SIF Project Registration

Date of Submission

Mar 2022

Project Reference Number

10027307

Project Registration

Project Title

CEV: Critical factors for the adoption of smart homes for energy efficiency and implications for consumers and providers

Project Reference Number

10027307

Project Licensee(s)

Northern Gas Networks

Project Start

March 2022

Project Duration

2 Months

Nominated Project Contact(s)

LRobson@northerngas.co.uk

Project Budget

£55,396.00

Project Summary

This project seeks to understand the factors influencing the adoption process for all customers, identifying challenges, barriers, and risks of adoption of data and digital technologies in the context of smart-homes by reviewing and analysing both academic and industry-level research and project outcomes, which would then be applied to the testing phase of this project to prove or disprove the findings and identify appropriate mitigating factors

Nominated Contact Email Address(es)

innovation@northerngas.co.uk

Problem Being Solved

In order to meet the challenge of achieving net-zero by 2050, the UK needs to decarbonise 20,000 properties each week for the next 25 years to meet its goal. This includes work to improve households' energy and water efficiency, which considers the technologies and appliances, as well as the building fabric itself. Even small changes at the household level can result in a significant impact on the energy network when aggregated. Such a large-scale implementation requires influencing household behaviours. The ability to engage with the transition to net-zero is not something that customers universally possess. An individual may be limited by their 1) capacity to engage, 2) the opportunity to participate, or 3) their willingness to take the risk, as explored by CSE (2018): 1. A customer requires the intellectual capability to understand the benefits of the solution being offered, the financial capabilities to purchase the solution being offered, and the technical capability to use the solution appropriately. 2. A customer requires the opportunity to participate, be that a service provider offering them the opportunity, or if there is a need for their participation on the system they are connected to. 3. Often with innovation comes risk and uncertainty. A customer, particularly one with additional needs, may not have the same appetite for risk and therefore may be unwilling to participate. Low-income and/or vulnerable households, often considered the hard to reach, can often be left behind due to one, or a combination of, the above points being true. The adoption process may not be directly relevant to these households, as the decision is made for them at the first stage based on the barriers to entry they face. As such, the majority of those who are currently engaged with the journey to net-zero and may already be using low-carbon technologies are not those who would benefit the most from the potential bill savings derived from these technologies. The decarbonisation agenda must therefore address

this, ensuring that nobody is left behind or disadvantaged

Project Approaches And Desired Outcomes

The Big Idea

Aims: Understanding customer desire to change and their risk appetite is vital to delivering benefits for consumers from the decarbonisation of energy. Doing so, and building an assessment framework of key principles, will allow future projects to be user-driven, informed by past learning and successes. Our aim is to provide a smart-home adoption framework that can be used as a starting position for projects involving a significant data/digital side. Such a framework can facilitate the delivery of the next generation of user driven digital products, services, and processes. In particular, we are interested in how consumers can share data to engage in energy system innovation whilst maintaining privacy and security, and secondly how digital infrastructure including (smart home/energy) sensors can be effectively utilised.

Discovery Phase: The project will undertake a full analysis of existing academic and industry research and project reports related to smart-homes, to provide an evidence base of key insights and learning to be built upon. Systematising the findings related to novel uses of data and digital platforms will not only make it possible to better understand customers but can provide useful findings that can improve network planning, modelling, and forecasting capabilities. Our review findings will underpin the development of a framework which can then be utilised by NGN and other networks and organisations, to aid their transitional net zero projects.

Future Work: It is proposed that the smart-home framework be tested with consumers as an extension to the NIA funded Customer Energy Village energy efficiency project. The Alpha phase submission will apply the framework and learning from the proposed Discovery phase, engaging customers to validate their attitudes to change and risk in the context of energy, and then work to identify mitigating factors to overcome any barriers or challenges, co-designing energy efficiency solutions which work for them. Following this, a Beta phase submission will make it possible to test in action and revise/expand the framework further, by identifying additional consumer-focused energy efficiency projects to engage with, alongside more targeted customer testing through the Customer Energy Village project.

