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# Public Engagement with Energy System Change in Scotland

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## Context

The Scottish Government published its draft Energy Strategy in January 2017. The draft Strategy is Scotland's first overarching, system-wide strategy for energy. In the draft, the Scottish Government has committed to consultation, engagement and deliberation with consumers and communities about their energy future. Evidence about Scottish public values and attitudes towards energy system transformation is essential to inform the development of those engagement processes. To that end, this report provides a summary of the current evidence.

The report provides a brief introduction to current thinking on public engagement with science and technology issues (part 1) together with a summary of the survey evidence obtained under the UK Energy Research Centre (UKERC) study on Public Values for Whole Energy System Change (part 2)[1]. We conclude with brief pointers for further developing public engagement regarding the Scottish Energy Strategy and future energy system change (part 3).

## Part 1 - The value of public engagement with energy systems

Public engagement is a generic term that describes all the different ways that institutions interact with the general public outside of formal democratic structures such as elections. This engagement ranges from one-way forms of interaction such as information campaigns and social research activities such as opinion surveys, through to more interactive public consultations and initiatives that seek to share decision-making power with members of the public[2]. The general case for engaging various publics about science and technology, including that of energy, rests upon three very broad sets of argument, characterised by Fiorino in 1990 as normative, substantive and instrumental[3].

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- The **normative argument** stresses that dialogue and engagement is a good thing in and of itself in a democratic society. People have a right to be consulted and involved in decisions which might affect them and their families.

- The **substantive argument** is that engagement can help to generate new insights for achieving better quality outcomes and decisions through opening up the processes of problem framing, risk and benefit assessment, and overall option evaluation. Such opening up is often most useful where deep uncertainties exist (in so called 'wicked' problems[4]), or alternatively where specific groups such as local communities hold relevant knowledge that is not routinely available to experts. In this respect engagement is sometimes described as providing invaluable 'social intelligence' for policy makers, not only regarding how the public views the new technologies themselves but also the associated societal and economic changes that they are likely to bring about. This type of knowledge may be absent in the more formal impact and risk assessments.

- The **instrumental argument** is that dialogue and engagement helps to increase the legitimacy of decisions, and by so doing foster greater trust in science and the policy-making process.

Taken together, these imply an imperative to make controversial decisions in science and technology sensitive to the ethical and value concerns of directly affected individuals, groups and populations. Put simply, for some developments and applications scientists, engineers and policy makers cannot stand entirely aside from the concerns of society.

### Public Engagement Practice – Some Contemporary Thinking

The past 15 years have seen a wide range of different experiments in public engagement with science and technology across the UK and in domains ranging from new materials to biotechnology to energy. One important point to recognize from the outset is that in most cases there is no single 'public' with which to engage, but rather different or multiple publics with different values, locations, communities and interests. Hence the term 'public(s)' is often preferred in both academic and policy documents. Equally there is no simple one-size-fits-all approach to public engagement. The Royal Society nanotechnologies report[5] points out that engagement can take many forms, including:

- **scenario analysis and participatory technology assessment**, typically with stakeholders, to identify significant uncertainties that might emerge;

- **direct public engagement** such as citizen juries or panels for identifying broad 'desired futures', significant ethical concerns, or the acceptability of key applications and options at an early stage;

- **participatory decision analytic methods**, which draw upon more formal approaches for framing problems, as well as for identifying preferred options and their attributes (useful for complex policy problems or ones with high-stakes);

- **multi-stage methods**, which combine different approaches over time as appropriate, and as an issue arises, develops, and then leads on towards a definitive policy or decision. Typically involving a linked series of initial framing activities, science and economic appraisal, option appraisal and acceptability judgement, and final choice, often involving different groups of stakeholders and the public at various stages;

- and finally, **quantitative and qualitative research into public views**, can also be used (albeit with considerable care) to generate good quality 'social intelligence' about a technology and public concerns.

A further important distinction is the one between **invited** and **uninvited** publics[6]. These terms arose after the *GMNation?* public debate on biotechnology, held by the UK government under the direction of an independent steering board in 2003. During *GM Nation?* a range of spontaneous engagement events (formed of highly engaged, interested, but initially uninvited 'publics') sprang up alongside the more formal proceedings that had been planned (with typically invited publics) by the debate sponsors. A major controversy subsequently arose over which form of event had reflected the 'true' view of the public[7]. For some critics, the issue with an invited form of participation is that it may unintentionally or intentionally exclude important voices in a debate, while also running the risk of framing the topics for discussion too tightly around pre-existing policy concerns. The latter becomes a particular problem when participants want to voice concerns and issues that the sponsor has defined to be out of scope a-priori. Equally sponsors of engagement events rightly point to the unrepresentative nature of typical uninvited public(s) as potentially offering a less than solid basis for policy decisions that will affect everybody. While these dilemmas remain, and always have to be considered, it is clear in hindsight that both forms are compatible within systems of democratic governance such as that represented by the UK.

