

Changes to the energy landscape and potential impacts on Scotland's consumers

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Executive summary

This review – completed in 2019 - examines how the energy landscape is changing and how this will impact on, and alter, the consumer experience – both positively and negatively. Its primary purpose is to inform the development of a vision and action plan which will set out how the Scottish Government will deliver a consumer-focused low carbon transition. ClimateXChange commissioned the review on behalf of the Scottish Government's Energy and Climate Change Directorate.

Figure 1 overleaf shows the main targets and policies considered in this research. At the centre is the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019¹, setting legally binding carbon reduction targets. The Scottish Energy Strategy² starts to apportion these targets to different sectors of the economy, supported by detailed plans and roadmaps. We have looked specifically at Scottish Government policies on renewable energy and energy efficiency (with reference to UK and European-level policies for comparison). The UK government retains powers over regulation of the energy sector as well as the power to raise taxes from energy bills – and here we have picked out the important future developments in consumer-facing policies. Our analysis and findings are grouped under three policy themes – the smart consumer, energy decarbonisation and energy efficiency.

Key findings

The smart consumer

Consumers can exert some limited control over their energy bills by switching supplier, but the vast majority of consumers do not routinely exercise this right.

- Consumers are being expected to take control over their energy costs by exercising their right to switch supplier. However, some customers simply do not have realistic levels of choice – because they are on restricted meters, tariffs or fuels. Among those that do have options, only the “happy shoppers” and “savvy searchers” switch regularly, but they are in the minority. In 2018 14% of Scottish consumers had switched in the last 12 months. More than 60% of GB consumers have either never switched, or

¹ <http://www.legislation.gov.uk/asp/2019/15/enacted>

² <https://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/>

only switched once. The further north you are in Scotland, the less likely you are to switch – we don't know why, but this is likely linked to the higher incidence of off gas and restricted meter customers limiting tariff options.

- Ofgem has brought in a series of energy price caps, because “*Too many consumers are not seeing the full benefits of competition*”. These protections are only short-term, and are due to be rolled back with the full rollout of smart meters and measures to make switching easier. However, switching cannot, on its own, bring excluded consumers back into the energy market. Smart meters, whilst benefiting many consumers, risk creating new groups of excluded customers.

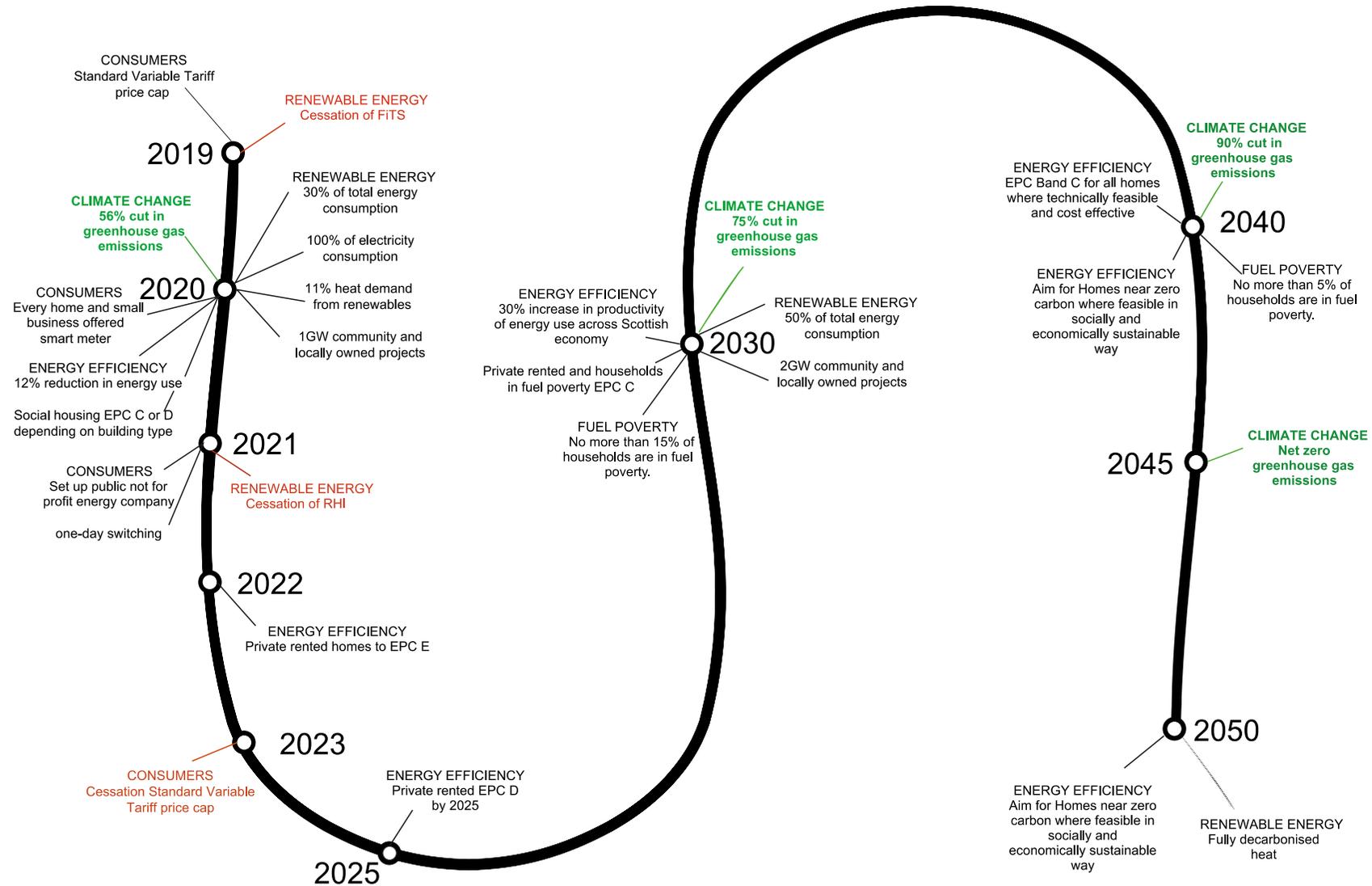


Figure 1: Key changes to the energy landscape for consumers in Scotland, 2019-2050

The smart energy revolution is underway, but significant groups of customers are unaware of, unable to, or simply not interested in, participating

- Decarbonisation is relying on the actions of individual consumers. Scenarios mapping the pathways to a reduction in greenhouse gases show not only further and large-scale decentralisation of energy, but a huge shift from generation serving consumers to consumers generating energy themselves, flexing their demand and buying into the “smart” energy future. The smart meter rollout is simply one of the enablers of a future in which consumers, their appliances, their cars and their decisions on when and how much energy to use, play an essential part in the integration of low carbon technologies into everyday life.
- Our research shows that most consumers do not yet know this. Whilst almost all consumers know about smart meters, only a third fully understand their functions. Only a fifth of customers express interest in signing up to a Time-of-Use tariff, with a bias towards younger consumers and those with higher incomes. The National Audit Office (NAO) has warned that the smart meter rollout will not meet its target of everyone being offered a smart meter by 2020. A study by Sussex University concluded that technical issues with the rollout have overshadowed significant consumer engagement barriers that need to be addressed – namely “vulnerability and poverty” and “consumer resistance and ambivalence” to smart meters. The NAO calls for a more realistic attitude to, and effective response to, consumer engagement.

Digital exclusion could worsen as the consumer experience is increasingly digitised

- The smart energy revolution could equally be called the digital revolution. Every single innovative tariff, business model, appliance, consumer engagement approach or “lifestyle” product that we found required at least a basic level of digital literacy and access to the internet. There are no signs that the energy market has stopped to think about the fifth of digitally illiterate adults. As a workshop participant in this project noted, no-one uses social media to complain about digital exclusion.

Geographically remote areas are, and look likely to continue to be, left behind

- Remote areas experience multiple exclusions. A lack of digital connectivity has delayed the smart meter rollout in some rural areas. This excludes customers from some of the better tariffs and limits opportunities to switch supplier and save money on bills. At the same time, fuel poverty levels are already amongst the highest in the country in the Highlands and Islands and switching rates amongst the lowest.

Energy decarbonisation

Less well-off consumers pay proportionately more for energy decarbonisation, but benefit less from the low carbon energy they fund

- Renewable energy support schemes at the UK level have been instrumental in the near-complete decarbonisation of Scotland's electricity needs. Householders, housing associations and businesses have also been able to install low carbon heating systems and invest in local energy projects.
- This is paid for as a levy on consumer bills – paying now for future protection for all consumers against rising and unpredictable fossil fuel costs. However, less well-off customers pay more as a percentage of income whilst lacking the capital to access the financial benefits of schemes that they fund.

- Support for household renewable energy is drawing to a close over the next few years, meaning that, if not renewed or replaced, tax receipts raised from consumers' bills will in the future go exclusively to commercial-scale projects.

Consumers are local to but not always engaged with, low carbon energy projects. There is untapped potential for novel and more transformational relationships between projects and consumers.

- Due to smaller more dispersed and local projects, we are much more likely to live and work by or travel past energy generation projects. Levels of public support remain consistently around 75-80%, and community benefit funds accrue to those living close by. There is some limited evidence that proximity to projects enhances engagement and support, but there is potential to build on this: through new business models that forge a direct commercial relationship with local customers; and through “transformative” community ownership of projects or land. This however coincides with a period of more uncertain revenue streams stemming from changes in the UK-wide support mechanisms.

Local renewable energy schemes can bring much-needed energy security to remote areas otherwise reliant on high cost, imported fuels.

Renewable energy has clear cost benefits in remote areas which face high costs to import fuel to heat often inefficient homes. With the right kind of investment, local renewable energy in sometimes completely off-grid areas provides the cheapest and most reliable source of power. Islanders like those on the community-owned Eigg, have swapped individual diesel generators for renewable energy supplied by an island microgrid. Residents manage their demand to when power is more plentiful – overcoming issues with the short-term energy security of intermittent power in return for the long-term security it provides.

Energy efficiency

Scotland's energy efficiency efforts have helped to protect households from rising fuel prices and have lifted some households out of fuel poverty.

- Again, funded in part from consumer levies, Scotland has made good progress in installing energy efficiency measures, leveraging support from consumer-levy-funded UK-wide schemes to target measures in social housing, harder-to-reach and harder-to-treat properties. As a result, Scotland has successfully countered what would have been an urban bias of schemes targeting the cheapest measures. Scottish social housing is also now performing better in energy efficiency terms than the private rented or owner-occupied sector. These home improvements are already having a protective effect against rising fuel prices and lifting some households out of fuel poverty.

Consumers need to be nudged into making home energy efficiency improvements. There are times – such as big life events – when consumers will likely be most receptive

- Despite this progress, there is a surprising lack of knowledge of the Energy Performance Certificate (EPC) regime and low individual pro-active take-up of measures. This has some quite significant implications for relying on individuals to improve their own homes, outside of any kind of incentive or obligation. Research undertaken on behalf of the Energy Saving Trust suggests that the best time to engage consumers on home improvements is at big life events – primarily moving to a new house, but also starting a family or changing jobs. Selling improvements on the basis of comfort and warmth, as well as money savings, are likely to gain more traction.

Modest energy efficiency improvements are achievable for most properties, with annual bill savings in the region of £400-1000 for meeting EPC E

- The financial incentives to take action already exist – investments of under £1000 will bring most properties up to EPC E for savings in the region of £400-1000 per year in bills. EPC E is the 2022 target for the Private Rented Sector (PRS) and in fact over 90% are already at this level. Further improvements will cost more but are mostly straightforward. A combination of insulated walls and loft and a modern boiler (or low carbon heating), alongside double glazing and draught-proofing, will enable a typical house in Scotland to meet EPC C. Solid-walled properties are the hardest to treat, although not all need wall insulation to achieve EPC C. A sandstone mid-floor tenement flat can usually achieve a C with a modern boiler and double glazed windows. Top floor flats will be at or close to that level if loft insulation is in place.

Low income consumers pay proportionately more in energy efficiency levies, but consume less energy, than high income consumers.

- High income consumers use more energy than those on lower incomes. In fact, smart meter data shows that income is the strongest driver of energy consumption. On a national scale we can see that when prices rise, consumption drops – promoting energy saving but probably driving consumption levels to dangerously low levels among the fuel poor and in so doing disadvantaging those that already have a low environmental impact by virtue of low incomes. In the future, smart meters might provide more insight into these effects and help to protect against under – as well as over-consumption.

Next steps

This research is primarily to encourage and support policy makers across the energy landscape to think about consumers in all their different guises. This report provides an overview of how consumer vulnerabilities could play out in the context of future developments in energy. The distributional impact assessment accompanying this report adds depth and breadth to the who, how much and sometimes where these impacts are being or will be felt. It uses a newly-developed Scotland-specific model to characterise groups of consumers by their circumstances and attitudes.

This research is independent and does not necessarily reflect Scottish Government policy.

Please also note that, although published in late 2020, this research was finalised in 2019.

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Acronyms glossary

ASHPs - Air Source Heat Pumps – transfers heat from the outside of a building to inside.

CCS - Carbon Capture and Storage – at fossil fuelled power stations, instead of releasing waste

Carbon dioxide into the atmosphere, it is captured and stored, probably in deep geological formations.

CfD – Contract for Difference – a form of subsidised contract offered by the government to selected renewables and nuclear generators which guarantees a market reference price for their energy.

DTS - Dynamic Teleswitch (meters) – allow energy suppliers to provide time-varying tariffs, which were originally designed to 'switch' to a lower tariff when there was plentiful cheap electricity, usually at night.

EVs - Electric Vehicles – vehicles powered by an electric battery that are fuelled at electric charge points.

FiT – Feed in Tariff – a scheme which provides a subsidised price for electricity generated by qualifying small-scale renewable technologies.

