

## WP1: Behavioural Insights - Case studies

### Heating strategies for domestic hot water

Dr Victoria Haines and Clare Lawton

Loughborough Design School

Loughborough University



# Domestic Thermal Energy Stores

- One local energy storage solution is to establish TES in UK homes to replace or supplement current hot water systems.
- However there has been a rising trend in penetration of combination boilers in households since 1991, growing from 1.2% in 1991 to 37% (condensing and non-condensing boilers) in 2007 to 48% in 2013 (EHS 2013).
- This has:
  - Reduced the actual energy storage volume present in the UK
  - Domestic space which HW cylinders previously occupied may have a significant value in itself.
  - Combination boilers may have altered end users expectations regarding the provision and use of hot water.
- End user's motivations/goals and their consequent actions to attain those goals can counteract the efficient use of products /systems.

# This presentation...

UCD Activities	Progress
Online questionnaire 'Your Home Your Heating'	<ul style="list-style-type: none"><li>• N= 300</li><li>• Analysis of results complete.</li><li>• Draft report produced.</li></ul>
<b>Current practices interviews - Heating strategies for domestic hot water</b>	<ul style="list-style-type: none"><li>• <b>35 interviews completed (Combination boilers, Hot water cylinders, Solar PV or thermal)</b></li></ul>
Future thermal stores interview - Interview facilitated by playing a game	<ul style="list-style-type: none"><li>• 35 interviews completed (Combination boilers, Hot water cylinders, Solar PV or thermal)</li></ul>
Heat emitters - Interviews and walk throughs in the home	<ul style="list-style-type: none"><li>• Winter 2016-17</li></ul>

# Participants

Type of household	All participants (N=35)	Participants with cylinder (N=21)	Participants with combi system (N=14)
Family	80% (n=28)	76% (n=16)	86% (n=12)
Couple	9% (n=3)	10% (n=2)	7% (n=1)
Retired couple	11% (n=4)	14% (n=3)	7% (n=1)
Total	35	21	14

# Interviews - Current use, behaviours and understanding



# Current practices interview findings...

- Hot water heating strategies
- Motivators / drivers for each strategy
- Instances of inadequate hot water
- Avoidance behaviours
- How avoidance behaviours selected and instigated



Journal paper to be submitted to Energy Research and Social Science (ERSS)

## Also

- Values of hot water systems  
i.e. Space saver, Airing cupboard, Additional source of heat, Enabler.
- Value of hot water  
i.e. Per-functionary, Relaxation, Reward, Play
- Behaviours relating to airing cupboards and radiators
- Changes in peoples behaviour with the addition of solar panels  
(recognised changes, successful changes, unsuccessful changes)



Drafting Journal paper

# Strategies for heating hot water – Type 0,1,2 and 3

Type 0 – Hot water heated demand

Type 1 - Frequent heating up and storing hot water for all eventualities. Set to continuous (throughout the daytime) or programmed with extensive heating times of prolong duration.

