



Consumer Insights on the Future of the Gas and Electricity Distribution Networks in Scotland

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Executive Summary

Throughout the UK, governments and local authorities have declared a climate emergency. The Scottish and UK Governments have also passed legislation that requires 100% reductions to net greenhouse gas emissions by 2045¹ and 2050², respectively. This will require a rapid and fundamental shift in consumers' relationship with energy and will necessitate significant changes to the way in which homes, businesses, industry, and transport are powered.

Gas and electricity transmission and distribution networks currently form vital components of the GB energy system, linking gas producers and electricity generators with domestic, industrial, and commercial end users, and improving energy security through connections with the energy systems of mainland Europe and the island of Ireland. However, the transition to net zero will place significant new demands on the energy system, and substantial investment in GB's energy networks will be required to support the UK's climate change commitments.

Citizens Advice Scotland (CAS) represents the interests of current and future energy consumers in Scotland. We aim to ensure that the transition to an energy system capable of supporting a net zero economy is realised in such a way that no consumers are unfairly disadvantaged, delivering maximum consumer benefits while minimising consumers' costs. Ensuring that consumers are genuinely engaged with and empowered by decision makers involved in the planning and delivery of the future of heat and electrical power in Scotland will be vital to achieving this, and it will be particularly important that the needs and interests of low income consumers and consumers in vulnerable situations are incorporated from the outset.

This report summarises research conducted in 2019 which aimed to provide consumer insights of the changing energy landscape in Scotland. With GB's gas and electricity networks and the Electricity System Operator (ESO) engaged in planning for the first price control to be set against statutory net zero targets, we were particularly interested in exploring consumers' views on and experiences of the gas and electricity distribution networks in Scotland, their priorities for distribution network investment, and their understanding and opinions of some of the technologies that are envisaged to aid the energy transition. We also explored consumers' attitudes towards a potential increase in the electrification of heat in Scotland, and their enthusiasm for and opinions of future opportunities to provide flexibility to their electricity distribution network operator (DNO).

Our research found that:

- > Overall consumer awareness of the gas and electricity distribution networks in Scotland is shallow, and energy literacy among consumers in Scotland is low. More than 93% of consumers in Scotland cannot identify their DNO or (where applicable) gas distribution network (GDN) by name, while a significant majority conflate the roles of the gas and electricity distribution networks with those of electricity generators, gas producers and shippers, gas and electricity transmission networks, and / or regulated energy suppliers. This has implications for networks' ability to engage effectively with consumers in vulnerable situations, with only 9% of digitally excluded gas and electricity consumers in Scotland indicating that they would contact their DNO or GDN in the event of disruption to their gas or electricity supplies.

¹ http://www.legislation.gov.uk/asp/2019/15/pdfs/asp_20190015_en.pdf

² https://www.legislation.gov.uk/ukxi/2019/1056/pdfs/ukxi_20191056_en.pdf

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- > 78% of consumers in Scotland are satisfied with the overall level of service they receive from their DNO and (where applicable) GDN. This is largely attributed to the perceived reliability of the regulated energy networks in Scotland, with consumers noting a decrease in the frequency and duration of supply interruptions since privatisation – particularly for electricity. Though only a small proportion of consumers have contacted their DNO (14%) or GDN (8%), around 80% of those who have are satisfied with the level of customer service received.
- > Vulnerable consumers in Scotland are significantly more likely to have contacted their gas and / or electricity distribution network than other consumer profiles and report particularly low levels of dissatisfaction with DNO / GDN customer service (2%). However, overall awareness of the Scottish gas and electricity distribution networks is no higher among consumers in vulnerable situations than it is among other consumer profiles. Up to 68% of Scotland's vulnerable consumers may therefore be unaware of the additional support which could be made available to them by their DNO, while up to 51% of vulnerable consumers may be missing out on support from the GDN.
- > Consumers in Scotland generally prioritise measures to improve the affordability, reliability, and safety of the gas and electricity distribution networks when asked to provide views on network investment plans. While all consumer profiles rank affordability concerns highest overall, consideration of gas and electricity distribution network costs is particularly strong among older consumers and consumers in lower socio-economic grades (SEGs).
- > The majority of consumers in Scotland welcome gas and electricity distribution networks' investment in support for consumers in vulnerable situations. Older consumers, consumers in vulnerable situations, and consumers in lower SEGs view these additional services as being particularly important and express particularly strong support for continued investment in this area.
- > Environmental concerns also resonate with the majority of gas and electricity consumers in Scotland. Though no consumer profile prioritises investment in environmental impact mitigation above that designed to improve the affordability, reliability, or safety of Scotland's gas and electricity distribution networks, it is recognised that this is an area in which energy networks should be allowed to invest. Support for such investment is found across all consumer profiles but is particularly strong among younger consumers and consumers in higher SEGs.
- > Current levels of energy literacy and awareness among consumers in Scotland mean that many consumers struggle to envisage how the energy industry's predictions of a smart, flexible, and responsive future will be realised. While not viewed as unimportant, the majority of consumers therefore currently display relatively low levels of support for gas and electricity distribution network innovation.
- > Satisfaction among traditional electric heating users in Scotland is low when compared with that of consumers who make use of other space heating solutions. These negative preconceptions are likely to prove a barrier to the acceptance of any future increase in the electrification of heat in Scotland.
- > A significant majority of consumers in Scotland (80%) are willing to change their energy behaviours to reduce their energy costs. However, almost half would only

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change their behaviour by a small amount, with many consumers stating that their ability or willingness to achieve more significant change would be limited by their lifestyle and / or real or perceived concerns regarding loss of convenience or control over their energy use. Older consumers and consumers in higher SEGs are considerably less likely to consider significant behaviour change a practical or desirable route to reducing household energy costs.

- > Interest in and views on new ways of engaging with the electricity system as a means of reducing energy costs is also mixed. Between 30% and 40% of consumers in Scotland are interested in smart electric vehicle (EV) charging, domestic battery storage, or smart electric storage heaters. Though 59% of consumers in Scotland are interested in the development of smart Time of Use (TOU) tariffs, many consumers are concerned about the impact of such tariffs on those who are unable to modify their energy consumption profile to avoid peak or super-peak energy pricing.
- > There is a high level of concern among consumers in Scotland that lower income households might be left behind by the energy transition, and for the impact that this could have on the future household energy costs of some of the most vulnerable consumers in Scotland.
- > 79% of consumers are worried that lower income households will be unable to afford new technologies designed to minimise energy costs. These households are perceived to be among those most in need of a reduction in energy costs, yet are felt likely to be least able to benefit from technologies that enable them to do so.
- > 80% of consumers in Scotland would support the DNOs and the GDN if they were to provide assistance for lower

income households to engage with the energy transition. 50% would also be supportive were distribution networks to provide targeted investment to aid with the provision of smart, low carbon heating systems for low income households, or funding to reduce the cost of other smart technologies that would make it easier for consumers to passively engage in the energy transition by providing flexibility to their DNO without having to engage in significant behaviour change. Such initiatives are perceived to offer mutual benefits to consumers and the energy distribution networks by increasing levels of energy efficiency, comfort, and demand flexibility, while decreasing network stress and consumers' energy costs.

Recent studies have shown that informed consumers are significantly more likely to become engaged in measures designed to support the energy transition³, but electricity distribution system operator (DSO) pilots have been descope when project partners have been unable to secure funding for the provision of facilitative technologies⁴. Improving consumers' energy literacy and their awareness of the challenges presented by the energy transition will therefore be crucial to securing support for any future increase in the electrification of heat and transport in Scotland. Strong community engagement in the development and delivery of Local Heat and Energy Efficiency Strategies (LHEES) will also be vital to realising the Scottish Government's climate change commitments. However, a reliance on market forces alone to deliver the required investment where and when it is needed is unlikely to deliver decarbonisation at lowest cost to consumers, and opportunities to share the benefits of the energy transition fairly with consumers will be missed. In some cases, it may therefore be necessary for Scotland's gas and electricity networks to provide funding and practical support to secure the strength of consumer response required to deliver on these objectives.

³ <https://save-project.co.uk/>

⁴ <https://www.ninnesmartgrid.co.uk/>

Introduction

Scotland's Citizens Advice network empowers people in every corner of Scotland through our local bureaux and national services by providing free, confidential, and independent advice. We use people's real-life experiences to influence policy and drive positive change. We are on the side of people in Scotland who need help, and we change lives for the better.

The Fair Markets policy team at Citizens Advice Scotland (CAS) uses research and evidence to put people at the heart of policy and regulation in the energy and water sectors in Scotland. We work with government, regulators, and business to put consumers first, designing policy and practice around their needs and aspirations. We aim to represent the views of different consumer profiles using evidence of consumer views and supporting research wherever possible.

CAS works with the gas and electricity networks sector in Scotland to ensure that consumers' interests are represented in the planning and delivery of network investment, and in discussions about network access and charging. With 25% of households in Scotland in fuel poverty and certain demographics considerably more likely to be fuel poor than the national average⁵, we believe that it is particularly important to ensure that the interests of low income consumers, consumers in vulnerable situations, off-gas consumers, and consumers in remote and / or rural locations are protected as policies and markets evolve.

The regulatory framework in which GB's gas and electricity networks must operate is subject to periodic review by the energy regulator, Ofgem, and their activities are dictated by a series of price controls. At the time of writing, Ofgem is working with the gas and electricity networks and the Electricity System Operator (ESO) to

set the next price control (RIIO-2). This will last for 5 years beginning 1 April 2021 for gas and electricity transmission, gas distribution, and the ESO, and for 5 years from 1 April 2023 for electricity distribution.

The RIIO-2 price control is particularly important as it will be the first price control to be set against statutory climate change targets that require 100% reductions to net greenhouse gas emissions by 2045⁶ in Scotland and 2050⁷ across the whole of the UK, the RIIO-1 price control having been set against a UK-wide target to reduce net greenhouse gas emissions by 80% of the relevant baselines by 2050⁸. Significant changes to how and where energy is produced, generated, and used will be needed if these revised targets are to be met, but this will have a profound effect on the scale and activities of GB's gas and electricity networks. Consumers' relationship with the GB energy system is therefore also likely to have to change considerably as the energy transition progresses.

Ofgem has been keen to ensure that consumers' views are incorporated in the development of networks' plans for RIIO-2, and CAS has been an active participant in the consumer and stakeholder engagement work that has been undertaken by Scotland's gas and electricity networks and the GB ESO. Our advocacy in this area is particularly important as the Scottish Government's net zero commitments may mean that decarbonisation needs to proceed more quickly in Scotland than elsewhere in GB. Any adverse consumer impacts arising from the energy transition may therefore be felt first by consumers in Scotland.

To aid with this engagement, we commissioned Accent to undertake research designed to ascertain consumers' awareness of and

⁵ Scottish House Condition Survey: 2018 Key Findings

⁶ http://www.legislation.gov.uk/asp/2019/15/pdfs/asp_20190015_en.pdf

⁷ https://www.legislation.gov.uk/uksi/2019/1056/pdfs/ukxi_20191056_en.pdf

⁸ http://www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf

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satisfaction with Scotland's gas and electricity distribution networks; consumers' attitudes towards potential changes in electricity use and the future of heat in Scotland; and the priorities of consumers in Scotland for gas and electricity distribution network investment. This study built on research conducted in 2017 which reviewed the support offered to consumers in vulnerable situations by the Scottish gas and electricity distribution networks and explored opportunities for improvement in this area⁹. This previous research found that:

- > Scottish specific circumstances need to be reflected in GB-wide policy development and regulatory programmes such as RIIO.
- > A strategic and forward-looking approach that puts the needs of consumers at its heart requires to be adopted by Scotland's DNOs to ensure that no-one is left behind in the transition to a smarter electricity network.
- > Whole system planning is necessary to ensure that Scotland's energy networks are properly integrated into LHEES.
- > Scottish DNOs should invest further and increase the reach of programmes for consumers in vulnerable situations across Scotland, supported by the appropriate organisations and Ofgem.
- > An open, consumer-orientated policy debate on the future of the Fuel Poor Network Extension Programme in Scotland is needed, and fuel poor consumers who are off the gas grid must be given priority support while decisions are made. This could be targeted at fuel poor electric heating customers as a priority.

Our latest research involved a survey of 1,507 consumers from across Scotland. Participants

were screened to be responsible for paying for their household's energy consumption and quotas¹⁰ were set against the following parameters to ensure that the sample was representative of the overall population:

- > parliamentary constituency
- > urban / rural status
- > on / off gas grid
- > age
- > gender
- > socio-economic grade

Data was then weighted to correct for any over- or under-representation of particular groups.

Following completion of the survey, a series of discussion groups and 1-to-1 in-depth interviews was conducted to explore the views of a range of energy consumers, including those in vulnerable situations. Collectively, this provided a robust set of results and an understanding of why certain views were held among the survey participants.

This report is published alongside a summary of the key findings of our research and the final report compiled by our research partner, Accent. It provides evidence of consumers' experiences of Scotland's gas and electricity distribution networks, and their priorities and needs in terms of future network investment. It also explores the views of consumers in Scotland on potential changes to the way in which energy is used that may be required by the transition to a net zero compatible energy system, and considers how Scotland's gas and electricity distribution networks can help redefine consumers' relationship with the energy system in support of Scottish and UK Government climate change policies.

⁹ <https://www.cse.org.uk/downloads/reports-and-publications/fuel-poverty/policy/energy-justice/energy-networks-in-scotland-and-their-changing-role-with-consumers.pdf>

¹⁰ Quotas were set on the basis of demographic data from the 2011 census, the National Readership Survey for January – December 2016, and the Scottish Government's urban / rural classification.

Background and policy context

The way in which energy is produced and used in GB is undergoing significant change. For more than a century, the majority of the nation's electricity demand was met by a series of large thermal power stations burning carbon-intensive solid fuel extracted from the coalfields of Central Scotland, Central and Northern England, and South Wales. However, in recent years the rollout of a multi-billion pound network of distributed renewable power generating assets has allowed GB's reliance on coal-fired electricity generation to diminish significantly. By April 2020, only 3 coal-fired power stations remained operational in GB¹¹, with coal accounting for just 2.1% of total GB electricity generation in 2019/20¹².

Once the mainstay of GB power production, the UK Government has announced that by no later than the end of 2025, coal will effectively have no place in the GB electricity generation mix¹³. However, growing evidence of climate change also calls into question the long-term future of natural gas, both for electricity generation and as a source of heat. Despite significant steps having already been taken to reduce the carbon intensity of GB electricity generation, such progress must therefore mark the beginning of a much larger effort to decarbonise the wider GB energy system.

Recognition that an average global temperature increase of more than 1.5°C will lead to significant adverse economic and environmental impacts¹⁴ led the UK parliament to declare a climate emergency in May 2019¹⁵. The UK

Government responded by amending the Climate Change Act 2008 to commit the UK to becoming a net zero emitter of greenhouse gases by 2050¹⁶. The Scottish Government has gone further still, with the introduction of the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 committing Scotland to achieving net zero status by 2045¹⁷. 75% net reductions on the relevant baseline greenhouse gas emissions levels are also due in Scotland by 2030, with 90% net reductions required by 2040.

The scale of the challenge in meeting these statutory targets is significant. The transformation of the nation's energy system into one that is decentralised, decarbonised, and digitalised will require substantial investment in new infrastructure and the rollout at scale of a wide variety of new technologies and services. It will also demand that solutions are found for the sustainable transport of both people and goods; that the nation's homes and businesses meet stringent energy efficiency standards far beyond those typical of properties today; and that significant changes are made to the way in which space heating and hot water are provided.

The Scottish Government has proposed that each of Scotland's 32 local authorities will be required to prepare LHEES¹⁸. These will build on the data from Scotland's Heat Map¹⁹ to produce local plans for the decarbonisation of heat in all communities in Scotland. This is a significant undertaking and will both rely on and have major implications for Scotland's gas

¹¹ <http://www.powerstations.uk/coal-countdown/>

¹² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/877047/Press_Notice_March_2020.pdf

¹³ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/672137/Government_Response_to_unabated_coal_consultation_and_statement_of_policy.pdf

¹⁴ https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf

¹⁵ <https://hansard.parliament.uk/Commons/2019-05-01/debates/85FE0864-18D1-42BA-9D3C-CB2D0958D067/EnvironmentAndClimateChange>

¹⁶ https://www.legislation.gov.uk/ukxi/2019/1056/pdfs/ukxi_20191056_en.pdf

¹⁷ http://www.legislation.gov.uk/asp/2019/15/pdfs/asp_20190015_en.pdf

¹⁸ <https://www.gov.scot/binaries/content/documents/govscot/publications/research-and-analysis/2019/09/local-heat-energy-efficiency-strategies-phase-1-pilots-technical-evaluation-report/documents/local-heat-energy-efficiency-strategies-phase-1-pilots-technical-evaluation-report/local-heat-energy-efficiency-strategies-phase-1-pilots-technical-evaluation-report/govscot%3Adocument/local-heat-energy-efficiency-strategies-phase-1-pilots-technical-evaluation-report.pdf>

¹⁹ <https://www2.gov.scot/heatmap>

Background and policy context

and electricity networks; efforts to decarbonise space and hot water heating are likely to result in levels of electrification beyond the current capabilities of the electricity networks, while the displacement of natural gas with hydrogen and / or biomethane as combustible fuels, and a significant rise in the prevalence of heat networks, are likely to impact on the future role and extent of the mains gas network.

