insights - Experiments

## Experiment 1.4.2a – Temporal Discounting: Preliminary Findings

### © Framing

- All responses to framing showed a preference for the efficient solution (>2.5)
- The 50% benefits offered suggests a ceiling effect which will be addressed in follow-up study using 30%
- Marginal effects that save yearly and earn yearly frames lead to increased likelihood of selecting the energy efficient versus standard technology

Condition	Frame	N (403)	Subset	
			1	2
7	Bill reduction	36	3.6389	
9	Control group (no frame)	40	3.8	
6	Spend monthly with examples	42	3.9048	
5	Extra to spend yearly	40	3.975	
2	Save monthly	50	4.06	
4	Extra to spend monthly	49	4.1224	
1	Earn monthly	56	4.1429	
8	Earn yearly	44		4.2727
3	Save yearly	46		4.3261
Sig.			0.101	<b>0.073</b>

# WP1.4: Behavioural Insights - Experiments

## Experiment 1.4.2a – Temporal Discounting: Preliminary Findings

### ◎ Patience effects

- Study establishes clear link between patience & willingness to invest in energy efficient technology
  - A one-way between subjects ANOVA revealed a significant main effect of average patience scores on heating system preference:  $F(2,399) = 6.77, p=.001$ , with greater patience scores ( $M=1$  vs.  $M=2$ ) associated with an increased likelihood of selecting the energy efficient option ( $M_s = 3.56$  vs.  $4.11$ ).
  - We are not aware of the link between patience and environmental factors being reported before
- Our study finds that on the whole people are patient, with the vast majority opting to wait for the larger reward on the two patience measures used
  - Group 1 (N=16) – Impatient (prefer smaller sooner option in both cases)
  - Group 2 (N=52) – Present focused or classic hyperbolic discounting (prefer smaller sooner, larger later)
  - Group 3 (N=9) – Future focused (prefer larger sooner, and smaller later)
  - Group 4 (N=325) – Patient (prefer larger later in both cases)
  - This is in contention with previous work which has largely assumed that people are impatient, and generally prefer to “experience rewards sooner and to delay costs until later” (O’Donoghue & Rabin, 1999, pp. 103). Did the choice test prime them into assessing themselves as patient?
  - Patient people show greater likelihood of selecting energy efficient option (significantly so, see next chart), but all had a preference (>2.5) and so need to repeat with a lower benefit level

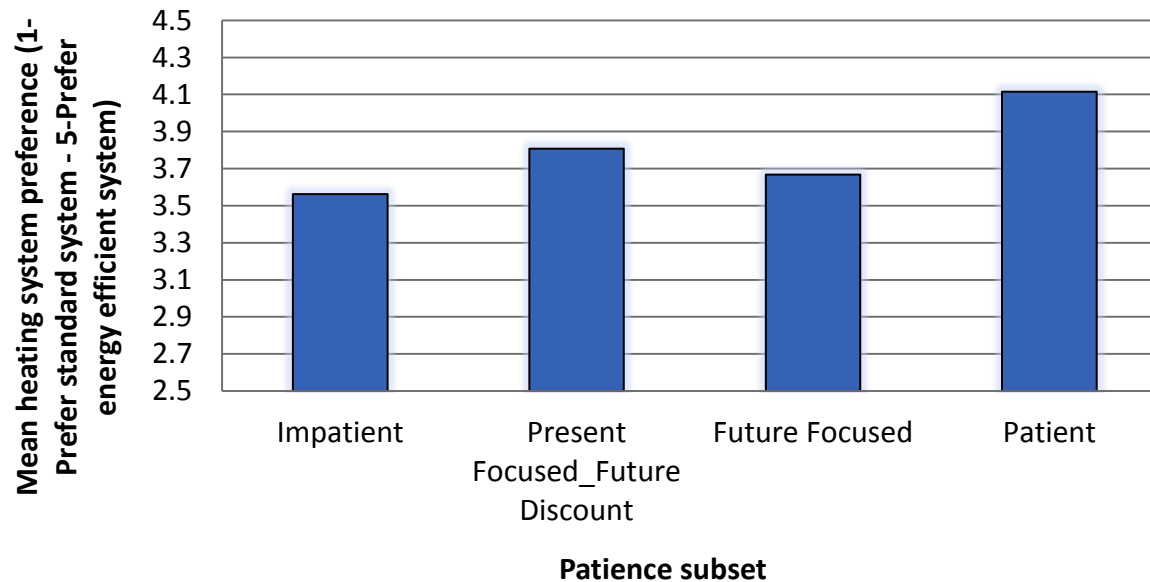


# WP1.4: Behavioural Insights - Experiments

## Experiment 1.4.2a – Temporal Discounting: Preliminary Findings

A one way between subjects ANOVA was conducted to assess the impact of patience groups on heating system preference.

Results revealed a significant main effect of patience on heating system preference [ $F(3,398) = 4.78$ ,  $p=.004$ ] with the patient subset being most likely to choose the energy efficient option



Bar chart displaying the effects of patience on standard versus energy efficient technology preference.