PRS – Private Rented Sector – properties rented by private landlords

RHI – Renewable Heat Incentive – a scheme which provides a subsidised price for heat generated by qualifying small-scale renewable technologies.

RO – Renewables Obligation – an obligation on suppliers to purchase a certain amount of renewable energy.

SVT - Standard Variable Tariff – the basic supplier energy tariff which fluctuates with prevailing energy prices.

TOU – Time of use (tariffs) – time-varying prices for energy, either notified to consumers in real time or different prices at fixed times such as cheaper overnight.

Introduction

ClimateXChange has commissioned this review on behalf of the Scottish Government's Energy and Climate Change Directorate. Its primary purpose is to inform the development of a vision and action plan which will set out how the Scottish Government will deliver a consumer-focused low carbon transition. This review examines how the energy landscape is changing and how this will impact on, and alter, the consumer experience – both positively and negatively.

The 2017 Scottish Energy Strategy frames Scotland's energy future, articulating six priorities for a whole-system, smart and inclusive approach [1]. One of the six priorities is to promote consumer engagement and “*protect consumers from excessive or avoidable costs and promote the benefits of smarter domestic energy applications and systems*” for all consumers.

Privatisation, decarbonisation and the digital age have transformed the energy sector over the last two decades. Consumers experience this in many ways – perhaps by being excited by its local energy opportunities and tuned in to the smart energy revolution; or perhaps by being side-lined as the local energy company withdraws from the high street and the consumer experience is digitised. Existing vulnerabilities are relatively well understood, but these changes continue apace with the potential to benefit and leave behind different groups. This is our focus.

The emphasis is on the next five years and on the most vulnerable and supposedly “disengaged” consumers. Our analysis is framed by the wider picture – the direction of travel on energy, what can be considered near certain and where the main difficulties and uncertainties lie. We look at policy and practice under the influence of the Scottish and UK governments, and Europe.

This forward-looking view will help the Scottish Government: to influence the future landscape for maximum consumer benefit; to plan and provide for change with an understanding of how consumers will respond; and to ensure that the necessary support is provided to customers to minimise the risk of any groups being worse-off.

Our report starts with a scene-setting overview of over-arching climate change targets, key industry and government outlooks on energy and potential disruptors. Chapters are organised around the key themes of:

- Smart consumers
- Energy decarbonisation
- Energy efficiency

These themes have emerged as we have catalogued and classified energy policies and targets. Climate change is the main driver for energy decarbonisation and improved end-use efficiency, which in turn is combining with changes already brought by privatisation to transform the consumer side of the meter. It has not always been clear how to categorise different policies, and no meaning is ascribed other than as a convenient categorisation for the report.

For each category we provide a commentary on key policies and trends over the next five years and more and a literature review-based narrative on likely consumer impacts. We have grouped impacts under six categories of exclusion (Table 0.1) – namely ways, by virtue of their circumstances, are excluded from all that the energy market offers.

Table 0.1: Categories of exclusion

Category of exclusion	Description and rationale
Financial	25% of households in Scotland were fuel poor in 2017 [2].
Geographical	Nearly 10% of the Scottish population live remotely [3]. Orkney and Shetland island groups are all entirely off the gas grid. 84% of dwellings in the Western Isles and 62% in Highland are off the gas grid [4].
Digital	A fifth of adults in Scotland lack basic digital skills [5] and for clients of Citizens Advice Bureaux, this goes up to a third [6].
Engagement in energy market	Switching energy supplier is one but not the only way in which consumers engage in the energy market. In 2018 14% of Scottish consumers had switched in the last 12 months. "Happy shoppers" and "savvy searchers" switch regularly, but are in the minority [7].
Flexibility in when energy is used	Research by Citizens Advice found around a fifth of customers across the UK might be interested in signing up to a Time of Use tariff which demands flexibility in when energy is used, with a bias towards better off and the young [8].
Flexibility in what energy is used	22% of Scottish homes do not use or have access to mains gas and are forced to use expensive heating oil or electric heating instead [9].

This review of policies, targets, trends and impacts provides an overview of where future changes in the energy landscape are likely to be felt. A stakeholder workshop held on 7th February brought together these findings with those of a parallel consumer segmentation study to reflect and consult on how we take this forward into a quantitative distributional impact assessment – i.e. which policies impact which groups of consumers and by how much? Workshop outcomes on the policy landscape are summarised in Appendix 1.

Direction of travel

Mitigating and preventing irreversible climate change is a central plank of dominates the energy agenda and will continue to do so well into the future. Targets to substantially reduce carbon emissions have been set at the European, UK and Scottish level – and are the ultimate outcome for policies and actions across the economy aimed at decarbonisation. Industry and government-developed scenarios take these targets and help us to understand how we will get there, looking at the collective size and speed of change required. We briefly review climate targets here, as well as two key energy-based scenarios for meeting those targets. We also consider the main potential disruption on the horizon, Brexit.

Climate Change targets

Table 0.1 shows the European, UK and Scottish targets for greenhouse gas emission reductions. Scotland has a legally binding obligation to achieve net zero by 2045 [10] and the UK by 2050 [11]. Scottish legislation also commits to a series of interim targets and the UK provides for rolling carbon budgets. In both cases the net zero targets were passed or proposed in 2019, amending earlier Climate Change legislation, meaning there is further and ongoing work to update policies and practices.

Table 0.1: Percentage reduction in Greenhouse Gas Emissions from 1990 levels

Year	Scotland	UK	Europe
2020	56%	34% [13]	20%
2030	75%		40%
2040	90%		60%
2045	Net zero		
2050		Net zero	80%

From the consumer perspective, these targets are both abstract yet at the same time the driving force for near-complete decarbonisation of energy which will impact across multiple aspects of everyday lives. As an earlier Scottish Climate Change Plan shows, carbon savings will need to come from every sector. The Plan is organised around carbon reduction “pathways” for electricity, buildings, transport, industry, waste, agriculture, forestry and other land use [16]. Even set out like this, plans do not ‘come alive’ from a consumer perspective until we start to fill in what this actually means at ground level, and where impacts will fall.

To-date, the electricity sector has seen some of the biggest changes and delivered some of the most significant reductions. The Committee on Climate Change’s annual report on UK Climate Change Act targets reports that 75% of emissions reductions since 2012 and to 2017 have come from the power sector and a significant amount of the remainder from waste [17]. From 2011 to 2016, Scotland has similarly achieved the majority of its reductions from power, and most of the rest from waste. The closure of Longannet coal fired power station in 2016 means power sector emissions will fall even further in 2017. It also marks the end of

opportunities for further rapid power sector decarbonisation and an imperative to find reductions elsewhere [18].

Based on current policies, the Committee on Climate Change has told Scotland that it is

“on course to outperform the interim emissions reduction target for at least a 56% reduction in actual emissions by 2020.” And that *“As a path to meet the [previously] legislated targets to 2032, the emissions envelopes are stretching, credible, and well-balanced across most sectors.”*

Future Scottish policies are starting to shift emphasis on previously under-represented sectors, notably transport and buildings. For example, the Scottish Government publishes an assessment of spending allocated to climate change mitigation alongside each year's draft budget, by sector. The draft 2018/19 budget represented a two-thirds increase in climate change mitigation spend in the transport sector, compared to the previous year [19]. Chapters 3 and 4 consider this in more detail.

Scenarios

“Fooling around with alternating current is just a waste of time. Nobody will use it, ever.”

—Thomas Edison, 1889

Government policy, politics, market forces, consumer choices and our physical environment all have a bearing on change in the energy landscape. But if anything is certain, it is that nobody knows exactly how the future energy system will evolve – for consumers this might mean that what was new technology is made redundant by a rapidly developing market or conversely that technology cannot keep up with consumer's needs. We have learnt from past “certainties”, such as in the quote above and the infamous claim that nuclear energy would be *“too cheap to meter”* [20]. This is why many institutions employ scenarios, or models of different versions of the future.

The box below sets out two sets of scenarios – visions of the future energy system developed to provide insight into possible future developments. These are briefly described to set the scene for discussion of energy landscape changed relevant to consumers. Note that they are illustrative only.

Both sets of scenarios are similar in the means by which energy decarbonisation is achieved – continued decarbonisation of electricity and – as a result – some (yet to be determined) degree of heat and transport electrification, and a huge push towards decarbonisation of gas and its potential for use in heat and transport. In all scenarios, Scotland will play a pivotal role in meeting its own needs and in exporting low carbon power and fuels to other parts of GB and further afield.

Box 1 Energy scenarios summary

- The Future of energy in Scotland, Scottish Energy Strategy

The Scottish Energy Strategy [1] sets out two distinct decarbonisation pathways to meeting a target of 80% reduction in greenhouse gases by 2050 – an electric and a hydrogen future. These serve to stress-test the two extremes when, in all likelihood, the reality will be a mixture of both.

In the **electric future**, electricity generation accounts for over half of final energy delivered, powering a significant increase in electric heating (e.g. Air Source Heat Pumps (ASHPs)), and Electric Vehicles (EVs). Homes are highly insulated, households charge cars at home and increasingly store and generate their own energy. To power this large increase in electrical demand, there is more electricity generation (wind, including Carbon Capture and Storage (CCS) and pumped storage) and associated infrastructure. Even under this electric-centric scenario, over 10% of residential and service sector demand is served from networks purpose-built to distribute heat³.

In the **hydrogen future**, natural gas is replaced by hydrogen. As we transition to hydrogen, natural gas consumption increases to supply hydrogen production, and for electrical system flexibility. There will need to be extension and expansion of the gas network, a new hydrogen pipe distribution system and CO₂ piped to the North Sea from CCS facilities. There will be hydrogen boilers and fuel cells in homes. 100% of cars and light goods vehicles will be hydrogen powered. Again, over 10% of residential and service sector demand will be from heat networks.

- Future Energy Scenarios, National Grid

National Grid's Future Energy Scenarios (FES) [21] include two separate visions differ on the degree to which energy will be centralised or localised – a key factor when considering how the connecting networks will evolve. Both show higher levels of decentralisation compared to today.

Community Renewables represents a wholesale shift from small numbers of large generating stations to dispersed smaller ones, culminating in 60% of total generation capacity being "local" by 2050. Electricity demand increases as heat and transport make greater use of electricity through heat pumps and EVs respectively. Scotland sees increases in wind power, twinned with storage⁴. By 2030 a third of consumers are using smart appliances and increasingly becoming "prosumers." There is an evolution of local energy markets trading demand reductions, EV storage capability and domestic generation.

Two degrees is still more decentralised than today's energy system but has much more reliance on renewal and expansion of large power stations, including new nuclear and gas-fired power stations with CCS. There is widespread use of hydrogen for heating as well as in commercial vehicles. The uptake of EVs is the same as for Community Renewables. Also, like Community Renewables there is a reliance on a smarter demand-side to balance the grid, as well as large scale storage, flexible gas and interconnectors.

In all scenarios, consumers are increasingly playing an important part in the transition to more decentralised energy, no longer passive but automatically and pro-actively taking part in the smart energy revolution. None of this is guaranteed in the long-term, but notwithstanding any major shocks, this is very likely to be the direction of travel, and in fact – as we will see in this report – it is a transition that is well underway in Scotland.

³ Heat networks distribute heat by piping hot water or steam to individual households, with the heat generated at a central generating station rather than in individual gas boilers in each house.

⁴ Technology that can store excess generation at times of low demand

Disruptors

We have also considered if there are any known disruptive events with the potential to derail key policies and plans and the wider decarbonisation agenda. Natural disasters (increasingly likely if climate change is not contained) and wars can and do disrupt access to resources, and our capacity and ability to undertake ambitious change in the energy sector. However, these kinds of events are out with the scope of this report. Brexit is our main focus here. Even though no-one knows what form it will or won't eventually take, we can start to think about what kind of broad impacts it might have.

Appendix 2 details some sectoral analysis of where Brexit has the potential to impact on the energy landscape. In particular we have looked at where it could impact on consumers either on the timing or cost of changes. The EU has largely had a positive influence on decarbonisation in member countries, driving through renewable energy, energy efficiency and climate change targets. Whilst Scotland is even more ambitious in many areas, that has not always been and may not always be the case. A supportive UK-and European-wide environment is also conducive to Scotland's ambition.

The main short-term impacts are likely to be related to currency fluctuations and the impact on the cost of imported technology and technology components. This will likely feed through into consumer energy prices. Depending on the final settlement, there may also be limitations on buying and selling energy with Europe. The UK will need to replace European funding for strategic energy interconnections, if projects like a planned Scotland-Norway connection are to reach fruition.

In the medium to long-term, the UK will start to feel the effect of sitting outside the development of EU standards and legislation. In the energy sector, this could impact on our influence in relation to cross-border aspects of the energy landscape.

Smart consumers

Summary findings

Large groups of consumers are simply not exercising their right to switch energy supplier, missing out on energy bill savings as a result.

Energy price caps, previously considered unnecessary in a competitive energy market, have been re-introduced on a short-term basis.

Consumers are excluded from the full benefits of the energy market by a lack of digital skills or internet access, by restricted fuels, meters and tariffs, often in combination and often exacerbated by remote locations.

Digital exclusion in particular could worsen as the consumer experience is increasingly digitised. Geographically remote areas are already being left behind in the smart meter rollout.

Many consumers lack interest in and / or knowledge of, what smart meters can do. This needs to change for the full benefits of smart meters to be realised.

The UK government is expecting the smart meter rollout and easier, faster switching, to improve consumer's ability to control their energy bills. We do not think though that on their own, these measures will be enough.

New ways of doing business in the energy market – from a publicly owned energy company to automated switching to consumers buying and selling their own energy – all offer new avenues for consumer engagement and protection. Consumer experiences and impacts should be monitored to see if they live up to expectations.

Introduction

Here we consider the protections in place for consumers, implemented across the GB-wide energy market by the energy regulator Ofgem. We have focused on near-term price protection measures and the smart meter rollout. We have also looked at longer term fuel poverty targets set in Scotland.

