Behavioural Insights - Case studies

Thermal stores for future domestic heating and hot water systems.

Victoria Haines and Clare Lawton

Loughborough Design School
Loughborough University
Two projects

Aims

1. Thermal stores
   • To understand the user requirements for future thermal stores for domestic heating and hot water systems.

2. Heat emitters
   • To understand the user requirements for future low temperature heat emitters for domestic heating.
   • To explore potential changes in behaviour that may result from the introduction of new low temperature systems.
   • To ascertain the practicalities of retrofitting new low temperature systems into existing housing stock.
Methods

Thermal stores
- Online questionnaire
- Context mapping and interviews
- Workshops

Heat emitters
- Online questionnaire
- Interviews and Walk throughs in the home
Purpose

- Explore issues relating to hot water tanks current use and satisfaction/dissatisfaction
- Explore/provide answers to Bob’s questions relating to heat emitters
- Recruit for interviews – filtering process
Online questionnaire  ‘Your home Your heating’

Type of information collected

- Heating and hot water types of generation (Solar PV, Thermal, Heat pumps, Type of boiler etc.)
- General demographics – house type, household / occupancy

Heating
- Sources used for providing heat in addition to / or instead of central heating
- Ways in which radiators are used for drying and warming tasks
- Perceived warmth of house
- Satisfaction with warm up times
- Scenarios where quick increases or decreases in temp would be beneficial
- Acceptable response times

Hot water
- Schedules for heating hot water
- Satisfaction of use and meeting hot water demands
- Information used for planning and/or conducting hot water tasks
- Additional information that would be useful or desired
Online questionnaire  ‘Your home Your heating’

N= 218

<table>
<thead>
<tr>
<th>Solar panels</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar thermal</td>
<td>2</td>
</tr>
<tr>
<td>Solar photovoltaic (Solar PV)</td>
<td>14</td>
</tr>
<tr>
<td>Both - Solar photovoltaic (Solar PV) and Solar thermal</td>
<td>4</td>
</tr>
<tr>
<td>Don’t know</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boiler</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combination</td>
<td>65</td>
</tr>
<tr>
<td>Condensing combination</td>
<td>31</td>
</tr>
<tr>
<td>Condensing (with hot water tank)</td>
<td>39</td>
</tr>
<tr>
<td>Non condensing (with hot water tank)</td>
<td>26</td>
</tr>
<tr>
<td>Open fire with Back boiler</td>
<td>0</td>
</tr>
<tr>
<td>Gas fire with back boiler</td>
<td>5</td>
</tr>
<tr>
<td>Closed room heater with back boiler</td>
<td>1</td>
</tr>
<tr>
<td>Don’t know</td>
<td>28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heat pump</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Source Heat Pump (ASHP)</td>
<td>4</td>
</tr>
<tr>
<td>Ground source heat pump (GSHP)</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hot water supplied from..</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>A hot water tank/hot water storage cylinder</td>
<td>91</td>
</tr>
<tr>
<td>A thermal store</td>
<td>3</td>
</tr>
<tr>
<td>A combination boiler</td>
<td>91</td>
</tr>
<tr>
<td>A community hot water supply</td>
<td>0</td>
</tr>
<tr>
<td>Don’t know</td>
<td>6</td>
</tr>
</tbody>
</table>
Other tasks data collected for includes
- Drying towels / tea towels
- Drying shoes
- Warming towels prior to use
- Warming clothes prior to wearing / going out/ going to bed
- Warming shoes prior to wearing / going out
- Warming duvet prior to going to bed

78% (n=170) of all respondents reported using a source of heating to dry clothes.

Of those 170, 162 provided additional information on the type of heat sourced used and distance/location.

70% (153 out of 218) reported drying clothes using radiators.
41.5% hot water tank / thermal store users (39 out of 94) check or consider how much hot water is available before doing a task that needs hot water.

Methods and the how likely they are used to check/consider how much hot water is available are shown here -

![Bar chart showing methods and their likelihood for checking/considering how much hot water is available.](chart.png)
Ratings for what information/function people with hot water tanks would find useful – from a provided list.
Online questionnaire  ‘Your home Your heating’

Progress

• Links to online questionnaire distributed end of March 2015 - ongoing
• So far 262 responses
• Further avenues to increase and broaden response rate are being under taken, including press releases, targeted leaflet drop (local area) ETI, HP association, LAs
• Households with Solar panels and Heat pumps to be targeted
• Considering paying for ‘Survey distribution service’
Online questionnaire  ‘Your home Your heating’

Please circulate the link to as many people as possible.

