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USING A SCENARIO-BASED METHODOLOGY TO ASSESS USERS' REQUIREMENTS FOR FUTURE THERMAL ENERGY STORAGE SYSTEMS

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1. INTRODUCTION

Across the UK, forward-looking government policies are pointing towards the development of new, more sustainable and efficient technologies to meet the target of reducing 80% of greenhouse gas emissions by 2050 [1]. To realise this ambitious target, future energy systems are likely to rely heavily on intermittent energy generation and thermal energy storage. To design future socially, technically and economically viable thermal energy storage systems, a fundamental aim is to understand users' attitudes towards energy storage. This paper takes a user centred design approach to understand the users' requirements for future thermal stores for domestic heating and hot water systems by developing and assessing the effectiveness of innovative methods of requirements capture. An exploratory design game, the *Energy Game*, was developed and employed, aided by vignettes, to introduce users to the notion of future energy generation and identify key barriers and challenges to deployment and adoption within UK households. The inclusive nature of the game aims at enhancing users' input into innovation and encourages them to contribute to the co-design of future energy storage systems. This research study was conducted as part of the i-STUTE End Use Energy Demand centre.

2. METHODOLOGY

Data were collected from 10 families with mean household income £40,000–50,000, diverse educational background and hot water systems that included hot water tank, combination boilers and PV systems. The data collection proceeded in two steps; an unstructured interview during which participants were introduced to the game and real-life scenario: participants were asked to put themselves in the situation of the 'Little People'- a family living in the future represented by vignettes [2] and complete a series of hot water and heating-related tasks using a timeline tool (Step 1). The timeline tool was constructed for the purposes of the current study and represented a typical day in which the home is likely to be most occupied e.g. Saturday. Schematic representations served to visualise the daily hot water family routine and the hot water tank/store (Figure 1). Then, a semi-structure interview was conducted to explore users' views towards future energy storage and proactively engage them in the co-design of a more efficient system in order to maximise adoption (Step 2). The use of the scenario-based game methodology has been considered an effective way for contextualising occupants' attitudes towards future systems as it allows users to envision interactions

and functions leading to more suitable, valuable and environmentally friendly technologies [3]. The *Game* was developed from previous work that examined the use of creative methodologies to encourage user involvement in design [4, 5]. NVivo, qualitative data analysis software, was used for the data coding and identification of themes. Data from the interviews were analysed using a combination of inductive [7] and deductive approaches [8].

Figure 1. Illustration of the scenario-based game.

3. CONCLUSIONS

The use of the *Energy Game* elicited a mixture of reactions and user requirements. The introduction to the game and potential future energy generation made users more energy aware (n=3) and helped them appreciate the environmental benefits along with the cost efficiency of using a thermal energy storage (n=3). The use of schematic representations and visual information, specifically, the ability to see inside the hot water tank (n=3) and awareness of the upcoming tasks (n=2) seemed to be essential for participants when making decisions for either completing or postponing a task. Also, through the *Energy Game* it was evident that the majority of the participants were concerned about the inconsistent energy generation (n=4) and the inconvenience of the system (n=4). Therefore, to overcome these barriers of adoption, key requirements for the design of future energy efficient systems and appliances are, feedback on energy use and consumption (n=4), information on the cost of hot water use (n=2) and embedded features that would help occupants reduce consumption (n=2). The creative scenario-based game developed for this paper proved to be an insightful avenue for offering a glance into the future allowing users to envision future circumstances, their usage and interaction with future technology.

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