Targets and policies

Figure 0.1 shows key targets and policies on a timeline. Most of the policies considered here are within the GB energy market regulator Ofgem's remit, with little if any influence from Europe. Scotland does have powers to define fuel poverty and set fuel poverty targets but can only partially influence the outcome through its devolved powers on energy efficiency described in Chapter 5.

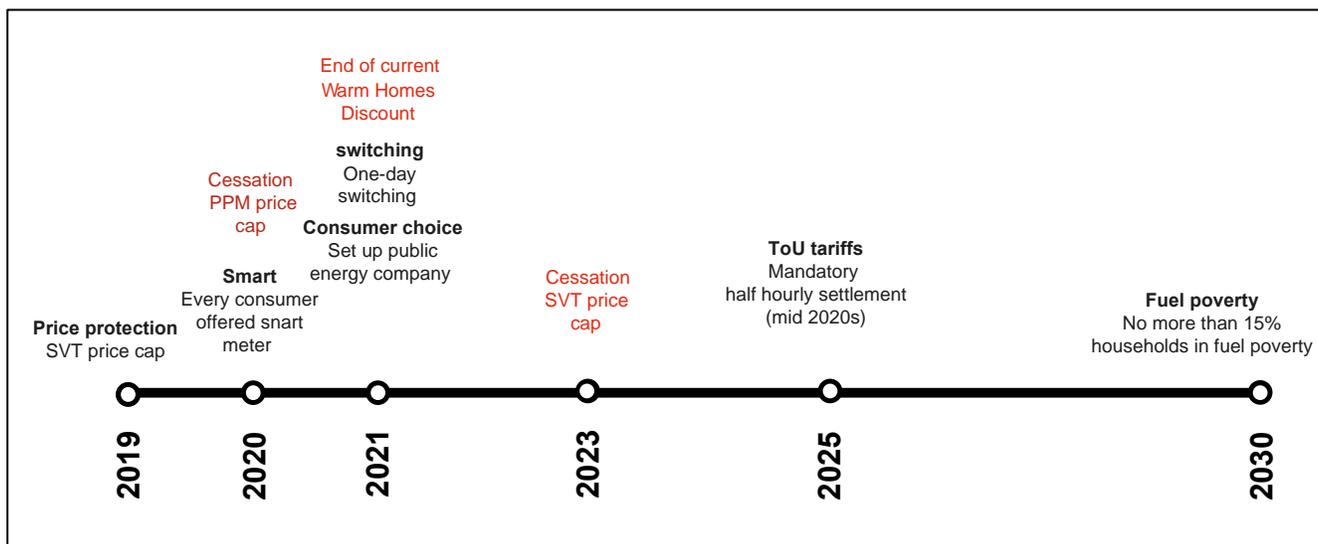


Figure 0.1: Targets and policies for consumers

Consumer choice – switching supplier or tariff

Consumers are being expected to take a much more active role in the energy market. Initially, this has been driven by privatisation and companies competing for customers, with those switching mostly doing so for better prices. For example, participants in a 2018 collective switching trial run by the energy regulator, Ofgem, achieved an average £300 per year saving [22].

Ofgem conducts annual consumer engagement surveys and from 2017 has started an attitudinal consumer segmentation. In 2018 just 14% of Scottish consumers had switched in the last 12 months, slightly less than the 15% in England and Wales. “Happy shoppers” and “savvy searchers” switch regularly, but that they are in the minority [7]. More than 60% of GB consumers have either never switched, or only switched once. [23]

The policy response in the near-term is to make switching easier – something Ofgem is taking forward by introducing one-day switching by 2021, alongside a set of switching service standards [24].

Price protection – the price cap

In the meantime, the UK Government has asked Ofgem to re-introduce consumer price protection, which was rolled back at the millennium with full retail deregulation. A cap for customers on pre-payment meters and for those in receipt of the Warm Homes discount is already in place, and a cap on Standard Variable Tariffs (SVTs) was implemented on 1 January 2019. More than half of all consumers are on SVTs.

These caps are designed to be short-term measures and will be rolled back by 2023 at the latest. The current Warm Homes discount lasts until 2021. The regulator hopes that by the time switching rates will have improved and smart meters will be delivering further consumer savings. These outcomes are far from guaranteed. Switching rates have been on the rise for the last four years or so, but to-date they have only recovered back up to rates seen in 2008 [25].

Fuel poverty – definition and target

Fuel poverty levels in Scotland have gone from around 16% of households in 2003/2004 to 25% in 2017, peaking at 38% in 2011. Following a recommendation by the Scottish Fuel Poverty Strategic Working Group a review of the definition of fuel poverty in Scotland was carried out. The recommendations of the Fuel Poverty Definition Review Panel have informed the new definition that has been enshrined in the Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019. Under the new definition there is a two-fold test - a household is in fuel poverty if after having paid its housing costs it would need more than 10% of its remaining net income to pay for its reasonable fuel needs and if after deducting fuel costs, childcare costs and benefits received for a care need or disability the remaining net income is insufficient to maintain an acceptable standard of living (defined as 90% of the UK Minimum Income Standard). It also sets longer-term targets and milestones on reducing fuel poverty and extreme fuel poverty and requires the Scottish Government to create a fuel poverty strategy. **Figures used in this report are based on the previous definition of fuel poverty and have not been updated following the publication of the Scottish House Condition Survey 2018 which shows estimated levels of fuel poverty based on the new definition.**

Consumer choice – public energy company

Whilst there may be a perception that consumer confidence in the energy market is low, Ofgem's consumer engagement survey shows that trust in energy suppliers is rising. 51% of consumers trusted their supplier to charge them a fair price in 2014, a number which has steadily risen to 65% in 2018. Older people and poorer households are more likely to trust they are being charged a fair price. [7]

That nonetheless leaves a substantial proportion of consumers dissatisfied. In part to offer trusted alternatives, Bristol and Nottingham local authorities have set up their own energy companies, and a number of others use local authority branding to front an existing supplier's bespoke tariff for its residents (so-called "white labelling"). The Scottish Government has

announced its intention to set up a public energy company by 2021. The initial focus will be on white label supply. Further developments might include publicly-owned generation and eventually a fully owned and licensed supply company [27].

Smart consumers – smart meters

At the same time, a vision of a more flexible and responsive energy system is very much encompassing and involving consumers. Whilst traditionally, energy generation follows and meets the pattern of demand, energy decarbonisation is turning this on its head. The evening demand peaks can be expensive to serve from generation (e.g. fossil fuelled spinning reserve), and the alternative is to smooth out these peaks, incentivising demand to shift instead. A new generation of Time-of-Use (ToU) tariffs, apps to control heating, responsive appliances and micro-generation in the home will, it is envisaged, take hold amongst a new generation of 'prosumers.'

One of the main enablers of this smarter energy future is the smart meter rollout. Smart meters tell consumers and their suppliers what energy has been used in small (half hourly or less) parcels of time. They allow energy consumption and bills to be closely monitored and open the door for ToU tariffs.

There have been problems with the rollout of smart meters with the first wave (SMETS 1) pre-dating industry-wide agreement on communications protocols, meaning that some smart meters revert to 'dumb' mode when customers switch supplier. As of September 2018, around a quarter of domestic meters operated by the large energy suppliers were operating in smart mode [28].

The National Audit Office has said that suppliers will not meet the government's aspirations for 100% rollout by 2020, and that this is in part due to consumer disinterest in what smart meters can do [29]. Government has accepted this and at the end of 2019 announced that the rollout would be delayed by four years to 2024.

Consumer's appetite for exploiting smart meter functionality is relatively untested, but research suggests that only around a fifth of customers might be interested in signing up to a ToU tariff, with a bias towards better off and younger people [8]. Around 13% of GB consumers are on legacy Economy 7 tariffs. [30]

If customers are charged on a half-hourly basis, then suppliers need to be able to bill them on a half hourly basis. In technical terms this means we need the energy market to move over to what is called half hourly "settlement" (amongst other things replacing customer profiling with actual half hourly consumption data). Ofgem is now mandating that this is in place by the mid 2020s. In the meantime, any suppliers offering ToU tariffs undertake half hourly settlement on a voluntary basis. Customers must give opt-in consent to share half-hourly consumption data with their supplier. Ofgem is considering privacy issues around access to customer's data [31].

Charging for capacity as well as energy

Smart meters also monitor the amount of energy used by a household at any one time – namely capacity. This matters because energy networks need to be sized to accommodate the maximum collective amount of energy used in any one time, which is usually (although increasingly not) the early evening peak. Network companies are beginning to look ahead to the demands on the network and considering how they might manage new peaks and troughs

driven by local generation, EVs being charged at home and perhaps higher levels of electric heating.

As with managing energy use, there are discussions on how to encourage consumers to manage their capacity. At the moment the cost of a network upgrade to accommodate increased use of EVs would make its way to all consumers, even though around just 2% of those who have a car or a van have a hybrid or full EV. Research suggests that “early adopter” or “keen green” consumers are prevalent amongst the fifth of car owners who say their next purchase will be a hybrid or full EV [32] [33].

There is work underway, being led by Ofgem, to think in terms of a core capacity which everyone needs, and an optional, chargeable capacity which only some people need. This work is in its early stages and is being taken forward as part of wider reform of how distribution costs are re-charged to consumers and generators [34]. But increasingly, consumers will need to become more attuned to capacity limits in terms of how much energy they are using at the same time. An extreme example can be found on the Isle of Eigg. Without a mainland connection, residents rely on their own microgrid served by wind, hydro and solar power. Every household observes a 5kW restriction, allowing them to run a washing machine whilst making a cup of tea [35].

‘Disruptive’ business models

As consumers become more engaged, they may if they don't already, start to take an interest in where their energy is coming from. Some households already generate their own energy and export it back onto the grid. Community projects develop links between an area and its energy resources. But even if you invest in and live next door to a community project, it is difficult to buy your energy directly from it. This is because licensed suppliers perform a central role in buying and selling energy, and they generally do this on a wholesale basis. This means consumers usually pay the same for their energy wherever they are, based on the market-wide energy mix. At around a third of total charges, this gives consumers minimal control over the largest cost item on their bill.

Ofgem has said it wants to change this “supplier hub” model to facilitate, amongst other things, peer to peer trading, which allows consumers to deal directly with, for example, local energy generators. These are ambitious reforms and are likely to take some time to be fully implemented. However, it is possible that new “disruptive” business models will become more common, with trial and bespoke regulatory arrangements to test what is possible and consumer preferences

Impacts

The following sections consider consumer impacts by potential exclusions, grouped under the pre-defined categories of financial, digital, energy market engagement, the ability to flex energy use, the ability to flex energy source and geographical exclusion.

Financial

Switching

Historically, some of the poorest consumers have found themselves disadvantaged by the energy market, for example, prepay customers paying more per unit of energy and lower income customers being less likely to shop around for the best energy deal [7]. Pre-pay customers are also likely to be amongst the last groups with functional smart meters,

following the revelation that pre-pay smart meters are being delayed due to technical issues [29]. Ofgem's consumer attitudes survey found that consumers with a smart meter are more likely to switch supplier (but are careful not to conflate lack of a smart meter with lack of market engagement) [7].

The north of Scotland fares particularly poorly for switching rates. Recent analysis for Citizens Advice Scotland found the lowest rates of switching in one year – 2018 – to be, in descending order, Orkney Islands, Argyll and Bute and Highland (all just under 15%), Western Isles at 14% and Shetland at just under 10%. The highest rate of 22% was in East Renfrewshire [36]. In explaining these results, CAS refers to Highland and Island consumers on restricted meters and electric-only heating. The former refers to a particular group of mainly Scottish consumers on Dynamic Teleswitch (DTS) meters – used to remotely control electric storage heaters and help balance the grid. Like those with pre-pay meters, such customers find it difficult to switch due to a lack of tariff options.

The ability to switch supplier is the key market mechanism for exerting competitive pressure on consumer prices. But the recent set of measures to improve switching rates and introduce price caps essentially recognise that competition hasn't been serving all customers equally. Ofgem said before the SVT price cap was introduced on 1 January 2019 that:

“Too many consumers are not seeing the full benefits of competition. That is why we are consulting on the introduction of temporary price protection for domestic customers on default tariffs.”

But that in the long-term it still has faith in competition, with some market reform:

“In parallel, we are also taking steps to promote competition and consumer engagement, as in the long-term a competitive market will get the best outcomes for consumers. At the moment, barriers to innovation – like access to data, complexity of industry codes and the entrenched role of traditional suppliers within the energy system – mean that it can be difficult for market participants to bring beneficial, and potentially disruptive, propositions to market.” [37]

Ofgem's own impact assessment on the SVT price cap estimates that it will drive lower switching rates – between 10 and 50% lower, the wide estimate reflecting the difficulty of predicting how both consumers and industry will respond to the cap [38].

The link between low incomes and disadvantage in the energy market is complex. Some pre-pay customers may simply not have enough choice when switching supplier, customers may have built up too much debt to be able to switch supplier, some may not have access to the internet to switch easily, and others may simply have more pressing needs on a day-to-day basis.

Not all non-switching customers are vulnerable. “Loyal” is a word that comes up when speaking to consumer groups in Scotland [39] and others may simply need to be motivated to do so. Automated switching has the potential to improve switching rates – there are several brokerage services available in GB which, in return for signing up (which involves submitting usage information as if the customer were switching) and paying a subscription fee or commission – the provider will thereafter keep customers on the best deal.

Digital

Digital exclusion has been a long-standing characteristic of vulnerability in the energy market. In some respects, energy companies are getting much better at reaching vulnerable customers [40] in times of need such as blackouts, including those who do not use the

internet. But access to – and ability to use – the internet is pretty much essential for easily switching and accessing the best tariffs and will become even more crucial with the move to smart meters and as so-called “disruptive” business models hit the market.