Drawing upon this line of thinking, a review by the University of East Anglia of UK activities for Sciencewise-ERC describes three broad categories of approach to public engagement, as follows[8]:

> **Invited micro-public dialogue** - where members of the public are invited to participate (in interaction with stakeholders, scientists and policy makers) in highly structured and managed group dialogue organised in terms of a host decision-making institution.
>
> **Invited macro/informal public engagement** - open, unstructured public engagement (which can incorporate forms of dialogue) that occurs in wider public arenas beyond formal decision-making institutions (but can be initiated by them) shaping public understandings and policy more indirectly.
>
> **Uninvited public engagement** – this involves more organic, spontaneous public engagement (which can incorporate forms of dialogue) initiated and organised by

citizens themselves rather than decision institutions, which may be directed at their own actions and/or challenging formal institutions.

Evidence shows that public engagement across this broad spectrum can be initiated by a range of actors: including academic researchers, government departments, NGOs, businesses, or even by communities and individuals themselves when they become concerned about, or otherwise engaged with, a science issue. As the above list and wider report show, there are multiple different ways public(s) can and do engage with energy systems. A recent UKERC review[9] has mapped the diverse ways in which public(s) engage with energy system elements by examining the range of possible participatory practices – from invited public engagement events to more situated and emergent participation where public(s) interact with institutions or systems of energy provision in everyday life. They note 32 projects (over the period 2010-2015) that have taken place partly or wholly in Scotland, some 14% of the total (with an additional 72 projects claiming to engage participants from all regions of the UK). Although the projects covering Scotland span a number of topics, for example engagement with renewable energy, community energy and smart city systems, there is substantial scope and need to conduct further analysis and research (see Part 3).

Public engagement organised or sponsored by government in the UK has tended to fall into the first category of invited micro-dialogue, with many funded and organised though the Sciencewise-ERC programme[10]. Sciencewise list five general principles for public engagement: the **context and aims** of engagement should be made transparent for participants; the **scope** should cover the concerns and aspirations of public, scientists and public sector, including broad framings to encourage wide-ranging discussions; **delivery** should draw upon state of the art methodologies; dialogues should have ways of achieving **impact**; and some form of **evaluation** should be conducted against objectives for outcomes and impacts.

A clear conclusion to be drawn from experience to date is that members of a varied cross-section of publics are perfectly capable of debating quite complex issues of environmental science, technology and policy with which they have little day-to-day familiarity given the right tools and sufficient opportunity to do so[11]. While people will typically come into a research exercise (e.g. an interview, focus group, deliberative event, or informed preference survey) with very limited technical knowledge of the topic, many will engage enthusiastically with the subject by drawing upon a range of shared cultural narratives and resources regarding the way in which science and technology is located in (and shapes) society. As part of this process, public(s) often expound insightful views on the institutions involved and on the promise and perils of scientific progress. In this respect people often focus less on the technology or science per se, than on the social context within which it is to be deployed, including complex arguments about the regulatory or governance conditions surrounding the application of science[12].

For the Scottish Government's Energy Strategy planning, a clear implication of this line of thinking is that significant effort will need to be put into the 'who', 'what' and 'how' of any engagement process (and it may well be that multiple methods with different publics are ultimately needed). In addition, the pathways to impacting policy in a meaningful sense will also have to be thought through and developed with care[13].

## How we got here: Public Engagement with Science, Technology and Risk 1990-2000.

In the immediate post-WWII era the reconstruction of UK infrastructure, including much of the existing UK energy supply and distribution system, followed an expert-led model of decision-making and policy. In this mode of science governance, decisions were arrived at centrally, typically with reference to detailed engineering, economic and policy assessments, but without any real direct public input beyond that offered through the normal processes of public consultation, Ministerial decision-making and Parliamentary oversight. This system of expert-led decision-making regarding a range of science and engineering issues began to come under strain during the 1960s-80s, with rising public opposition in the UK and elsewhere to nuclear energy and proposals for siting radioactive waste disposal facilities. Many of these initial controversies focused around the nature and degree of 'acceptable risk' as seen by affected communities and other civil society groups. In its 1992 report the UK Royal Society argued that risk assessment for complex technological and environmental problems should involve a careful weighing up of both scientific facts and public values[14]. While science could, in principle at least, say what the nature and level of risks were, their acceptability is always a value-based judgement. The Royal Commission on Environmental Pollution likewise offered a detailed analysis of the need to include deliberation of public values when setting environmental standards and regulation[15].

Public faith in expert-led decision-making was eroded further by the rising controversy in the late 1990s over the commercialisation of genetically modified (GM) agriculture and the simultaneous crisis prompted by the discovery of Bovine Spongiform Encephalopathy (BSE) 'mad cow' disease in humans. As a result the House of Lords Science and Technology Committee report on Science and Society[16] concluded that there was an urgent need to redefine the relationship between scientists, engineers, policy-makers and various publics such that the public could be brought into greater dialogue at an early stage of technology policy and decision-making.