At present, GB's gas and electricity transmission and distribution networks are privatised, regulated, monopoly businesses on whom the vast majority of domestic, industrial, and commercial energy users rely for heat, light, and electrical power. Although there is no direct billing relationship between the regulated energy networks and consumers, the costs attributable to the activities of GB's gas and electricity transmission and distribution businesses currently comprise 23.77% of a typical GB consumer's dual fuel bill²⁰. With 25% of households in Scotland in fuel poverty in 2018²¹, the question of how the energy transition can be funded without increasing inequality is therefore both complex and pressing.

The technical and financial challenges presented by the energy transition are considerable.

However, one of the most significant barriers to the delivery of a net zero compatible energy system is arguably found in the relationship between consumers and the energy industry itself.

In Scotland, the majority of gas and electricity consumers are currently disengaged²² from what is a relatively simple energy market that relies almost entirely on the interaction between consumers and energy suppliers. With an increase in the use of electricity for heat and transportation coinciding with an increased reliance on sources of electricity generation that are less dependable than traditional thermal power stations, the ability of the ESO and DNOs / DSOs to match demand to both network capacity and variable levels of available supply will become increasingly important. New and more complex energy markets will develop as a result²³, but without the widespread uptake of technologies designed to facilitate consumer engagement in these markets the energy transition is likely to take longer and cost more to achieve. Without suitable support, this will impact on those in society least able to afford an increase in essential living costs and jeopardise efforts to ensure a just transition²⁴ to net zero.

²⁰ <https://www.ofgem.gov.uk/consumers/household-gas-and-electricity-guide/understand-your-gas-and-electricity-bills#thumbchart-c6544416133875424-n83314>

²¹ Scottish House Condition Survey: 2018 Key Findings

²² <https://www.cas.org.uk/news/new-data-shows-huge-differences-across-scotland-energy-switching-rates>

²³ https://www.theade.co.uk/assets/docs/resources/Lets_Talk_About_Flex_DigitalRep_FINAL-min.pdf

²⁴ http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_432859.pdf

Consumer Awareness of the Gas and Electricity Distribution Networks in Scotland

GB's gas and electricity networks have undergone significant change since the end of the Second World War. The pace of this change has accelerated since the mid-1990s as privatisation has matured and regulation has evolved, with numerous mergers, demergers, and rebranding exercises undertaken over the past 25 years. However, the gas and electricity transmission and distribution networks of today continue to play as fundamental a role in the safe and reliable delivery of energy across the country as ever.

Despite their importance, consumers in GB have traditionally had very little direct contact with the regulated energy networks as the structures adopted by the post-privatisation gas and electricity industries place energy suppliers at the heart of their interactions with consumers. In the absence of a direct billing relationship between the regulated energy networks and consumers, most consumers therefore normally only have cause to contact their DNO or GDN to arrange a new connection, or in the event of planned or unplanned interruptions to their gas or electricity supplies. Contact between consumers and the gas and electricity transmission networks is even more limited in its extent.

Given the above, it is perhaps unsurprising that when asked to name their DNO and (where applicable) GDN:

- > 56% of consumers in the SSEN distribution area stated that they did not know the name of their DNO.

- > 66% of consumers in the SPEN distribution area stated that they did not know the name of their DNO.
- > 66% of mains gas connected consumers stated that they did not know the name of their GDN.
- > Only 1% of consumers in the SSEN distribution area identified 'Scottish and Southern Electricity Networks' or 'SSEN' as their DNO.
- > Only 3% of consumers in the SPEN distribution area identified 'SP Energy Networks' or 'SPEN' as their DNO.
- > Only 6% of mains gas connected consumers identified 'SGN' or 'Scotia Gas Networks' as their GDN.

While a significant minority of survey participants volunteered the name of a predecessor brand when asked to identify their DNO (23% in the SPEN distribution area and 33% in the SSEN distribution area), comparison with answers provided for the GDN suggest that these figures are likely to have been inflated by the vertically integrated nature of the post-privatisation electricity system in Scotland and consumers' conflation of the activities of electricity generation, transmission, distribution and supply.

Consumer Awareness of the Gas and Electricity Distribution Networks in Scotland

For example, when presented with a range of possible DNO functions, only 22% of consumers from the SSEN distribution area were able to identify all of the relevant roles correctly; this compared to 32% of consumers in the SPEN distribution area. In the Highlands and Islands, where gas network penetration is particularly low and where non-Economy 7 restricted electricity meters are deployed at scale, consumers' correct identification of a DNO's functions was just 14%²⁵.

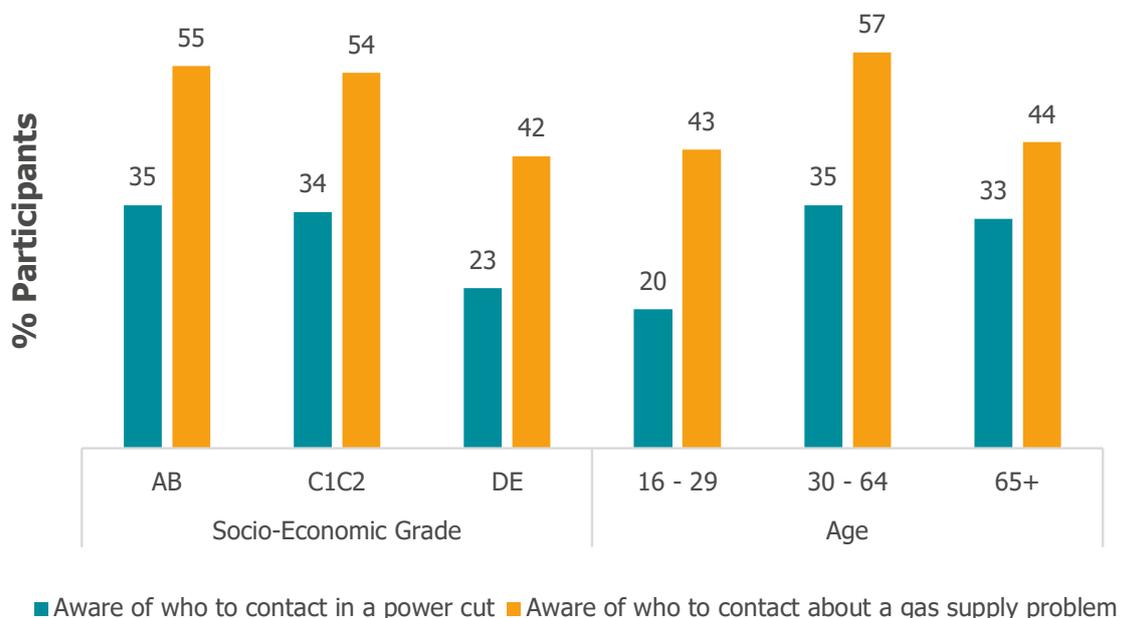
Our survey also found that:

- > 70% of consumers in Scotland believe that the DNOs and the GDN are responsible for the national gas and electricity transmission infrastructure.
- > 48% of consumers in Scotland believe that the DNOs and the GDN produce, generate, or source gas and electricity for consumers.

- > 45% of consumers in Scotland believe that the DNOs and the GDN sell gas and electricity to end users.

It can therefore be inferred that the majority of consumers in Scotland have a very shallow understanding of how the energy industry is structured, and that their understanding of the role of the gas and electricity distribution networks that operate in Scotland is limited. This has a direct impact on consumers' understanding of the role of their DNO or GDN in the event of an interruption to or problem with their energy supply, with only 31% of those surveyed indicating that they would contact their DNO in the event of a power cut and 51% of mains gas connected consumers indicating that they would contact their GDN if they had a problem with their gas supply.

Figure 1: Awareness of gas and electricity distribution networks' role in the event of supply disruption



Sample: surveyed consumers with a mains electricity supply (n=1,505) or mains gas supply (n=1,110)

²⁵ Until September 2017, very few suppliers other than SSE were able to supply the most common types of non-Economy 7 restricted electricity meter employed in the North of Scotland. This resulted in a sizeable number of SSE customers whose ability to switch to an alternative supplier was extremely limited. Consequently, SSE maintained a dominant market share of supply to these customers. With conflation of SSE's electricity generation, transmission, distribution, and supply businesses widespread among consumers it is therefore unsurprising that those in the Highlands and Islands were least able to correctly identify a DNO's functions in the test as they are more likely to have remained a customer of SSE than consumers elsewhere – see <https://www.cas.org.uk/news/new-data-shows-huge-differences-across-scotland-energy-switching-rates>

Consumer Awareness of the Gas and Electricity Distribution Networks in Scotland

Significant variation in consumers’ awareness of the role of a DNO or GDN in the event of supply disruption was also found between different

consumer profiles. Notable examples of those with lower levels of awareness include:

For Gas	For Electricity
Those with no children in the household (47% vs. 64% with children)	Those resident in urban areas (29% vs. 42% rural)
Those resident in the SSEN electricity distribution area (44% vs. 54% in the SPEN electricity distribution area)	Those with no children in the household (29% vs. 38% with children)
Those with health problems (45% vs. 54% without health problems)	Women (27% vs. 35% men)

In addition, just 9% of digitally excluded gas and electricity consumers in Scotland indicated that they would contact their DNO or GDN to report problems with their gas or electricity supplies. With 21% of Scots lacking in basic digital skills²⁶, this figure is particularly stark.

Taken together, these findings suggest that Scotland’s gas and electricity distribution networks need to rethink how they engage with consumers – particularly those who are unwilling or unable to access services and information online.

These findings also underline the scale of the challenge faced by Scotland’s regulated energy networks as the energy transition progresses. For example, the anticipated increase in the electrification of both heat and transport is expected to result in increased electricity network stress at times of peak demand or low renewable electricity generation. In addition to work to increase the capacity of the electricity transmission and distribution networks, it is envisaged that this will require electricity distribution networks to have the ability to constrain network access and time-shift demand at both primary and and feeder substation level

through the deployment of smart grids, demand-side response (DSR) technologies, and other flexibility and balancing services. This will require the transition from distribution network operation to distribution system operation. Many of these interventions are also likely to significantly alter consumers’ interactions with the energy system and may require the uptake of new technologies at scale, but without strong brand recognition and consumer trust it may be difficult for DNOs / DSOs and 3rd party market participants to convince consumers to engage in the energy transition in a mutually beneficial way.

Similarly, the proposed deployment of hydrogen for space and hot water heating in Scotland is likely to require the development of gas microgrids and the systematic replacement or upgrade of gas boilers and other gas burning appliances by a defined terminal date. It will therefore be essential that consumers and landlords are provided with clear, consistent, and unambiguous information on the local future of heat in Scotland to limit consumers’ exposure to asset stranding risk.

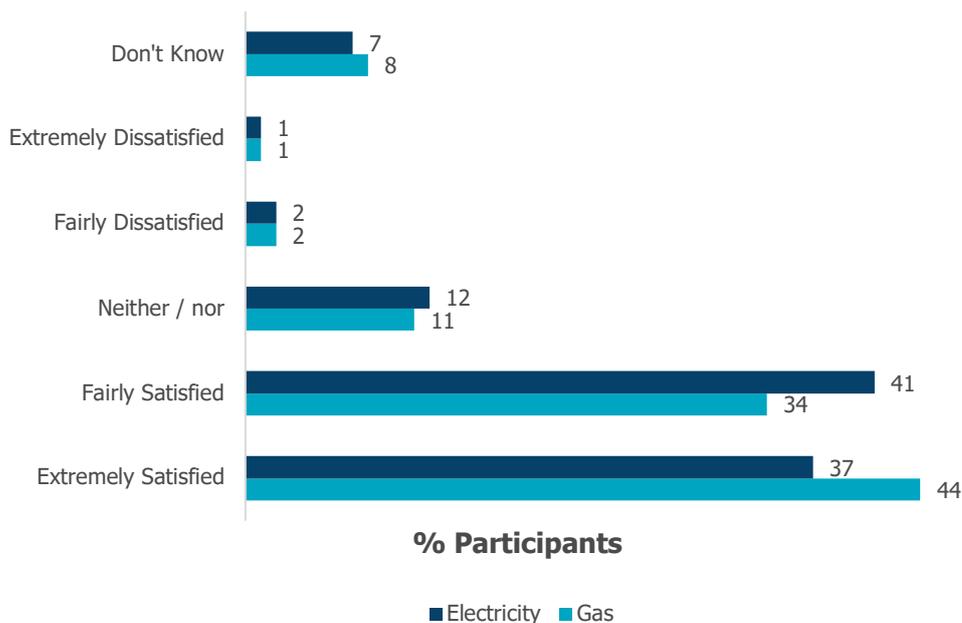
²⁶ <https://storage.googleapis.com/scvo-cms/digital-participation-charter/tackling-digital-exclusion-in-scotland-a4.pdf>

Consumer Satisfaction with Gas and Electricity Distribution Networks in Scotland

Our representative survey of more than 1,500 consumers in Scotland has revealed that the majority of consumers are unfamiliar with some or all of the roles played by their DNO and (where applicable) GDN. However, our survey also found that when provided with a better understanding

of regulated energy distribution network functions, consumers' overall satisfaction with those networks is high (78% for both gas and electricity distribution), and compares favourably against consumers' attitudes towards regulated energy supplier²⁷.

Figure 2: Satisfaction with the overall level of service received from the Scottish gas and electricity distribution networks



Sample: consumers with a mains electricity supply (n=1,505) or mains gas supply (n=1,110)

Qualitative discussions revealed that consumers recognise the essential role that the gas and electricity distribution networks play in the energy supply chain. With an increasing reliance on electricity to power the nation's homes, businesses, and transport, it is also recognised that the reliability of the energy networks is increasingly vital to the success of both the Scottish economy and consumers' quality of life.

It was also apparent that many of those who took part in the survey believed that the reliability of their gas and electricity networks has improved since privatisation. Furthermore, where interruptions to supplies do still occur, the consensus view among consumers in Scotland is that the duration of outages has decreased, and that communication relating to such interruptions has improved. Consumers in Scotland therefore appear to value the emphasis that has been placed by Ofgem and

²⁷ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/906452/BEIS_PAT_W34_-_Key_findings.pdf

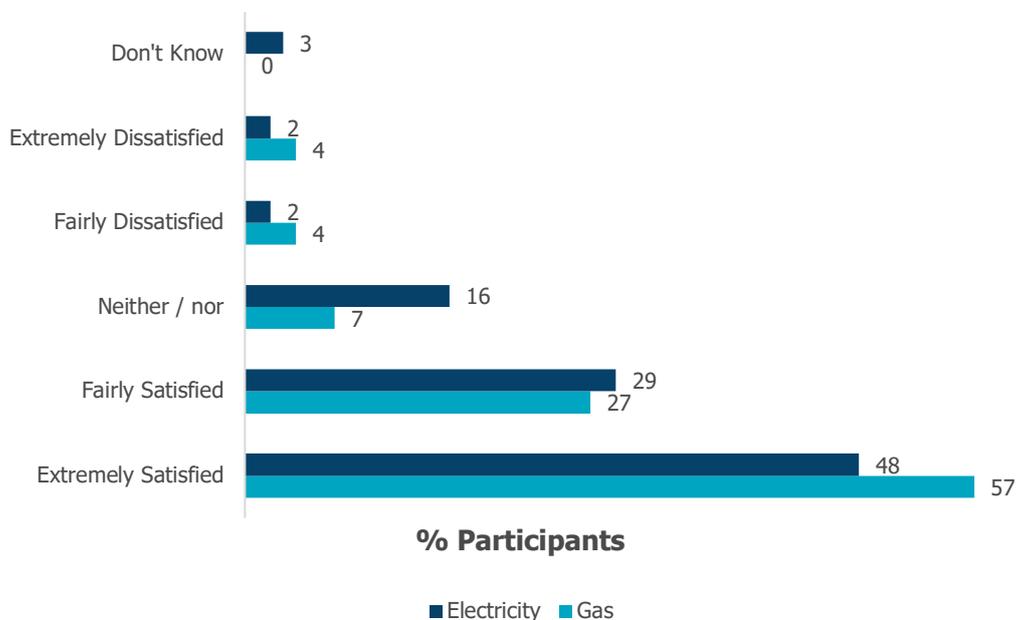
Consumer Satisfaction with Gas and Electricity Distribution Networks in Scotland

the regulated energy networks on reliability and have come to expect that their DNO and (where applicable) GDN will maintain or improve on current levels of resilience in the future.

