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Barriers to participation in smart home technology

Findings from desk research, stakeholder interviews and consumer research

A Collaborate Research report for Citizens Advice, March 2023

Contents

1. Executive summary

1.1 Introduction

More flexible energy use, supported by smart technology, has the potential to provide a number of important consumer and societal benefits. However, a key concern to Citizens Advice is that some people risk being left behind in the transition to a smart and flexible energy future. The aim of this research was therefore to address a gap in the evidence by focusing on specific groups of consumers that Citizens Advice considers to be most at risk of facing barriers to using smart home technology, including due to:

- having a physical, mental or cognitive disability;
- being digitally excluded or disadvantaged; or
- having lower literacy or English language competency.

This research was primarily concerned with exploring non-financial barriers, particularly related to the usability of smart home technology, for the above target audiences. There was also a related aim to update Citizens Advice's understanding of the smart home technology landscape in order to assess the extent to which access and inclusion is currently being considered by the market.

We undertook a multi-stage research programme between October 2022 and February 2023 to meet these aims:

Research method
1. A **Quick Scoping Review (QSR)** of available evidence on access and inclusion of smart home technology for the target audiences.
2. **10 interviews with smart energy companies and wider industry stakeholders,** to provide indicative evidence on current industry practices and what more is believed to be needed.
3. **Qualitative/deliberative consumer research, including 4 workshops and 6 in-home interviews in England and Wales**. The objective of this stage was firstly, to explore the target audiences' own awareness, experiences and views of smart home technology and secondly, to gauge their reactions once the concepts of smart home technology and smart energy have been further explained.
4. **A further 10 usability-focused in-home consumer interviews**, to get a more detailed understanding of participants' own technology use in the home and gauge their responses once introduced to an example of a smart energy system.

1.2 Key findings

We found little explicit focus in the literature currently on usability-related barriers to participation in smart home technology and none that specifically relates to people with low literacy or English language skills.

Our primary research addressed this evidence gap by identifying a multifactorial set of barriers which limit the target audiences' ability and/or willingness to participate in smart, flexible energy. Our focus was on exploring those specifically relating to technology usability but some people also had other barriers including:

- low financial resources meaning that they would struggle to afford such technology;
- low flexibility capital meaning that are unable to modify their energy usage behaviour; and
- low trust and confidence that a smart, flexible energy future would be beneficial to them.

The COM-B behavioural model provides a systematic framework for understanding the different usability barriers that are relevant to the target audiences, and these spanned their capability, opportunity and motivation to engage with smart home technology:

- **Capability:** While smart home technology was already present in some participants' homes, many lacked the required knowledge, skills and abilities to engage with it. This was due to digital exclusion, low literacy or English language competency, or cognitive impairments that affected their ability to interact with the technology.
- **Opportunity:** There were also external factors preventing some people being able to use smart home technology. These included not having suitably adapted technology for their needs in the case of people with certain disabilities (e.g. vision, hearing or dexterity impairments), having insufficient digital connectivity where they live, or not being able to have a smart meter at home.
- **Motivation:** While some smart devices are regarded more favourably than others, generally speaking the perceived negatives of smart technology outweigh the positives for many of those involved in this research. Participants voiced concerns about the financial costs, complexity, as well as what they regarded to be risks and potential negative behavioural impacts associated with the use of such technology. This meant that, in many cases, there was little willingness to engage with smart home technology.

It was evident in this research that some people experience more significant obstacles than others, including those with the lowest skill levels, barriers in multiple areas or with no access to support.

In terms of addressing these barriers, consumers' suggestions mainly focused on providing suitable information and guidance, as well as more intensive support for those with more complex needs.

We found limited published material on how access and inclusion is currently being considered by industry in the design and delivery of smart home technology. The smart energy companies we interviewed reported that they are considering access and inclusion in a variety of ways but there

was no evidence of specific accessibility standards being applied to the design of their smart technology. These companies expressed interest in receiving more information on the main usability barriers experienced by different consumer groups as well as guidance on how to address these.

The wider industry stakeholders we engaged with believe that some changes to the way smart home technology is designed is required to ensure greater access and inclusion, including:

- the application of inclusive design principles and potentially also minimum standards; and
- the involvement of people with diverse needs throughout the whole design process.

However, enabling everyone to participate in the smart flexible energy market is felt to extend well beyond just design considerations and also require efforts to ensure that consumers are able to:

- understand the concept of smart flexible energy and its benefits;
- can compare offers and choose the best solution for them;
- can set up the technology themselves or have it installed appropriately; and
- are able to deal with any issues or problems they may experience.

1.3 Conclusions and implications

Our consumer research findings plug a gap in the evidence about particular groups of consumers who are likely to struggle to participate in smart and flexible energy due to barriers they face in using the requisite technologies. It will be important for those involved in this market to understand and address these barriers in order to support the commitment set out in the Government's 2021 Smart Systems and Flexibility Plan[1] to ensure that the benefits of flexibility are accessible to all consumers.

The evidence from this research suggests that enabling the target audiences to participate effectively in smart and flexible energy will require a range of interventions at different stages of the consumer journey - from initial awareness and consideration of the concept of smart flexible energy, through to choosing, setting up and using the appropriate technologies.

The table below summarises what we regard to be some potential interventions at each of these stages:

	Potential interventions to increase access and inclusion	
	Why?	*How?*
Build understanding, trust and confidence	So that the target audiences understand the concept, why it's important and beneficial and do	• Public education campaigns • Measures to reduce the risk of participation (e.g. financial support, 'try before you buy' schemes)

[1] BEIS and Ofgem (July 2021): Transition to a net zero energy system - Smart Systems and Flexibility Plan 2021

	Potential interventions to increase access and inclusion	
	not feel coerced into making changes	
Facilitate informed choice	So that the target audiences can compare offers and choose the best solution for themselves	• Providing information in different formats and languages • Developing tools (e.g. a traffic light system, access to mock-ups) to help consumers to evaluate options • Providing the option to consumers of accessing free, impartial advice
Ensure appropriate set-up	So that the target audiences can set up the technology themselves or have it installed appropriately	• Simplifying the set-up process as much as possible • Ensuring installers understand and can respond to different consumers' needs • Providing access to appropriately trained customer service agents to provide set-up guidance and support
Enable use of the required technologies	So that the target audiences are able to learn how to use newly adopted technology and resolve any problems either initially or down the line	• Ensuring inclusive technology design • Providing support where needed • Enabling proxy use by trusted parties (e.g. family members) if required

Ofgem's current Consumer Vulnerability Strategy (CVS)[2] provides a relevant framework for considering potential interventions to address the barriers identified in this research. One of its five priority themes is 'encouraging inclusive innovation', which our research suggests could be achieved by applying appropriate principles and standards to smart technology design, as well as by involving a diverse user group in the design process. However, ensuring fair and positive outcomes for all consumers will require more than just attention to design; it will also require identifying, and providing appropriately tailored support to, consumers with significant barriers to engaging with smart home technology. In addition, continued efforts to increase digital access and inclusion will be required in order to reduce the incidence of consumers with these barriers to participating in smart and flexible energy.