The US National Research Council report on *Understanding Risk*[17] developed a detailed set of proposals for stakeholder engagement in relation to controversial risk and technology issues. They define the resultant analytic-deliberative process as combining sound science and systematic uncertainty analysis with deliberation by an appropriate representation of affected parties, policy makers and specialists in risk analysis. According to the report's authors, dialogue and deliberation should occur throughout the process of risk characterisation, from early problem framing through detailed risk assessment and then on to risk management and decision implementation. The risk characterization proposals of the Royal Society, Royal Commission and the US National Research Council can be viewed as the outcome of a growing transition from traditional forms of one-way science communication (from experts to publics), to more dialogic or discursive fora. The aim of such fora is to both empower participants in the (normative) processes of decision making about the issues and risks which might affect them or their communities and reflect useful (substantive) intelligence back to scientists, engineers and policymakers in order to shape technologies and their trajectories in more publicly acceptable ways[18].

At this point it is important to recognise that despite a long history of public engagement around policy, science and technology change issues in the UK, the EU and North America -

for example around GM agriculture, novel health interventions, open data, radioactive waste siting, nanotechnologies, community energy schemes, city and regional sustainability and planning, unconventional hydrocarbons and 'fracking'- there are relatively few cases that have focused explicitly upon engaging the public with national energy system change (see Part 2).

### 2003-2010 Public Engagement Moves Upstream

The Royal Commission and National Research Council proposals to develop deeper engagement around science, risk and the environment are paralleled by approaches to public participation that have emerged from the field of Science and Technology Studies (or STS)[19]. STS research documents how the operation of discourses, interests and politics frames and legitimises what counts as knowledge about a complex science or 'risk' issue[20]. It further shows how the resulting public perspectives are often driven by these more fundamental issues rather than the absolute level of knowledge that an individual might hold about the basic scientific facts of the matter. A focus simply on degrees of knowledge would lead to the conclusion that public engagement with science and technology is a matter solely of suitably presented communications about the science from expert sources – the so-called deficit model of science communication[21].

There are two implications of taking the more complex view of public understanding of science offered by STS. First, the values and local frames of reference of affected publics deserve to be understood, and where possible accommodated in policy, when making decisions about future technology change. Second, participation can be thought of as a means of fostering more democratic engagement between policy makers, scientists and publics, as well as more reflective governance processes within science and science policy themselves[22]. Such engagement will need to involve learning and capacity building amongst the citizens involved (since an energy literate citizenry is important if people are to participate fully), but should not be viewed naively as a simple matter of building public acceptance.

STS researchers also point out that public engagement often only occurs at the point when a controversial ethical or risk question has already arisen, or when decisions have already been made. At such a point public engagement might only serve token purposes – or worse still, be explicitly designed to manipulate public opinion and force acceptance of pre-existing decisions which are locked in by commercial, political or other constraints. Here the important notion of promoting 'upstream engagement' for emerging technologies was advanced by the think-tank Demos[23] and the Royal Society and Royal Academy of Engineering nanotechnologies report[24]. This involves consideration of potential risks, as well as deeper uncertainties and social/ethical issues, in advance of significant research and development, and before deployment decisions are made.

There are clearly benefits to facilitating public engagement at an early stage of any emerging technology's life. Most important of these is the potential to debate critically, and then potentially revise, the fundamental visions for change offered by technology proponents[25], and the associated societal trajectories that the uptake of a particular technology or system change might involve. Salient questions here include: What is this

change in technology for? What is the need? Who owns it? Who will be responsible if things do go wrong? Who will lose and win from these societal trajectories, and will there be unintended or unanticipated consequences? What regulatory or governance mechanisms might be necessary for research, for development and for 'downstream' deployment?[26]

The upstream-downstream metaphor is useful for thinking about the future energy system transition for Scotland. Some potential elements of a low carbon energy future are 'upstream' in the sense of being currently under development or untested at scale: e.g. novel energy storage solutions; proposals for flexible integrated gas and electricity networks; novel lifestyle changes in relation to the ways we live, travel, work, own and use products; carbon sequestration and storage systems; and tidal power. Other elements of system change are already relatively familiar to people, and are firmly 'downstream' in the sense of being familiar to the Scottish public, already deployed, or under deployment currently; e.g. conventional solar and hydropower; onshore and offshore wind; land use change and reforestation; traditional energy efficiency measures such as home insulation or condensing boilers. However, note that the classification of 'upstream' and 'downstream' here is to some extent an artificial divide.

One lesson for future public engagement in Scotland is that any methodology adopted must take account of both upstream elements (that is, unfamiliar system components requiring extensive information provision and potentially raising unanticipated societal or ethical concerns) as well as more familiar, downstream, aspects of system change. In addition there will be a challenge in making real for people – in terms of impact on the everyday lives[27] of different groups within Scotland – the visions underlying future energy strategy, as well as exploring the trade-offs that are explicit or implicit in policy.