Only 14% of the survey participants could recall having made contact with their DNO, with 8% having contacted the GDN. However, the vast majority of those who had contacted a regulated energy distribution network were satisfied with the level of service with which they were provided. Overall levels of dissatisfaction with DNO / GDN customer service are low and were found to be significantly lower among consumers who self-identified as vulnerable than those who did not (2% vs. 11%). However, while consumers with multiple vulnerabilities were found to be significantly more likely than other consumer

profiles to have contacted their DNO or (where applicable) GDN (29% vs. 3% of consumers with no vulnerabilities), awareness of the Scottish gas and electricity distribution networks is no higher among consumers in vulnerable situations than it is among other consumer profiles. This suggests that while the support provided to consumers in vulnerable situations by Scotland’s regulated energy distribution networks is welcomed by those who rely on it, up to 68% of vulnerable electricity consumers and 51% of vulnerable gas consumers in Scotland may be unaware that such support is available. More therefore still needs to be done to increase awareness of the gas and electricity distribution networks in Scotland and their role in the wider energy system if the benefits of that support are to reach all those in need.

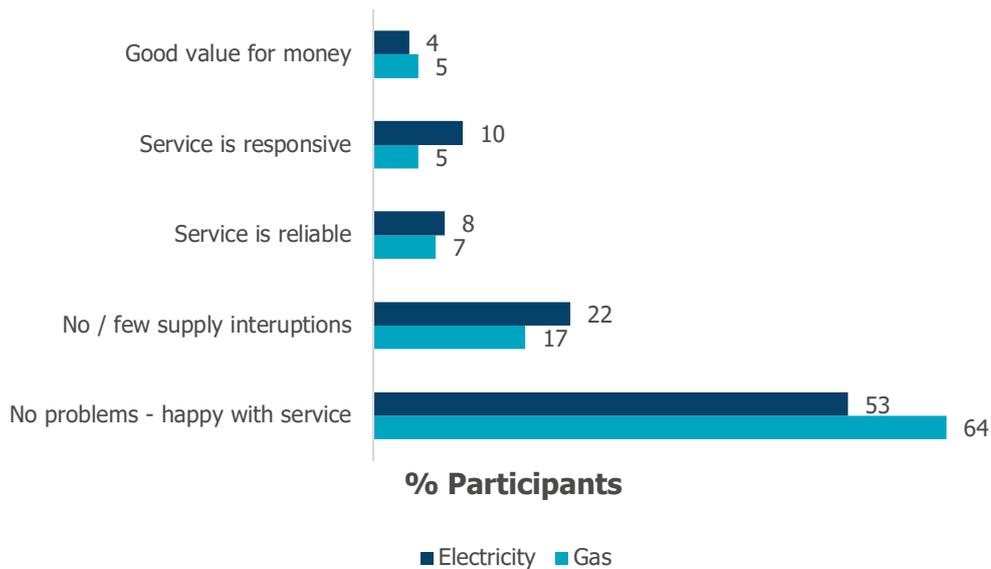
Figure 3: Satisfaction with Scottish gas and electricity distribution network customer service



Sample: surveyed consumers who have contacted their DNO (n=216) or GDN (n=90)

Consumer Satisfaction with Gas and Electricity Distribution Networks in Scotland

Figure 4: Reasons for satisfaction with the Scottish gas and electricity distribution networks



Sample: surveyed consumers who are satisfied with their DNO (n=1,169) or GDN (n=864)

Analysis of the responses provided by different consumer profiles reveals that overall satisfaction with Scotland’s gas and electricity distribution networks tends to be higher among higher SEGs, and increases with age. There are no significant differences by urban / rural status or by regulated energy distribution network. However, all consumer profiles were found to be less satisfied

with the value for money they receive from their DNO and (where applicable) GDN, with little variance between the gas and electricity distribution networks. Younger consumers and consumers in lower SEGs were found to be particularly concerned about the impact of gas and electricity distribution networks’ activities on household energy costs²⁸.

²⁸ Participants were asked about value for money after having been presented with information on the amount that households pay, on average, towards the activities of the relevant DNO and (where applicable) GDN, and a description of regulated energy distribution network roles and responsibilities.

Consumer Satisfaction with Gas and Electricity Distribution Networks in Scotland

Figure 5: Satisfaction with the Scottish DNOs by Consumer Profile

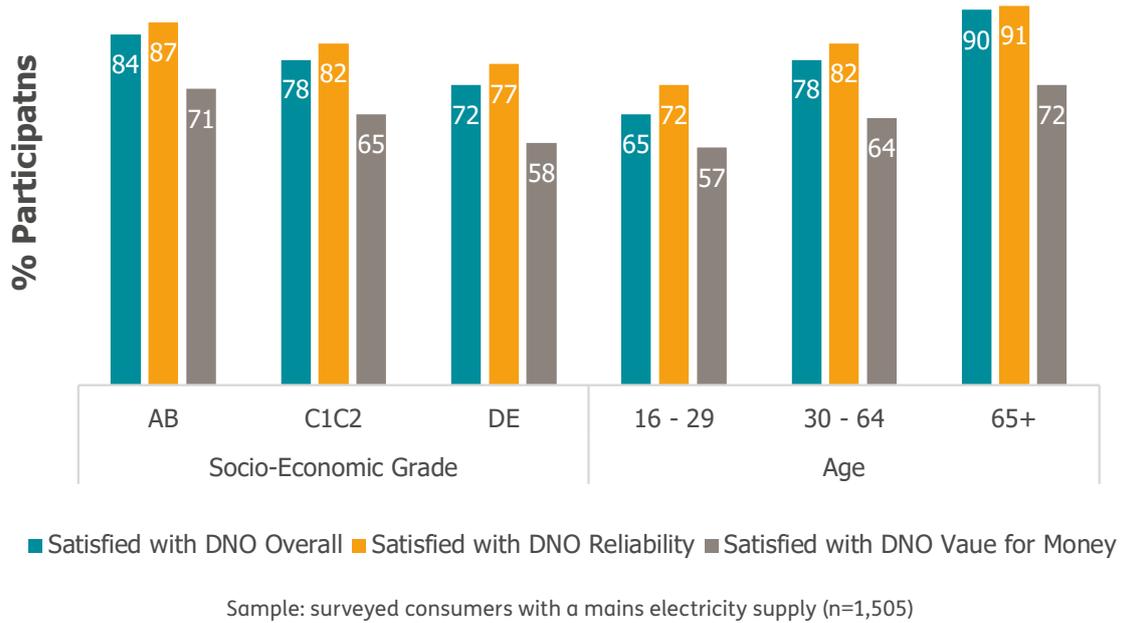
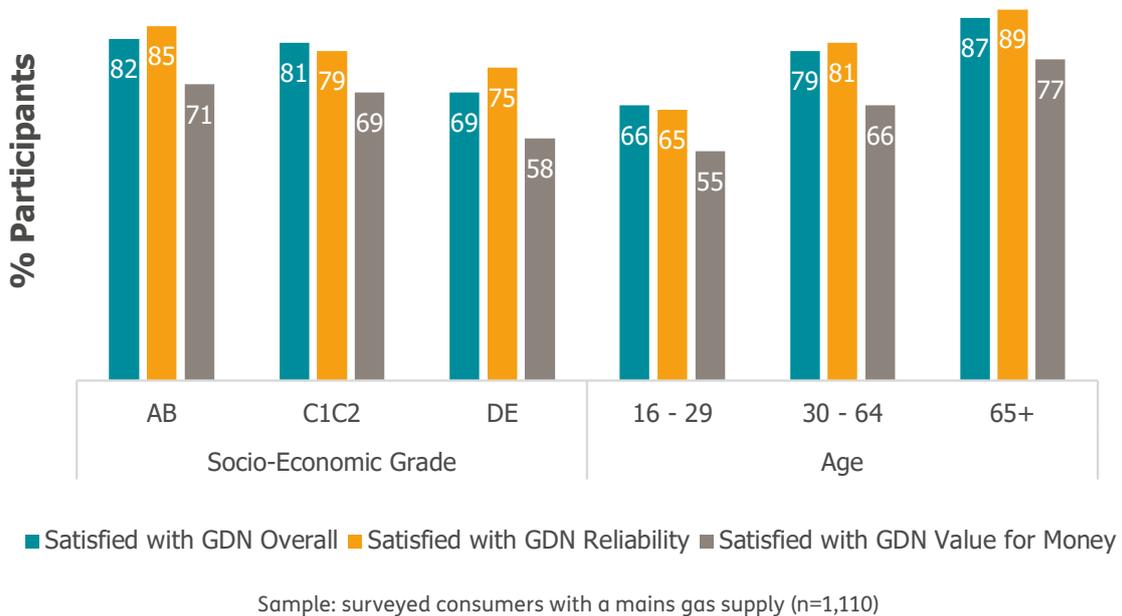


Figure 6: Satisfaction with the Scottish GDN by Consumer Profile



Consumer Satisfaction with Gas and Electricity Distribution Networks in Scotland

Among the small minority of consumers who expressed dissatisfaction with their DNO or GDN, reasons provided were found to focus on issues of cost and service. Qualitative discussions revealed that these complaints were principally driven by concerns about affordability and

consumers' ability to pay for their household's energy needs.

Many participants – and particularly those on lower incomes – felt that more should be done to keep bills affordable.

Table 1: Reasons for dissatisfaction with the Scottish gas and electricity distribution networks²⁹

Theme	Reason for dissatisfaction	Gas (n=29)	Electricity (n=39)
Cost	Too expensive	10	9
	% of energy bill is too high	3	2
	Focus on profit	2	1
Customer Service	Requires improvement	2	6
	Should be more responsive	2	5
	Unhappy with service	4	3
	Little or no contact	0	1
	Communication problems	2	1
Reliability	Problems with supply	1	7
Awareness	Didn't know about the distributor	1	5

²⁹ As the number of participants who expressed dissatisfaction with their DNO or GDN was very small as a proportion of the overall sample (2.6%), the data shown is expressed as the absolute number of participants who expressed dissatisfaction (n) rather than as a percentage of the overall survey. Not all participants provided reasons for their dissatisfaction and some respondents selected more than one reason, so the sum of the responses does not equal n.

Consumer Priorities for the Gas and Electricity Distribution Networks in Scotland

The Scottish and UK Governments have established legally binding targets for decarbonising the economy, with 100% reductions to net greenhouse gas emissions attributable to human activity required by 2045³⁰ and 2050³¹, respectively. However, while the direction of travel is now clear there remains a great deal of uncertainty about what the transition to a net zero economy will mean for individual consumers, not least because the long-term future of heat in Scotland is still undecided. As a result, the future role and extent of the gas distribution network in Scotland remains unclear.

The substitution of natural gas with hydrogen or biomethane has been proposed as a possible net zero compatible means of providing space and hot water heating to mains gas connected consumers throughout GB. However, the combined demands of heat, power generation, transport, and industry are likely to outstrip the availability of such fuels even if hydrogen production can be delivered at scale via the reformation of natural gas³². It is therefore likely that in many areas of the country that are geographically distant from large industrial clusters, the drive towards a net zero economy will rely heavily on an expansion in the use of renewable and low carbon electricity for heating and transportation.

There is little in the way of detailed government policy currently available on how net zero can or should be achieved. However, the ESO's 2019 Future Energy Scenarios³³ illustrated that electricity demand throughout GB is likely to increase significantly over the course of the next 30 years, regardless of the specific route(s) chosen to reach net zero. This will require the electricity transmission and distribution network operators to upgrade and expand their networks, while the transition away from reliable, centralised, and synchronous methods of electricity generation will also require the rollout at scale of technologies providing flexibility, energy storage, and system balancing services.

25% of households in Scotland are currently in fuel poverty³⁴. With the cost of the country's gas and electricity networks ultimately paid for by consumers, it is therefore essential that the investment required to support the energy transition is targeted appropriately to avoid consumers bearing unnecessary expense. However, in the continued absence of clear policy signals from government on the chosen pathway(s) to net zero, it may be necessary for the country's regulated energy networks to initially focus their investment on a core of least regrets options that facilitate a range of future energy scenarios while also meeting the current needs of both consumers and the networks themselves.

³⁰ http://www.legislation.gov.uk/asp/2019/15/pdfs/asp_20190015_en.pdf

³¹ https://www.legislation.gov.uk/ukxi/2019/1056/pdfs/ukxi_20191056_en.pdf

³² Steam methane reformation (SMR) of natural gas is currently used in the industrial production of hydrogen. When combined with Carbon Capture, Utilisation and Storage (CCUS), it has also been proposed as a net zero compatible route to the production of hydrogen at sufficient scale for use in the decarbonisation of industry, heat, and transport. However, current processes are energy intensive and typical SMR efficiency is less than 75%. The grid scale displacement of natural gas with hydrogen produced by this method may therefore require significant sources of low carbon electricity and could result in an increased reliance on imported natural gas, reducing energy security.

³³ <http://fes.nationalgrid.com/media/1409/fes-2019.pdf>

³⁴ Scottish House Condition Survey: 2018 Key Findings

Consumer Priorities for the Gas and Electricity Distribution Networks in Scotland

With this in mind, we asked a representative sample of more than 1,500 consumers in Scotland what the future investment priorities of their gas and electricity distribution networks should be, having first introduced them to the type of challenges that are likely to be faced by the networks as the energy transition progresses. Consumers were each given a ‘budget’ of 10 tokens for their DNO and 10 tokens for their GDN, and were asked to allocate these against the following 7 areas of potential network investment:

- > safety
- > reliability
- > affordability
- > environmental impact
- > protection for vulnerable customers
- > customer satisfaction
- > innovation

The consumers who took part in the survey prioritised the 7 investment areas into 3 distinct groups, with the delivery of gas and electricity distribution networks that are affordable, safe, and reliable considered to be of paramount importance among each of the consumer profiles surveyed. Overall, the concern of older consumers, consumers in vulnerable situations, and consumers in lower SEGs as to the affordability of their gas and electricity distribution networks’ activities placed cost considerations comfortably ahead of both safety and reliability in terms of ranking. However, while all consumer profiles prioritised DNO and

GDN affordability ahead of all other investment areas, and GDN safety was prioritised ahead of GDN reliability, consumers in higher SEGs, those from more rural parts of the country, and those resident in the SSEN distribution area prioritised electricity distribution network reliability ahead of electricity distribution network safety.

The second grouping of DNO / GDN investment areas saw consumers prioritise investment in measures designed to protect vulnerable consumers and in reducing the environmental impact of the gas and electricity distribution networks. Older consumers, consumers in vulnerable situations, and consumers in lower SEGs tended to prioritise investment in measures to protect vulnerable consumers, as did those from more rural areas and those resident in the SSEN distribution area. Younger consumers and consumers in higher SEGs were more inclined to prioritise networks’ efforts to mitigate and reduce the impact of their activities on the environment.

Lowest on the priority list across all of the consumer profiles who took part in the survey were investment in innovation and in improving customer satisfaction, with older consumers and consumers in lower SEGs more inclined to prioritise investment in customer satisfaction, and all other consumer profiles more inclined to prioritise investment in innovation. However, while neither of these areas was generally considered to be unimportant, the affordability of the gas and electricity distribution networks received roughly twice as many tokens as either customer satisfaction or innovation across the survey as a whole.