[2] Ofgem (25 October 2019): Consumer Vulnerability Strategy 2025

2. Introduction

2.1 Background and aims

A large-scale transition to a smart and flexible energy system, where smart technology supports more people to use energy flexibly, is key to achieving the government's net zero goals as set out in the 2021 BEIS and Ofgem Smart Systems and Flexibility Plan.[3] The rollout of smart metering has opened up the potential for energy tariffs to draw on real-time price signals from the grid and offer dynamic pricing for using energy at different times. In the near future, it is expected that there will be more smart time-of-use tariffs available which provide households financial rewards for shifting their energy usage away from peak times, communicated via dynamic price signal notifications.[4] Alongside these new tariffs, it is expected that more households will utilise smart home products, such as smart washing machines or smart electric vehicle home chargepoints, to automatically use energy when there is less demand or excess renewable power on the grid (subject to each household's flexibility preferences as set out in a home energy app).[5]

More flexible energy use, supported by smart technology, has the potential to provide a number of important consumer and societal benefits such as reducing emissions, keeping people's homes warm and saving them money on bills by enabling the grid to run more efficiently. However, a key concern to Citizens Advice is that some people risk being left behind in the transition to a smart and flexible energy future, especially as fully reflective pricing can be expected to mean costs will rise for those who are unable to participate, causing detriment to these consumers and potentially increasing social inequality. It is therefore critical that the smart energy market is developed in a way that is inclusive of all consumers, including those who can be expected to face increased barriers to using smart home technology due to their circumstances.

While Citizens Advice's previous research has considered consumers with barriers to participation in smart energy, it was part of a larger sample. The aim of this study was to address a gap in the evidence by focusing on specific groups of consumers that Citizens Advice considers to be **most at risk of facing barriers to using smart home technologies**, including due to:

- having a physical, mental or cognitive disability[6];

[3] BEIS (2021) Transitioning to a net zero energy system: smart systems and flexibility plan 2021

[4] See Citizens Advice's previous research on modern time-of-use tariffs: Citizens Advice (2021): Innovation in the tariff market: Discussion paper on how new tariffs can work better for people

[5] The British Standards Institute defines an 'energy smart appliance' or ESA as a communications-enabled device able to respond automatically to price and/or other signals by modulating or shifting its electricity consumption. Services provided to the electricity network through this consumption modulation are known as 'demand side response' or DSR. BSI: Energy smart appliances programme [accessed February 2023]

[6] 17.8% of the population of England and Wales identified as being disabled in the 2021 Census

- being digitally excluded or disadvantaged[7]; or
- having lower literacy or English language competency[8].

This research was primarily concerned with exploring **non-financial barriers**, particularly related to the **usability** of smart home technology for the above target audiences. There was also a related aim to update Citizens Advice's understanding of the smart home technology landscape in order to assess the extent to which access and inclusion is currently being considered by the market.

2.2 Methodology and sample

We undertook a multi-stage research programme to meet these aims, as summarised below:

Summary of research method
1. A **Quick Scoping Review (QSR)** of available evidence on access and inclusion of smart home technology for the target audiences.
2. **Stakeholder interviews,** to provide indicative evidence on current industry practices and what more is believed to be needed.
3. **Qualitative/deliberative consumer research,** firstly, to explore the target audiences' own awareness, experiences and views of smart home technology and, secondly, to gauge their reactions once the concept of smart home technology and smart energy is explained further.
4. **Further usability-focused consumer interviews**, to get a more detailed understanding of participants' own technology use in the home and gauge their responses once introduced to an example of a smart energy system.

More detail on the primary research (stages 2-4) is provided in the table below:

	Stakeholder interviews	Qualitative/deliberative consumer research	Further in-depth consumer interviews
Recruitment approach	Stakeholders were identified through Citizens Advice's networks or had taken part in previous	The sample was free found by specialist research recruiters using a variety of methods including databases, snowballing and	Most participants were reconvened from the earlier research stage. Additional participants were free found using

[7] Previous research by Lloyds, as reported in Citizens Advice (2022): Access Denied: Digital disadvantage and exclusion in the energy market, shows that in 2011 around 1 in 20 UK adults did not use the internet and 1 in 5 adults lacked some of the 'essential digital skills for life', like using email or search engines.

[8] 8.9% of the population of England and Wales reported that English was not their main language in the 2021 Census. Most amongst this group said that they were proficient in English but 1.5% did not speak English well and 0.3% could not speak English at all. Each UK nation has a different definition of basic literacy skills but the latest available statistics, as reported by the National Literacy Trust, show that 16.4% adults in England in 2012 had 'very poor literacy skills' and 12% in Wales in 2010 lacked 'basic literacy skills'.

	Stakeholder interviews	Qualitative/deliberative consumer research	Further in-depth consumer interviews
	Citizens Advice research.	referrals from relevant charities.	similar methods as in the previous stage.
Sample size	10 stakeholders	30 consumers	10 consumers
Data collection approach	Interviews by video or telephone lasting c.45 minutes	4 x 2.5 hour mini-workshops and 6 x 75-minute in-home depth interviews	In-home depth interviews lasting c.75 minutes
Sample composition	• Representatives of 4 companies active in the smart energy market and 6 wider industry or third sector stakeholders	• People with disabilities including physical vision and hearing impairments, mental health problems, learning disabilities and neurodiversity (n=18) • People who are not online, have limited connectivity or low digital skills (n=14) • People with lower literacy or English language skills (n=11) • Representation of people from minoritised backgrounds (n=10) • A mix of gender, ages (from 29 to 82), household compositions, housing tenures, meter types and income levels	• Disabled people (n=7, including two with physical impairments, two with hearing impairments, two with learning disabilities and one with a vision impairment) • Digitally excluded or disadvantaged people (n=3) • People with low literacy or English language skills (n=4) • Representation of people from minoritised backgrounds (n=4) • A mix of other socio-demographic characteristics

	Stakeholder interviews	Qualitative/deliberative consumer research	Further in-depth consumer interviews
Locations	National coverage	Both stages of the consumer research were conducted in 4 locations across England and Wales: Greater London, Leeds, Reading and Cardiff	
Timing	10th October to 11th November 2022	15th November - 8th December 2022	6th - 17th February 2023

2.3 How we made the consumer research accessible and inclusive for the target audiences

As the target consumer audiences in this research were 'harder to reach', we employed a number of approaches to overcome any barriers to participation and ensure the research was inclusive. These included:

- Working with a specialist recruitment agency, with past experience of engaging the target audiences, which drew on multiple recruitment methods to identify eligible participants.
- Opting for smaller workshops (6 participants) to provide a more intimate setting for the discussions, ensuring that all workshop venues were accessible and minimising the length of the workshops to minimise the burden of participation.
- Offering in-depth depth interviews as an alternative to the workshops for people who would find it difficult to participate in a group setting.
- Providing whatever adaptations and support individual participants required, as identified through the recruitment process (e.g. some participants with low English were accompanied by family members to help with translation).
- Ensuring that the moderator read out any written information during the sessions, as well as providing alternative ways to enable participants to express their views (e.g. an image bank and emojis).