## PART 2 - Insights into public perceptions of energy transition options in Scotland

### The UKERC 'Energy System Change' Project

Energy system change might seem on the surface to be an esoteric topic in engineering and technology provision. However, national energy systems comprise a set of interacting components including supply technologies, patterns of demand and behaviour, and governance and regulatory structures. Accordingly, people and communities will need to be involved in the energy system transition at multiple levels and scales – whether this is as individuals adopting (or not) new low carbon vehicles, in-home energy technologies, or new energy efficient practices and behaviours; as active proponents or opponents of planned major energy infrastructures; or when acting as citizens exercising their democratic right of challenge and support for energy system change through the ballot box or political lobbying channels.

While there has been considerable research done on what citizens think about particular elements of possible future energy systems - such as nuclear power, renewable energy, or energy efficient technologies and behaviours[28] - we know far less about responses to the idea of energy system change as a whole, or to elements of the system when placed in the

context of other available options for change. Some recent research has begun to explore aspects of this question, either by eliciting people's judgements of portfolios of energy supply options[29] or of future energy scenarios for particular cities and communities[30]. Also, a recent review by UKERC has outlined the multiple ways that different systems of citizens are engaging on-the-ground with elements of energy system change[31].

What follows summarises findings for Scotland from a research project that we ran between 2010 and 2013 (supported by a major research grant from the UK Energy Research Centre) in which we explicitly sought to elicitation a range of public attitudes and values towards energy system change for the UK as whole. The approach we adopted falls within the 'invited-micro-dialogue' model of public engagement described above. Our orienting principle in designing the project was that research and public engagement in the energy systems field must be attuned to the inherent complexities and issues of scale that publics have to contend with when taking a broad view of the energy system and its interdependencies. To do this we took a 'whole-system view' considering public perspectives on the combined set of supply and demand transformations envisioned in UK national energy policy scenarios. The project was structured in three stages involving (1) initial stakeholder interviews to elicit different scenarios for the UK energy system in 2050 (2) six in-depth one day public deliberative workshops (involving a total of 68 people), and (3) a nationally (GB) representative online survey of 2,441 people. Adopting such a mixed-methods design for the project allowed us to combine several relevant data sources.

Although there is no hard and fast rule regarding the number of groups and participants required for national-level public engagement in the deliberative workshops, in our case the final numbers and composition reflected a desire to gain a diversity of 'average citizen' views from a geographically diverse sample. Accordingly, two workshops were held in each of England, Scotland and Wales in both city and rural locations - in Scotland these comprised a workshop with participants living in the capital Edinburgh, and a second workshop with participants from a more rural area in proximity to Britain's largest onshore windfarm (Whitelee, just south of Glasgow). The nationally representative online survey in stage 3 then yielded statistical representativeness while also allowing for provision of key information to participants. In this way the synthesised findings from stages 2 and 3 could be sufficiently deliberative but also stand to reflect wider, nationally held public views. As with the workshops, the survey phase also facilitated exploration of differences in opinion from participants in both Scotland and Wales, through oversampling of respondents.

Further methodological details of our project and its specific findings are reported elsewhere[32]. The following sections summarise the findings from the Scotland specific sample, collected as part of the survey element of the project.

## Survey analysis: Public perceptions of energy transition options

### Introduction

The quota survey was carried out online with Ipsos MORI panellists aged 18+ years old living in Great Britain. The survey collected 2,441 responses in total, but only the Scottish sample data is presented here. The sample from Scotland is based on 502 respondents and is weighted by age, gender, region, and working status to the profile of the known population in Scotland. Fieldwork was conducted between 2nd and 12th August 2012.

This report provides an account of the findings and explicitly highlights where they diverge significantly from the findings from the British sample.

All the percentages below relate to the Scottish sample except when clear comparisons are made between the British and Scottish sample (in this case both percentages are reported).

In addition to the findings we present below, our first project report (see Box) presents the main findings from the full British sample and offers conclusions and interpretations alongside a discussion of the survey findings. Many of these interpretations and conclusions are also relevant for the Scotland-only sample.

**Methodological note:**

All differences between the two samples were analysed using two-tailed z-tests for comparing two proportions from two samples. Differences were judged to be significant if the test returned a p-value below 0.05.

In most cases we only report one proportion per question, for example we report the percentage of respondents that are concerned about climate change, but do not report the number of respondent 'not' concerned about climate change. Full wordings and complete data tables for all survey questions are to be found in the two additional reports.

Demski, C., Spence, A. and Pidgeon, N.F. (2013). *Transforming the UK Energy System: Public Values, Attitudes and Acceptability – Summary Findings from a Survey Conducted August 2012.* Project Report. London: UKERC.

Our second project report contains the complete data tables for the Scotland-only sample:

Demski, C., Spence, A. and Pidgeon, N.F. (2013) *Transforming the UK Energy System: Public Values, Attitudes and Acceptability – Scotland Survey Results.* (Cardiff University: Cardiff).