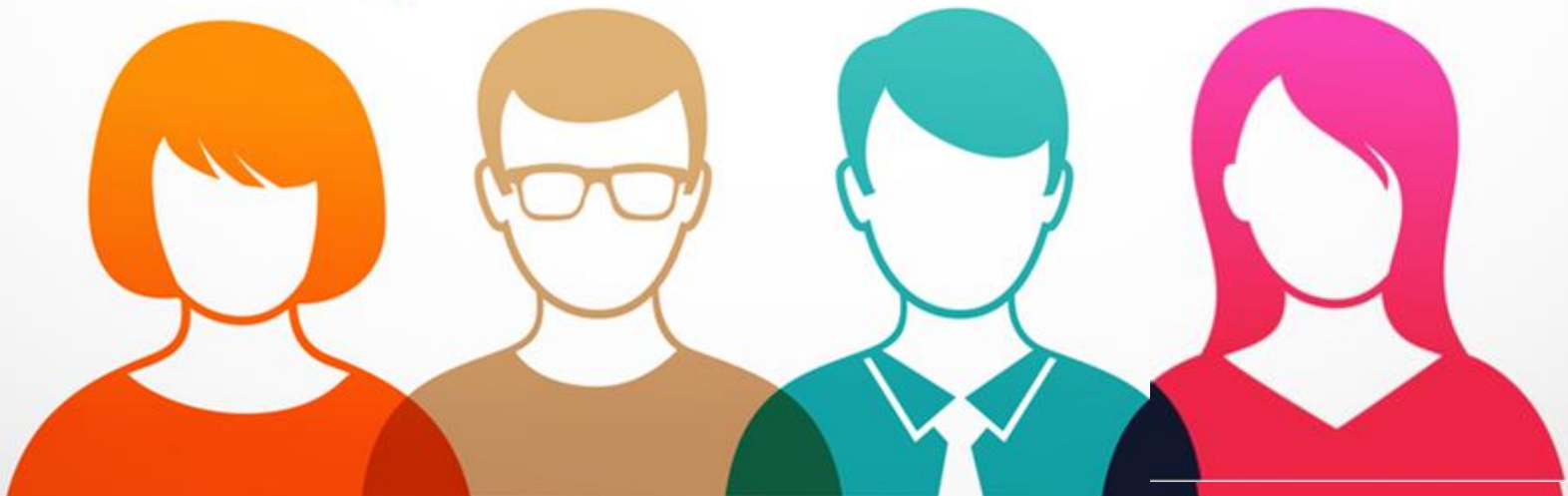
Type 2 - Using two pre-programmed boiler heating times of short duration providing 'just enough'.

Type 3 - Solar energy used to heat hot water with no pre-programmed contributions from the boiler. Therefore timing of heating hot water likely to be unknown and unpredictable. Type only used in summer months.

# Type 0 – Hot water heated on demand

*“It's not like I've got to say ooh, there's no hot water at the moment. It suits a family where everybody's coming and going at different times”.*

*“We had a house with a tank before. I can remember the second shower, you'd complain to the first person for using too much. There would be quite a lot of arguments and continual discussions of who's doing what.”.*



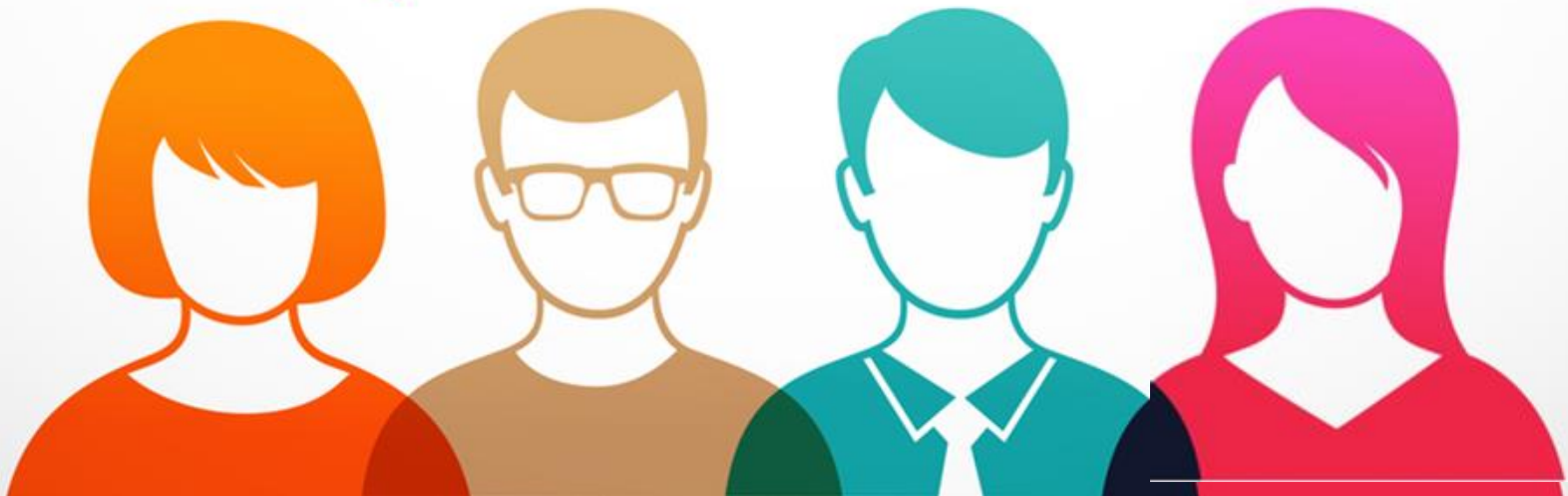


# Type 1-Frequent heating up and storing hot water for all eventualities

*“To heat the tank and have continual hot water 24/7.”*

*“I set the times so that I know that nobody’s going to come and hassle me and say, can you put the water on or whatever.”*