Given the expected low base of awareness amongst the target consumer audience of smart home technologies, we used deliberative methods in the consumer workshops to develop participants' understanding, following an initial unprimed exploration of their awareness and views. We drew on a toolkit of techniques to build knowledge, including simple fact sheets and group exercises designed to enable participants to develop solutions to any challenges they had identified.

In the subsequent usability-focused interviews, we drew on ethnographic and usability testing methods:

- We commenced by observing and discussing how each participant used technology in their own home.
- We then introduced participants to a smart home heating system (including two dummy thermostat units and a demonstration app) and gauged how they interacted with this and their views on its usability. The purpose of this exercise was not to evaluate this specific system but to use it as stimulus material to ascertain the general requirements of participants for them to be able to use a smart energy system.

2.4 This report

This report covers the main findings from all four stages of this research. The detailed findings that follow are arranged into the following two sections (listed according to their numbering in the report):

3. Learning from the QSR and stakeholder interviews
4. Insights from the consumer research

We used a primarily grounded thematic approach for analysing the primary research findings, which is a systematic process that identifies all the themes emerging from the research responses and measures their prevalence. In addition, to add further insight we applied the behavioural science-based COM-B Model[9] to help interpret the behavioural barriers affecting the target consumer audiences involved in this research.

Anonymised verbatim quotes have been presented alongside the narrative commentary in this report to provide a flavour of the views expressed, and selected case studies have also been included to illustrate individual experiences (with all names changed to protect participants' confidentiality).

There is also a standalone executive summary (Section 1) that precedes this Introduction, and a final section (Section 5) that sets out what Collaborate Research regards to be the key Conclusions and Implications from this research.

[9] See, for example, Social Change (2019): A guide on The COM-B Model of Behaviour

3. Learning from the QSR and stakeholder interviews

3.1 Summary of findings

- There is little explicit focus in the literature currently on usability-related barriers to participation in smart home technology and none that specifically relates to people with low literacy or English language skills.
- We also found only limited published evidence on how access and inclusion is currently being considered by industry in the design and delivery of smart home technology.
- The smart energy companies we interviewed reported that they are considering access and inclusion in a variety of ways, however there was no evidence of specific accessibility standards being applied to the design of their smart technology.
- These companies expressed interest in receiving more information on the main usability barriers experienced by different consumer groups as well as guidance on how to address these.
- Wider industry stakeholders believe that some changes to the way smart home technology is designed is required to ensure greater access and inclusion, including:
  - the application of inclusive design principles and potentially minimum standards; and
  - the involvement of people with diverse needs throughout the whole design process.
- However, enabling everyone to participate in the smart flexible energy market is felt to extend well beyond just design considerations and also require efforts to ensure that consumers are able to:
  - understand the concept of smart flexible energy and its benefits;
  - can compare offers and choose the best solution for them;
  - can set up the technology themselves or have it installed appropriately; and
  - are able to deal with any issues or problems they may experience.

3.2 Existing evidence on barriers to participation for the target audiences

Our quick scoping review (QSR) established that most of the existing literature on consumer barriers to using smart technology is not directly relevant to this research as it is concerned with the either:

- consumers generally rather than the specific audiences of interest for this research; or

- barriers due to other characteristics (e.g. low income or low 'flexibility capital'[10]) rather than due to the usability of technology as was the focus of this research.

There is limited literature on the additional barriers faced by disabled and digitally excluded people. These barriers are reported to be:

- A lack of digital technological readiness (due to not having the digital hardware, connectivity, skills and/or level of digital engagement) to participate in and benefit from opportunities[11,12].
- Issues related to the accessibility of consumer information on technological solutions[13].
- Issues related to the installation of smart devices[14].
- Lack of accessibility of apps to control devices for disabled people generally[15] and for people with vision impairments[16].

However, we were not able to identify any literature which considers the barriers specifically for people with low literacy or English language competency.

3.3 Indicative evidence on if and how industry is considering access and inclusion

Our QSR found the following limited publicly available evidence on how access and inclusion is currently being considered by industry and other relevant parties in the design of technology:

- The Web Accessibility Initiative (WAI) provides non-statutory guidance on website accessibility[17].
- Some other organisations also provide guidance and/or consultancy services on technology accessibility[18].
- Amazon published an article for Global Accessibility Awareness Day 2022 detailing how it has incorporated accessibility features in its devices[19].

[10] See Powells, G and Fells, M (2019): "Flexibility capital and flexibility justice in smart energy systems" in *Energy Research and Social Science* (Volume 54, Aug 2019). Available at ScienceDirect
[11] Centre for Sustainable Energy (2020): Smart and Fair? Exploring social justice in the future energy system
[12] Scope (2018): Independent. Confident. Connected. Achieving equality for disabled people
[13] RiDC (2022): How accessible is consumer information on renewable home energy & heating solutions?
[14] RiDC (2022): Research report into the accessibility of electric vehicle home charging
[15] Amazon: Amazon marks Global Accessibility Awareness Day 2022 [Accessed February 2023]
[16] Araujo de Oliveira, G et. al (2016):"Accessibility of the smart home for users with disabilities: An evaluation of opensource mobile applications for home automation", a conference paper for the 15th Brazilian Symposium. Available at Researchgate
[17] W3C Web Accessibility Initiative [Accessed February 2023]
[18] For example, AbilityNet and the Accessibility Technology Group within the UK's technical trade association, techUK [both accessed February 2023]
[19] Amazon: Amazon marks Global Accessibility Awareness Day 2022 [Accessed February 2023]

- The Research Institute for Disabled Consumers (RiDC) and Energy Systems Catapult are currently undertaking a major funded project to help develop innovative and accessible smart, low carbon energy products and services[20].

In addition, the smart energy companies we interviewed reported that they were considering access and inclusion in a variety of ways, including by:

- using simple language in their communications;
- providing guidance and support to their customers and users who require it;
- ensuring their user interfaces are intuitive;
- minimising the manual intervention needed from consumers, including through automation of processes; and
- conducting user research or instigating conversations with representative bodies on the barriers faced by some consumers.