Energy policy framings and strategy

Within the survey we asked participants about their views on climate change and aspects of energy security, as well as their views on energy system change overall. In line with previous research, a majority of respondents were concerned about climate change (69%, Figure 1) and believed that the world's climate is changing (80%). Uncertainty about the existence of climate change was generally limited to a minority (16%); however uncertainty was higher over what the effects of climate change will be (58%).

Although the overall conclusions about public perceptions of climate change are the same for the British and Scottish sample, fewer participants in the latter were very or fairly concerned about climate change compared to the British sample (69% vs. 74%). On the other hand, a somewhat lower percentage of respondents reported being uncertain about climate change (16% vs. 20%).

The Scottish and British samples both show high concern for all the aspects of energy security asked about in the survey (Figure 1). For the Scottish sample, the least amount of concern was expressed for future power cuts (61% very or fairly concerned). The greatest concern was expressed for potential unaffordability of electricity and gas (83% very or fairly concerned). There are however some differences evident between the two samples. Fewer participants from Scotland, compared to the British sample, were very or fairly concerned that Britain will become dependent on energy from other countries (75% vs. 82%). Similarly, fewer Scottish respondents reported concern that Britain will not have alternatives in place if fossil fuels run out (76% vs. 84%). Of course this still represents high concern in both samples.

With regards to policy priorities we do not find differences across the two samples. A majority of respondents thought keeping energy affordable was the most important (42%), followed by making sure that Britain has enough energy (31%). When forced to prioritise in

this way, climate change was rated as least important by almost half of respondents in the Scottish sample (48% considered it least important, 24% considered it most important). Therefore our wider conclusion that the "issue importance" of climate change and environmental issues may be particularly low in the context of the economic downturn, coupled with strong concerns about increasing energy prices, is also true for Scotland.

With regards to overall energy system change, the answers from the Scottish respondents also do not differ from the British sample. Both agreed that that changes need to be made to both the supply and demand side (83%) and that national governments are primarily responsible for overseeing successful energy transitions (54%). Respondents overwhelmingly agreed (86%) that we (in Britain) need to radically change how we produce and use energy by 2050.

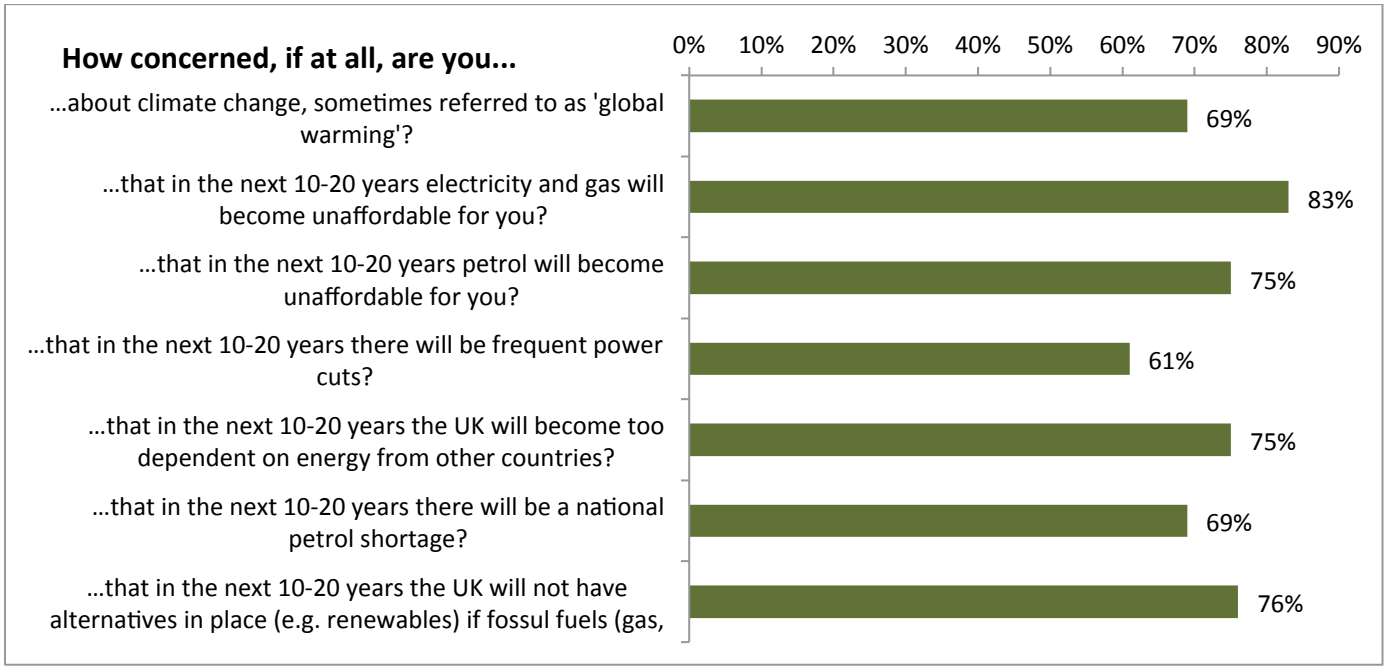



***Figure 1.*** *Percentage of respondents (Scotland sample) very or fairly concerned about climate change and a number of energy security aspects.*

Electrification and energy demand

We posed a number of questions about electrification of heating, cooking and driving to our survey respondents. From our British sample we concluded that, in principle, the British public is willing to consider using electric options especially if certain conditions are met. Specifically, comparative costs and perceived performance are important. This conclusion also holds when examining the Scotland-only sample. For example, willingness to consider using electric heating increased from 37% without additional considerations, to 82% if it was significantly cheaper than conventional models. Cost may be particularly important if other factors associated with performance (e.g. comfort, convenience) are judged to be poorer than existing options.