*“The water would store in the tank for the morning... the temperature will drop a bit but it’s not wasted energy.”*

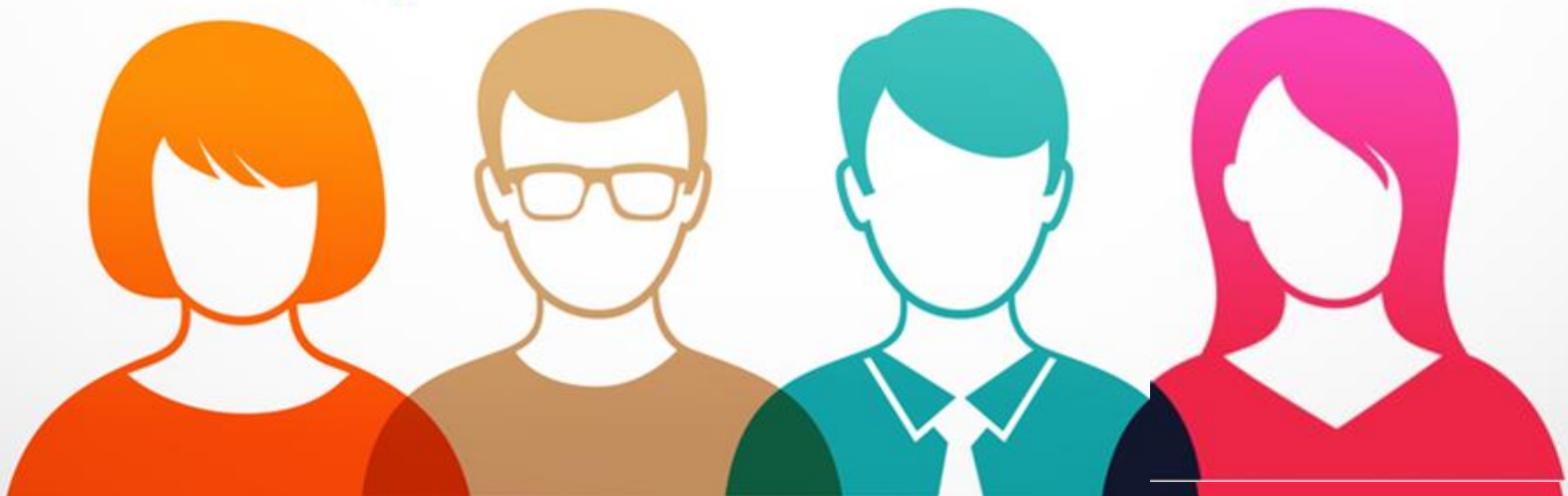


## **Type 2** -Strive to provide 'just enough' hot water'

*We tweaked the times until we got to the point where I think it's more adequate and not being excessive."*

*"We do know that we're on the edge because as soon as we have something happening out of the ordinary we do run out of hot water."*

*"I don't really see the point in having a tank that's constantly being warmed up sitting in the middle of a house that we might not be in. It seems inefficient."*