However, there was no evidence of specific accessibility standards being applied in the design of smart technology. Some reasons for this may be that:

- while there are compulsory accessibility standards for public sector websites and apps[21] there is no equivalent for the websites or apps of smart technology or smart energy providers;
- the current British Standards Institute (BSI) standards for Energy Smart Appliances (ESAs) do not cover accessibility, and the new accessibility standard for public electric vehicle (EV) charging[22] does not as yet have an equivalent for installation of at-home EV charging; and
- there is a voluntary code of conduct, Flex Assure[23], for flexibility services providers (aggregators) who contract with non-domestic users but not yet an equivalent for the domestic market.

3.4 What stakeholders suggest to overcome barriers and enable participation

The published literature also includes some points of view on how inclusive technology can best be achieved. The disability charity Scope supports a focus on developing mainstream technology which is inclusive by design rather than specific adaptations for disabled people[24]. The Centre for

[20] RiDC (2021): "RiDC, in partnership with Energy Systems Catapult, has been awarded almost £250,000 to research how disabled consumers can have greater access to sustainable energy". Available at ridc.org.uk
[21] Accessibility requirements for public sector bodies available at gov.uk
[22] PAS 1878 and PAS 1879 are the two BSI standards related to ESAs and PAS 1899 relates to public EV charge points [All accessed February 2023]
[23] Information on the Flex Assure voluntary code of conduct for aggregators is available at flexassure.org [accessed February 2023]
[24] Scope (2018): Independent. Confident. Connected. Achieving equality for disabled people

Sustainable Energy (CSE) concurs that all technology offers should be as inclusive as possible to enable a diverge range of consumers to take them up, and they feel that this could be achieved through enhancements over time in some cases, presumably as more is learnt about different consumers' access and inclusion needs. In addition, they are of the view that achieving fairness may also require "the development of tailored products or services which enable participation by consumers otherwise at risk of being left behind."[25]

The Research Institute for Disabled Consumers (RiDC) and Energy Systems Catapult have published initial findings from their large-scale project, *Enabling Inclusive innovation and Sustainable Choice* which relate not only to product design but also installation and consumer information. They conclude that:

- Clear standards and codes of practice are required to ensure that both product and installation are accessible and meet the needs of all people, including those with different abilities and age[26].
- Innovators should involve people with diverse needs throughout the whole design process (from early exploration through to design, development and testing) to ensure everyone's needs are considered[27].
- All providers of consumer information should carry out user testing research focused on the accessibility of their websites to ensure easy access by disabled users including those using assistive technologies[28].

The smart energy companies we interviewed all recognise the importance of access and inclusion, and are keen to continue developing their products and services in order to achieve this. To support them in this endeavour, they would welcome:

- guidance on the main accessibility barriers for different consumer groups and how to address these (including good practice standards and how to prioritise their application);
- funding to support research and development in this area; and
- potentially also training for their frontline staff on how to support customers with additional needs.

However, they felt it is important not to over-regulate in this area in order not to risk stifling innovation.

The wider stakeholders we interviewed called for smart energy companies to prioritise access and inclusion in their design processes by:

[25] Centre for Sustainable Energy (2020): Smart and Fair? Exploring social justice in the future energy system
[26] RiDC (2022): Research report into the accessibility of electric vehicle home charging
[27] RiDC and ES Catapult (2022): Trialling with Disabled Consumers: Enabling energy innovation to be inclusive
[28] RiDC (2022): How accessible is consumer information on renewable home energy and heating solutions?

- applying design principles, and potentially also minimum standards, to foreground accessibility and inclusivity;
- directly involving disabled people in the development and testing of technology;
- identifying and reconciling, as much as possible, any conflicting access needs; and
- ensuring interoperability and compatibility of smart energy with other types of smart home technology (e.g. smart speakers/home assistants) as well as accessibility tools that disabled people use.

In addition, those we interviewed (both smart energy companies and wider industry stakeholders) felt that enabling everyone to participate in this market would extend well beyond just design considerations and also require efforts to ensure that consumers are able to:

- understand the concept of smart and flexible energy and why it's important/beneficial (public education);
- compare offers and choose the best solution for them (information in different formats, simple traffic light system to evaluate suitability, impartial advice);
- set up the technology themselves or have it installed appropriately (guidance and support); and
- deal with any issues or problems they may experience (transparency about responsibility, problem resolution and redress measures).

4. Insights from the consumer research

4.1 Summary of findings

- This research identified a multifactorial set of barriers which limit the target audiences' ability and/or willingness to participate in smart, flexible energy. Our focus was on exploring those specifically relating to technology usability but some people also had other barriers including:
  - low financial resources meaning that they would struggle to afford such technology;
  - low flexibility capital meaning that they would be unable to modify their energy usage behaviour; and
  - low trust and confidence that a smart, flexible energy future would be beneficial to them.
- The COM-B behavioural model provides a systematic framework for understanding the different usability barriers that are relevant to the target audiences, and these spanned their capability, opportunity and motivation to engage with smart home technology:
  - **Capability:** While smart home technology was already present in some participants' homes, most lacked the required knowledge, skills and abilities to engage with it. This was due to digital exclusion, low literacy or English language competency, or cognitive impairments that affected their ability to interact with the technology.
  - **Opportunity:** There were also external factors preventing some people being able to use smart home technology. These included not having suitably adapted technology for their needs in the case of people with certain disabilities (e.g. vision, hearing or dexterity impairments), having insufficient digital connectivity where they live or not being able to have a smart meter at home.
  - **Motivation:** While some smart devices are regarded more favourably than others, generally speaking the perceived negatives of smart technology outweigh the positives for many of those involved in this research. Participants voiced concerns about the financial costs, complexity, as well as what they regarded to be risks and potential negative behavioural impacts associated with the use of such technology. This meant that, in many cases, there was little willingness to engage with smart home technology.
- It was evidence that some people experience more significant obstacles than others, including those with the lowest skill levels, barriers in multiple areas or with no access to support.
- In terms of addressing these barriers, whilst the inclusivity of technology design is regarded as important, participants' suggestions mainly focused on providing suitable information and guidance, as well as more intensive support for those with more complex needs. It is also acknowledged that it may not be possible to overcome everyone's barriers so enabling proxy use by trusted family members is also likely to be required in some cases.