# WP1.4: Behavioural Insights - Experiments

## Experiment 1.4.2b – Follow-up on Temporal Discounting Effects

- ◎ **Outline:** In depth exploration of framing/patience effects.
  - Interaction between long versus short term financial frames and patience effects:
  - Sequence of choice test and patience test
  - Different level of benefits for a more marginal choice
- ◎ **Status:** Design complete, testing to commence shortly
- ◎ **Output:** 1.4.2a written up as white paper. Upon completion 1.4.2b will be incorporated into two study paper and submitted to high impact journal for publication
- ◎ **Implications:** Considerations of temporal discounting and patience could have substantial impact on the attractiveness of i-STUTE technologies. Results tentatively highlight the importance of decision frame and patience on option selection, both of which will be explored further in 1.4.2b.

# WP1.4: Behavioural Insights - Experiments

- ◎ Experiment 1.4.3 – Norms and Action Inertia
  - **Outline:** Exploring the comparative impact of normative and default interventions in increasing new technology selection
  - **Design:**
    - Following procedures established in earlier experiments, participants given choice of standard versus energy efficient heating systems
    - Participants allocated to one of two interventions – normative vs. action inertia
    - Normative intervention group are informed of majority preference for either standard or energy efficient system (counterbalanced)
    - Action inertia intervention group are informed that either the standard or energy efficient system will be installed as default, unless an active choice is made to switch to the other option
    - Comparative influence of the two interventions on likelihood of selecting (or opting to stick with) energy efficient system assessed
  - **Output:** Design complete. Data collection to commence shortly

# WP1.4: Behavioural Insights - Experiments

- ◎ Experiment 1.4.4 – Messenger effects
  - **Outline:** Experiment to explore the impact of messenger influence on likelihood of selecting new vs. standard technologies
  - **Progress:** Design discussions underway
  - **Design ideas:**
    - Study to use same procedure as previous work assessing choice of standard versus energy efficient heating systems
    - Systems will be presented with information from varying messenger sources (energy providers; local installers; government officials; researchers; industry experts)
    - This study will allow us to determine the most effective messenger type to use in later policy and/or marketing communications in order to promote new technologies

# WP1.4: Behavioural Insights - Experiments

- ⦿ Original intentions and timescale:
  - Activities commenced earlier than plan and progress as described
- ⦿ Achievements to date & Outputs to date
  - Experiments now producing insights on energy choices present in i-Stute
  - Some confirm established thinking... some differ from prior work
  - Impact has been academic dissemination so far
    - Plan for further academic dissemination prepared. Need to firm up plans for policy and business impact
- ⦿ Has the effort been justified?
  - Yes; i-Stute decisions being analysed within recognised behavioural science frameworks and identifying how such choices might be presented
- ⦿ Synergies with other WPs
  - Need to converge what WP1.4.1 is proposing with what other WPs can achieve
- ⦿ Recommendations - is it worth continuing?
  - Yes

# Summary

- ⦿ **WP1.1: Review and synthesis of existing activities.**
  - Completed – Ongoing dissemination through papers & cases
- ⦿ **WP1.2: Business model typology.**
  - Work underway, need to consider securing more company participation
- ⦿ **WP1.3: Behavioural Insights – Case studies.**
  - Started as per schedule; Ongoing work in the four cases plus one shelved
- ⦿ **WP1.4: Behavioural Insights – Experiments and focus groups.**
  - Started earlier than plan (Oct 2014 vs July 2015)
  - Significant experimental programme now delivering results

# Reminder: Review and synthesis of psychological barriers to behaviour change

Promoting Behavioural Change to Reduce Thermal Energy Demand in Households

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## Abstract (199 words)

A reduction in thermal energy consumption in buildings is vital for achieving the reductions in CO<sub>2</sub> emissions that are part of EU-2020 targets. A key challenge faced by behavioural scientists is to understand what encourages people to adopt more efficient ways of achieving a satisfactory thermal experience. We review the psychological barriers to reducing thermal energy demand in the context of energy-efficient technology adoption, and discuss ways these barriers may be overcome. The barriers include: demand on cognitive resources due to decision complexity; the tendency to procrastinate and discount future consequences; deferral to simplifying strategies including repeating past experience and copying the behaviour of others; the desire to act in ways that maintain a positive self-image; and inertia due to fear of regret that one's decision might be wrong. We discuss behavioural approaches to overcome these barriers, such as emphasising public choice of “green” technology, reframing of benefits, simplifying and optimising the choice environment, focusing on symbolic attributes of new technologies, and changing the temporal structure of costs and benefits. We provide a framework of suggestions for future research which together constitute an important first step in informing behaviour change efforts designed to reduce thermal energy consumption in buildings.

**Keywords** Behavioural science; sustainability; energy-efficient technology; demand reduction; behaviour change; choice optimisation

- Consideration of these seven psychological barriers to behaviour change, with consideration of how each may counteract or supersede rational economic choices, and how each may be overcome in order to reduce the energy efficiency gap and encourage uptake of new technologies

- Action inertia: Why do I have to change?
- Social norms: What do my friends or neighbours do?
- Messenger effects: Who told us?
- Emotions: How does it make me feel?
- Perceived behavioural control: Can I do it?
- Temporal discounting: When will I get it?
- Habit: What do I usually do?