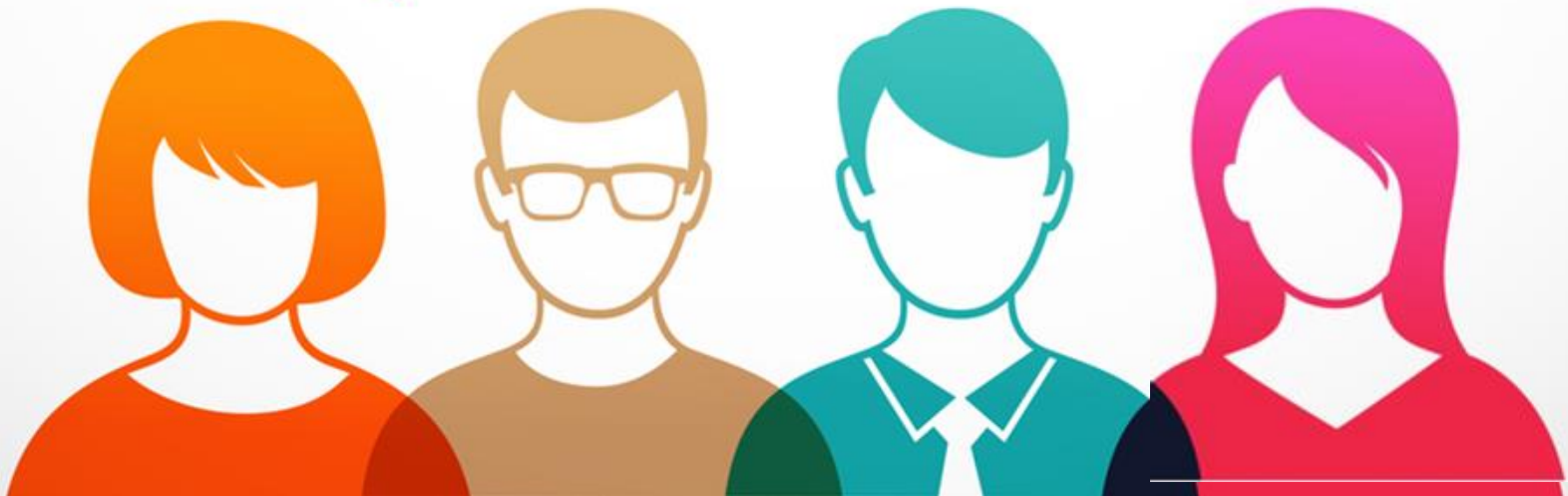


# Type 3 – Solar energy used to heat hot water with no pre-programmed contributions from the boiler

**“May, September, that’s when I am running out of hot water and use the kettle more to do any washing up or whatever.”**

**“Summer months we use the excess electricity from the solar panels. We just don’t bother switching the hot water on at all. You can pretty much do it. Other than if two people have a bath”.**

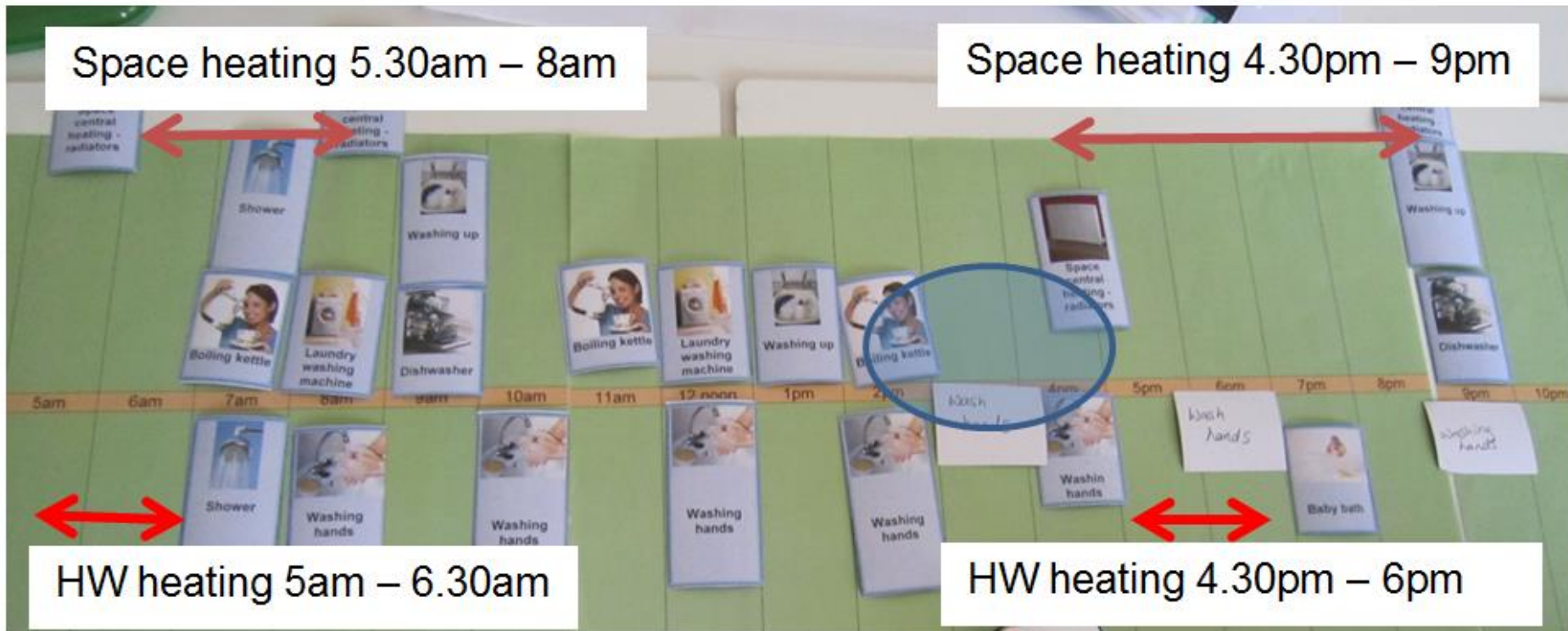
**“I think what a fabulous position to be in. Cost it doesn’t even occur to me”.**