Consumer Priorities for the Gas and Electricity Distribution Networks in Scotland

Figure 7.1: Priorities for Scottish DNO investment by consumer profile

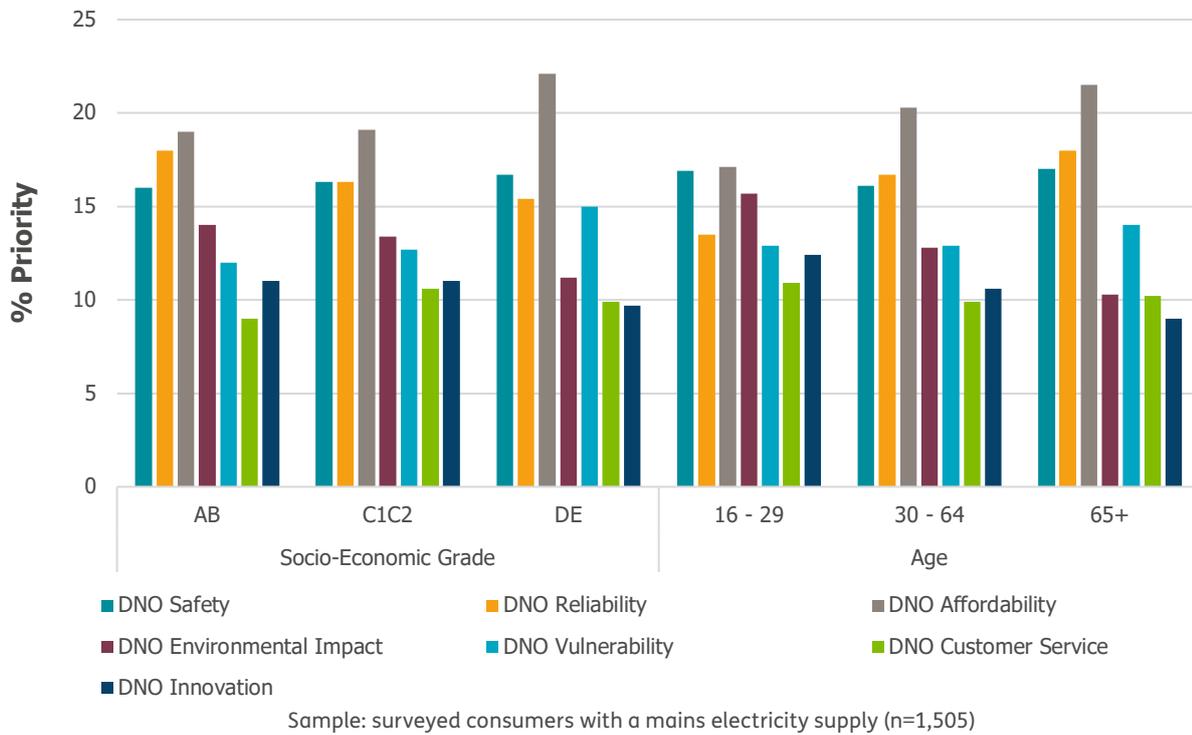
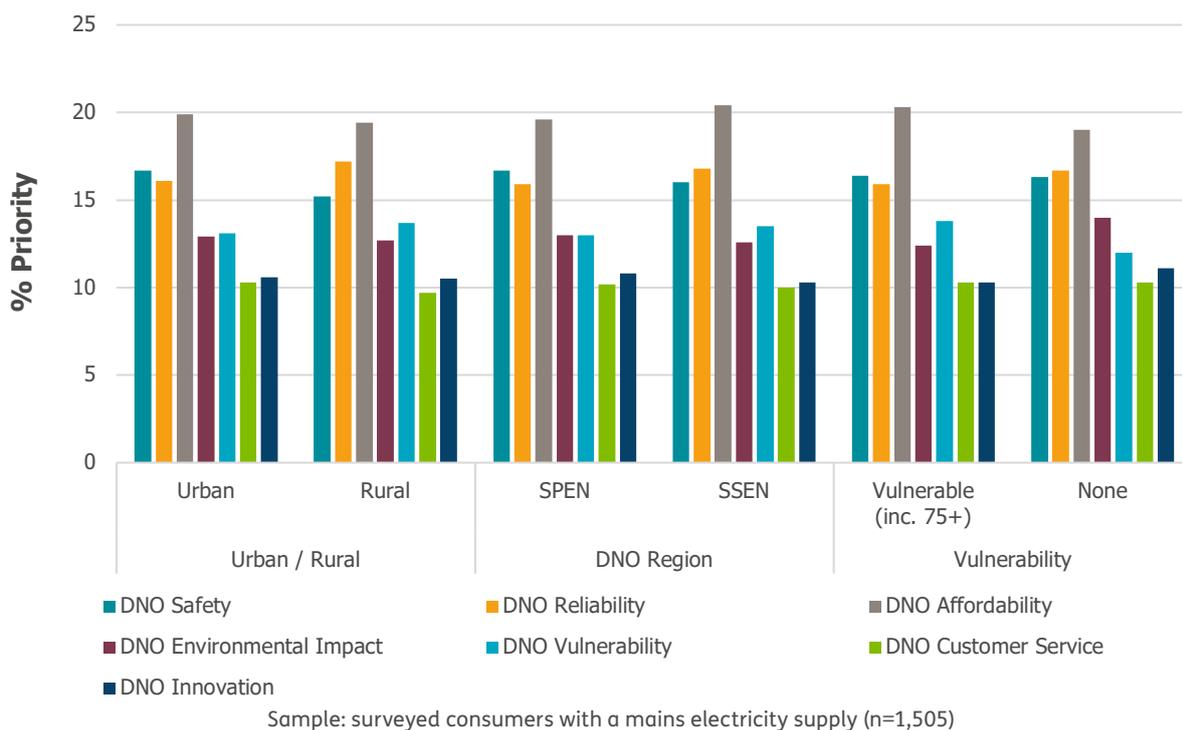


Figure 7.2: Priorities for Scottish DNO investment by consumer profile



Consumer Priorities for the Gas and Electricity Distribution Networks in Scotland

Figure 8.1: Priorities for Scottish GDN investment by consumer profile

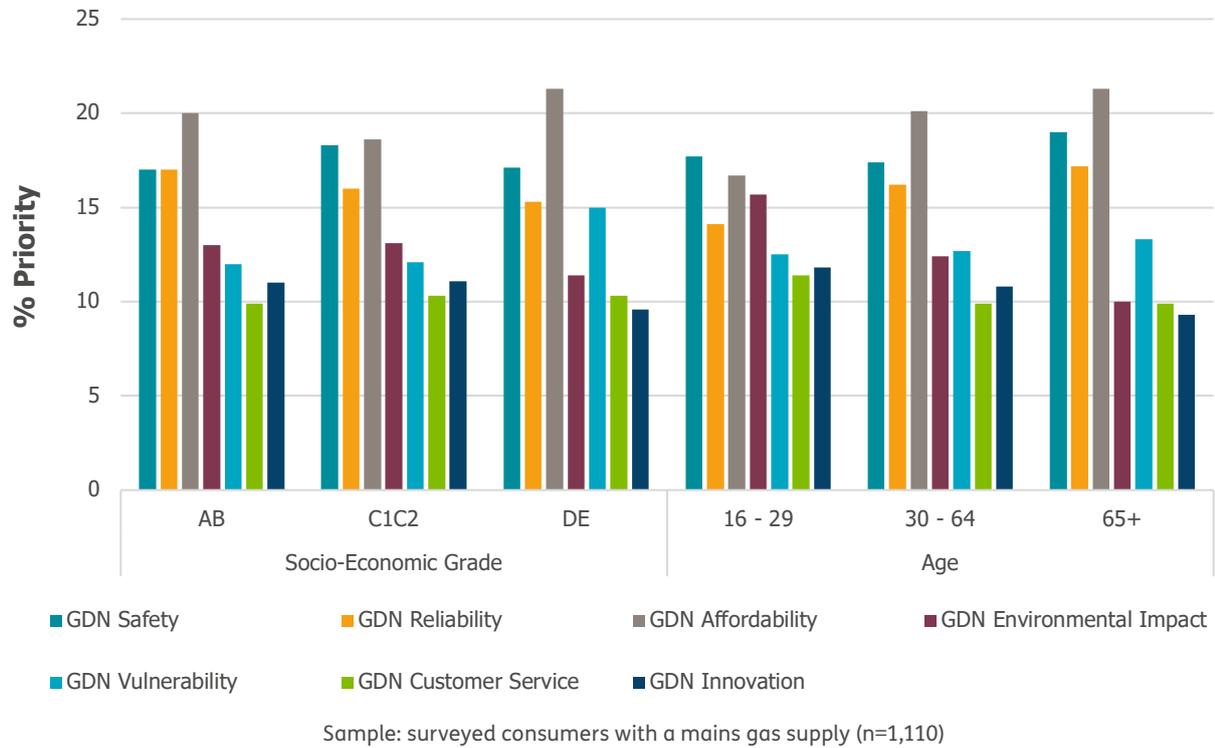
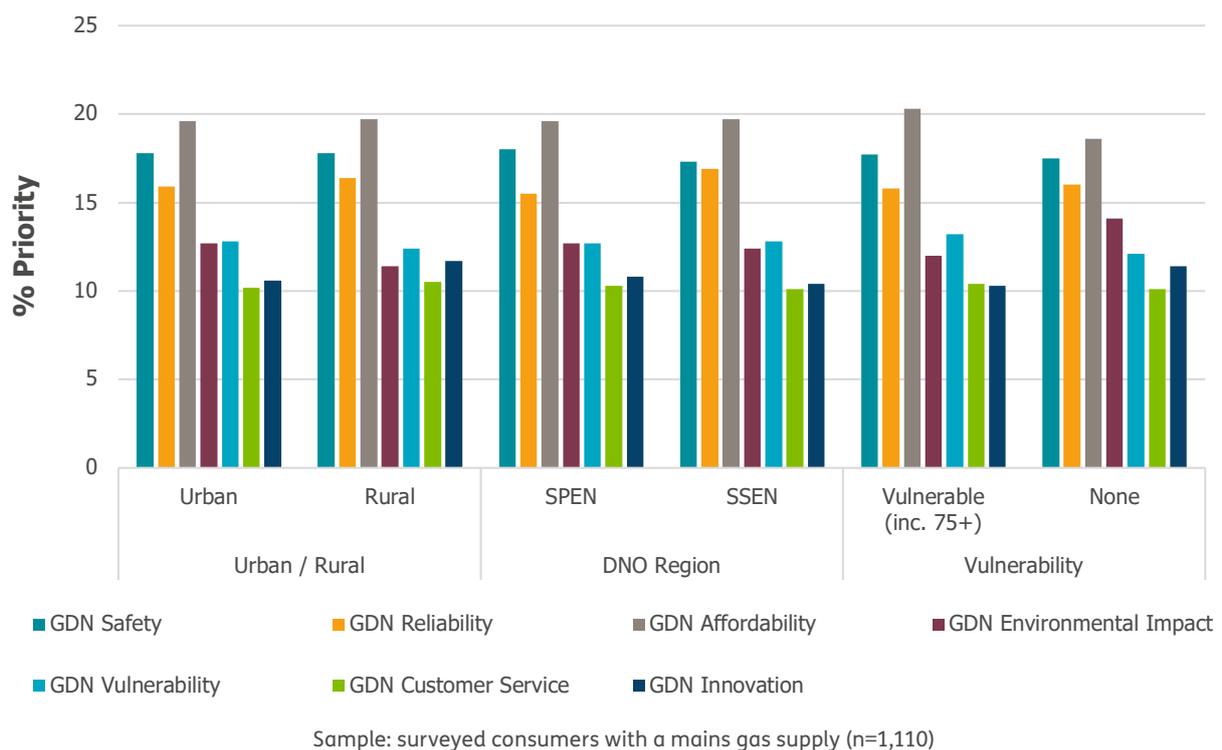


Figure 8.2: Priorities for Scottish GDN investment by consumer profile



Consumer Priorities for the Gas and Electricity Distribution Networks in Scotland

Qualitative discussions with consumers that took part in our survey revealed that the relatively low priority afforded to customer satisfaction in this exercise was influenced by high baseline levels of overall satisfaction and a relatively low incidence of direct interaction with the DNOs / GDN within the sample. In addition, among the minority of those who took part in the survey that had prior experience of contact with their gas or electricity distribution network, around 8 in 10 reported that they were satisfied with the service they received, and dissatisfaction levels were low. The currently distant relationship between consumers and the gas and electricity distribution networks and the limited experience among the survey participants of DNO / GDN customer service issues may therefore mean that consumers struggled to see value in investment to improve customer satisfaction when so few customer interactions currently take place. However, it is also possible that with overall levels of DNO / GDN satisfaction already high, consumers believe that significant investment to achieve further improvements in this area is unnecessary.

In contrast, the low priority given by the consumers who took part in our survey to investment in innovation gives a further indication of the scale of the challenge with which gas and electricity distribution networks are faced as the energy transition progresses.

Qualitative discussions revealed that despite having been provided with an overview of the energy industry's vision of a smart, flexible, and responsive future, consumers still struggled to envisage how this will be realised at scale without significant disruption to daily life.

Nevertheless, it is notable that among those who took part in our survey, younger consumers were more inclined to allocate priority to innovation than those in older age groups (and significantly so for electricity distribution). This suggests that younger consumers are more aware of the need for change in response to the climate emergency and may well be more receptive to the adoption of new technologies providing services such as flexibility and energy storage. However, if the energy industry is to deliver a future where domestic consumers play a key role in providing flexibility, it is clear that much work is still required to educate consumers as to the requirement for and benefits of such an approach. The question of what flexibility will look like for consumers is therefore one of many that needs to be addressed, and overall energy literacy needs to improve if consumers are to become sufficiently engaged in the energy transition.

Flexibility and the future of heat in Scotland

Flexibility is seen by the energy industry as key to the cost-effective delivery of GB's future energy system, with a network of smart, responsive technologies working in harmony with the energy networks to better match energy demand to available supply and network capacity. This is particularly crucial for the electricity networks as electricity generation continues to move away from fossil fuels and the electrification of both heat and transport place additional demands on the system at both a national and local level. However, our research has found that consumers' awareness of these challenges and the solutions that will be required to overcome them is currently shallow, presenting a significant barrier to the widespread uptake and efficient use of aggregatable flexibility services in a domestic setting.

At the time of writing, the vast majority of flexibility secured by GB's energy networks has come from a combination of industrial and commercial (I&C) DSR³⁵ and grid-scale batteries³⁶. Among GB's 8 DNOs, UK Power Networks and Western Power Distribution have been most active in this area³⁷ as they seek to find innovative ways of alleviating constraints on their networks. However, in an immature market both have reportedly found it difficult to secure the scale of flexibility tendered for

at economic cost³⁸. With both of the Scottish DNOs set to tender for significant flexibility in 2020³⁹ and beyond, overcoming this barrier will become increasingly important for consumers in Scotland. Much is therefore riding on the success of projects such as SPEN's FUSION⁴⁰, flexibility trading platforms like Piclo Flex⁴¹, and the Energy Network Association's efforts to develop standardised flexibility contracts⁴², if flexibility markets are soon to fulfil their potential.

One of the challenges with flexibility is that its benefits tend to be highly locational. For this reason, it is unlikely that sufficient flexibility can be secured through I&C DSR to meet the future needs of Scotland's DNOs in all areas. With DNOs currently prevented from owning energy storage assets, in many cases it is therefore likely to be necessary to procure significant flexibility from domestic consumers, creating new markets in which a sizeable proportion of consumers may need to participate if the requirements of the DNO are to be met at lowest cost.

While many consumers may be unfamiliar with the term "flexibility", or with aggregation services offered by companies like Kaluza⁴³, the provision of domestic flexibility is far from a new concept for consumers who have experience of electric storage heating.

³⁵ <https://gridbeyond.com/demand-side-response-dsr-what-is-it-why-do-it/>

³⁶ https://www.solarpowerportal.co.uk/blogs/uk_battery_storage_market_reaches_1gw_landmark_as_new_applications_continue

³⁷ <https://www.energynetworks.org/electricity/futures/flexibility-in-great-britain.html>

³⁸ <https://theenergyst.com/ofgem-dnos-must-make-progress-with-flexibility-this-year/>

³⁹ <https://theenergyst.com/ena-gets-closer-to-standardised-flex-contract-as-dnos-eye-2gw/>

⁴⁰ <https://www.spenergynetworks.co.uk/pages/fusion.aspx>

⁴¹ <https://picloflex.com/>

⁴² <https://news.energynetworks.org/news/market-changing-standard-contract-for-flexibility-delivered>

⁴³ <https://www.kaluza.com/>

Flexibility and the future of heat in Scotland

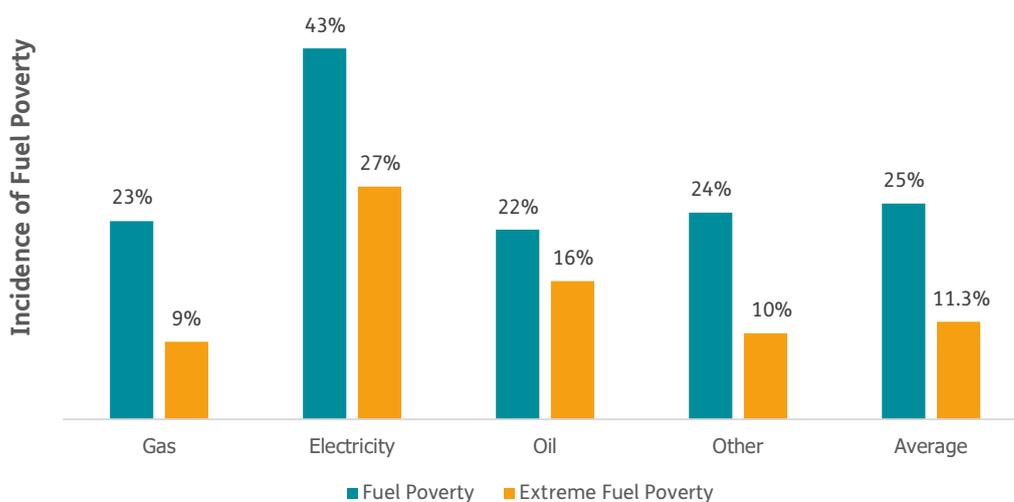
Traditional electric storage heaters were installed in many thousands of off-gas properties across Scotland in response to a significant reduction in overnight electricity demand following a sustained decline in overnight industrial electricity consumption that began in the 1960s. This left considerable headroom to shift demand for electricity used in the provision of domestic space heating and hot water away from the daytime peaks to periods where overall electricity demand was lower. In conjunction with the development of Economy 7 style restricted meters and associated TOU tariffs, this allowed those investing in traditional electric storage heating to heat their properties during the day using cheaper off-peak electricity procured overnight⁴⁴, this energy having been converted to and stored as heat until it was needed.