One energy supplier is already offering a half-hourly, dynamic ToU domestic tariff [41] designed to benefit consumers with electric storage heating and/or an electric vehicle. It can be combined with smart plugs and appliances to automate charging at cheaper times. However, subscription to various services, receiving updates on energy prices – essentially what you need to make the best of the tariff - all require the customer to be digitally literate.

Evidence from one smart meter trial with vulnerable groups found some households are reticent in interacting with smart meter displays and functionality for fear of ‘messing things up’ [42]. An annual survey of digital skills suggests that around a fifth of adults in Scotland lack the basics (compared to a fifth in England and a third in Wales) [5] and for clients of Citizens Advice Bureaux, this goes up to a third [6]. If you are older, on lower income, disabled or a woman, you are more likely to be digitally excluded. Lack of digital skills impacts on confidence in engaging with the market and on your ability to access any help on offer.

There is simply no sign that those unable to use the internet are going to be equally-served. Perhaps more than any other kind of exclusion, digital exclusion is compounding existing exclusions and leaving people even further behind. This is going to be a huge issue for an ever more complex and remote relationship with energy suppliers.

Engagement in energy market

Smart meters

The GB energy market for the most part remains one based on consumers making choices. Consumers may decline a smart meter, or they may have a smart meter but choose to ignore it. Research by Smart Energy GB found that in 2017, although most people (over 90%) are aware of smart meters, just over a third of the population actually understand what they do. This is very low in the context of an aspiration for every home to have a smart meter by 2020 [43]. The same question did not appear in the following year’s survey.

Whilst consumers are paying for the smart meter rollout, it will only bring consumer benefits if they actively engage with them. Whilst there will in any event be lower billing costs for consumers, on their own these are not enough to justify the rollout. A study by Sussex University concluded that technical issues with the smart meter rollout have overshadowed what are significant consumer engagement barriers – namely “vulnerability and poverty” and “consumer resistance and ambivalence.” It criticises the rollout for misattributing smart meter awareness with smart meter acceptance, and calls for a more realistic attitude to, and effective response to, consumer engagement issues [44].

Smart homes

Focus group research by Citizens Advice shows consumers are sceptical about the benefits of smart home technology, even if they have it in their homes already. They do not instinctively think about data security but are concerned about the volumes of data collection [45]. A survey for Smart Energy GB found half of respondees were attracted to the idea of buying energy as a “lifestyle” product packaged with services such as broadband or music streaming. It was more likely to be attractive to the young demographic (18-34) and those with a smart meter [46].

Flexibility of energy source and energy use

The Isle of Eigg would not have been able to access cheaper and more reliable energy sources if residents were not prepared to be more flexible in how they use that energy. So-called 'smart' solutions based on being able to be flexible about when energy is used, can be an essential requirement for exploiting new sources of energy.

In the meantime, gas is still the cheapest form of heating for most households, yet 22% of Scottish homes do not use or have access to this [9]. Remote areas of Scotland, particularly in the north, have some of the highest rates of households off the gas grid (100% on Orkney and Shetland). Electric-only heating can be up to three times as costly as gas. This is perhaps why 89% of RHI applicants in Scotland are off the gas network.

Other research shows that many groups of consumers simply do not have the day-to-day flexibility to take advantage of ToU tariffs, for example, households with children or those with complex medical needs. Others may lack the ability or knowledge to engage with ToU pricing – if consumers are already unwilling or unable to switch suppliers, it seems unlikely that they will have the time, energy or inclination to constantly monitor energy prices. It seems reasonable to assume that if some customers move over to ToU tariffs and avoid peak times in order to save money, those customers unable to do so will be paying the higher peak-time costs, even if not explicitly so on a ToU basis. The same arguments will likely apply for consumers unable to shift energy use to manage any new capacity-based limits.

Developments such as appliances which can automatically respond to ToU price signals, will make flexible energy consumption more user-friendly, but with the exception of longstanding DTS and Economy 7 tariffs, this is in its infancy. Most of the literature on consumer impacts of ever-more sophisticated tariffs and appliances are speculative – we simply do not know how consumers will respond. Citizens Advice Scotland has looked at consumers on DTS and Economy 7 tariffs, and found only half actively try to avoid peak prices and only a quarter actually knew when these occurred (and of those, when probed, an even smaller proportion could provide accurate details) [47]. Again, it will likely be the early adopters that benefit from technology in the near-term, those people who are already 'controlling their homes from their phones'.

Geographical

Internet access

Digital and geographical exclusion combine in Scotland, in so far as remote areas are more likely to suffer poor digital connectivity. Scotland's rural areas have the lowest levels of access to basic broadband speeds (75% of rural households compared to 85% for rural households across the UK). 4G coverage is better than the UK average but is still only 43% (40% for the UK in rural areas) and much more concentrated amongst fewer providers. [48]

Smart meters

Geography is already impacting on the smart meter rollout. We can find no information on geographical uptake of smart meters, but the NAO recently revealed that of 109,000 fully functional meters (SMETS 2), only 3000 are in the North of England and Scotland. This is because of problems integrating the meters with its communications infrastructure [29]. This is particularly concerning as consumer price protections are due to be rolled back as smart meters (and easier and quicker switching) are introduced.

Local generation benefits not fully realised

Scotland, and in particular remote areas of Scotland, hosts some of the cheapest generation in the country and, for onshore wind power in particular, the cheapest in Europe. As has been the case for decades for oil and gas, Scottish consumers do not currently benefit from hosting this energy, through cheaper energy costs. This is because most suppliers buy a lot of their energy (and green certificates) on a wholesale basis. Where specific costs are reflected to customers, this is typically to charge them more, not less, for a 'green' benefit. At the same time, network costs are re-charged to consumers on a locational basis.⁵

Ofgem's reform of the supplier hub model offers an opportunity for Scotland as a whole and communities individually to benefit directly through energy bills and energy services. Research for Ofgem calls this "disintermediation" (essentially cutting out the intermediaries between the consumer and the energy). Ofgem's research cites a variety of real-life business models from flat-rate subscription for energy services (rather than units of energy) to public and community ownership removing the profit motive and providing more consumer agency, to peer-to-peer local trading of energy [49].

Energy decarbonisation

Summary findings

Energy decarbonisation benefits consumers in the long-term, protecting against fluctuating fossil fuel costs.

In the medium-term, measures to support low carbon technologies will, by 2030, cost the average consumer £200 per year as a levy on energy bills.

The levy is regressive in so far as it falls disproportionately, as a percentage of income, on those least able to afford it. Collecting levy funds as income tax or as a re-structured energy charge weighted towards high levels of energy consumption, would be fairer.

Levy-funded schemes which support householders to install low carbon technologies are only available to those with up-front capital. Notwithstanding grant support which can make these schemes more accessible, they tend to benefit higher income households.

Support for domestic-scale electricity comes to an end this year, and for heat in 2021. If not reinstated or renewed, consumers will be paying exclusively for large-scale commercial projects.

There are sustained and high levels of public support for renewables, even though energy schemes are more visible and dispersed throughout the landscape. Many communities host low carbon projects and there is some limited evidence that this can enhance local support.

New energy supply business models offer the potential to enhance and strengthen relationships between projects and communities, and the Scottish Government wants community ownership to feature in half of all new projects by 2020.

Local renewable energy schemes can be transformational for geographically remote areas otherwise reliant on high cost, imported fuels. Examples include Orkney, with over 700 micro

⁵ explaining how this works is a report in of itself but broadly this results in low(ish) transmission costs for Scottish consumers to signal the benefit of being close to large amounts of generation, and cost-reflective distribution costs which are high in north Scotland.

wind turbines and the UK’s first locally-managed, renewables-fuelled grid, Unst in the Shetland Isles pioneering wind powered hydrogen production and the Hebridean Eigg with its carbon-free, 24/7 island micro-grid.

Introduction

This chapter considers energy decarbonisation from the consumer’s perspective – the balance between the costs being incurred now and the benefits accruing now and in the future. Whilst Scotland leverages its devolved powers in planning, renewable energy promotion and economic development to facilitate renewable energy, the UK retains important powers over green energy market support mechanisms.

Policies and Targets

Table 0.1 shows renewable energy targets set at the Scottish, UK and European levels out to 2030. A commentary on the context for and development of these targets is provided in Appendix 4. A short summary is provided here.

Table 0.1: Renewable energy targets

Year	Scotland	UK	Europe
2020	Energy: 30% including 1GW of community and locally owned projects Electricity: 100% of consumption Heat: 11% of non-electrical heat	Energy: 15% Electricity: 31% of consumption Heat: 12%	Energy: 20%
2030	Energy: 50% Energy: 2GW community and locally owned projects		Energy: 32% energy

Growth of renewables electricity – large scale developments

Largely fuelled by a favourable UK-wide support mechanism, the Renewables Obligation (RO), Scotland has been able to expand its renewable generation base. It has used devolved powers on planning and the promotion of renewable energy to supplement market forces which attract developers to Scotland’s favourable resource. This includes good practice guidance on community benefits [50], grant and loan support for community ownership [51] [52] and commercial incentives for wave and tidal schemes. The RO has now been replaced by a UK-wide “Contracts for Difference” (CFD) support regime⁶.

Onshore wind in particular has seen unprecedented growth, going from virtually nothing in 2001 to around 7.5GW of capacity installed in Scotland by 2018. As an indication of how this compares, hydro power – Scotland’s second largest renewable energy source – sits at around 2GW, installed over the last 70 years. Renewables met over 70% of Scotland’s electricity consumption in 2017 [53].

⁶ Scotland had executive devolved powers over the operation of the RO in Scotland (apportionment of spend). These powers have been re-centralised to Westminster under the CFD regime.

A target of 500MW of community and locally owned projects by 2020 was upgraded in the third Climate Change Plan to 1GW when the 500MW target was surpassed in 2015 [54]. The Scottish Government wants half of all newly-consented projects to have an element of shared ownership by 2020 and is aiming for a further GW of community and locally owned renewables between then and 2030.

Renewables electricity and heat for households

On a smaller scale, Feed-in-Tariffs (FiTs) and latterly the Renewables Heat Incentive (RHI) has made a smaller but nonetheless appreciable contribution in Scotland. Households, businesses and communities have accessed support available to, amongst other things, build community wind turbines and install Air Source Heat Pumps and biomass boilers. Scotland is securing significantly more than its proportionate UK share of installations under these schemes. However, the UK-wide FITs came to an end in March 2019 and the RHI has not been confirmed beyond 2021. No equivalent schemes supporting local and domestic-scale energy are planned, although UK Government has consulted on a guaranteed market-based price for small-scale generation (the Smart Export Guarantee).

A shift from electricity to heat

As the shift in target emphasis between 2020 and 2030 shows, there is a re-focusing of effort away from electricity generation and on to energy as a whole. Renewable energy generation had reached just under 18% in 2015, the latest year for which data is available [55]. For renewables, an all-energy target means heat is now a key area in which significant progress needs to be made. A 2009 Climate Change Plan target for just 11% of non-electrical heat to be met from renewables by 2020 is – as of the end of 2017 – around half-way there [53].

Impacts

The literature pays a lot of attention to financial impacts and gives less detail on some of the more complex or difficult to quantify impacts such as consumer engagement and long-term energy security. More detail is provided in the following commentary.

Financial

Pay now for future benefits

Scotland has hosted green energy both to meet its own citizens' needs as well as to contribute significantly towards green energy targets and consumption in the rest of the UK. In the long-term, a shift towards green energy will benefit the climate and the wider environment.

In 2008, Ofgem's duties were extended to include sustainable development and to consider the needs of future as well as current consumers. In investigating future consumers' needs, Ofgem ran some scenario-based analysis on energy markets. Ten-year scenarios where green energy policies were pursued resulted in lower electricity bills, with early green subsidies more than offset in the longer term by lower energy costs. Gas bills were broadly comparable due to green heat subsidies kicking in later in the modelled period [56].

In the shorter-term, the most direct consumer impact of these policies has been a levy on UK consumer energy bills⁷ which pays for the various renewable energy and energy efficiency support schemes. These levies will continue over the next five years and beyond, paying out to operational projects. The Committee on Climate Change estimates that with energy

⁷ Charged on a uniform basis per unit of energy billed

efficiency support included, green levies will represent around £200 on an annual consumer bill by 2030 [57].

In 2010, an Eaga Charitable Trust-commissioned distributional impact analysis of policies including the RHI, FiTs and the RO concluded that there were more progressive options for recovering these costs. This is because whilst (domestic) high energy consumers pay more in gross terms, lower income households spend proportionately more of their income on energy costs and are thus hit hardest by additional costs. The report suggested re-structuring levies to allow a basic level of energy consumption at low cost, with higher consumption levels taxed at higher rates [58]. More recent analysis found that in 2016, when green levies added £123 to the average annual bill, re-allocating this to general taxation would reduce costs for 70% of the population. The poorest households would save £102 and the richest would pay an additional £410 [59].

Local and personal income

There are financial benefits associated with hosting and investing in renewable energy. At the commercial-scale, community benefits payments typically support local grant schemes, with wide-ranging scope. Whilst a voluntary database of community benefits in Scotland is kept [60] information submitted can be sparse and coverage is not comprehensive. Nonetheless, all commercial-scale schemes supported under the RO and the CFD regime will have a community benefits scheme, and the benefits will be distributed locally, and sometimes regionally.

Renewable energy schemes may also offer opportunities to invest. Communities may choose to capitalise community benefits funds to contribute to a community-wide buy-in. Or there may simply be opportunities to purchase shares in a project, for those that can afford to do so.

The Scottish Government has set targets for community renewables. The definition encompasses farm and estate and publicly owned projects, which make up the majority of the 697MW of capacity (as of 2018). 80MW is owned by community groups [61].

The Scottish Government advocates £5000/MW per year index-linked in community funds [62], although some projects have offered more in the past and some less [63]. It is also consulting on the principles of community shared ownership of projects [64]. With the closure of the RO to new applicants some developers are exploring subsidy-free schemes, but with probably more unpredictable revenues available. This will likely impact on the extent to which developers exceed recommended contributions. It will also have a bearing on how some communities may view ownership propositions, which will inevitably come with heightened risk on investment returns.