Innovation Justification

Despite the increasing interest in data/digital technologies in making homes “smarter”, research in this domain is confined within the boundaries of three themes. Firstly, papers do not typically consider the multidimensionality of the concept of the smart-home, thus leading to a one-sided representation of its implications, services and user segments. Only one review in 2008 offered insights into the state of smart-homes adopting a multidimensional perspective, rather than focusing on a specific target audience, service, or technology. The authors pointed out the tendency to describe potential benefits of technology ignoring the users’ viewpoint and following a product-centric approach. According to them, the prevailing technological focus of the research explains the low acceptance of smart-homes in the market. Secondly, papers tend to examine smart-homes through a technological perspective, by focusing on the functions of devices, the infrastructure, and the architecture of automated homes. Third, the majority of studies propose potential benefits that smart-home technology is capable of capturing, while providing little empirical evidence regarding the users’ perception of the challenges and benefits of the smart-home technology use. In addition to the above academic and industry research are often treated separately, which misses the opportunity to synthesize technology adoption research with empirical validation in the energy context.

Similarly, four limiting factors related to technology acceptance in the context of energy management and sustainability have recently been identified in the area of technology acceptance, which need to be considered when it comes to understanding the impact of data and digital technologies on the environment. These limiting factors include the technology use predictors, the task-technology impact, implementation issues and the knowledge gap, and system lifetime and long-term implications. The above factors indicate that, although emphasis on the antecedents of technology acceptance is understandable, considering the rapid pace with which technology has developed and how users had to adapt to it, less emphasis has been put on the expected outcomes and impact that acceptance and associated individual behaviours can have when aggregated. When it comes to examining the smart-home factors predicting technology use, more research could consider specific factors that precondition environmentally compliant behaviours and a positive outcome of technology use and at the same more actively examine the implications and impact of the technologies, contributing to our understanding of the societal impact that information and communication technologies have in energy management.

Project Plans And Milestones

Project Plan And Milestones

The project will be split into four work programmes (WPs), with four associated milestones (MSs) and a final project deliverable.

WP1: Define the objectives and scope of the review / 1 week

As two teams with appropriate backgrounds and skills will be reviewing the two main bodies of literature related to smart-homes, it is important that we set a robust review protocol to follow. This will guide the efforts of the two teams in the main part of the project and ensure consistency between the two teams. MS1: Review Protocol for the academic and industry smart-home reviews

WP2: Undertake the review / 4 weeks

The two teams will undertake the review of the literature, which involves selecting/filtering relevant smart-home articles, classifying them, identifying the key themes, and then discussing the content. MS2: An academic review and an industry smart-home review

WP3: Joint review / 2 weeks

The two teams will work together to produce a joint report based on the reports produced as part of WP2, and develop the framework of key principles MS3: A joint review report

WP4: Dissemination / 1 weeks

We will disseminate the report online and organise a webinar presenting the main findings. MS4: A webinar presenting the main findings of the review. An online resource will be created from the outset and updated during the project.

Final Deliverable: A publicly available review report on smart-home and energy efficiency

Route To Market

A strong foundation based on knowledge and understanding is critical to facilitating large scale change. Multiple smart-home projects are currently being undertaken, each looking at discrete areas of the journey to net zero, some directly working with consumers, but many looking only at the technical aspects. Harvesting valuable insights from each of these projects and applying those findings to future ones is crucial to maximising the value, impact, and reach of the work undertaken. We cannot influence change if we do not assess both the desire to change, and the risk appetite, of our consumers. This is not a one-off process, rather it is a knowledge base which can, and will, be built upon throughout the journey to net zero, and beyond. As technologies change, and consumer understanding of the challenges, and their willingness to respond to them, increases, the knowledge base will grow, and outputs will change accordingly. But it cannot grow, and we cannot learn from it, unless we hold all relevant information in one place.

This discovery phase project seeks to achieve this by providing a comprehensive review and a good-practice framework related to smart-homes and energy utilisation and management that can inform future projects. The analysis undertaken during this discovery phase will build the knowledge base to influence future smart-home projects and scaling-up of initiatives to support the journey to net zero. Understanding the outcomes and insights from both academic research and industry projects to identify the challenges and barriers customers face, their willingness to change, and their acceptance of risks, will then inform both current and future projects in this area, including the NIA funded Customer Energy Village energy efficiency project, and more. This synthesis of evidence can then be built upon as projects and smart-home technologies evolve and will be made publicly available through multiple dissemination routes to ensure all networks and industry stakeholders can access and learn from the knowledge base. In addition to the various published reports, a framework of key principles will be produced and made accessible to external stakeholders, to provide a mechanism to implement key findings and best practice in future project design. The above will help understand whether users' habits and behaviour comply with sustainability practices and facilitate the implementation of the full potential of technology

Costs

Total Project Costs

55396

SIF Funding

55396

This project has been approved by a senior member of staff

☑ Yes