This system provided mutual benefits to consumers and the electricity system alike: off-gas consumers were provided with an affordable means of space and hot water heating; the electricity networks could avoid reinforcing their infrastructure to meet relatively short duration

daytime peaks in electricity demand; and levels of off-peak curtailment among large-scale electricity generators was limited, enhancing both their efficiency and profitability. In Scotland, the use of dynamic radio teleswitching also became commonplace, allowing the off-peak period offered to relevant consumers to be altered remotely in response to available network capacity and the prevailing weather conditions, thus providing an early example of semi-flexible domestic DSR.

However, in recent years the move away from bulk electricity generation at large thermal power stations to a network of decentralised and less dependable renewable generation technologies has meant that the reliable overnight surplus of electricity that once existed can no longer be guaranteed. As a result, the price of off-peak electricity provided to consumers has risen substantially⁴⁵. With 20.44% of a typical GB electricity bill also accounted for by social and environmental levies⁴⁶ – many of which are consumption-linked – a significant number of consumers in Scotland are therefore now finding

Figure 9: Fuel Poverty and Extreme Fuel Poverty in in Scotland by Primary Heating Fuel⁴⁷



⁴⁴ *Electricity Supply in the United Kingdom: A Chronology – From the beginnings of the industry to 31 December 1985*, Electricity Council, UK, 1987, p.127

⁴⁵ For example, the price of heat – which represents 43% of a typical household's energy costs for a consumer in the south of Scotland whose electricity consumption is metered through ComfortPlus White Meter – increased by 112% on ScottishPower's Standard variable rate tariff in the 8 years between February 2012 and February 2020. If prices had risen in line with inflation during this time, this increase would have been just 19%.

⁴⁶ <https://www.ofgem.gov.uk/consumers/household-gas-and-electricity-guide/understand-your-gas-and-electricity-bills>

⁴⁷ Scottish House Condition Survey: 2018 Key Findings

Flexibility and the future of heat in Scotland

that traditional forms of electric heating have become unaffordable. This is one of the reasons why the incidence of fuel poverty and extreme fuel poverty among households in Scotland who use electric heating is considerably higher than it is for any other fuel type.

247,000 Scottish households currently use electricity as the primary source of space and hot water heating⁴⁸, but this number seems likely to increase significantly as the energy transition progresses. However, consumers in Scotland consider traditional forms of electric heating to be expensive, outdated, and inefficient by modern standards. Satisfaction among traditional electric heating users is also particularly low when compared with that of consumers who make use of other space heating solutions. These negative preconceptions are therefore likely to prove a barrier to the acceptance of any future increase in the electrification of heat in Scotland.

There are, however, a number of alternative forms of electric heating now available that aim to surmount the shortcomings of these older systems, including modern water-based and water-free storage heating systems; heat and electrical batteries; and air, ground, and water source heat pumps. Nevertheless, while these might provide consumers with greater efficiency and / or improved levels of comfort when compared to traditional electric storage heaters, any appreciable increase in the use of electricity as a source of space and hot water heating on the journey to net zero – and the weather dependency of output from many renewable electricity generation technologies – will still give rise to electricity network constraints if demand cannot be better matched to available capacity.

Table 2: The heating system satisfaction gap⁵⁰

Heating system	Satisfaction
Electric storage heaters ⁴⁹ (n=197)	42%
Plug-in electric fire or heater (n=152)	56%
Electric panel heating (n=57)	63%
Portable LPG (e.g. Calor gas) or paraffin heater (n=24)	67%
Fixed gas fire / gas convector heater (n=41)	71%
Other (n=14)	71%
Heat pump systems (n=19)	79%
Solid fuel (open grate / enclosed grate / stove) (n=63)	79%
Oil-fired central heating with radiators (n=83)	81%
Warm air central heating (n=37)	81%
Gas central heating with radiators (n=1081)	85%

⁴⁸ Scottish House Condition Survey: 2018 Key Findings

⁴⁹ This data does not differentiate between traditional and ‘smart’ storage heaters

⁵⁰ Consumer Attitudes to Energy Networks in Scotland – Final Report (Accent, 2019)

Flexibility and the future of heat in Scotland

One relatively simple means of providing flexibility among electric heating users may lie in the development and widespread adoption of smart TOU tariffs. These can best be thought of as a modern successor to dynamically teleswitched TOU tariffs of the type often used by consumers with electric heating in Scotland. However, unlike these more traditional tariff structures, a smart TOU tariff will be capable of responding to both available supply and network capacity, adjusting consumers' pricing as often as every 30 minutes. Smart TOU tariffs will therefore retain a price incentive for consumers to shift their electricity demand away from periods of network stress but will be capable of being far more responsive to variations in generation and demand than more traditional TOU tariff structures.

In theory, smart TOU tariffs therefore hold the potential to offer valuable flexibility to Scotland's DNOs while minimising consumers' energy costs. However, with the availability of such tariffs reliant on the functionality afforded by smart meters, their widespread use by consumers in Scotland has been limited by technical issues⁵¹ that have contributed to delays to the smart meter rollout of at least 4.5 years⁵².

In addition, many smart TOU tariffs are unlikely to be suitable for many consumers with electric heating – particularly those with more traditional storage systems which were designed to operate most efficiently following a sustained off-peak charging cycle of several hours' duration. The inappropriate sale and use of smart TOU tariffs could therefore result in a significant reduction in comfort levels and / or an increase in energy costs, and many consumers may have to invest in a smarter, more flexible means of space heating before they are able to engage in DSR in future. Consequently, it may be that much of the demand for smart TOU tariffs, and the potential for domestic DSR they will facilitate, will initially come from sources other than properties with electric heating.

At the time of writing, the UK Government intends to end the sale of all conventionally fuelled cars and vans by 2040, but has recently consulted on whether it should accelerate this target by at least 5 years⁵³. The Scottish Government aims to move faster still, with a target to remove the need for the sale of all new conventionally fuelled vehicles by the end of 2032⁵⁴. Though EVs accounted for just 3.2% of all new vehicle registrations in GB in 2019⁵⁵, it therefore seems certain that the sale of EVs will increase significantly over course of the next decade.

⁵¹ https://www.ofgem.gov.uk/system/files/docs/2018/05/2018.05_open_letter_-_observations_from_rollout_plans.pdf

⁵² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/893124/delivering-smart-system-post-2020-govt-response-consultation.pdf

⁵³ <https://www.gov.uk/government/consultations/consulting-on-ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans/consulting-on-ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans>

⁵⁴ A nation with ambition: the Government's Programme for Scotland 2017-2018

⁵⁵ <https://www.nextgreencar.com/electric-cars/statistics/>

Flexibility and the future of heat in Scotland

In their 2018 Future Energy Scenarios, the ESO modelled that there may be as many as 36 million EVs on British roads by 2040⁵⁶. With a typical domestic EV charger placing a prolonged demand of 3 – 7kW on the electricity system, and with commercially operated fast and rapid chargers rated at up to 350kW⁵⁷ also becoming increasingly prevalent⁵⁸, such a dramatic upturn in demand for EVs will inevitably require significant investment in electricity distribution network capacity to support a national EV charging infrastructure. However, the widespread use of smart EV charging has been modelled⁵⁹ to hold the potential to limit the resulting increase in peak network demand by automatically shifting electrical load on the networks arising from EV charging to periods where greater

headroom is available, significantly reducing the need for electricity network reinforcement. Where smart 2-way charging is employed, vehicle-to-building and vehicle-to-grid services can also be provided as part of a virtual power plant (VPP) capable of either reducing electricity network demand or providing a short-term boost to electricity generation capacity.

The UK Government has recently consulted on making all new non-public EV chargers smart⁶⁰, potentially stimulating significant demand for smart TOU tariffs among EV users. However, strong consumer buy-in will remain essential if the benefits of additional DSR services which can be derived from smart EV charging, such as those provided by a VPP, are to be fully realised by both consumers and DNOs.

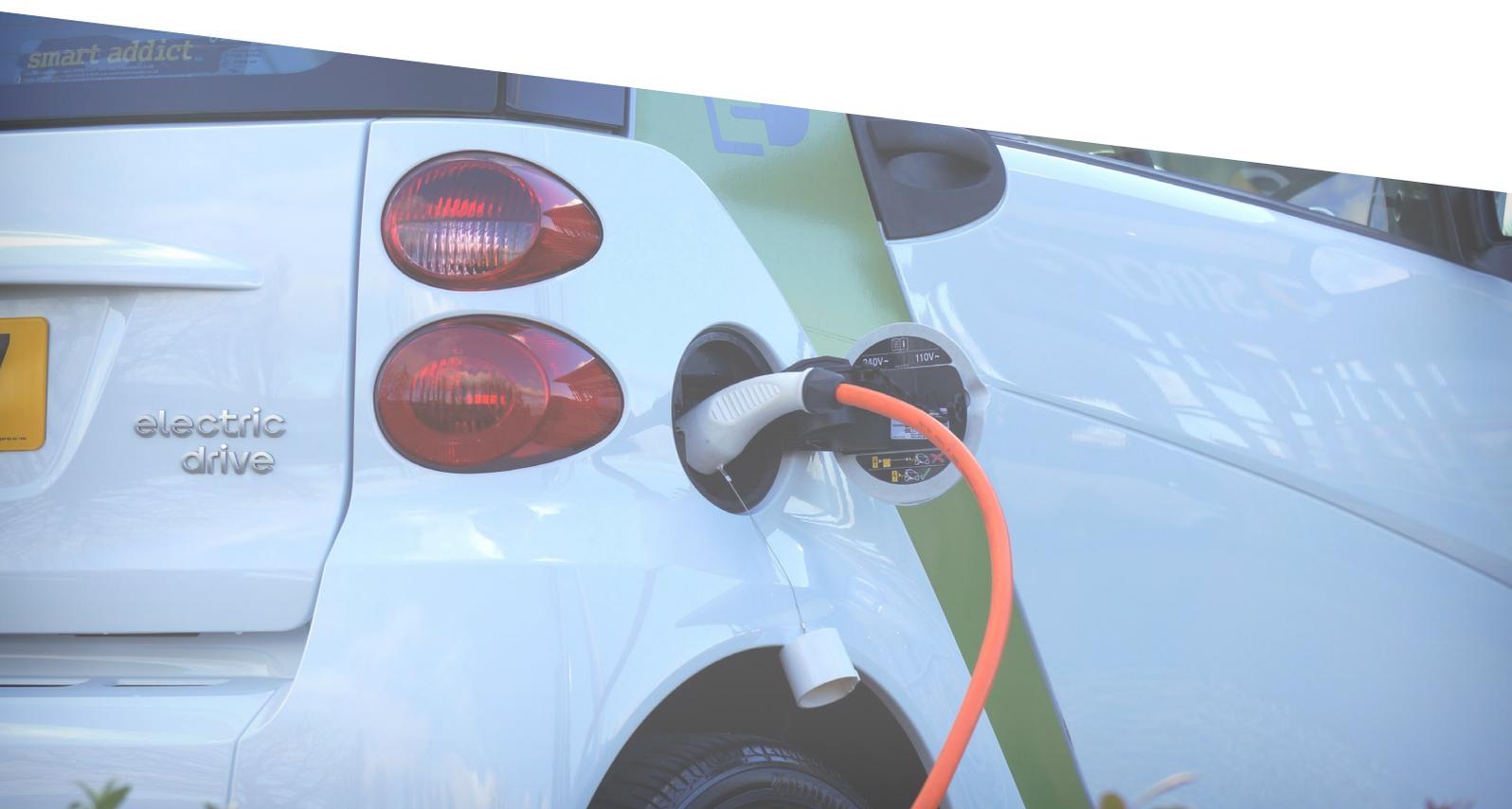
⁵⁶ <http://fes.nationalgrid.com/media/1363/fes-interactive-version-final.pdf>

⁵⁷ <https://www.autoexpress.co.uk/car-news/101586/uk-s-first-350kw-ev-charging-station-opens-in-kent>

⁵⁸ <https://www.zap-map.com/live/>

⁵⁹ <http://fes.nationalgrid.com/media/1363/fes-interactive-version-final.pdf>

⁶⁰ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/817107/electric-vehicle-smart-charging.pdf



Consumer attitudes to the future of domestic flexibility in Scotland

A variety of new technologies hold the potential to facilitate the provision of flexibility by domestic energy consumers. However, if domestic flexibility is to be secured at sufficient scale in the locations required by Scotland's energy networks, consumer awareness of and engagement with these technologies is likely to be of fundamental importance. We therefore introduced a representative sample of more than 1,500 consumers in Scotland to a range of simple domestic flexibility services, providing a brief explanation of how each would work, and of the benefits each would be expected to bring from a bill-payer perspective. We then asked consumers to indicate their level of interest in each of the technologies explored.

The results of this exercise revealed that consumers' enthusiasm for domestic flexibility and the technologies designed to provide it is currently mixed. For example, despite its likely importance to future electricity system balancing, only 31% of the consumers who took part in our survey expressed any level of interest in smart EV charging – the lowest of all of the domestic flexibility services presented. However, among the small minority of participants who already owned an EV or any form of renewable energy generation, smart EV charging was of interest to 52%. This suggests that as EV ownership becomes more common, so too will an appreciation of the benefits to individual consumers – if not the electricity system – of smart EV charging. Nevertheless, with almost half of early adopters of low carbon technologies

still unconvinced of its merits it is clear that more work is required to educate consumers on why smart EV charging will be of such importance to efforts to decarbonise the economy; of the mutual benefits it will bring for consumers and the DNOs; and of the consequences of adopting a 'do nothing' approach.

It is also important to note that in 2018, 28.6% of all households in Scotland did not have access to a car for personal use – a figure which rose to a high of 59% among households with a net annual income less than £10,000⁶¹. Vehicle ownership also varies greatly by household type and by urban / rural location, with 46% of single pensioner households having no access to a car or van for personal use and vehicle ownership per head of population in major urban areas such as Glasgow, Edinburgh and Dundee all significantly below the national average⁶². For a significant minority of consumers in Scotland, the value of smart EV charging is therefore likely to be of little obvious relevance and it might be expected that this would have a negative effect on consumers' enthusiasm for such technology.

Low income households in Scotland are among those least likely to have access to a private vehicle. 88.6% of income poor households in Scotland are also in fuel poverty⁶³. If a national EV charging infrastructure and any associated network reinforcement were to be funded via a universal or consumption-linked charge on all consumers' electricity bills, this would place further financial stress on many households who are already struggling to meet their essential fuel

⁶¹ <https://www.transport.gov.scot/media/47196/scottish-transport-statistics-2019.pdf>

⁶² <https://www.transport.gov.scot/media/47196/scottish-transport-statistics-2019.pdf>

⁶³ Scottish House Condition Survey: 2018 Key Findings

Consumer attitudes to the future of domestic flexibility in Scotland

costs. The vast majority of these households are also among those least likely to directly benefit from such investment. Socialising the costs of the EV rollout among all consumers would therefore run counter to the Scottish Government's Economic Strategy, which aims to promote inclusive growth and tackle inequality⁶⁴, and efforts to reduce the incidence of fuel poverty in Scotland to no more than 5% by 2040⁶⁵.

In order to ensure that such investment is both fair and financeable, DNOs will therefore need to work closely with Ofgem, central and local government, licensed electricity suppliers, and the private sector to design a funding model that allows the network costs associated with EVs to be borne by those who will use this infrastructure and who are able to pay for its rollout. This might involve a combination of local and / or national taxation, and electricity bill levies payable only by those who use EVs.