On a smaller scale, FiTs and RHI schemes were and are both open to domestic consumers, who earn revenue from the installation of microgeneration in the home. Access to these payments requires an upfront investment in equipment. Analysis of domestic RHI applicants and installations found costs ranging from £6000 for a solar thermal installation to £20000 for a Ground Source Heat Pump. Biomass boilers, at £17000, predominate in Scotland. The mean household income for those installing a biomass boiler is £60000 per year. Three-quarters of all RHI applicants used personal savings, with the remainder using a loan or re-mortgaging their house [65].

The Scottish Government does provide loans and grant support to community projects, rural SMEs and others, including through its Community and Renewable Energy Scheme (CARES)

programme, which helps groups to access FiTs and RHI. With the closure of both schemes in 2019 and 2021 respectively, new avenues for communities to benefit through ownership of energy projects will need to be found – some of these are discussed in the following Section.

Engagement

Renewables have literally changed our energy landscape, with a shift from fewer large centralised power stations to many, projects distributed much more widely. Power stations are becoming more familiar, less iconic. Appendix 4 maps the change in quantity and distribution of projects over the last two decades.

We have used this mapped data to pilot-test some geographical distributional impacts, looking at the relationship between proximity to a renewable energy scheme and a community's level of deprivation [66]. This shows, for averaged distances, virtually no relationship between levels of deprivation and average distance from a project for wind, and a complex relationship for biomass. The results are reproduced in Appendix 3. It is hard to draw any conclusions on the basis of this limited analysis, but it would be interesting to look at whether project size makes a difference, and whether the result would be different when performed on conventional power stations.

Whilst conventional energy projects might have had a deep and long-lasting connection with a community – mass local employment, embedded in the social fabric and provision of discounted fuel – this model is much less common now. It is difficult to know why this kind of relationship has fallen out of favour.

Nonetheless, there is potential for a more meaningful relationship between low carbon projects and the community that goes deeper than community benefits-funded civic improvements. Some politicians welcome these benefits but want to see more “transformative” impacts, citing for example land reform and the opportunity for communities as landlords [63]. Although it is difficult under the current regulatory structure (see Section 7), there is an example of at least one UK project in Cornwall providing electricity direct to the community at a discounted rate [67]. Others have advocated for Norway-style strategic trusts which take a long-term view, such as the charitable trust in Shetland which manages oil and gas community benefit funds [68].

There is potential for local projects to promote and encourage local engagement in energy, the energy market and decarbonisation. The extent to which this is realised is not well understood, but there are some interesting examples. For example, there is some historical evidence (from 2009) that the closer you are to a renewable energy project, the more likely you are to be in favour of renewables. The same study found higher levels of support for renewables in the Highlands and Islands [69]. More recently, BEIS' public attitudes tracker shows consistently high levels of support for renewable energy which hovers around 80%, with little difference between the UK regions. Even for the most visible technology, onshore wind, levels of support are around 75% (77% in Scotland as of November 2018) [70].

Renewable Heat

Whilst there are reasonable levels of awareness of renewable heat – around 65% of adults know that renewable heating systems exist – there is little awareness of details around costs, performance and reliability. Just 3% of people have a renewable heating system installed, and of those that don't only 7% were likely to install solar thermal panels, 2% a biomass boiler, 2% an ASHP and 1% a ground source heat pump [71]. These figures are UK-wide so there is a need to better understand if there are Scottish differences.

Flexibility in energy source and energy use

Intermittent renewable energy has inherent characteristics that mean it both enhances choice of energy sources and improves domestic energy security – it is provided locally and does not rely on imported fuel. At the same time it cannot always respond on-demand with an increase or decrease in output.

For long-term energy security then, renewables are helpful. They promote self-sufficiency, reduce reliance on imports and thus exposure to external events. Short-term energy security – securing demand on a minute, hourly or daily basis – is more challenging for intermittent renewables and is at the heart of a shift towards a more actively managed and responsive demand-side. It enhances the importance of storage technologies which can bridge the gap between when energy is harnessed and when it is needed. None of these challenges are specific to Scotland, they are world-wide. But in being ambitious for renewables, Scotland is at the forefront of developing solutions. The implications for consumers are considered in Section 5.

Geographical

Renewables can be more cost effective in remote areas with few energy choices, rich resources and high fuel import costs. Orkney and Shetland island groups are all entirely off the gas grid. 84% of dwellings in the Western Isles and 62% in Highland are off the gas grid [4]. This is exactly why remote islands are often early-adopters of renewable energy – examples include Orkney, with over 700 micro wind turbines [72] and the UK's first locally-managed, renewables-fuelled grid, Unst in the Shetland Isles pioneering wind powered hydrogen production and the Hebridean Eigg with its carbon-free, 24/7 island micro-grid.

Although there is no regional breakdown by MW or number of projects, Local Energy Scotland has mapped community energy schemes. Interestingly the 81MW of community group-owned projects show a noticeable contribution from the main Scottish island groups.

Geographical impacts are weaved into and overlap with other impacts such as financial impacts. In many respects, remote areas benefit from rich resources and the potential benefits this brings when projects come to fruition – such as community benefits. However, there is a debate around whether projects could and should lead to more transformative local benefits. For example, on Shetland, a community trust built disbursing community benefit payments from the oil industry is re-investing in a large wind farm in Shetland, which, if built, will be almost 50% community-owned [73].

Whilst we look here at geographical impacts on remote areas it is important to note that densely populated urban areas can be disadvantaged in similar ways., for example urban areas that are not connected to the gas grid.

Digital

No specific impacts identified.

Energy efficiency

Summary findings

Energy efficiency is working. Improvements in Scotland's housing stock has had a protective effect against rising fuel prices and has helped to lift some households out of fuel poverty

Energy Performance Certificates do not have the recognition levels of energy appliance labels, and neither are as effective as they could be in nudging consumers to save energy.

More work needs to be done to convince consumers to take individual action on home improvements. The best time to engage consumers on home improvements is at big life events – primarily moving to a new house, but also starting a family or changing jobs.

Energy efficiency improvements are achievable for most properties, with annual bill savings in the region of £400-1000.

Low income consumers pay proportionately more in energy efficiency levies, but consume less energy than high income consumers. When prices rise, it is low income consumers that cut their consumption even further, sometimes to dangerously low levels.

Geographically remote areas, especially the Highlands and Islands, have very high levels of fuel poverty and low-EPC rated housing. The EPC methodology understates the problem by not properly accounting for lower ambient temperatures.

Introduction

This chapter reviews energy reduction, buildings energy efficiency targets and associated policies. Responsibility for buildings energy efficiency is devolved and so targets are compared at the Scottish, English and Welsh and European levels. As with renewable energy, powers to pass through the costs of energy efficiency measures through consumer bills sit with Westminster. Consumer impacts and experiences of energy efficiency standards and measures are reviewed, including a focus on the Scottish fuel poor.

Policies and Targets

Table 0.1 shows existing energy consumption targets as well as targets for Minimum Energy Efficiency Standards (MEES) for the Private Rented Sector (PRS), social housing and home in fuel poverty. The Scottish Government is currently consulting on new standards for the owner-occupied sector [74]. MEES are framed as the Energy Performance Certificate (EPC) band achieved by a property. A commentary on the context for and development of these targets is provided in Appendix 5. A short summary is provided here.

Energy Efficient Scotland

Some financial support for energy efficiency is, like renewable energy, provided via a UK-wide Obligation on suppliers to deliver energy efficiency savings, which is paid for by electricity consumers⁸. Scotland's main vehicle for promoting energy efficiency is the relatively new Energy Efficient Scotland (EES). This is bringing together new devolved powers on distributing levy funds and combining and consolidating a range of Scotland-only grant and

⁸ Since 2006 Scotland has had devolved powers to determine how obligations are delivered, but not to determine amounts, obligated parties and collection of funds.

loan programmes. Local authorities are taking on key responsibilities, including development of Local Heat and Energy Efficiency Strategies (LHEES). The delivery landscape for consumers has been rather fragmented in the past and this provides an opportunity for consumers to experience a more coherent and familiar local energy efficiency offering.

Table 0.1: Energy use and buildings energy efficiency targets

Year	Scotland	UK / England and Wales	Europe
2020	<p>Energy use 12% reduction in final energy use compared to 2005-7 baseline (ACHIEVED 2014)</p> <p>Buildings Private Rented Sector (PRS) being marketed must be Energy Performance Certificate (EPC) E (all PRS by 2022)</p> <p>Social Housing must be EPC C or D depending on the building type</p>	<p>Energy use 18% reduction in final energy use compared to 2007 business as usual projection (UK)</p> <p>Buildings PRS EPC E unless exemption sought for marketed properties by 2018 and for all by 2020 (E&W)</p> <p>1 million homes benefit from ECO or Green Deal between 2015-20 (UK)</p>	<p>Energy use 20% reduction in energy use compared to 2007 business as usual projection</p> <p>Buildings All new buildings should be near zero carbon</p>
2025	<p>Buildings PRS EPC D</p>		
2030	<p>Energy use 30% increase in productivity of energy use across Scottish economy</p> <p>Buildings PRS and households in fuel poverty EPC C</p>	<p>Buildings Households in fuel poverty EPC C</p>	<p>Energy use 27-30% reduction in energy use</p>

As of 2017, 42% of homes were EPC C or better [2]. 91% of Private Rented Sector (PRS) properties are already EPC E or better – close to the PRS fully EPC E by 2022 target. PRS targets move through to EPC D and C between 2020 and 2030. In 2017, 76% of PRS properties were EPC D or above and 39% were EPC C and above [2]. Social housing has – of the entire housing stock – the highest proportion of properties rated C or above, at 55%. Only 7% of the social rented housing stock was below a D rating in 2017.

European energy labelling

Europe has also had longstanding regulations on products energy efficiency, which have been rolled out to encompass a wider selection of every-day items from lightbulbs to fridges and washing machines. From 2021 onwards there will be a re-scaling of the A-E rating, eliminating A+ ratings and removing appliances at the bottom end of the scale.

Impacts

Financial

Upfront investment for future bill savings

Improved home energy efficiency can translate directly to savings in energy bills. Analysis for Citizens Advice on the PRS found modelled net energy bill savings of between £422 and £1055 per year when going from an F or a G up to an E rating. Factoring in rent increases of 0 to 6.3% for the improved accommodation, there was always a net benefit for tenants, from around £400 to over £1200. Average capital costs for the improvements were assumed to be £943 F to E and £3773 G to E (over 80% of the former and 20% of the latter could be achieved at under £1000) [75].

A combination of insulated walls and loft and a modern boiler (or low carbon heating), alongside double glazing and draught-proofing, will enable a typical house in Scotland to meet EPC C. Solid-walled properties are the hardest to treat, although not all need wall insulation to achieve EPC C. A sandstone mid-floor tenement flat can usually achieve a C with a modern boiler and double glazed windows. Top floor flats will be at or close to that level if loft insulation is in place.

There is also evidence that, independent of other factors such as location, there is a positive correlation between EPC rating and house price [76].

Fuel poor and energy efficiency measures

Since around 2011, energy efficiency savings have been helping to protect households from higher energy prices. According to data collated in the Scottish Housing Condition Survey, fuel poverty levels tracked energy prices closely up to this point, but then the relationship starts to break – a phenomenon it has attributed to both improvements in energy efficiency as well as in household incomes. The key trends are shown below, reproduced from [2].

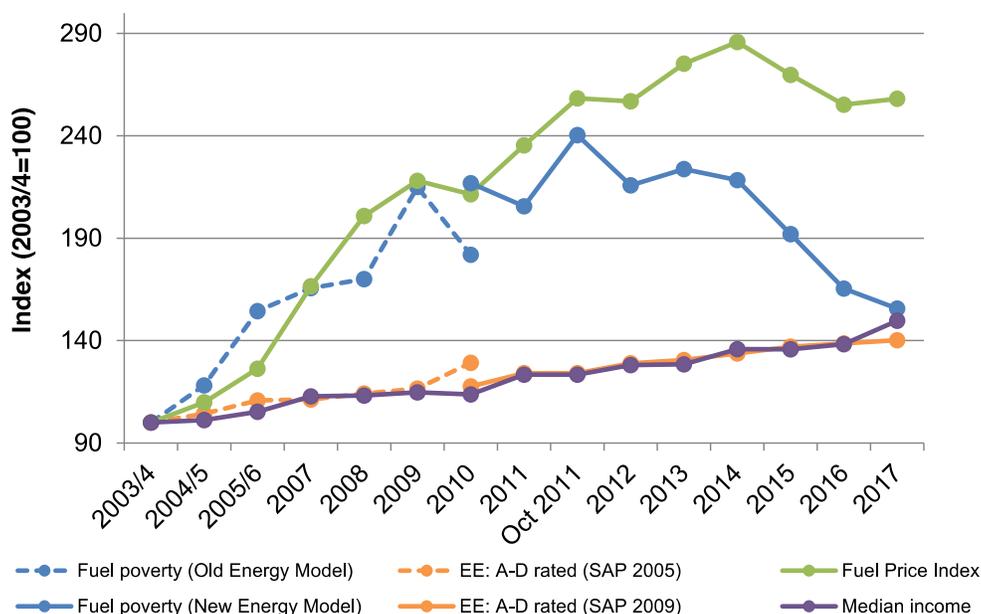


Figure 0.1: Trends in Fuel Price, Energy Efficiency and Median Income, 2003/4 to 2017

Whilst energy efficiency is having some protective effect against fuel poverty – 69% of all those living in F and G rated homes were in fuel poverty in 2017 – income is still an important factor in fuel poverty - 13% of households in homes rated EPC B and C still remained in fuel poverty in the same year.