Comparing the Scottish and British samples, small differences can be observed within this more general conclusion about public acceptance of electrification. More respondents in Scotland reported negativity about heating with electricity than British respondents (42% were negative and 27% positive in the Scottish sample vs. 32% negative and 36% positive in the British sample). This difference is also evident when asked how willing respondents were to use electric heating in their homes in the future. Only 37% respondents from Scotland expressed willingness compared to 42% from the British sample. Although more positive than attitudes towards electric heating, Scottish respondents also, on the whole, were less positive about driving an electric car compared to the British sample (48% positive vs 54% positive). However there were no real differences when it came to willingness to drive an electric car in the future (51% vs. 53%).

Attitudes towards demand reduction were the same across the British and Scottish samples. A substantial majority of respondents thought Britain should reduce its energy use (71%). A majority also reported being prepared to greatly reduce their personal energy use (59%). There are no significant differences across the samples for this finding (although we do find that a slightly lower proportion, 77%, of the Scottish sample reported wanting to reduce their energy use as compared to the British sample, 81%).

The survey also included a host of questions gauging respondents' reactions to a number of energy demand management strategies. Many of these options assume use of smart meters and sharing energy use data with a third party. In the Scottish sample, we find that most respondents would be willing to share their data with their electricity supplier (35%) and a similar proportion (35%) would be willing to share their data but would have some concerns about this as well. However, 23% indicated not being willing to share data with their electricity provider. Similarly, most respondents would also consider sharing their energy data with other parties, although this varies depending on the organisation. There was some willingness to share data with an independent energy regulator (44% willing, 29% willing but with concerns, 20% not willing), and an independent third party for research purposes (33% willing, 35% willing but with concerns, 23% not willing). Government organisations seem to be least trusted (30% willing, 33% willing but with concerns, 29% not willing). Although the percentages differ slightly, there are no significant differences between the two samples.

When presented with a number of demand-side management (DSM) scenarios involving automation and remote control of energy use (Figure 2), we find a similar pattern of results for the British and Scottish samples. Over a third of respondents felt negative about an electricity network operator controlling some household appliances for the purpose of balancing the grid (42% negative, 33% positive and 22% neither). The level of acceptance of various DSM scenarios depended on the type of management being proposed (e.g. what activity or appliance it involved). Generally automation was more acceptable to people than remote control and interference with energy use. For example, a large majority thought having digital appliances automatically turned off after a period of time was acceptable (78% acceptable, 11% unacceptable), however having a set time after which the shower would turn off (with manual override option) was much less acceptable (47% acceptable, 35% unacceptable). Allowing a network operator to switch off the fridge and fridge-freezer for a short period of time was considered unacceptable by a majority of respondents (31% acceptable, 47% unacceptable).

Overall, the findings from the two samples were similar, although 'unacceptable' responses to the DSM scenarios were slightly higher in the Scottish sample. Nonetheless, only two of these differences reached statistical significance: More respondents in the Scottish sample compared to the British sample were opposed to a scenario in which the washing machine was remotely controlled (35% vs. 29% unacceptable). Similarly, a scenario in which respondents would have to set a time by which hot water needed to be available (and the network operator would determine the optimum time to run the boiler) was thought to be unacceptable by more respondents in Scotland compared to the British sample (46% vs. 41% unacceptable).