Of the other asset-driven flexibility services presented to the consumers who took part in our survey, battery storage and smart electric storage heaters were found to be of interest to around 40%, with interest in smart electric storage heaters increasing to 75% among consumers who already make use of electric heating and relatively consistent across SEGs.

Qualitative discussions revealed that many of the consumers who took part in the survey viewed domestic battery storage as a particularly

novel concept, with some imagining it being of particular benefit for those with access to domestic microgeneration technologies. Many also saw it as a way of providing increased resilience to individuals or communities that are particularly vulnerable to interruptions to the electrical power supply. However, as with each of the other asset-driven flexibility services explored in the survey, many consumers were also concerned about the financial investment required to take advantage of these new technologies, with concern for and among consumers in lower SEGs as to their ability to engage with the energy transition on these terms.

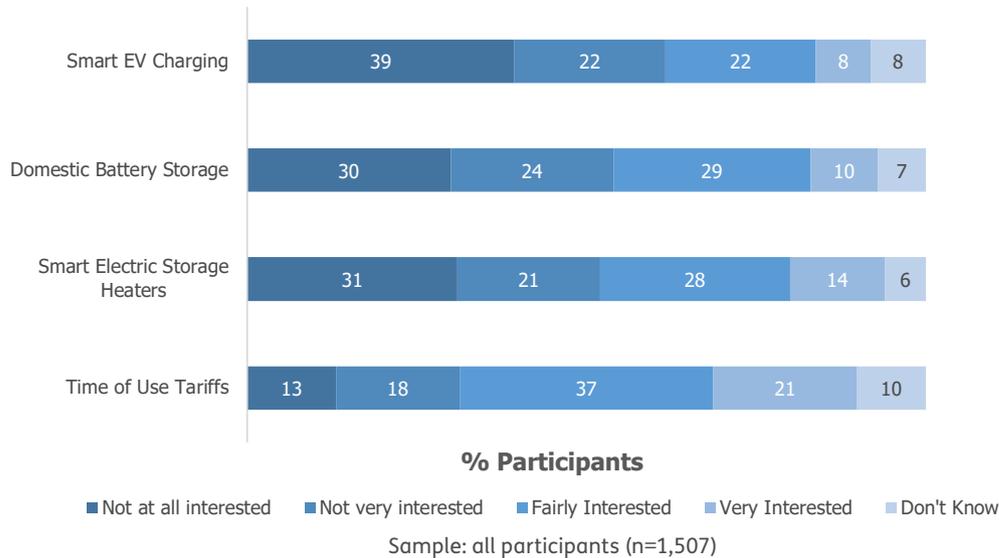
The most popular of the flexibility services presented to the consumers who took part in our survey was therefore the proposed expansion in the use of smart TOU tariffs, with interest particularly strong among consumers who already benefit from the use of a smart meter (67% vs. 55% among consumers with a traditional meter). This suggests that the smart meter rollout is not only acting as a key enabler of smart grids from a data and technology perspective, but that it is also having a positive effect on consumer attitudes towards the needs of the energy transition more generally, underlining the importance of completing the smart meter rollout to all consumers in GB as soon as is reasonably practicable.

⁶⁴ Scotland's Economic Strategy

⁶⁵ http://www.legislation.gov.uk/asp/2019/10/pdfs/asp_20190010_en.pdf

Consumer attitudes to the future of domestic flexibility in Scotland

Figure 10: Interest in new ways of using energy by technology⁶⁶



Levels of interest in an expansion in the use of smart TOU tariffs were also found to be more consistent across age groups than any of the other flexibility services explored in the survey, with consumers typically finding TOU pricing to be a relatively straightforward concept to understand and an accessible means by which they could directly influence their household’s energy costs.

However, despite relatively high levels of interest in such tariffs, qualitative discussions revealed that many consumers are concerned about the impact of smart TOU tariffs on consumers who are unable to modify their energy consumption profile to avoid periods of peak or super-peak energy pricing. Some also highlighted that an expansion in the availability of smart TOU tariffs may lead to an increase in what might be described as ‘unhelpful or antisocial’ energy behaviours (e.g. the overnight use of washing machines with a spin cycle in tenement buildings,

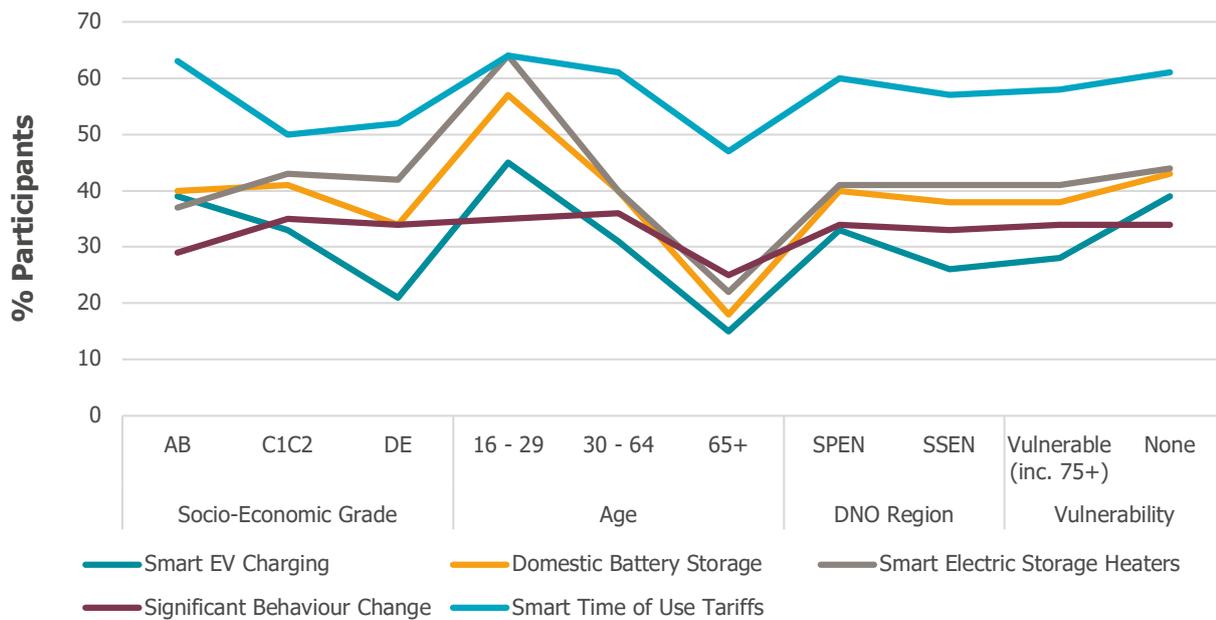
flats, and semi-detached or terraced housing, where it was felt that the transfer of vibration and noise to neighbouring properties would be disruptive).

With the exception of smart electric storage heaters, consumers’ interest in engaging with the energy transition tends to be higher among younger consumers and consumers in higher SEGs. There are no differences by urban / rural status across any of the flexibility services that were explored in our survey, but consumers in the SSEN distribution area are significantly less interested in smart EV charging than those in the SPEN distribution area (26% vs. 33%). Interest among older consumers is significantly lower across all of the routes to domestic DSR that were discussed, but with the exception of smart EV charging the responses of consumers who self-identified as vulnerable were consistent with those of the wider survey.

⁶⁶ Totals may not add to 100 due to rounding.

Consumer attitudes to the future of domestic flexibility in Scotland

Figure 11: Interest in new ways of using energy by consumer profile



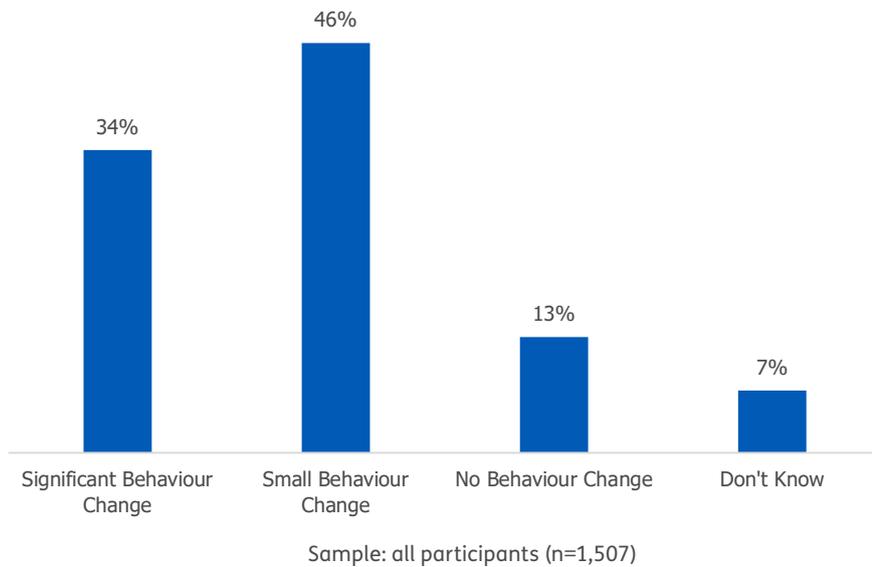
Sample: all consumers (n=1,507)

We also asked the consumers who took part in our survey how willing they would be to change the way in which they use energy, if such a change were to lead to a reduction in their bills. Unsurprisingly, there was a relatively high level of support for such a proposition, with 80% of those surveyed stating that they would be prepared to change their behaviour to reduce energy costs and only 13% indicating that they would be resistant to such an idea. However, in qualitative

discussions it was found that most consumers (57% of those who indicated that they would be prepared to change their behaviour) did not envisage an ability or willingness to make significant lifestyle changes as a route to reducing their household's energy costs, with older consumers and consumers in higher SEGs considerably less likely to consider significant behaviour change a practical or desirable route to reducing household energy costs.

Consumer attitudes to the future of domestic flexibility in Scotland

Figure 12: Consumers' willingness to change behaviour to reduce energy costs



Taken together, these findings suggest that while consumers are attracted to providing flexibility by the lure of reduced energy costs, their willingness or ability to engage in the behaviour change necessary to realise the benefits of smart TOU tariffs is likely to be limited. The widespread and efficient use of smart TOU tariffs for purposes other than smart EV charging may therefore rely on the availability of low-cost domestic battery storage. This could remove many of the incentives that might exist for unhelpful or antisocial energy behaviours and could mean that many consumers would be able to passively engage in the energy transition by providing flexibility to their DNO without requiring significant behaviour change.

The availability and uptake of automation and technology are therefore likely to be crucial for many consumers to be able to reliably engage with smart TOU tariffs, and for the network benefits of the flexibility that such tariffs have the potential to facilitate to be realised by the DNOs.

The benefits to DNOs of the ability to 'lock in' smart TOU tariff-facilitated DSR by reducing reliance on individuals' behaviour are likely to be considerable. However, the ability of many lower income and vulnerable consumers to make the necessary capital investment(s) is likely to prove a barrier unless sources of funding are made available to enable them to participate in and benefit from the provision of flexibility.

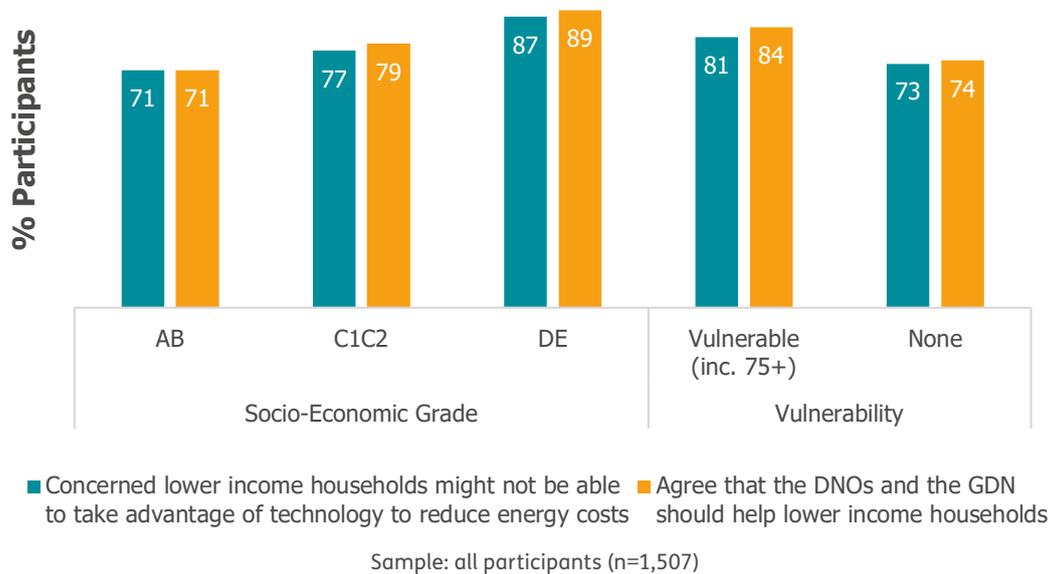
Consumer attitudes towards a Just Transition

Our representative survey of more than 1,500 consumers in Scotland has revealed that there is a high level of concern that lower income households might be left behind by the energy transition, and for the impact that this could have on the future energy costs of some of the most vulnerable consumers in Scotland.

For example, 79% of the consumers who took part in our survey expressed concern that households on lower incomes may not be able to take advantage of technology that helps them to reduce their impact on the gas and

electricity distribution networks, with only 5% of the consumers who took part in our survey expressing an opposing view. An even higher proportion of consumers (80%) thought that gas and electricity distribution networks should assist households on lower incomes to engage with the energy transition, with only 3% of the consumers who took part in our survey disagreeing with this proposition. In both cases the strength of feeling of consumers was considerable, with more participants ‘strongly’ agreeing with the concepts raised than those who indicated that they were merely ‘tended to’ agree.

Figure 13: Attitudes towards financial support for low income consumers



Consumer attitudes towards a Just Transition

In qualitative discussions, these opinions were found to stem from a view that gas and electricity distribution networks are to some extent duty bound to provide a level of support to financially vulnerable consumers, with the networks and the energy that flows through them providing an essential-for-life service.

These findings indicate that there would be widespread support in Scotland for the introduction of a price control deliverable in the next electricity distribution price control (RIIO-ED2) in the form of a ‘use-it-or-lose-it’ allowance, targeted at the needs of low income and vulnerable consumers and delivered through existing bodies such as Scottish local authorities and / or Home Energy Scotland. This could be used by DNOs to provide funding for innovative solutions to help their vulnerable and low income customers keep pace with the energy transition, and might include the provision of funding for:

- > targeted, high value interventions such as domestic battery storage for low income consumers with a health condition that leaves them reliant on mains-powered medical equipment or otherwise at increased risk of harm from interruptions to their electricity supply;
- > smart, high efficiency, low carbon heating systems for low income homeowners who are unable to access alternative sources of funding, such as that provided by the Energy Company Obligation and the Scottish Government’s Warmer Homes Scotland scheme; and

- > lower value interventions that could be spread more widely among a DNO’s customer base.

The appetite among consumers in Scotland for the provision of such financial support is strong. For example, of the 80% of consumers who took part in our survey that supported the idea of Scottish gas and electricity distribution networks assisting lower income households to engage with the energy transition, 62% would support the provision of smart, high efficiency, low carbon heating systems to those homeowners least able to afford them. 63% would also support the provision of funding to reduce the cost of other smart technologies such as domestic battery storage that would make it easier for such households to take advantage of smart TOU tariffs. In the event that hydrogen forms part of the future energy mix for space heating, the provision of funding for hydrogen-ready boilers and / or appliances to vulnerable and low income households by the GDN is also likely to be supported.

Delivering ‘Whole System’ solutions for Scotland

Scottish local authorities will play a pivotal role in the planning and delivery of viable local pathways to net zero. Central to this will be the proposed development of LHEES, which will be vital in ensuring that a coordinated approach is adopted in the rollout of low carbon heating in communities throughout Scotland. However, with every decision taken having implications for the future of the gas and electricity networks in Scotland it is essential that local authorities are cognisant of the whole system costs of their LHEES proposals.

If decarbonisation is to be achieved at lowest possible cost whilst ensuring maximum consumer benefits, this means that the 32 LHEES have to work together to deliver the lowest whole system cost solutions to the decarbonisation of heat in Scotland. Though not requiring local authorities to become whole system planners, by design this means that decisions that underpin LHEES must be made with due consideration having been given to their cost implications on consumers outwith a local authority’s boundaries, as well as on non-heat sectors such as transport and industry.