Reduction in energy use

As Table 0.1 shows, Scotland's 2020 energy use reduction target was achieved in 2014. Undoubtedly, success in reducing energy use has been in part due to energy efficiency measures. However, economy downturns and increases in energy prices have also delivered savings as consumers cut down on what they use to save money. Ofgem notes in its State of the Market report that from 2006 to 2016 energy consumption fell by around 20% whilst gas prices increased by 46% and electricity by 28%. Despite significant savings in energy use, average household bills were still rising over this period [77]. Average bills fell by just 1% between 2016 and 2017, helped by continuing energy savings, but prices have risen again over 2018 [23]. The concern is of course that fuel poor consumers are responding to prices in a way that compromises an acceptable standard of living. At the other end of the scale, income level is the strongest predictor of energy use in the home [78]. So those fuel poor customers limiting energy use in response to price are already those with the smallest environmental impact.

Engagement

Home energy efficiency

A UK adult is more likely to have installed insulation measures if they are a higher earner, an owner occupier, elderly, living in a house and resident in London or Northern Ireland. Scotland has some of the highest levels of solid wall insulation, but still only 7% of adults in Scotland live in a household with solid wall insulation (it is 1% in Wales). Scotland has amongst the lowest levels of under floor insulation (14% compared to highest of 29% in East Midlands).

42% of UK adults do not have any awareness of home EPC ratings, with little GB-variation in this. Of those who are aware of them and recall seeing home improvement suggestions, 20% in Scotland made large changes and 19% small – and only 2% of all adults in Scotland answered yes to all these questions. And of the 39% of the 2% who made changes, 69% would have done them anyway [70].

In the short to medium-term PRS properties and the social housing sector are prioritised by the Energy Efficient Scotland routemap. There are extremely low levels of awareness of PRS standards and Scotland and Northern Ireland have the lowest – 98% know not very much or nothing.

There have been around 21 different schemes promoting energy efficiency and tackling fuel poverty UK or Scotland-wide since the turn of the century [79], and well-publicised problems with the Government's Green Deal programme which has dented consumer confidence [80] [81].

So, whilst there might be good progress in actually installing energy efficiency measures, there is perhaps a surprising lack of knowledge of the EPC regime and low individual pro-active take-up of measures. This has some quite significant implications for relying on individuals to improve their own homes, outside of any kind of incentive or obligation. Research undertaken on behalf of Energy Saving Scotland suggests that the best time to engage consumers on home improvements is at big life events – primarily moving to a new house, but also starting a family or changing jobs. Selling improvements on the basis of comfort and warmth as well as money savings are likely to gain more traction [82].

Energy labelling

Historical (2011) evidence suggests that UK consumers have a good level of awareness of energy labelling on appliances (76% were aware of their existence) and, an understanding of what it means (4 in 5 could demonstrate specific understanding). In the same survey just under 60% of those who were aware of the labelling system often or always used it when making a purchasing decision [83]. There have been some well-publicised press campaigns about the loss of familiar but energy inefficient versions of household appliances – focusing on the perceived control element from Brussels [84]. More recent research suggests that UK and French consumers are alone amongst EU consumers in prioritising price over performance of an appliance, and this is reflected in lower sales of the most efficient appliances in these countries [85].

Flex in fuel source

In the UK Government's attitudes tracker, those most likely to act on EPC recommendations are households off the gas grid [70], hinting at poorer energy efficiency levels for homes with limited or no flex in how they heat their homes. Fuel poverty levels are also higher for off-gas homes, likely reflecting a combination of poor energy efficiency and higher heating costs. Research for Citizens Advice Scotland found some limited evidence that higher-priced efficiency improvements in off gas properties (e.g. Ground Source Heat Pumps) were likely to produce greater bill savings than cheaper interventions (e.g. ASHPs or smart storage heaters) [86].

Flex in energy use

No specific impacts identified.

Geographical

Local authority data for 2014-2016 shows that each of the island council areas have amongst the lowest average energy efficiency ratings across the housing stock which are also lower for rural areas than for urban areas. Orkney and the Western Isles have the highest prevalence of low EPC-rated housing – 25 and 21% respectively – compared to central belt levels of around 1-5% and a national (Scotland) average of 5%. Fuel poverty rates⁹ in the Highlands and Islands are also 50% or more, compared to 31% national average for the measured period [4]. The Scottish Government's proposed new definition of fuel poverty is more closely correlated with low income and so in future may improve its geographical representation.

Understanding this rural-urban and north-south divide is not straightforward. Previous research by CAG, for Citizens Advice Scotland (CAS), on the number of energy efficiency measures installed found that Scotland-specific schemes from grant funds helped to balance out the otherwise Central Belt emphasis of Supplier-obligation schemes (which were seeking out the cheapest measures). Intervention rates can also be low in some of Scotland's most urban areas such as central Glasgow, which has high concentrations of hard-to-treat solid wall tenements [79]. Whilst these findings only hold for the schemes analysed, it does show that where the government has intervened, it has been successful in making sure that harder to reach and harder to treat homes are not left out.

Another important consideration is that the energy efficiency (EPC) rating methodology factors in heating costs [87]. This means that urban-rural differences are in part due to higher fuel costs in some rural areas, for example where properties are off the gas grid and the main fuel is heating oil, as well as a higher prevalence of houses compared to flats, the latter being cheaper to heat. Furthermore, the methodology assumes that all houses are based in central England, meaning that if temperature differences were taken into account, heating costs would be higher, and energy efficiency rating lower, in Scotland and even more so in northern Scotland.

Digital

No specific impacts identified.

⁹ Defined by the existing simple definition rather than more targeted definition in the new Fuel Poverty Bill

Conclusions and recommendations

This report reviews policies, plans and trends across the energy landscape, focusing particularly on the key challenges for decarbonisation, and the consumer experience of modern energy markets. Climate change targets set the scale of the task ahead, and downstream policies, plans, targets and measures provide the shape and form of how we go about meeting these targets.

A key aim of this report is to better understand policy impacts on vulnerable and excluded groups of customers. We catalogue both beneficial and disruptive impacts – often for the exact same policy. Precisely who benefits and who might be left behind is a question of the distributional impact of policies on different groups of consumers. Understanding this will support the Scottish Government's aim for a “just transition to a carbon-neutral economy” [88], [89].

We have reviewed the literature on impacts, and sometimes this provides evidence on distributional impacts. It is clear though that we need a much better understanding of this and that is what we intend to start unravelling in our follow-on modelling work, by testing some of the policies reviewed in this report.

Summary of impacts

Table 0.2 and Table 0.3 summarise impacts, positive and negative, for each of our three themes. Some notes and commentary to inform the distributional impact assessment are also provided.

Recommendations

The primary purpose of this work is to inform rather than recommend. However, in looking at the evidence base some recommendations do emerge on promoting better understanding of consumer impacts.

A relatable low carbon transition

There is a great deal of modelling and analysis underpinning climate change targets, as well as associated sector plans, policies and road maps. This is essential work, but more could be done to drill down into how this translates into everyday lives. We found some archived ‘day-in-a-life’ videos of what a greener future day might comprise, but nothing current. There is some excellent literature available – for example the “Energy in Scotland” annual publication which monitors progress towards targets alongside accessible contextual information – but it isn't always easy to find.

Better understanding of community benefits

Renewable energy projects routinely provide voluntary direct community benefits, in cash and otherwise, something that is not at all a given in other development sectors. These benefits are therefore very welcome, but there is scope for better understanding of outcomes on a consistent and comprehensive basis. The voluntary register of community benefit schemes is a useful starting point which could be built upon.

Better understanding of consumers

There are some good attitudinal surveys which track the same or similar subjects on a regular basis – notably the BEIS attitude tracker and Ofgem's consumer survey. Data availability is improving and Scotland-wide data is often available. However, Scotland is a large and diverse

country, and there is a need for statistically-significant survey data at sub-national levels which follows attitudinal trends year-on-year.

Smart meter installations

There is no published data on where smart meters have been installed. Given the importance placed on smart meters for resolving a number of issues with the energy market, access to this data is essential for policy makers.

Table 0.1: Consumer impacts of changes in smart consumer landscapes

	Positive impacts	Negative & uneven impacts	Comments for distributional impact assessment
Financial	Switching can be beneficial for consumers, and bring savings in the region of £300 per year.	The potential for savings from switching are not evenly distributed amongst consumer groups. Of those who can switch, not all exercise their right to do so, and the assumption that they will with the introduction of smart meters and easier switching is untested.	There is limited data on switching rates across Scotland, and little understanding of why consumers don't switch. Consumer segmentation starts to characterise consumers but would be improved by better data on Scottish attitudes and engagement.
Digital	New ToU tariffs, smart appliances & enhanced control over energy use are playing an essential role in energy decarbonisation. They have the potential to enhance consumer engagement and consumer power.	Almost without exception smart adaptations require digital literacy and internet access. If you are older, on lower income, disabled or a woman, you are more likely to be digitally excluded. The digitally excluded risk being left even further behind, and in complex ways that are difficult to predict.	The distribution of digital exclusion is not well understood at sub national levels. Lack of data precludes it from the distributional impact assessment, despite it being a key increasingly important indicator of exclusion.
Engagement	Smart meters offer potential for transforming energy use and the way in which consumers engage with the market...	...however, there is evidence that many consumers lack interest in and / or knowledge of, what smart meters can do. This needs to change for the full benefits of smart meters to be realised.	Data on smart meter installations is available only as one aggregate number. There is no data on where they are or who has them, and therefore on who doesn't have them yet.
Flex energy source & use	The ability to be flexible in energy use can open up opportunities to exploit new low carbon energy sources, epitomised by the Isle of Eigg example.	Conversely, consumers with no flex in their energy source may similarly find it difficult to be flexible in their use of energy. Consumers unable to change when they use energy may find themselves left behind as others benefit from cheaper ToU tariffs.	There is very limited information and analysis on the consumer impacts of ToU tariffs. At the moment expected impacts are speculative.

Geographical	Remote areas could potentially gain from new business models which allow customers to directly access local generation.	Remote areas ¹⁰ can experience multiple exclusions where a lack of digital connectivity has delayed the smart meter rollout. This can exclude customers from some of the better tariffs and limit opportunities to switch supplier and save money.	New business models are in their infancy. Consumer experiences and impacts should be monitored to see if they live up to expectations. Multiple geographical exclusions are worsening with increasing reliance on digital connectivity in the energy market.
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Table 0.2: Consumer impacts of changes in the energy decarbonisation landscape

	Positive impacts	Negative & uneven impacts	Comments for distributional impact assessment
Financial	Average cost savings of £200 per year on annual bills by 2030 provides longer-term protection against rises in fossil fuel costs.	Consumer levies which collect the £200 per year on average, actually fall disproportionately on less well off.	Well understood distributional impacts, readily quantifiable.
	Community income from community benefits, around £5000 per MW and targets to increase local ownership.	Reliability of community income levels at risk with changes to renewable energy support schemes	Income levels available from community benefits database. Outcomes and distributional impacts of community benefits not well understood.
	Personal return on investment by participating in domestic FITs and RHI.	Financial barriers for initial upfront investment of multiple £K. RHI and FITs schemes coming to an end.	Upfront investments quantifiable, limited research on characteristics of who is accessing domestic schemes. Future analysis should look at impact of scheme closure on consumers and potential for replacement and improvement.

¹⁰ Although this did not come up in the literature review, high rise flats can have similar problems.

Engagement	Sustained and high levels of public support for renewables. Some limited evidence that local schemes promote engagement in the energy market.	<p>Low levels of public understanding of renewable heat technologies.</p> <p>Politicians have advocated for more transformative relationship between local projects and host communities.</p>	<p>BEIS attitudes tracker provides consistent and reliable data, but no breakdown for Scotland's diverse regions.</p> <p>Evidence on relationship between local projects and levels of engagement is sparse.</p>
Flex energy source & use	Renewables improve long term energy security.	...but complementary solutions such as storage and demand flexibility are needed to maintain short term energy security.	These are well understood characteristics of a low carbon energy system. Consumer-related impacts considered in more detail in Section 5.
Geographical	Enhanced viability of renewables in remote setting, benefits can be life-changing – for example introduction of 24 hour power for Isle of Eigg residents.	We tested a hypothesis that areas of high deprivation would be more likely to be in proximity to energy infrastructure. The findings were inconclusive, and may merit further investigation if of interest.	Examples of pioneering island projects are largely anecdotal in nature. Little systematic analysis of renewables in remote settings and consumer benefits and impacts.

Table 0.3: Consumer impacts of changes in energy efficiency

	Positive impacts	Negative & uneven impacts	Comments for distributional impact assessment
Financial	Investments in energy efficiency improvements, taking a property from EPC F to G or E cost between £400-1000 and give bill savings of around the same, per year. Better energy efficiency improves the rental and sale value of properties.	Efficiency improvements at the lower end of the EPC scale are more cost effective than at the higher end, when the cheapest measures have already been taken.	There is extensive modelling on home energy efficiency improvements informing the setting and monitoring of MEES targets. Household-level EPC data is publicly accessible and there is good data on energy efficiency measures installed under organised schemes.
	As of 2011, fuel poverty levels in Scotland stopped tracking fuel prices, indicating that energy efficiency is starting to have a protective effect against price-related fuel poverty.	Rises in energy prices demonstrably promote energy savings but could drive consumption levels to dangerously low levels in the fuel poor. This disadvantages those that already have a low environmental impact by virtue of low incomes.	Analysis of smart meter data has demonstrated the link between income and energy consumption and could also be used in the future to analyse where consumption is dangerously low. Fuel poverty data is updated annually. The new fuel poverty definition will take some time to bed in and for trends to emerge.
Engagement	Energy labelling of appliances has very high levels of recognition amongst the public.	Despite significant improvements in home energy efficiency, the public is not particularly engaged in the subject. EPC home ratings are failing to prompt individuals into taking action. And despite high levels of awareness of energy labelling of appliances, this doesn't always follow through in purchasing decisions.	These observations rely on attitudes surveys rather than a more in-depth analysis of why consumers are not taking action outside of organised schemes. There is no data on individually-installed home energy efficiency measures.