https://www.surveymonkey.com/s/YourHeatingQuestionnaire
Thermal stores

Context mapping and interviews
Thermal stores- context mapping and interviews

**Two parts**

- **Part 1** - Participants current hot water system
- **Part 2** - Potential future hot water system using a thermal store within the home
Part 1 - Current use, behaviours and understanding

**Part 1 interview explores...**

- Participants current hot water system
- Current use of the system
- Planned use (heating times)
- Strategies of use (i.e. negotiation, awareness, decision making)
- How deal with unexpected events (What if…)
- Points of user satisfaction / dissatisfaction
- Practicalities of the system
- Any suggested improvements
Part 1 - Current use, behaviours and understanding
Part 1 - Current use, behaviours and understanding
Part 2 - Future use, behaviours and requirements

Part 2 interviews

Purpose

• To help visualise potential future systems (thermal stores) and future use scenarios

Aim

• To explore and develop future requirements for thermal stores and associated appliances
Part 2 - Future use, behaviours and requirements
What sort of ‘Future energy scenarios’ will a thermal store be functioning in?

Assumptions:
- Domestic heating will be predominantly electrical
- Microgeneration will be commonplace in homes
- Grid supplied electricity will have highly variable tariffs
- Electrical supply could therefore be intermittent or expensive
- Demand-side management will be expected at a household level
Part 2 - Future use, behaviours and requirements
Part 2 - ‘Future scenarios’ interviews aim to explore…

- Planning behaviours and decision processes
- What information is or would be useful, where and when
- Potential changes in behaviour
- Potential interaction with appliances
- What information / designs would encourage/enable appropriate changes
- How a thermal store would fit within their current home / lifestyle, practicalities etc..
- What would be needed to make it fit within their current home / lifestyle
- Potential positive attributes of a thermal store as the energy hub of their home
- Link between hot water and energy
Thermal stores- context mapping and interviews

Participants

- Solar panels
- Heat pumps
- Combination boilers
- Boiler with hot water tank

Households with 3 or more occupants

Progress

- Pilot trials complete (n=5)
- Trials to be conducted July – August (n=40)
- Recruitment and bookings for trials has started
Hot water tanks and Thermal stores

Unvented Hot Water Cylinders

Introducing the Quantum® water cylinder

Benefits
- Energy storage feedback display.
  Helps homeowners to plan their water usage accordingly.
- Holiday function.
  Ensures heating function is disabled during holiday periods.
- Energy consumption history.
  Helps homeowners to identify usage patterns and modify consumption.
- Family setting.
  Enables increase of stored hot water volume to accommodate short-term visitor needs.
- Party function.
  Extends timer programme by a number of hours.
- Time programme:
  Enables user to create profiles with four on/off times and independent volume and temperature settings.

Smart feedback display:
- The display will turn red once a high temperature (e.g., 60°C) is exceeded, at the top of the cylinder. The display will also indicate the volume of water available at the user-defined preset temperature.
- Unrefilled heat retention:
  Minimizes heat loss for lower energy consumption and running costs.
- Four temperature sensors for unparalleled accuracy.
  Follows target temperature, adjustable to ±1°C.
- Primary and boost temperature settings:
  Enables users to increase temperature as and when required.
- Ensures hot water availability meets usage demands.
- Hygiene function:
  Ensures hygienic water delivery from the cylinder.
- Flexible delivery:
- Smart Grid ready:
  (Additional components required)
- Supports upcoming changes in energy supply.
  To improve efficiency and lower costs.
- Fast reheat for freely available hot water.
- Low maintenance.
- No hidden costs.
- Overheat boost switch:
  Can be located in kitchen or wherever convenient.
Synergies with HotHouse

HotHouse is focusing on hot water and future stresses on demand for domestic hot water.

We are focusing on domestic thermal stores, which might be a hot water tank, the potential for managing the store and the information needed to facilitate this.

Shared data collection, shared publications

- Meeting regularly with Hothouse colleagues
- Identifying common areas and avoiding overlap
Heat emitters - Informal interviews / walk through and ‘Future scenarios’

**Purpose**
- To determine the use and location of heat emitters in homes
- To ascertain how future heat emitters might fit within existing and future lifestyles

**Progress**
Product review of fan assisted radiators completed
1st visit (interviews and walk through)
- Sensitisation and immersion activities developed
- In-depth interviews / walk through procedure developed
- Pilot trials conducted (n=4)
2nd visit - ‘Future scenarios’
- ‘Future scenarios’ activity to be developed and piloted

Trials to be conducted Oct- Feb 2016 (heating season)
Thank you.

Any questions?