Scotland’s gas and electricity distribution networks are ideally placed to provide expert support to Scottish local authorities to enable whole systems costs to be accounted for in the development and delivery of LHEES. For example, the data they hold will be vital if the competing demands on the energy networks of the heat, power, transportation and I&C sectors at both a national and local level are to be adequately understood by LHEES planners. It is therefore essential the Scottish Government ensures that Scotland’s energy networks are empowered to consistently play a full and active

role from the outset of the LHEES programme if decarbonisation in Scotland is to be achieved efficiently and at lowest possible cost. Regulators must also ensure that networks are appropriately incentivised to work collaboratively on the development of lowest whole energy system cost solutions to the net zero challenge, and that allowances are set accordingly when decisions on networks’ funding are made.

LHEES represents a significant opportunity for Scotland’s energy distribution networks to help shape and support the transition to net zero in every community in Scotland. This will benefit both consumers and the networks themselves, but it will be essential to ensure that those benefits are shared fairly and that no consumers are left behind. Recent projects such as NINES⁶⁷ have demonstrated what can be achieved when innovative, whole energy system approaches to the relief of electricity distribution network constraints are taken, but also highlight the problems that can arise when commercial markets need to be relied upon for funding.

NINES was developed to support the decarbonisation of Shetland’s isolated electricity system by maximising the potential of the islands’ embedded renewable electricity generation capacity whilst improving overall electricity distribution network resilience. The result was a project that aimed to combine large- and small-scale energy storage solutions, active distribution network management technologies, and investment in domestic energy efficiency measures. However, 2 of the original partners in the project withdrew when appropriate funding could not be secured. This significantly reduced the benefits of the overall NINES project to both the DNO and consumers.

⁶⁷ <https://www.ninessmartgrid.co.uk/>

Delivering ‘Whole System’ solutions for Scotland

Investment in energy efficiency is often the least technically complex way of providing a dependable solution to energy network demand constraints, and NINES is not alone in exploring the benefits to consumers and DNOs that can be derived from such investment⁶⁸. However, while other projects have focussed on low value interventions such as LED lighting, the revised NINES project partnered with a local social housing provider to help fund the installation of smart electric storage heaters and smart hot water cylinders in 234 homes.

Together with the commissioning of a 1MW electrical battery, this investment improved the DNO’s ability to balance the electricity system in Shetland and reduced the level of curtailment that renewable generators on the islands have to contend with. In addition, all consumers in the SSEN distribution area in Scotland have benefitted financially through the avoidance of costly network reinforcement in Shetland and additional upgrades to Lerwick Power Station. Many consumers in Shetland have also benefitted from improved energy efficiency, resulting in lower household energy costs and significantly improved levels of comfort.

While the challenges and opportunities presented to SSEN in Shetland were unique, this type of whole system approach must become the norm if the benefits of the energy transition are to be shared by consumers and the energy industry alike. However, it is notable that the long-term success of such projects is often likely to depend on embedded consumer behaviour change and / or the acceptance and efficient use of new technologies at scale. Where I&C DSR cannot be procured at sufficient scale, and it would prove more cost effective than traditional network reinforcement or would deliver appreciable consumer benefits for marginal additional cost, Scotland’s gas and electricity distribution networks may therefore need to provide targeted funding to Scottish local authorities and / or Home Energy Scotland to help fund the provision of domestic technologies that would increase the participation of low income and vulnerable households in LHEES and the energy transition.

⁶⁸ For example: <https://www.gov.uk/guidance/electricity-demand-reduction-pilot>

Putting consumers at the heart of the energy transition

Effective community engagement successfully empowers consumers to influence decisions that affect their lives and impact upon the communities in which they live and work. It goes beyond the type of public relations exercise that is often employed by infrastructure providers to inform stakeholders of the impact on them of decisions that have already been made, and instead places the views and needs of communities at the very centre of decision making on infrastructure investment projects.

At present, only 35% of Scottish citizens feel they have any influence over decisions which impact their community, yet 82% state that they would like more of a say in decisions that affect them⁶⁹. Traditional methods of community engagement are therefore failing to reach the majority of those who are willing to participate. In the context of the energy transition, this presents a significant risk that traditional energy network reinforcement and the provision of additional generation and grid-scale flexibility technologies will remain the only guaranteed means of meeting the country's legally binding emissions reduction targets whilst also continuing to ensure reliability of supply. This will come at significant cost, and consumers will ultimately be required to pay for an energy system that is larger and less flexible than it needs to be.

In an attempt to understand and overcome some of the barriers to effective community engagement that can be faced by both infrastructure providers and consumers, SSEN recently partnered with the University of Southampton, DNV GL and Neighbourhood Economics in an Ofgem-funded pilot project (SAVE) in the south of England⁷⁰. This 5-year study tested a range of different approaches to community engagement and investigated

how the provision of low value energy efficiency technologies, targeted messaging, innovative price incentives, and improved energy literacy can influence consumers' willingness and ability to provide domestic DSR.

The results of the study found that consumers were more than twice as likely to engage with the project through locally branded initiatives than they were if the DNO was seen to be the lead partner. Consumers were also more attracted by the idea of becoming part of a caring, connected community than they were by messages about saving money or tackling climate change. This suggests that consumers are generally wary of the energy industry and that traditional messaging on energy issues, which tends to focus on household energy costs, is ineffective in reaching many consumers – a feature which may help to explain why a significant majority of domestic consumers are chronically disengaged from the retail energy market⁷¹.

SAVE also found that consumers were receptive to learning more about the challenges presented by the energy transition if those messages were conveyed in an accessible way. The ability of communities to shape this messaging and to become active partners in the in the development of potential solutions to the net zero challenge was also seen as vital to both achieving and sustaining high levels of consumer engagement.

The response of communities to the project's aims was also stronger and more sustained where informed and engaged consumers were incentivised to provide the level of flexibility required by the DNO. In addition, participation levels significantly improved where there was no cost to consumers to take part.

⁶⁹ <https://www.ipsos.com/sites/default/files/migrations/en-uk/files/Assets/Docs/Scotland/scotland-cosla-topline-2013.pdf>

⁷⁰ <https://save-project.co.uk/>

⁷¹ <https://assets.publishing.service.gov.uk/media/5773de34e5274a0da3000113/final-report-energy-market-investigation.pdf>

Putting consumers at the heart of the energy transition

While SAVE revealed that many consumers are willing to change their energy consumption patterns when sufficiently incentivised to do so, it also confirmed that such behaviour change is difficult for many consumers to sustain over a prolonged period of time in the absence of facilitative technologies. In contrast, NINES⁷² has provided a lasting, technology-based solution to electricity distribution network constraints that locks in the benefits of domestic DSR to the DNO and is capable of providing a flexible yet reliable response to unexpected changes in consumer demand and unplanned system outages.

Taking the findings of NINES and SAVE together suggests that novel, local initiatives led by partners that are trusted in the local community will be key to engaging consumers in the energy transition – findings that, in the context of LHEES, are equally as relevant to local authorities in Scotland as they are to Scotland's gas and electricity distribution networks. Early engagement and clarity of messaging will also be crucial if consumers are to be sufficiently informed and empowered to enable them to feel like part of the solution to the challenges presented by the energy transition, and communities must be given the opportunity to help shape decisions that will impact upon their members.

With uncertainty as to the extent to which low carbon gases such as hydrogen may be deployed for space heating in Scotland, this is particularly important with respect to the decarbonisation of heat as the rollout of heat

networks and increasing levels of electrification may require many consumers to fundamentally alter how their homes and businesses are heated. While gas and electricity distribution networks are already incentivised to work with stakeholders to aid their understanding and visibility of consumer vulnerability, it will become increasingly necessary for networks to leverage those relationships and forge proactive new partnerships to help educate and inform consumers as to the challenges and opportunities presented by the transition to a net zero compatible energy system.

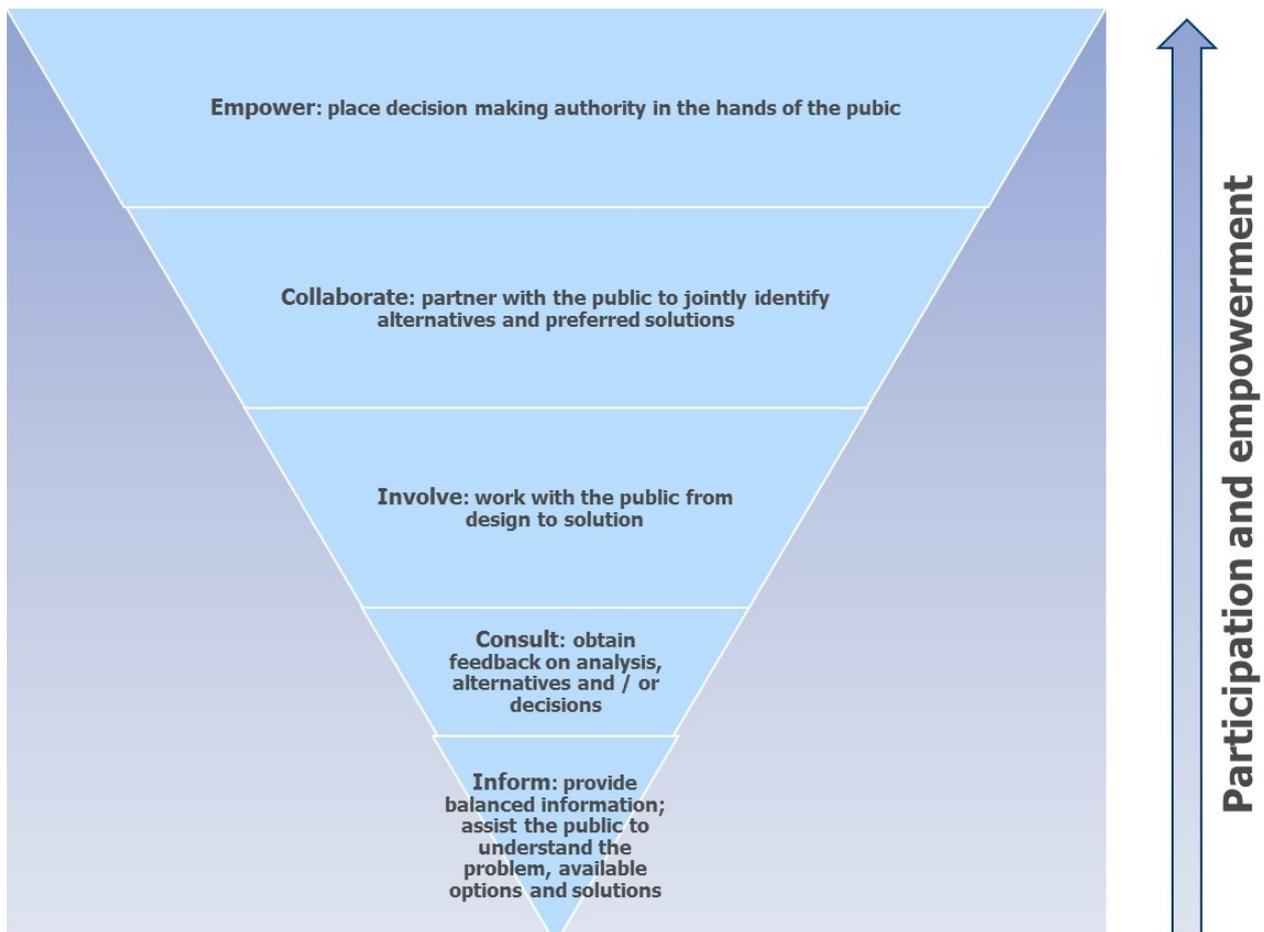
In a recently published report⁷³ we noted that in order to successfully engage with communities, many organisations need to fundamentally change their approach. Rather than organisations simply thinking *about* communities, we argued that successful community engagement requires organisations to think *like* communities. In addition, we noted that it is crucial that sufficient expertise and experience is available if an organisation is to be able to identify the most appropriate engagement method(s) and messaging for a given community. Organisations should also avoid adopting engagement methods that simply aim to demonstrate that community views have been gathered and should instead aim at all times to deliver an involved engagement process that empowers communities to influence decision making and delivers outcomes that reflect communities' needs.

⁷² <https://www.ninessmartgrid.co.uk/>

⁷³ https://www.cas.org.uk/system/files/publications/engaging_hearts_and_minds_jan_2020_web_final_0.pdf

Putting consumers at the heart of the energy transition

Figure 14: Spectrum of Community Engagement⁷⁴



Our previous research has revealed that successful community engagement should:

- > be inclusive, accessible and representative;
- > ensure communities are fully involved in engagement programmes as early as possible;
- > establish communities' trust and confidence in engagement programmes;
- > tailor engagement methods to individual communities; and
- > be flexible enough to respond to and incorporate community ideas and needs.

⁷⁴ Strengthening the voice of consumers in energy networks' business planning (Citizens Advice, 2018)

Putting consumers at the heart of the energy transition

In addition, we found that organisations must:

- > fully commit to delivering engagement programmes that genuinely enable communities to influence decision making;
- > scope engagement programmes in detail to allocate appropriate time, finance and staff resources;
- > engage external expertise where appropriate;
- > evaluate the impact of the engagement; and
- > evidence to the community how their input has influenced decision making and outcomes.

Scotland's gas and electricity networks were incentivised to engage with consumers under the RII0-1 price control via the Stakeholder Engagement Incentive (for electricity and gas transmission networks and the GDN) and the Stakeholder and Consumer Vulnerability Incentive (for the DNOs). As part of the planning for RII0-2, regulated energy networks have also been required to establish consumer engagement groups (CEGs). However, the consumer engagement that has been conducted during the planning for RII0-2 has been necessarily high level, seeking to understand and account for consumer priorities, attitudes and values. The demands of the energy transition and, in particular, the development of LHEES in Scotland will require far more detailed community engagement. A comprehensive education program may therefore be required to improve energy literacy among consumers of all ages. As demonstrated by SAVE, informed consumers are more likely to become engaged consumers, and engaged consumers are more prepared to change their behaviour or adapt to new technology than when changes are imposed.

Our representative survey of more than 1,500 consumers in Scotland has revealed that while there is currently a very shallow understanding of the energy system, there is also an appetite for information when the energy transition is explained. As new technologies become more mainstream, we also found that there is a tendency among consumers to view potential solutions to the challenges presented by the energy transition more positively. For example, despite consumers expressing only modest support for a variety of flexibility services, interest was found to be significantly higher than the mean among consumers who were already engaged with similar or facilitative technologies. This suggests that as programmes such as the smart meter rollout continue, consumers may become more aware of the potential benefits of developments like smart TOU tariffs and smart EV charging via their interactions with energy suppliers.

However, in 2016 the CMA found that a significant proportion of consumers is chronically disengaged from what is still a relatively simple retail energy market⁷⁵ and a recent survey of more than 3,000 consumers in Scotland found that only 22% had switched tariff within the previous 12 months⁷⁶. It therefore seems unlikely that the smart meter rollout and the development of a wider range of smart TOU tariffs will by themselves mean that a significant proportion of consumers will choose to provide flexibility to their energy distribution network through a purely retail offering. As the principal beneficiary of large-scale domestic flexibility, DNOs may therefore have a role to play in helping to bridge the intention-behaviour gap by educating consumers of the need for and benefits of domestic DSR. Where cost barriers prevent consumers from market engagement, DNOs may also have a role to play in providing gap funding for low income and vulnerable households in areas where the need for domestic flexibility is high.