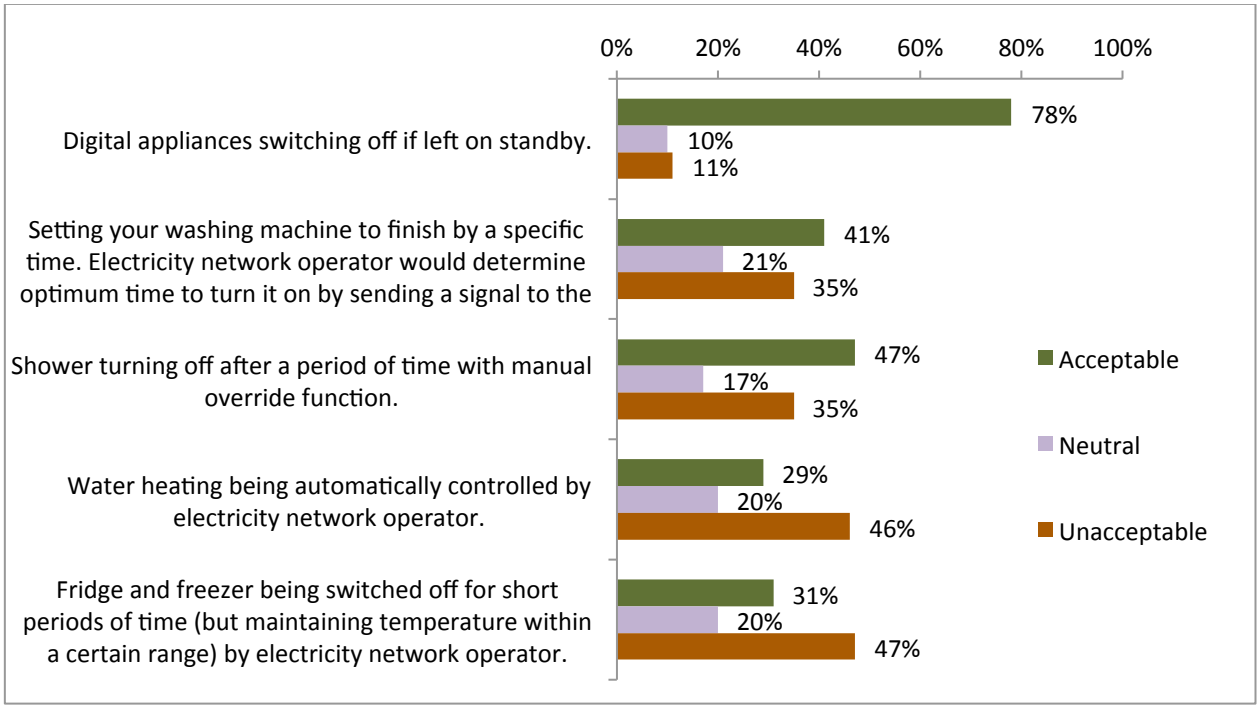



***Figure 2.*** *Percentage of respondents finding five demand-side management scenarios acceptable or unacceptable (Scotland sample). For complete wording of scenarios please see Demski et al. (2013) Transforming the UK Energy System: Public Values, Attitudes and Acceptability – Scotland Survey Results.*

## Energy supply technologies

With regards to the favourability of different energy supply technologies, the overall pattern of findings is the same across both the British and Scottish samples. Renewable energy technologies were viewed favourably by a large majority of respondents (e.g. 78% report being very or mainly in favour of hydroelectric power, 85% for solar power, 74% for wind energy and 80% for marine power). This is somewhat reduced for biomass which is less closely associated with renewable energy more generally (58% were favourable). Coal and oil were generally viewed as unfavourable by a majority of respondents (43% and 37% unfavourable respectively); whereas gas was judged to be more favourable (40%) than unfavourable (22%) across the sample (Figure 3).

Two differences are however noticeable. The respondents from Scotland were less likely to be unfavourable towards oil compared to the British sample (37% unfavourable vs. 43%). This is also reflected in the finding that there was *less* agreement among the Scottish sample with the proposition that the British should reduce its use of fossil fuels (73% vs. 79% in the British sample). Of course it is evident that a large majority still thought this is a good strategy.

Perhaps the most notable difference between the two samples can be found for nuclear power. More people reported being unfavourable towards nuclear power in the Scottish sample (45%) compared to the British sample (39%). This lower favourability for nuclear power within the Scottish sample was also reflected in judgements about the positive and negative aspects of this technology. Generally respondents from Scotland disagreed more with positive statements about nuclear power – for example nuclear being clean, safe and good for the economy. Nonetheless concerns in relation to the disposal of radioactive waste and the risk of accidents were equally high in the British and Scottish samples.