Flex energy source		Households with lower levels of choice on energy source, principally off gas customers, are likely to be associated with poorer efficiency outcomes and higher levels of fuel poverty.	Whilst it is clear that off gas households find it harder to heat their homes, there is very little analysis on the most appropriate improvements for these hard to treat properties.
Geographical		Geographically remote areas, especially the Highlands and Islands, have very high levels of fuel poverty and low-EPC rated housing. The EPC methodology understates the problem by not properly accounting for lower ambient temperatures.	The problem of hard to heat and treat homes in remote parts of Scotland is well understood, and quantifiable. There is a reliance on modelled data in defining the problem, with a need for real monitored data (if smart meters reach the Highlands and Islands – see Section 5).

Appendix 1 – Workshop notes

Which policies to put through the distributional impact assessment?

Scenarios:

- Scottish Future Energy Scenarios – how will the different scenarios impact on the archetypes? To paint a realistic picture of (e.g.) who will have EVs, who will have heatpumps, how will this affect fuel poverty.

Energy efficiency:

- ECO
- Scotland Energy Efficiency Plan
- EPC targets (EESHS); how will different archetypes respond?
- Private rented sector MEES

Heat:

- District heating:
 - Support programmes
 - Regulation on consumer protection
 - For info/data on these see 2x SG consultation documents on these
- Renewable heat – or at least policy intentions for this. Might be difficult to model impact, but might be possible to show who are/are not likely to benefit

Meters, tariffs and bills:

- Smart meter rollout: could have major impacts in remote areas. Need to prod suppliers to provide this data
- Time of use tariffs – how will these affect different people.
- Tariff caps and removal of these
- Warm Home Discount and devolved responsibility and control of this (in terms of eligibility)
- Winter Fuel Payment
- DTS signal provided by old BBC radio frequency will be cancelled in 2020

Others:

- 2032 ban on sale of diesel cars. Research shows about 80% of EV charging is done at home. A lot of the charging at home will be smart charging. Limited on data for this.
- Local and Community Energy – where? How much? Who?
- Ofgem's Targeted Charging Review (TCR) and possible impacts on different consumers – e.g. low-income high users and high income low users (self-consumers)

What are the key impacts to understand?

- kWh
- Bills and fuel poverty
- Comfort levels – ability to keep warm
- CO2
- Inclusion; don't leave people behind in terms of new technology
- Consumer engagement – there are lots of things consumers simply don't want to be involved in. If wanting public to make changes, need information and how to best use new technologies.
- Smart meters could be used to identify vulnerability (e.g. is consumption high enough?)
- Internet access; may impede e.g. switching supplier in the highlands (not enough bandwidth to complete the transaction)

- Unregulated heating sector – impact on those who rely on heating oil, LPG, storage heaters
- EV uptake; look at car ownership levels as an indicator of EV uptake in different areas; geographically remote communities may be left behind due to lack of infrastructure or car clubs, as well as those without a driveway (for charge point)

Other points:

- Also useful to consider changes to archetypes going forward in terms of numbers in each

Is there additional data we could use?

- CAS data on attitudes to switching
- CA data (not available yet) on EV and ToU attitudes (national data)
- Imperial College data on trust (5 GB archetypes); will be published 'soon' and freely available
- Scotland-wide customer satisfaction trends

Possible data to be pulled in to future iterations:

- Data on where the smart meters are – SG feel they should be able to get this
- PRS data; SG to look at whether this is something that could be included in the future
- Highland Fuel Poverty taskforce may have data
- Climate change attitudes as a proxy for those more likely to take action
- Community social structures and those involved in the sharing economy
- LHEES could be used in future for more data
- Consumer Service data

Appendix 2 – Brexit impacts

Energy markets

The Scottish Energy Strategy notes that with dwindling production from the North Sea, we will be getting 67% of our gas from international markets by 2025. Analysis commissioned by National Grid in 2016 [90] suggests that this supply will not be materially impacted by Brexit in the short to medium term, because commercial gas markets are largely independent of the EU apparatus.

The same is not true of international electricity markets, where European trading platforms already operate under the rules and regulations developed as part of the Single Market in Electricity. In fact, the level of EU oversight and EU-wide harmonisation in electricity is extensive, covering everything from industry structure (liberalisation and unbundling of monopoly and competitive activities) to the detailed technical codes for connecting to, operating on and charging for, the electricity networks. As the UK was in any event ahead of Europe in liberalising its electricity sector, Brexit is unlikely to have any immediate impacts in this case. However, there is a risk that in order to trade electricity in Europe, the UK will over time become a rule-taker without being part of the rule-making, limiting opportunities to reflect the UK's evolving circumstances and, at the same time, for the EU nations to benefit from the UK's experiences.

Surrounded on all sides by Europe, this is a particular issue for electricity because of the lack of alternative markets with which to interconnect. The EU puts substantial funds into the development of interconnectors and has already allocated €10M to Northconnect which is planned to connect Scotland with Norway. Post-Brexit, government would need to match this level of funding.

The Scottish Energy Strategy notes that:

“The ability to continue trading energy openly and fully across Europe can, if unaffected, play a big part in the progress we make towards our renewable and climate change targets, and the growth of Scotland’s low carbon energy sector.”

National Grid’s 2016 analysis found the most significant risk to consumers to be higher energy prices stemming from a devalued pound and higher cost of imported energy equipment. The Lord’s EU Energy and Environment sub-Committee’s work on energy security post-Brexit found there to be vulnerability on managing periods of supply shortage. The Committee has also asked the government to assess the impact on consumer prices of an end to frictionless trade [91].

Climate change

Both Scotland and the UK already have their own national and legally-binding climate targets out to 2050. Brexit will not immediately alter this, and these targets are all more ambitious than the equivalent EU targets. Furthermore, the EU will no longer be able to balance off the UK’s over-average performance with other Member State’s under-average performance. That said, Scotland and the UK have also developed their own climate change plans in response to and in tandem with action at the European level. Brexit will also remove the UK from climate change negotiations as part of the EU block. The Scotland Climate Change Plan says that:

“Through the UK’s membership, Scotland has benefited from being a direct part of the EU’s considerable diplomatic clout in the climate negotiations, projecting our domestic climate leadership internationally through collective effort with our EU partners.”

Renewables and energy efficiency

The UK may no longer be bound by renewable and energy efficiency Directives from Europe. It is hard to predict the precise impact of this – at some points the UK has helped the EU to be more ambitious and at other times, vice versa. The Scottish Energy Strategy states that

“Legally-binding EU renewable energy and energy efficiency targets have played a defining role in stimulating the huge growth in renewable energy in Scotland, and significant inward investment.”

Historically, the EU has been instrumental in requiring support for both renewables and nuclear power when the UK has been seeking state aid support for the latter. A break from Europe may allow administrations to pursue individual technologies, to the exclusion of others, with greater freedom. If UK-wide funds for renewables fall away as a result of heightened support for nuclear power, this will impact negatively on Scotland’s aspirations to further grow its renewable energy industry.

Smart consumers

Europe has a number of initiatives and organisations for technical standardisation of smart grids and smart appliances (for example the European Committee for Standardisation). As the UK’s smart meter rollout has learnt to its cost (SMETS 1 meters being rolled out before the development of a central market communication protocol, many being rendered obsolete as a result), standardisation and co-ordination is essential. If the UK wishes to trade energy with Europe, as well as buy and sell smart appliances from and to Europe, then it will need to

adhere to the burgeoning and detailed technical standards issued by Europe. The UK may not though, have a say in how these develop and how quickly they are adopted.

Summary

This is just a brief review of the potential for disruption. Currency fluctuations seem most likely to bring impacts in the short to medium term. If we continue to follow European rules and regulations associated with the Internal Energy Market, then some kind of negotiated access to its trading platforms is a credible – if as yet still uncertain – outcome. In the longer term, it is also not clear if there will be a political solution that allows ongoing UK influence in the evolution of these markets.

Appendix 3 – Commentary on renewable energy policies and targets

Promotion and development of renewable energy in the UK has historically been influenced by Renewable Energy Directives from Europe [92], [93]. The current Renewable Energy Directive sets national targets on the proportion of final energy supplied by renewables. UK-wide targets on energy, electricity, heat and transport are all taken from this Directive. Scotland's targets are more ambitious and are confirmed in the Energy Strategy [1].

Largely fuelled by a favourable UK-wide support mechanism, the Renewables Obligation (RO), Scotland has been able to expand its renewable generation base. It has used devolved powers on planning and the promotion of renewable energy to supplement market forces which attract developers to Scotland's favourable resource. This includes good practice guidance on community benefits [50], grant support for community ownership [51] [52] and commercial incentives for wave and tidal schemes.

Onshore wind in particular has seen unprecedented growth, going from virtually nothing in 2001 to around 7.5GW of capacity installed in Scotland by 2018. As an indication of how this compares, hydro power – Scotland's second largest renewable energy source – sits at around 2GW, installed over the last 70 years. Renewables met over 70% of Scotland's electricity consumption in 2017 [53], up from around 11% before the RO, with the majority of this increase attributable to onshore wind. Scotland's target for 100% of consumption to be met from renewables by 2020 is more than catered for in planning-consented projects, but recent changes in the support environment (discussed in the following paragraphs) means that its being met is not guaranteed.

A target of 500MW of community projects by 2020 was upgraded in the third Climate Change Plan to 1GW when the 500MW target was surpassed in 2015 [54]. The Scottish Government wants half of all newly-consented projects to have an element of shared ownership by 2020 and is aiming for a further GW of community renewables between then and 2030.

The RO has now been replaced by a UK-wide "Contracts for Difference" (CFD) support regime¹¹. As part of this transition, (mainland) onshore wind no longer receives any subsidy, halting developments whilst developers consider if they can proceed without support. Offshore wind is still being supported by periodic CFD auctions. In Scotland this will, if plans go ahead, result in a new 950MW wind farm off the Moray coast by around 2022 and a

¹¹ Scotland had executively devolved powers over the operation of the RO in Scotland (apportionment of spend). These powers have been re-centralised to Westminster under the CFD regime.

450MW wind farm in the Firth of Forth by around 2023. A planned auction for 2019 will also be open to Scottish islands onshore wind proposals for the Western Isles, Orkney and Shetland, competing with offshore wind.

On a smaller scale, Feed-in-Tariffs (FiTs) and latterly the Renewables Heat Incentive (RHI) has made a smaller but nonetheless appreciable contribution in Scotland. As of the end of 2017/18, Scotland was second only to the South West of England in MW of FiT's installations, with just over 750MW split between nearly 300MW of wind energy, 260 MW of Photovoltaics, around 180MW of small hydro and a small amount of anaerobic digestion [94].

RHI data is recorded as number of installations rather than installed capacity. Up to October 2018, Scotland accounted for just under 20% of all registered ASHPs, 30% of all biomass registrations and 13% for each of Ground Source Heat Pumps and solar thermal installations [95]. On that basis, Scotland is securing significantly more than its proportionate UK share. However, the UK-wide FiTs come to an end in 2019 and the RHI has not been confirmed beyond 2021. No equivalent schemes supporting local and domestic-scale energy are planned.

Despite the cooling down of the UK market, aspirations for renewable energy remain high in Scotland. A 2020 target for renewable energy has been increased from 20 to 30% and a 2020 electricity target has progressively increased from 30 to 50 to 100% of consumption, largely to stay ahead of installation levels. Marine energy has not progressed as quickly as many had hoped. The Saltire Prize, launched by Alex Salmond in 2008, offering £10M for continuous 2-year production by June 2017, went unclaimed. However, Orkney and the north of Scotland in particular have developed a strong R&D base with projects operational just after 2017, and the Saltire Prize has since been relaunched.

As the shift in target emphasis between 2020 and 2030 shows, there is a re-focusing of effort away from electricity generation and on to energy as a whole. Renewable energy generation had reached just under 18% in 2015, the latest year for which data is available [55]. For renewables, an all-energy target means heat is now a key area in which significant progress needs to be made. To date it has been lagging far behind electricity. A 2009 Climate Change Plan target for just 11% of non-electrical heat to be met from renewables by 2020 is – as of the end of 2017 – around half-way there [53]. Most of the recent increase in the proportion of renewable heat is due to large reductions in heat consumption (driven by rising prices, efficiency and higher temperatures) rather than an increase in renewable heat production [55].

Appendix 4 – Renewable energy projects, geographical analysis

Figure A4.1 below shows current Scottish power stations > 5MW commissioned by 2001 (“conventional” includes old hydro plant, and note that it excludes power stations that are now closed – notably Longannet, Cockenzie and Chapelcross) and Figure A42, renewable energy installations > 5MW which started operating after this date.