4.2 The target audience's experiences of smart home technology

Most participants reported having some types of smart technology at home but a number lacked the skills to utilise the smart functionality. Several also have low confidence when engaging with technology generally, as evidenced by the pictures they chose from a bank of images to represent their feelings about technology:

“Sometimes it can be a bit of a whirlwind, sort of getting the head around all the different things that come with technology.” (Female participant from a minoritised ethnic background with low digital skills and English as an additional language, Reading)

"Everything is up in the air, I’ve got no idea what to do. I’m afraid to press things in case I make a mistake.” (Female participant who is deaf and has low digital skills, Cardiff)

I'm useless, I'm too old to learn. My grandkids bought me a new phone and try to teach me but the next day I've forgotten what they've said." (Male participant who is over 80, has an impairment affecting his dexterity and very low digital skills, Cardiff)

This combination of a lack of skills and confidence meant that the smart home technology participants had access to was often going unused or was being used by other family members on their behalf.

“*My wife will set Hive so that when we get in 10 minutes or 15 minutes later, the heating's on place is warm.”* (Male participant with a vision impairment and low digital skills, London)

> *"I've got a camera there so if I'm bad the kids can check on me. My middle son said the camera goes in or I'll need to move in with one of them. So that's why it's here. My son did it all for me, even the internet he put in.*" (Female participant who is over 75, has several long-term conditions and has never gone online, Cardiff)

> *"We are in the process of getting mum a ring doorbell I don't know how that's going to work to be honest. I can't imagine that she can work out the settings."* (Daughter of a female participant who is over 70 , has English as an additional language and very low English language skills, as well as low digital skills, London)

In addition, of those who had personally tried to engage with their smart home technology, some experienced functional problems with setting up or attempting to use these devices or anxiety associated with their use. A few reporting giving up on smart home technology due to these issues, including one participant who swapped her smart thermostat for a standard version due to having issues with the controlling the heating, another who stopped using a smart doorbell due to being worried by the notifications, and several who were not using their smart meters due to the display of their energy usage causing them worry regarding their bills.

> *"With the voice activated technology and things like that, a lot of time I can't understand what they're telling me because I only have 27% hearing in one ear."* (Male participant with a hearing impairment, Leeds)

> *"I've got a smart meter and I wish I didn't accept it in a way. It's just I think I look at it constantly, too much to see 'oh, has it gone up? oh, I'd need to turn it off.' It just makes me panic."* (Female participant from a minoritised ethnic background with low digital skills and pre-payment meter Reading)

4.3 Views of smart technology generally

In the research, we explored participants' views of smart technology generally before we examined smart technology specifically to support flexible energy use.

Not all smart home technology is perceived equally by those involved in this research. Some devices are regarded more favourably than others as participants are more familiar with them and could more readily identify benefits associated with their use:

- smart door bells and cameras are perceived to provide important safety and security benefits, and to support independent living for some people;

- smart speakers are liked for the convenience of voice control and they are being used as assistive technology by some participants with mobility or vision impairments; and
- smart lights and thermostats are also associated with greater convenience as well as with increased comfort in the case of smart heating.

> *"I'd definitely say the heating and the speaker devices and even things like the ring doorbells [are beneficial] because obviously they can be controlled by your speaker as well. So just anything like that, really, I just think you don't have as much worry. The doorbell you can you can speak to whoever it is first before opening the door, so if you don't know who it is, you don't have to answer first because you can speak to them beforehand. And with the heat you can check it's been shut down properly because you don't have to mess about with any buttons or anything to turn them off. I literally use my speaker for everything from setting timers to alarms to my music to my books. It's everything in one place."* (Female participant who is blind, Leeds)

> *"I think that [a smart thermostat] is good for people in my age. If they're ill and in bed all they're going to have to do is press a button. That's a good idea."* (Female participant who is over 80, has several long-term conditions and has never gone online, Cardiff)

On the other hand, benefits are less readily apparent and concerns more prominent with respect to:

- smart meters, as some were not convinced about their accuracy due to negative word of mouth or poor personal experiences of smart pre-payment meters not correctly applying payments to their account;
- smart white goods, as these are perceived to be more complex to operate and some are also worried about safety risks (e.g. flooding or fire) associated with their remote operation; and
- connected homes, as there are concerns about complexity and costs associated with integration, as well as data security and privacy.

Overall, the negatives associated with smart home technology outweigh the positives for a number of people involved in this research. The main negative points raised by participants included:

- **Affordability**: Whilst the focus of this research was on non-financial barriers to smart home technology use, affordability emerged as a key spontaneous concern. Participants expected that upfront costs could be high in the case of some smart devices, and that there may also be ongoing costs (including for contracts or subscriptions) as well as further associated costs (e.g. increased energy use or needing to upgrade their home broadband connection).
- **Complexity:** As mentioned, many amongst the target audiences lack confidence in using technology and are fearful of making mistakes. Participants expect that it would be

particularly challenging for them to set up new smart home technology or to make future changes to a product or service (e.g. to upgrade it or integrate it with other smart devices).

- **Risks:** The risks perceived range from safety (e.g. when remotely activating smart appliances such as washing machines), to data accuracy (primarily associated with smart meters), and data privacy and security (especially related to the integration of multiple smart devices in smart homes). A heavy reliance on smart home technology is also expected to make households more negatively impacted in the event of any power outages.
- **Negative behavioural impacts:** Some also foresee that increased reliance on smart home technology could lead to increased laziness, loss of practical skills and more anxiety related to technological reliance.

> *"At the moment, I'm sort of budgeting and watching my electric bill. If I had all this smart technology, it's gonna have to be on all the time - you can't just turn one thing off, it's all connected together. So you're going to use a lot more electric not even being home through it just waiting for you to come and say, 'open the door and put the kettle on'...."*
>
> *"...My brother's just got a new washing machine and tumble dryer and they're smart ones and he can put them on his way home. But he couldn't even do his washing the other day, he's quite good with computers and even he couldn't work it out..."*
>
> *...I feel if I had a smart house with everything smart in it, I may as well go live with big brother because they'd know exactly when you put the kettle on because it's all got to go through your Wi-Fi provider. The whole thing with smart is that I'll feel like I've been I've been watched."* (General discussion in the Cardiff workshop)

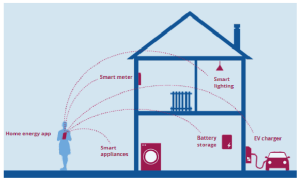
> *"I feel quite worried about it particularly for my children, for that generation, because everything is just technology. It's like you forget the old way of doing things."* (Female participant, from a minoritised ethnic background with low digital skills and English as an additional language, Reading)

> *"I see smart tech as a last resort, a luxury that I don't need. I also worry that I'd end up doing no exercise at all if I don't have to stand up to turn the lights on and off."* (Male neurodivergent participant, London)

4.4 Views of smart home technology to support flexible energy use

There was limited recall among participants of news reports related to the National Grid's Flexible Demand Flexibility Service (DFS) scheme for the winter of 2022/23[29]. In the research we explained this scheme in order to introduce the idea of consumers using energy flexibly in order to save money on bills. We told participants that, in future, it is expected that most households will routinely use their energy more flexibly in order to save money, reduce greenhouse gas emissions and protect the national grid. We then explained how smart home technology could help people use energy more flexibly. The briefing information we gave (and read out) to participants on smart flexible energy is included below.