⁷⁵ <https://assets.publishing.service.gov.uk/media/5773de34e5274a0da3000113/final-report-energy-market-investigation.pdf>

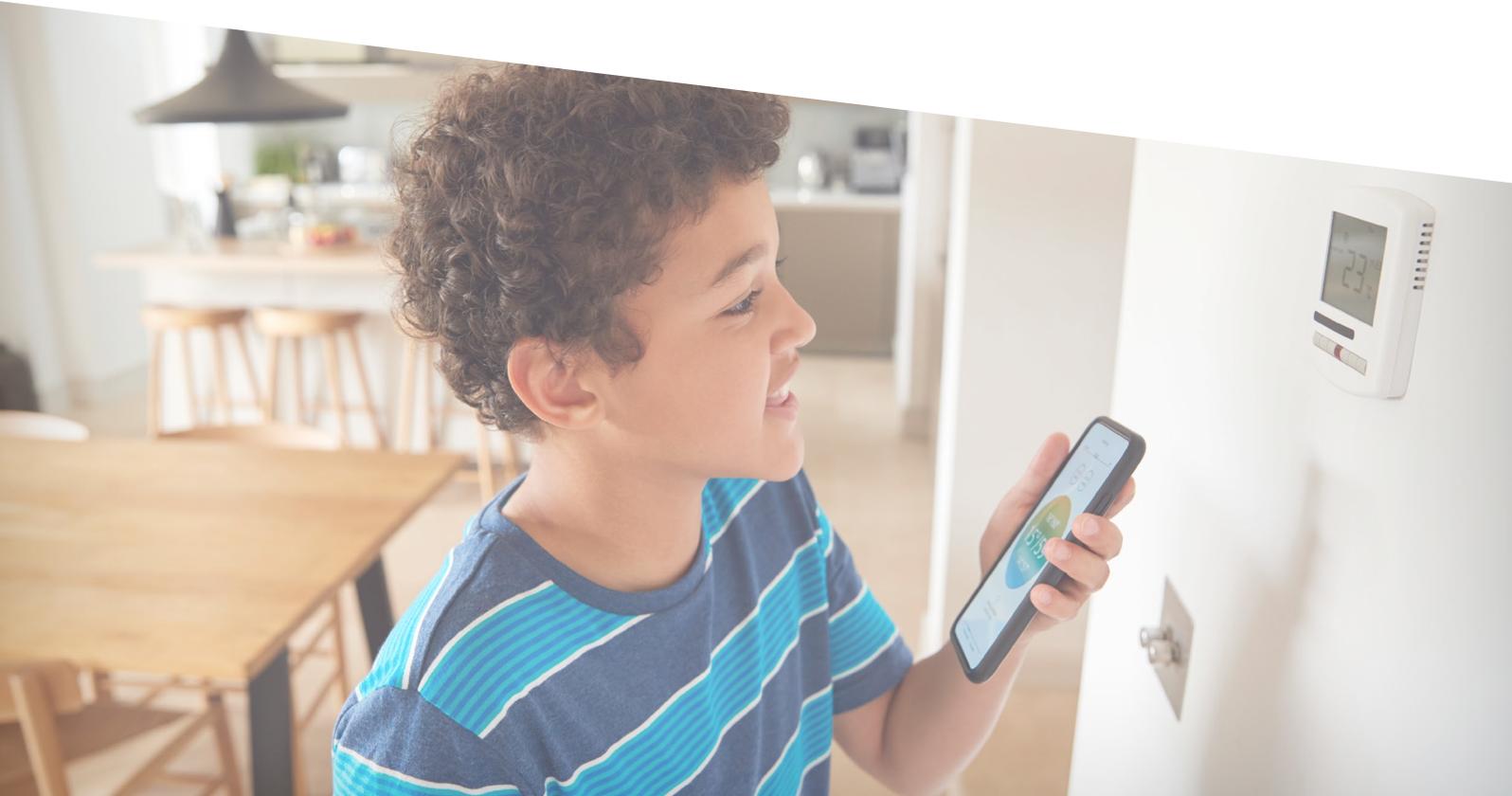
⁷⁶ https://www.cas.org.uk/system/files/publications/cas_market_pulse_energy_consumer_tracker_final_0.pdf

Putting consumers at the heart of the energy transition

However, the majority of consumers have no experience in modern flexibility markets, and consumer protection frameworks are yet to be properly tested. DNOs may therefore also need to help consumers to understand the risks and opportunities that these markets will present if public trust in the energy transition is to be maintained and the benefits to DNOs of domestic flexibility are to be realised. There is, for example, considerable concern among consumers in Scotland that low income and / or vulnerable households may be left exposed to

adverse impacts in GB's future energy markets. It is vital to the success of the energy transition that suitable protections are in place to ensure that this does not occur. With memories of significant detriment arising from the UK Government's Green Deal still fresh in many consumers' minds⁷⁷, Ofgem and the Scottish and UK Governments must therefore be alive to any potential for consumer detriment that may arise as these new markets develop to ensure that the benefits of the energy transition are shared fairly with consumers.

⁷⁷ https://www.cas.org.uk/system/files/publications/bad_company_citizens_advice_scotland.pdf



Conclusions and Recommendations

The results of a representative survey of more than 1,500 consumers in Scotland reveal that the public's energy literacy is low. Consumer awareness of the regulated energy networks in Scotland is extremely limited, with an overwhelming majority unclear as to who operates their gas and / or electricity distribution network. In addition, less than a third of consumers understand the role of the gas and electricity distribution networks as part of the wider energy system, with the majority conflating their functions with those of electricity generators, gas producers and shippers, gas and electricity transmission networks, and / or regulated energy suppliers. This has implications for the ability of Scotland's gas and electricity distribution networks to engage effectively with consumers in vulnerable situations, with only 9% of digitally excluded gas and electricity consumers in Scotland indicating that they would contact their DNO or GDN in the event of a disruption to their gas or electricity supplies.

Nevertheless, satisfaction with Scotland's gas and electricity distribution networks is high, and consumers have noted the reduced incidence of supply interruptions since privatisation. A strong majority of consumers are also generally happy with the level of service they receive from their gas and electricity distribution networks. Levels of dissatisfaction with DNO / GDN customer service are also generally low, and are particularly low among consumers in vulnerable situations. This suggests that Scotland's gas and electricity distribution networks are meeting the needs of vulnerable customers well. However, as awareness of the Scottish gas and electricity distribution networks is no higher among

consumers in vulnerable situations than it is among other consumer profiles, the majority of vulnerable consumers in Scotland may be unaware that additional support from their DNO / GDN may be available. Consequently, more still needs to be done to increase awareness of the gas and electricity distribution networks in Scotland and their role in the wider energy system if the benefits of that support are to reach all those in need.

Improving consumers' energy literacy and their awareness of the demands that the energy transition will place on the gas and electricity networks will also be key to securing support for the changes that will be required to deliver on the Scottish Government's climate change commitments. With uncertainty as to the extent to which low carbon gases such as hydrogen may be deployed for space heating, this is particularly important in respect of the decarbonisation of heat as the rollout of heat networks and increasing levels of electrification may require many consumers to fundamentally alter how their homes and businesses are heated. Strong community engagement in the development and delivery of LHEES will therefore be vital, and it will be essential that consumers and landlords are provided with clear, consistent and unambiguous information on the local future of heat if their exposure to asset stranding risk is to be limited. A national conversation about the future of the energy system in Scotland is therefore urgently required, alongside a consumer education campaign designed to inform and engage communities in discussions and decisions concerning the local future of heat.

Conclusions and Recommendations

By coordinating the rollout of low carbon heating in every community in Scotland, LHEES will give Scotland's local authorities a central role in the planning and delivery of viable local pathways to meet the Scottish Government's climate change commitments. However, with every decision taken within LHEES having implications for the future of energy networks it is essential that local authorities are cognisant of the whole system costs of their proposals if decarbonisation in Scotland is to be achieved efficiently. With the cost of the country's energy networks ultimately paid for by consumers and 25% of Scottish households in fuel poverty⁷⁸, it is vitally important that the investment required to support the energy transition is targeted appropriately to avoid consumers bearing unnecessary expense. The Scottish Government must therefore ensure that Scotland's energy networks are consistently able to play a full and active role in the design and delivery of LHEES, and regulators must ensure that appropriate frameworks are in place to ensure that networks consistently take a collaborative, whole energy system view of future investment needs.

Affordability concerns already dominate consumers' priorities for gas and electricity distribution network investment. These concerns are amplified by the demands of the energy transition, with many consumers worried that vulnerable and low income households are at risk of being left behind in the race to net zero. Concerns about inclusivity are evident both in relation to no-cost DSR facilitators such as smart TOU tariffs, which are perceived to hold the potential to unfairly penalise consumers who are unable to reprofile their energy consumption, and where access to and use of new technologies such as domestic battery storage or smart EV charging may be required. Consumers are

also concerned that the drive towards new technologies such as smart TOU tariffs may encourage some to engage in unhelpful or antisocial energy behaviours in an attempt to reduce their energy costs.

Our survey has revealed that consumers in Scotland believe that gas and electricity distribution networks have a duty to prevent such harms from arising, with the provision of practical assistance to help low income households to engage in the energy transition supported by 80% of survey participants. Of those in favour of such assistance, 62% expressed support for the provision of targeted investment to aid with the provision of smart, high efficiency, low carbon heating systems for those homeowners least able to afford them. 63% would also support the provision of targeted funding to reduce the cost of other smart technologies that would make it easier for vulnerable and low income households to passively engage in the energy transition by providing flexibility to their DNO without having to engage in significant behaviour change.

Initiatives such as these are perceived to offer mutual benefits to consumers and the energy distribution networks by increasing levels of energy efficiency, comfort, and demand flexibility, while decreasing network stress and consumers' energy costs. Where I&C DSR cannot be procured at sufficient scale and it would prove more cost effective than traditional network reinforcement, or would deliver appreciable consumer benefits for marginal additional cost, Scotland's gas and electricity distribution networks may therefore need to provide targeted funding to help increase the participation of low income and vulnerable households in both LHEES and the wider energy transition. This could be provided via a price control deliverable in the

⁷⁸ Scottish House Condition Survey: 2018 Key Findings

Conclusions and Recommendations

RIIO framework, with funding delivered through existing bodies such as Scottish local authorities and / or Home Energy Scotland.

However, consumers' enthusiasm for engaging in domestic flexibility is currently mixed. For example, while 80% of those who participated in our survey stated that they would be prepared to change their behaviour if this were to hold the potential to reduce their energy costs, the majority of those consumers indicated that they would be unwilling or unable to change their behaviour by a significant amount in order to achieve such savings. Many consumers cited lifestyle factors and a perceived loss of control over their energy use as barriers to more significant behaviour change.

These findings are consistent with those arising from SSEN's SAVE project, which found that while engaged consumers were willing to reduce their energy consumption during periods of network stress, these changes were difficult for consumers to maintain over time⁷⁹. In the absence of facilitative technologies such as domestic battery storage, consumers' concerns as to the potential downsides of smart TOU tariffs would therefore appear to have some justification, in that consumers' ability to reliably respond to price signals unaided is limited. In addition, with fewer than a quarter of consumers in Scotland actively engaged in the retail energy market⁸⁰, the strength of consumers' response to the possibilities provided by domestic flexibility may be limited. The availability and uptake of automation and technology are therefore likely to be crucial for many consumers to be able to reliably engage with smart TOU tariffs, and for the network benefits of the flexibility that such tariffs have the potential to facilitate to be

realised. However, the investment required in such technologies is likely to prove a high bar to market engagement which risks exacerbating inequality unless sources of funding are made available to enable the participation of low income and vulnerable consumers.

The decarbonisation of road transport also raises particular issues of fairness in the context of the support shown by consumers in Scotland for a just transition. 88.6% of income poor households in Scotland are in fuel poverty⁸¹, and low income households are among those consistently less likely than the national average to have access to a private vehicle⁸². If a national EV charging infrastructure and any associated electricity network reinforcement were to be funded via a universal or consumption-linked charge on all consumers' electricity bills, this would place further financial stress on many households who are already struggling to meet their essential fuel costs. The vast majority of these households are also among those least likely to directly benefit from such investment.

Socialising the costs of the EV rollout among all consumers would therefore run counter to the Scottish Government's Economic Strategy⁸³ and efforts to reduce the incidence of fuel poverty to no more than 5% by 2040⁸⁴. As a result, DNOs will need to work closely with Ofgem, central and local government, licensed electricity suppliers, and the private sector to ensure that EV-related network costs are minimised and distributed more fairly. This might involve shifting some or all of the burden of electricity network investment to support the proposed EV rollout away from all GB electricity billpayers to a combination of local and / or national taxation, and electricity bill levies payable only by those who use EVs.

⁷⁹ <https://save-project.co.uk/>

⁸⁰ <https://www.cas.org.uk/news/new-data-shows-huge-differences-across-scotland-energy-switching-rates>

⁸¹ Scottish House Condition Survey: 2018 Key Findings

⁸² <https://www.transport.gov.scot/media/47196/scottish-transport-statistics-2019.pdf>

⁸³ Scotland's Economic Strategy

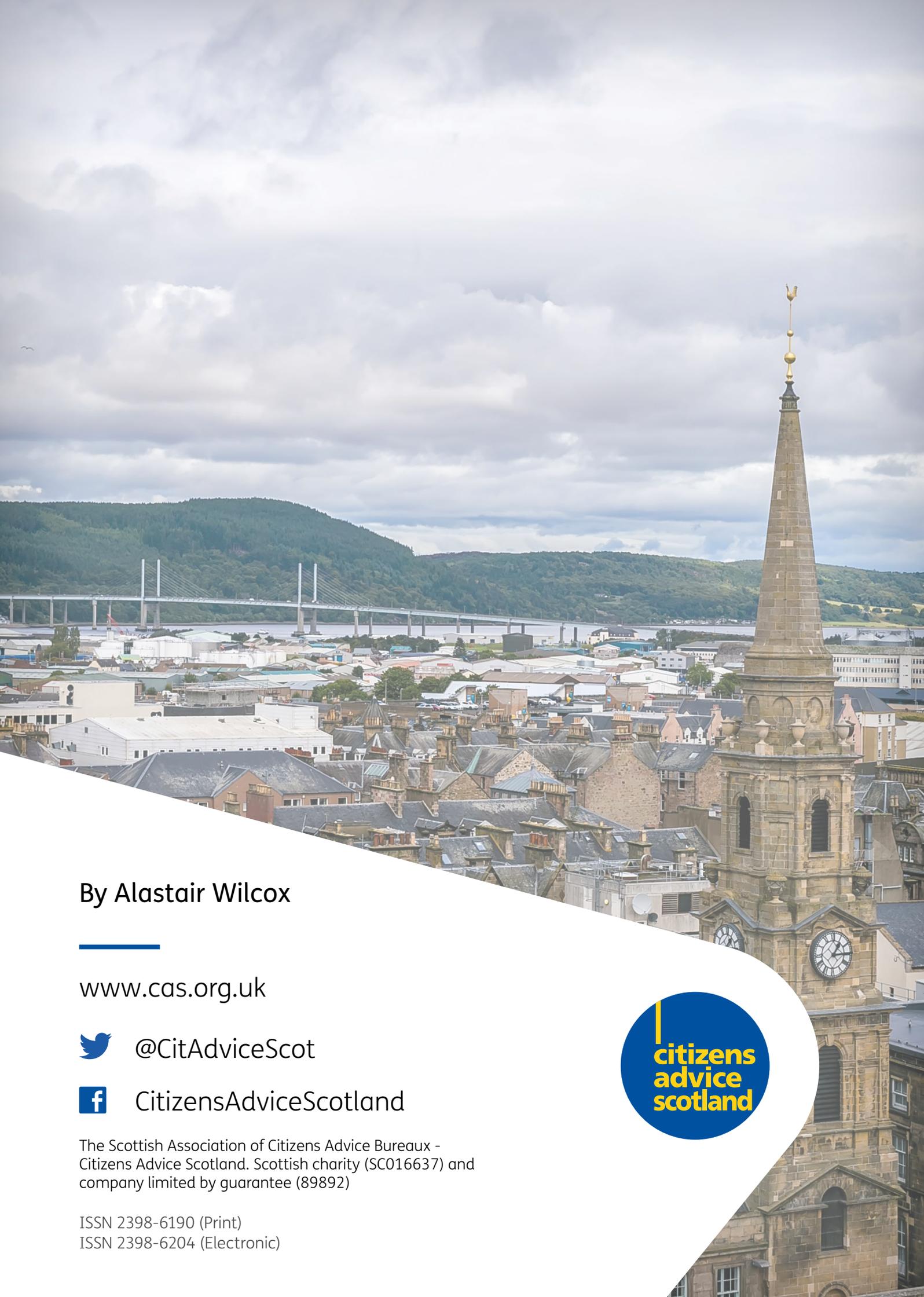
⁸⁴ http://www.legislation.gov.uk/asp/2019/10/pdfs/asp_20190010_en.pdf

Conclusions and Recommendations

Delivering an equitable and inclusive transition to net zero isn't just the right thing to do; our survey has revealed that there is a tendency among consumers to view potential solutions to the challenges presented by the energy transition more positively as new technologies become more widely adopted. For example, despite consumers expressing only modest support for a variety of flexibility services, interest was found to be significantly higher among consumers who were already engaged with similar or facilitative technologies. Interventions designed to help low income and vulnerable consumers engage with the energy transition will therefore also help to limit the extent to which energy network reinforcement or additional generation capacity is required, and so will help to deliver decarbonisation at lowest possible cost.

Findings from SAVE suggest that novel, local projects led by partners that are trusted in the local community will be key to the success of such initiatives – findings that, in the context of LHEES, are equally as relevant to local authorities in Scotland as they are to Scotland's gas and electricity distribution networks. However, with the majority of consumers currently lacking experience in modern flexibility markets, DNOs may need to help consumers to understand the risks and opportunities such markets will present if public trust in the energy transition is to be maintained and the benefits to DNOs of domestic flexibility are to be realised. Ofgem and the Scottish and UK Governments must also be alive to any potential for consumer detriment that may arise as these markets mature to ensure that the benefits of the energy transition are shared fairly with consumers.





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