Avoidance behaviours	Example quotes	Type 2 / 3 N=16
Override practices - i.e. immersion, boost, advance	<i>"I kind of think, oh we've had a couple of showers, I better put the heating on before they have their bath."</i>	94% (n=15)
Alternative source of HW supply	<p><i>"I use the electric shower, so I wouldn't have to put the hot water on for that, that's why I tend not to use the bath as much."</i></p> <p>"I'll be having to use the kettle more to do any washing up or whatever."</p> <p><i>"If my wife really needs to unwind I take up a few kettles full of hot water for her bath at that time when she can get away from the kids."</i></p>	56% (n=9)
Tactile Check	<p><i>"Open the airing cupboard, touch the pipes going to the cylinder and then decide whether to put the boost on."</i></p> <p><i>"I've run the water and actually there isn't any or nowhere near enough then I'd just switch it off, put the hot water on for a bit."</i></p>	50% (n=8)
Weather check	<i>"It's entirely weather dependent. So I'm more interested in what the weather's doing than anything else."</i>	25% (n=4)
Tolerate	<i>"The fact that during the course of the day I occasionally find myself washing up in lukewarm water is reassuring."</i>	50% (n=8)
Waiting or postpone		13% (n=2)



**Participant 13 (type 2)** “Um, we have done a couple of times when we’ve ended up doing loads of washing up in the day (participant indicates late afternoon, circled area).”



# Implications for domestic TES

**1. Ideally TES will supply hot water on demand** – to meet the values/motives previously identified; Convenience, Not having to plan, Not having to interact with the system, Enables non routine life styles, and to Facilitate household harmony.

**2. In cases where TES not able to do this – need to take insights from Type 2 and Type 3 strategies, for successful application of these strategies:**

- Participants rely on having predictable HW usage
- Participants have internalised mental model of a cylinders heating - charging and discharge times (Past usage and future usage)
- An understanding of number tasks typically conducted from a heated cylinder
- Awareness of likely 'At risk times' – to choose overrides, makes them more accepting of having to wait or tolerate inadequate HW.
- Ability to use avoidance behaviours.

# Domestic Thermal Energy Stores

Potentially-

- Heating times may be controlled by the system to match energy production times.
- End users may be aware of discharge times (i.e. use of hot water/space heating) but less aware of charging times and durations.
- The ability to override the system maybe counteractive to system efficiency.
- The size of TES unit maybe substantially different, it may be larger, smaller or distributed.
- The addition of providing space heating from the same store may add another layer of complexity in usage, demand and user understanding.

# Implications for domestic TES

Need for a future system that builds on end users existing motives, behaviours and understandings to increase acceptance and efficient use of the system.

- Future thermal stores interview - Interview facilitated by playing a game





# Current practices interview findings...

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Drafting  
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paper

## Future interviews

Thematic analysis- underway



Thank you

Any questions?

[V.J.Haines@lboro.ac.uk](mailto:V.J.Haines@lboro.ac.uk)

[C.Lawton@lboro.ac.uk](mailto:C.Lawton@lboro.ac.uk)