Smart home technology can help people use energy more flexibly



- Households decide the level of flexibility that's convenient to them, usually with a home energy app
- Smart meters know when there is cheap or green power available
- They tell this to smart appliances which use this information, alongside household preferences, to decide when to turn on

The future of smart, flexible energy

- There will be a range of smart 'time of use' tariffs with lower rates when there is less demand
- Most households will use smart home technology to help them use electricity flexibly and take advantage of when there are lower rates
- Some households with electric vehicles or home batteries will also be able to charge these at the cheapest times, and may even sell excess electricity they have stored back to the grid
- However, Citizens Advice is concerned that some consumers will be held back by barriers to using smart home technology

There was a more consistently negative reaction regarding smart flexible energy compared to smart home technology generally. This was even compared to smart thermostats which had previously associated primarily with increased convenience and comfort rather than flexible energy use. There are several reasons for this:

- the future requirement for consumers to use energy more flexibly, once explained, was perceived to be an externally driven systems change rather than led by consumers to meet their own needs;
- it is expected to require major behaviour change which won't be possible for all and could have some negative impacts (e.g. disruption, inconvenience, loss of control);
- people who can't or don't want to have smart meters would also be excluded; and
- there is scepticism about the extent of financial benefits that will be offered to consumers who are more flexible in terms of their energy use.

[29] National Grid ESO: Demand Flexibility Service [Accessed February 2023]

> *"At the moment, I do quite like the feel of when I need to use something, I can just use it. If you've got appliances that come on at two and three in the morning when you're asleep, no I don't like that either."* (Female participant who is blind, Leeds)

> *"In my house the washing machine's on 24/7 because of my grandchildren and our own clothes. So how can someone put it on at 12 o'clock in the night when you're doing loads of washing? You'd need come down and change them."* (Male participant with English as an additional language, low literacy and low digital skills, Cardiff)

> *"It's going to happen whether we like it or not. It's not my cup of tea, I don't think you're going to save as much as they say*." (Male participant with a mobility impairment and low digital skills, Cardiff)

4.5 Barriers to engagement with smart home technology

Participants had different levels and combinations of barriers which limit their ability and/or willingness to engage with smart home technology. Whilst obstacles to using the technology itself were the focus of this research, a number of participants also had limited financial resources that they could draw on to acquire such technology.

In addition, when considering smart home technology specifically to facilitate flexible energy use, some people had further barriers, such as low 'flexibility capital'[30] and also low trust and confidence in the change to smart flexible energy. This lack of trust was primarily due to doubts about whether there would be sufficient financial benefit to warrant changing their behaviour in this way. Some were also not convinced that there would be sufficient support or protection available for consumers in vulnerable situations who may be less able to adapt to this change.

> *"I like paying my debts but I think with energy costs now, I am frightened of it. I do have my heating on now and again because I don't like the cold. And I have television on day and night because if I'm in pain I'll sit and watch telly in bed."* (Female participant who is over 75, has a number of long-term conditions and has never gone online, Cardiff)

> *"You've got to be under 50 to understand this; my mum would really struggle...It's not accessible for everyone. It comes down to the costs to have smart things, you need to get new appliances to go with the tech..."* (General discussion in the Reading workshop)

[30] See Powells, G and Fells, M (2019): "Flexibility capital and flexibility justice in smart energy systems" in *Energy Research and Social Science* (Volume 54, Aug 2019). Available at ScienceDirect

Barriers to participation in smart home technology

The COM-B Model[31], drawn from behavioural sciences, provides a systematic framework for understanding the technology-related barriers specifically. The three types of barriers in this model - capability, opportunity and motivation - are each relevant to the target audiences of this research, as summarised in the table to follow:

	Behavioural barriers to using smart home technology	
Capability	*Not having the required knowledge, skills and abilities to engage in a particular behaviour*	• Not being online or having low digital skills • Trouble understanding instructions or navigating user interfaces due to having low literacy or English language skills • Experiencing challenges with concentration and retaining information due to a disability or health condition (e.g. brain fog due to pain or limited ability to concentrate due to mental health problems or ADHD)
Opportunity	*External factors (physical and social) preventing the execution of a particular behaviour*	• Suitably adapted technology may not be available for people with certain disabilities (e.g. vision, hearing or dexterity impairments) • Not having sufficient digital connectivity where they live • Not being able to have a smart meter at home (e.g. for people living in certain locations or types of dwelling)
Motivation	*Lacking cognitive processes (conscious and unconscious) to direct and inspire a particular behaviour*	• Not being open or willing to use smart home technology due to lacking confidence in their digital skills • Not perceiving sufficient benefit to warrant their uptake of smart home technology • Preferring familiar routines that work with their impairment • Experiencing anxiety about changes in routines that work for them and fear of failure associated with trying new technology

[31] See, for example, Social Change (2019): A guide on The COM-B Model of Behaviour

Barriers to participation in smart home technology

Capability-related barriers particularly apply to the earliest stages in the technology adoption journey - including the choice, set-up and initial use of smart home technology - as highlighted in the quotes that follow:

> *"I'm still apprehensive and would need a one-to-one discussion with an expert before I committed myself to smart technology. I'd want advice on the different smart brands and packages, and how they are different."* (Male neurodivergent participant, London)

> *"I don't know if it's just me, but whenever you set things up, it's always a huge problem. I mean, I'm okay when it's all set up and running smoothly, but setting things up I find very hard."* (Male participant with a vision impairment and low digital skills, London)

> *"I am not interested so it's really hard to sink in. It would have to be super easy. Someone else would have to learn for me, like a kid, and they could simplify it all for me."* (Female participant who is deaf and has low digital skills, Cardiff)

This research also indicates that some people are likely to experience more significant barriers than others to using smart home technology due to their specific circumstances:

	Differences in extent of barriers across the target audiences
Likely to experience higher barriers	• People with low capability to use technology, especially due to very low digital or English language skills • People with multiple technology usage barriers (e.g. related to capability plus opportunity and motivation) or usage barriers combined with barriers in other areas (e.g. low income or flexibility capital) • People with certain disabilities (e.g. vision impairments) who are more adversely impacted by inaccessible technology
Likely to experience lower barriers	• People who have opportunity-related barriers but are technologically capable, as they may have workarounds • People who have usage barriers but also access to support from family members or friends

Some case examples of people experiencing higher technology usability barriers are provided in the table that follows. These include people with the lowest skill levels, barriers in multiple areas or with no access to support. All names have been changed to protect participants' anonymity.