Conventional Power Plants

Projects over 5MW commissioned up to and including 2001

- Biomass and biogas
- Hydro
- Natural gas
- Nuclear
- Oil

Source:
Open Power System Data, 2018. Data Package
Conventional power plants. Version 2018-12-20

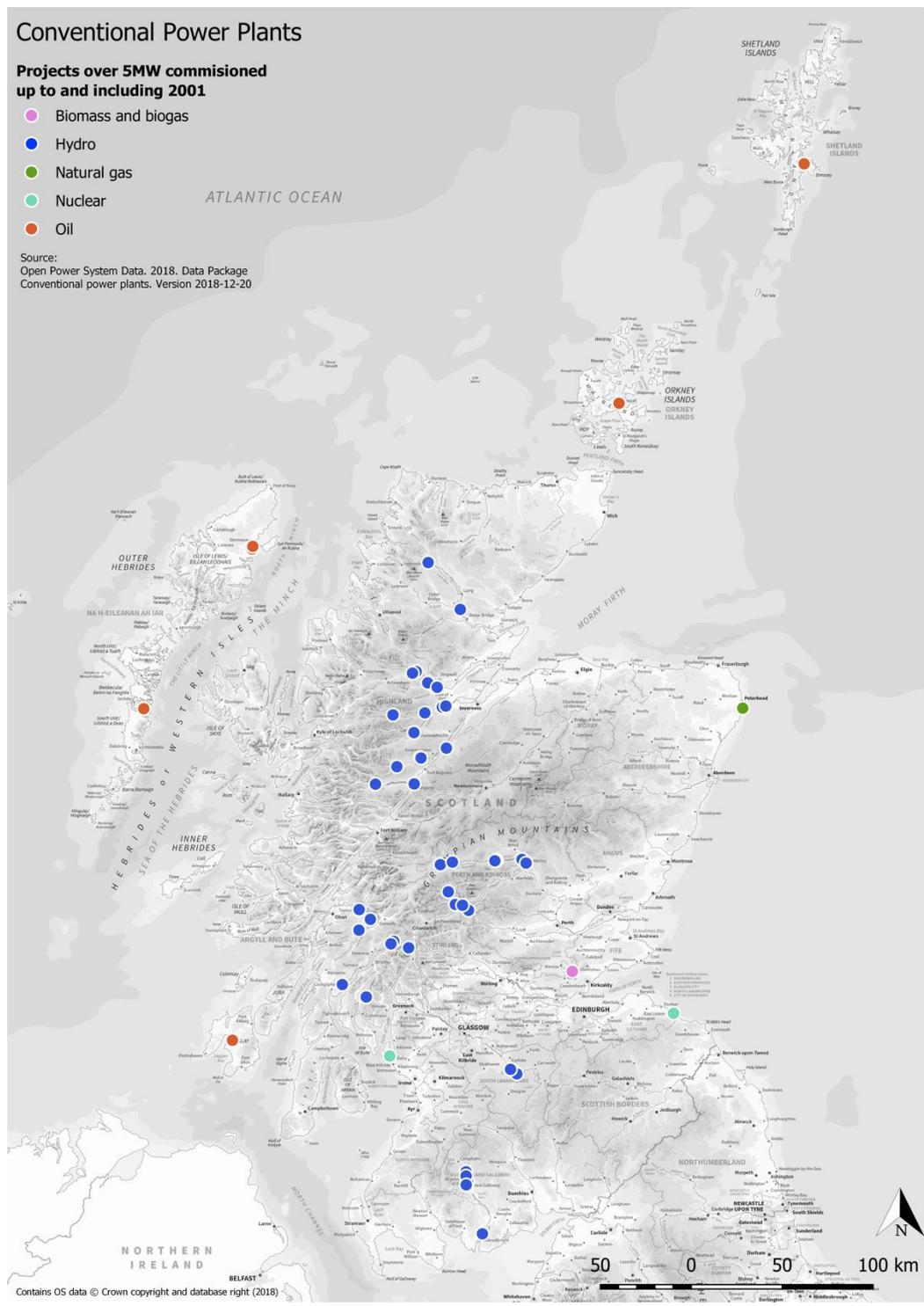


Figure A4.1 Power commissioned up to year 2001

Renewable Energy Technology

Operational Projects over 5MW

- Biomass
- Solar Photovoltaics
- Wind
- Wave / Tidal

Source:
Department for Business, Energy & Industrial Strategy
Scottish Government

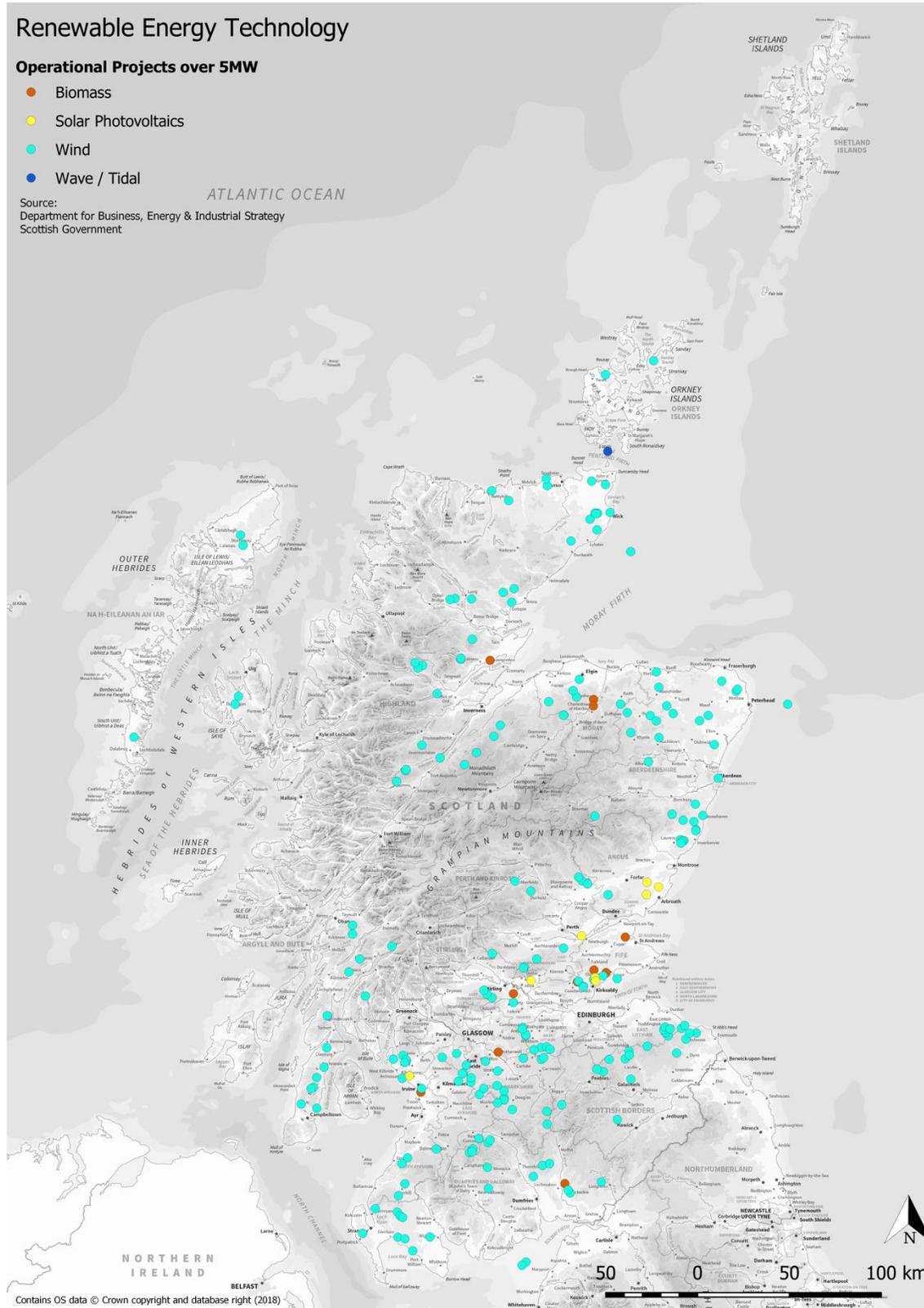


Figure A4.2 Renewable energy >5MW installed after 2001

Figure A4.3 shows the average distance from biomass and wind projects, by the Scottish Index of Multiple Deprivation (SIMD) decile for a datazone.

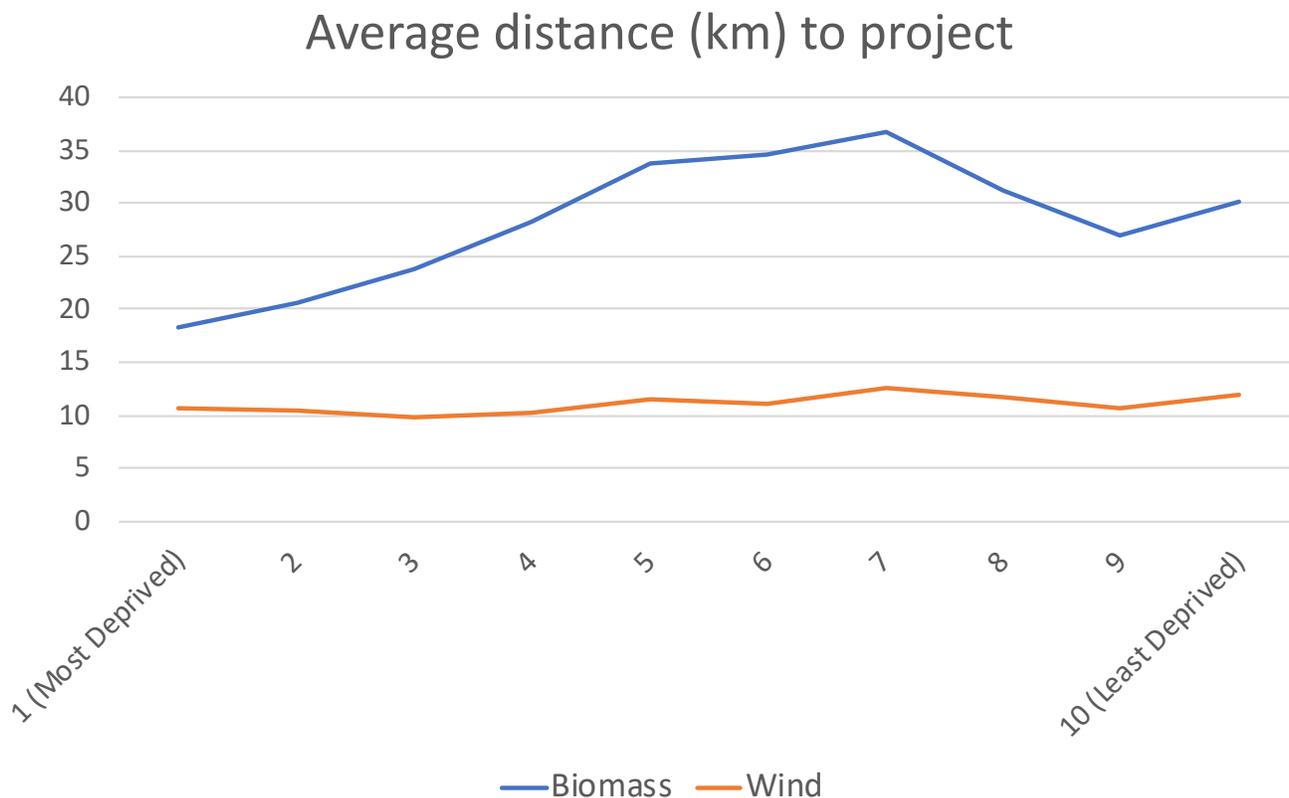


Figure A4.3 Average distance from project by SIMD decile

Appendix 5 – commentary on energy efficiency policies and targets

The 2012 Energy Efficiency Directive has been the starting point for the current suite of national policies on energy efficiency. A headline target of 20% reduction in final energy use has been apportioned to member states – the UK’s share translating as an 18% reduction. The Scottish targets are set out in the Energy Efficient Scotland Routemap, published in 2018 [96]. Scotland also has an aspiration to maximise EPC B in the social rented sector by 2032, and England and Wales are aiming for as many homes as possible to be EPC C by 2035.

Whilst MEES are broadly comparable between the UK and Scottish Governments, the Scottish Government has recently been praised by the Committee on Climate Change for its stronger compliance and enforcement framework – namely fewer opt-outs, consultation on MEES statutory backstops and meaningful enforcement [17].

Some financial support for energy efficiency is, like renewable energy, provided via a UK-wide Obligation on suppliers to deliver energy efficiency savings, which is paid for by electricity

consumers¹². Scotland's main vehicle for promoting energy efficiency is Energy Efficient Scotland (EES). This is bringing together new devolved powers over spending of levy funds and combining and consolidating a range of Scotland-only grant and loan programmes. Local authorities are taking on key responsibilities, including development of Local Heat and Energy Efficiency Strategies (LHEES). The delivery landscape for consumers has been rather fragmented in the past and this provides an opportunity for consumers to experience a more coherent and familiar local energy efficiency offering.

Scotland has been successful in leveraging a disproportionately high share of supplier-obligated energy efficiency measures relative to the number of households [79] and has made some good progress, especially on loft and cavity wall insulation. As of 2017, 42% of homes were EPC C or better, an increase on 39% the year before and continuing a longer-term upwards trend. 94% of homes have loft insulation of 100mm or more and 60% of walls are insulated (18% of solid wall dwellings and 75% of cavity wall homes) [2].

The target for PRS properties to be fully EPC E by 2022 looks achievable on paper. 91% of PRS properties are already EPC E or better. It is possible though that those remaining will prove the most expensive to upgrade or the owners particularly difficult to motivate. PRS targets move through to EPC D and C between 2020 and 2030. In 2017, 76% of PRS properties were EPC D or above and 39% were EPC C and above [2]. Social housing has – of the entire housing stock – the highest proportion of properties rated C or above, at 55%. Only 7% of the social rented housing stock was below a D rating in 2017.

Longer-term, a combination of insulated walls and loft and a modern boiler (or low carbon heating), alongside double glazing and draft-proofing, will enable a typical house in Scotland to meet EPC C. Solid-walled properties are the hardest to treat, although not all need wall insulation to achieve EPC C. A sandstone mid-floor tenement flat can usually achieve a C with a modern boiler and double glazed windows. Top floor flats will be at or close to that level if loft insulation is in place [97].

Europe has also had longstanding regulations on products energy efficiency, which have been rolled out to encompass a wider selection of every-day items from lightbulbs to fridges and washing machines. From 2021 onwards there will be a re-scaling of the A-E rating, eliminating A+ ratings and removing appliances at the bottom end of the scale.

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¹² Since 2006 Scotland has had devolved powers to determine how obligations are delivered, but not to determine amounts, obligated parties and collection of funds.

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