Case studies of people with higher technology usage barriers

Lisa's story

Lisa is 39 and lives in Leeds. She is registered blind and requires technology to be compatible with her screen reader and text to speech software. She is often unable to set up new technology as there is a lack of suitable adaptations to enable her to do so.

"The smart TV is great when it's all set up. But I need eyes to actually connect to Wi-Fi, and get all that done for me first, because I can't see to do it. So yeah, that's not very good."

Samara's story

Samara is 50, from a minoritised background and lives in London. She has a hand dexterity impairment which makes it difficult for her to interact with digital devices. In addition, she has mental health problems which mean it is more challenging for her to solve any problems she experiences using technology.

"I suffer from low mood and anxiety so once I start to go wrong, then my brain stops functioning. I also have a hand condition, I've had surgery on my hand, so scrolling things up, down, and sometimes trying to type things, it comes out completely different to what I wanted to do."

Robert's story

Robert is 58 and lives in London. He has Asperger's Syndrome, a form of autism, which affects his capability and confidence to use new technology. He also lacks support to assist him to choose, set-up and use new technology.

"I'm neurodivergent so that makes it even harder for me to actually understand how to set up technology. It's much more daunting, and much more off-putting, you know. I feel kind of excluded, kind of alone and isolated when it comes to sort of new technology because I don't have that support, so I feel I'm missing the boat."

Paul's story

Paul is 71 and lives in a rural area near Reading. His village has poor broadband coverage and no mobile signal. He consequently can't have a smart meter and finds that most technology doesn't work properly where he lives.

"I've been trying to get a smart meter for years but it just doesn't work. There's no point in getting into new technology because it won't work at home."

Felix's story

Felix is 33 and lives in Reading. He has dyslexia and ADHD which means he has a limited attention span, finds it difficult to decode unfamiliar words and finds too much written information overwhelming. He prefers familiar sites and apps, and doesn't like trying anything new in case he makes a mistake. He doesn't like to admit his struggles as he finds this embarrassing.

"If people knew they would be surprised. I try to muddle through but it does have a negative effect on me."

Ravi's story

Ravi is 60, from a minoritised background and lives in Cardiff. He has English as an additional language, low literacy and very low digital skills. He has difficulties with both his comprehension and memory when using technology, and he worries about making mistakes. He relies heavily on others in his household to use technology on his behalf.

"I was illiterate and I'm still not good at writing. I get scared that I'll do the wrong thing [online], write the wrong thing, press the wrong button, send the wrong message. I don't know my email, can't remember it all the time. I gotta get my daughter-in-law to put my emails in."

Case studies of people with higher technology usage barriers

Banvi's story

Banvi is 40, from a minoritised background and lives in Leeds. She isn't confident with technology partly because she has English as an additional language. She uses translator apps, speech to text tools and voice messages to help her when she is online. She doesn't use written instructions and prefers YouTube videos, ideally in her first language, Gujarati.

"With Gujarati I have comfort with the language, I know all the words so it's more instinctive. It makes me more confident more quickly."

Sana's story

Sana is 51, from a minoritised background and lives in London. She has English as an additional language and can't read or write in in English. She also has low literacy in her birth languages of Arabic and Kurdish, as she had very limited schooling due to her circumstances. This means she relies solely on visual and verbal communication. She also has very low digital skills and her children manage all the household technology and digital interactions on her behalf. She feels that digital by default services have made her life much more challenging.

"When I came here I would bring the forms and someone would help with the reading and writing for the poor people. Now everything is online, it's not easy. If the only way to buy bread was online I would starve!"

4.6 Additional learning from the usability testing

In the usability testing interviews, participants were introduced to dummy versions of two types of smart thermostat, and an associated app, provided by an energy company for this research. The intention was not to test the products in detail but to use these as examples to ascertain what sorts

of qualities the target audiences require from this type of smart home technology in order to be able to engage with it. The identity of the energy company and the thermostats used for the testing have been anonymised in this report.

Overall, this system was easier than participants had expected which further indicates that, for a number of people, the barriers they experience to engaging with smart home technology are likely to be pre-usage, at the consideration, adoption and set-up stages of the consumer journey.

> *"It's not that difficult. It's just getting used to it like any new thing."* (Female participant with impairments affecting her mobility and energy levels, Cardiff)

> *"It's something I could play around with and work out how to do the things I want*." (Male neurodivergent participant, London)

> *"It's way better than I thought it would be, 100% better. I would have expected something more complicated."* (Male participant with lower literacy, Reading)

That being said, some aspects of this smart home heating example worked better than others for participants in terms of ease of use:

	Aspects of the smart home heating system that were easier and more challenging for participants to use

Aspects contributing to ease of use	• Having a choice of thermostats meant that there was something to suit different needs:
	  o The first thermostat was preferred by most due to the haptic knob which was found to be intuitive, as well as familiar functions and intrinsic instructions on the device
	  o However, a few preferred the second type of thermostat due to it having limited functionality or because it didn't require a turning motion (which was challenging for people with certain dexterity impairments)
	• Semiotics on the thermostats aided comprehension e.g. colour change to illustrate temperature change
	• The app was regarded as easiest to use for more involved actions e.g. setting schedules

Aspects which could	• Written instructions with the thermostats were perceived to be too small and text based

	Aspects of the smart home heating system that were easier and more challenging for participants to use
create usage challenges	• The second thermostat lacked any instructions on the unit itself • It took longer to change settings on the second thermostat and required repetitive button pushing which was challenging for some people • Both thermostats go to sleep too quickly for some people • Some of the terminology and functions across the system were unfamiliar e.g. 'boost heating' • Font sizes on all of the devices can't be enlarged

4.7 What consumers suggest to overcome barriers and enable participation

We asked participants to suggest what they felt could overcome the usage obstacles they had identified and enable them to engage with smart home technology.

Their main focus was on providing suitable information, guidance and support, particularly to help people like them choose and set up the technology, explain how to use it and resolve any problems down the line. They felt that all instructional information should be very simple and pictorial, available across a range of channels (including video), and provided in different languages. However, they felt information alone would not suffice for some people and wanted to see one-to-one support being made available to those with higher barriers. There were also comments about the style of support required, with calls for anyone involved in installation of smart home technology or customer support to be trained in different consumer needs and to ensure they adopt a patient and empathetic approach when explaining smart home technology to people who can be expected to have usage barriers.

> *"Somebody that knows the product and can tell us the best ways of setting up and using it to the point where we can easily take over without thinking, 'Oh, my God, have I done something wrong? Should I have done that? Do I need to do this?' So, somebody that can explain exactly what we need to be doing, how it needs to be done and, yeah, that can give us the confidence to carry on really."* (Female participant who is blind, Leeds)

> *"I would like one to one sort of support or kind of coaching in you know, in in my own home, and not talking to me in jargon either, and then if I don't understand the jargon not sort of kind of trying to castigate me for being some sort of imbecile, you know.... they'd need to be patient as I may have misunderstood the instructions the first time round."* (Male neurodivergent participant, London)

Inclusivity of technology design is also regarded as important, including by ensuring any user interfaces are as simple as possible to use, enabling users to interact with them in different ways depending on their needs, and also by automating where appropriate to minimise the need for user involvement with more complex processes.

> *"It should be idiot proof and not too advanced."* (Male participant with a vision impairment and low digital skills, London)

> *"I'd hope it would be a simplified but modern version of existing technology in line with how phone apps work."* (Male participant with low literacy, Reading)

In addition, enabling trusted third parties to manage smart technology by proxy is expected to be required in some cases, especially for people without basic digital skills. This was already happening for some participants in this research, where other family members were managing smart home technology on their behalf.

Those involved in the usability testing additionally made some specific suggestions based on their experience of interacting with the smart heating system. These have been summarised in the table to follow.

	Suggestions from consumers involved in the usability testing
For the design of user interfaces	• Include main functionality on the app and keep the thermostat units as simple as possible • Simplify terminology used and enable customers to personalise this where appropriate e.g. changing 'zones' to rooms of their house • Harmonise the layout and actions between app and thermostat • Provide options to adapt the way people interact with the devices if needed e.g. increasing font sizes, increasing the time in active mode, using voice commands instead of touch etc. • Provide options to change the language in the app
For information, guidance and support	• Make set-up as straightforward as possible e.g. by automating parts of the process and ensuring new users can easily access quick start guides • Provide different options for more detailed instructions e.g. different languages and video-based as well as written information • Provide upfront guidance on how to set-up and use new technology where needed, e.g. by the installer or a customer service agent • Provide access to ongoing support in case the user runs into further problems with the set-up, initial use or future integration with other devices

"Someone would have to show me and talk me through, not just put it in and ask me to read the instructions. For me it has to be visual." (Female participant with low literacy, London)

"I would want a number to contact if I get stuck and find out more information." (Female participant with English as an additional language, Leeds)

5. Conclusions and implications

5.1 Conclusions

The detrimental impact of technology-related barriers to participation is already growing as the energy market becomes more digitised. Looking to the future, some people risk being left behind in the transition to smart and flexible energy, and consequently paying over the odds, due to not being willing and/or able to engage with the requisite technologies.

However, our quick scoping review found only limited published evidence on how access and inclusion is currently being considered by industry in the design and delivery of smart home technology. There is also little explicit focus in the literature currently on those consumers who can be expected to face higher barriers to using smart home technology and what interventions may be needed to address these.

The insights from our consumer research therefore fill a gap in the evidence and there was receptiveness from the industry stakeholders we engaged with to learn and do more in this area. Importantly, addressing the barriers identified in this research would also support the commitment set out in the Government's 2021 Smart Systems and Flexibility Plan[32] to ensure that the benefits of flexibility are accessible to all consumers.

5.2 Implications

The evidence from this research suggests that enabling the target audiences to participate effectively in smart and flexible energy will require a range of interventions to be applied at different stages of the consumer journey:

	Potential interventions to increase access and inclusion	
	Why?	*How?*
Build understanding, trust and confidence	So that the target audiences understand the concept, why it's important and beneficial and do not feel coerced into making changes	• Public education campaigns • Measures to reduce the risk of participation (e.g. financial support, 'try before you buy' schemes)
Facilitate informed choice	So that the target audiences can compare offers and choose the best solution for themselves	• Providing information in different formats and languages • Developing tools (e.g. a traffic light system, access to mock-ups) to help consumers to evaluate options

[32] BEIS and Ofgem (July 2021): Transition to a net zero energy system - Smart Systems and Flexibility Plan 2021

	Potential interventions to increase access and inclusion	
		• Providing the option to consumers of accessing free, impartial advice
Ensure appropriate set-up	So that the target audiences can set up the technology themselves or have it installed appropriately	• Simplifying the set-up process as much as possible • Ensuring installers understand and can respond to different consumers' needs • Providing access to appropriately trained customer service agents to provide set-up guidance and support
Enable use of the required technologies	So that the target audiences are able to learn how to use newly adopted technology and resolve any problems either initially or down the line	• Ensuring inclusive technology design • Providing support where needed • Enabling proxy use by trusted parties (e.g. family members) if required

Ofgem's current Consumer Vulnerability Strategy (CVS)[33] provides a relevant framework for considering interventions to address technology-related barriers for consumers who may otherwise struggle to participate in smart energy.

One of the five priority themes of the CVS is **'inclusive innovation'**, which this research suggests could be achieved by applying appropriate principles and standards to technology design, as well as by involving a diverse user group in the design process. Our engagement with industry stakeholders suggests some potential levers for encouraging smart energy companies to focus more on inclusivity in their technology design, including:

- **incentives**, such as innovation funding[34], competitions and the possibility of applying accessibility kitemarks;
- **guidance**, including insights on different consumers' barriers and needs[35], inclusive design principles and how to involve users in the design process[36]; and

[33] Ofgem (25 October 2019): Consumer Vulnerability Strategy 2025

[34] Some relevant innovation funding schemes already exist, including:
- the Strategic Innovation Fund, one strand of which is focused on 'supporting a just energy transition'; and
- the new Inclusive Smart Solutions Programme, which aims to achieve a step-change in access to, purchase of, and use of smart energy technologies, products and services among low income and vulnerable consumers.

[35] An example of such collaboration previously was between RNIB, a smart meter display manufacturer and trade body, Energy UK, to develop an accessible in-home display (AIHD)

[36] RiDC and ES Catapult have already produced such a guide for involving disabled consumers in one part of the innovative design process - testing or trialling new energy products and services before they are launched

- potentially also some **minimum accessibility standards**[37], especially for user interfaces and how devices are installed in consumers' homes.

However, according to the CVS, ensuring fair and positive outcomes for consumers in vulnerable circumstances will require more than just attention to design. Our research supports this and indicates the requirement also for:

- **'significant improvements in customer service'**, by identifying and providing appropriately tailored support to consumers who have significant barriers to engaging with smart home technology; and
- **'solving issues that cut across multiple sectors'**, particularly through efforts to increase digital access and inclusion in order to reduce the incidence of consumers with these barriers to participating in smart and flexible energy.

[37] As mentioned in Section 3, there are compulsory accessibility standards for public sector websites and apps but currently no equivalent for smart technology or smart energy providers. In addition, the current British Standards Institute (BSI) standards for Energy Smart Appliances (ESAs) do not include accessibility, and the new accessibility standard for public electric vehicle (EV) charging does not as yet have an equivalent for installation of in-home EV charging.