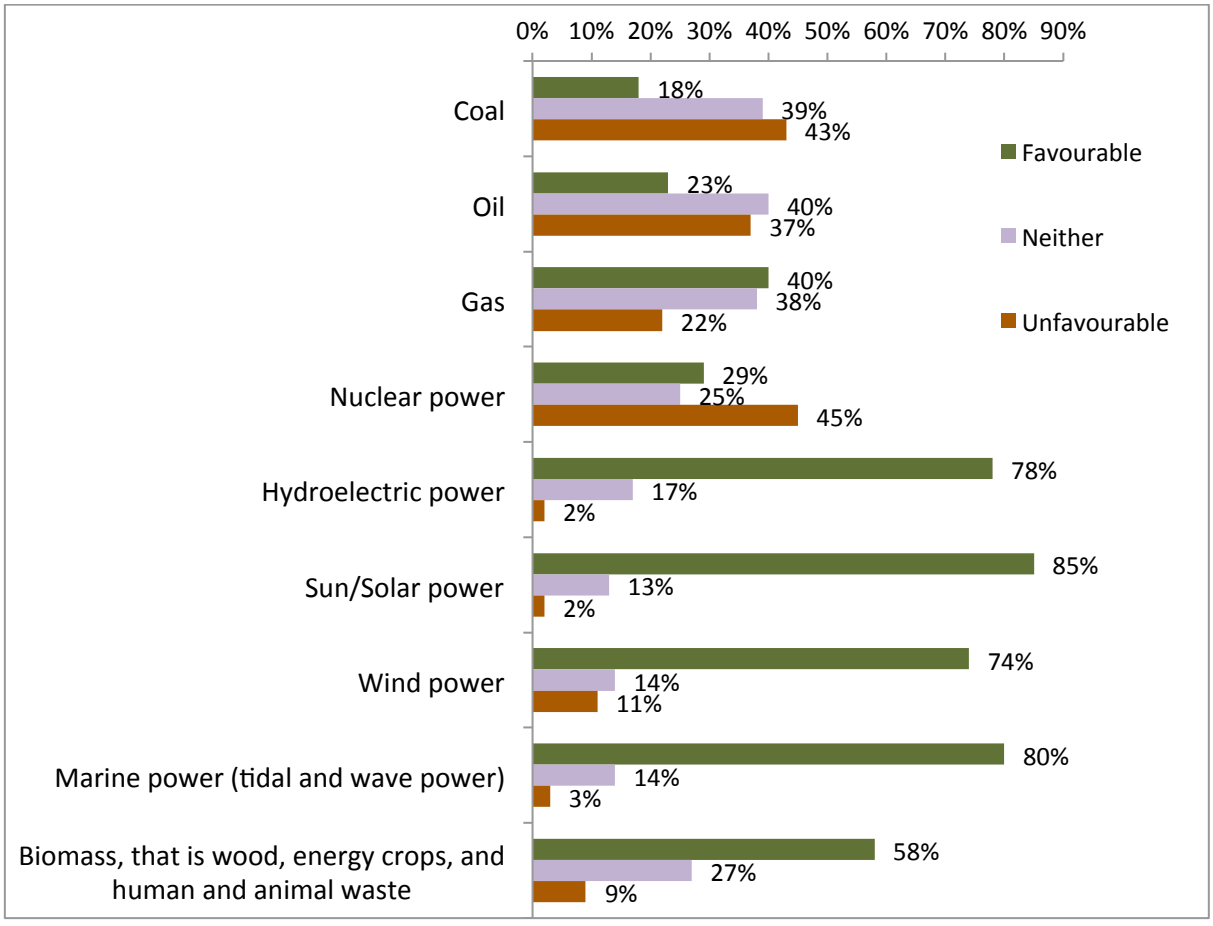



***Figure 3.*** *Favourability of energy supply technologies (Scotland sample).*

In line with these findings, we also find higher opposition to nuclear power in Scotland. Compared to the British sample, Scottish respondents were more opposed to nuclear in their area (61% vs. 54%), and higher numbers wanted to see nuclear power phased out (37% vs. 32%) or stopped immediately (14% vs. 9%). Similarly, fewer Scottish respondents wanted to replace existing nuclear power stations with new ones (21% vs. 26%). This trend

is continued when probing specific beliefs about nuclear power to test if support for the technology changes under certain conditions. The Scottish sample agreed in fewer numbers with statements such as “I am willing to accept the building of nuclear power stations if it would help to tackle climate change” (39% vs. 47% agree), “We need nuclear power because renewable energy sources alone are not able to meet our electricity needs” (47% vs. 54% agree), “Britain needs a mix of energy sources to ensure a reliable supply of electricity, including nuclear power and renewable energy sources” (61% vs 66% agree), and “I am willing to accept some nuclear power as long as we also focus on increasing renewable energy sources” (60% vs. 66% agree).

The survey also covered attitudes to wind energy in some detail although differences between the samples are much less evident compared to attitudes to nuclear power. Wind energy was viewed favourably by a large majority of respondents (74%), and agreement was high for ideas such as wind energy being clean (87% agree), safe (80% agree) and good for the economy (61% agree). Respondents also perceived little risk associated with wind energy technology (e.g. 26% believed wind energy poses risks to wildlife, and a very small minority of 5% believed wind energy is a hazard to human health). Mixed views were however evident when regarding judgements about wind energy spoiling the landscape (35% agreed, 38% disagreed) and being good for local communities (35% agreed, 25% disagreed). More Scottish respondents however *dis*agreed that wind farms should only be built in remote areas and out of sight, compared to the British sample (42% disagreed vs. 36% disagreed).

This translates to substantial support for building wind farms. Offshore wind farms attracted significantly more support (80%) than onshore wind farms (66%) with low opposition to both. A majority of respondents would also support a wind farm in their area (59%). As such, almost half of the respondents believed Britain should make extensive use of wind farms alongside other electricity sources (45%). An additional 32% thought wind farms should be built but only in some areas, whereas a minority believed most of our electricity should come from wind farms (9%) or that no more wind farms should be built anywhere (8%).

Finally, the survey gauged people’s knowledge and attitudes towards carbon capture and storage (CCS). Although a slightly higher proportion of respondents from Scotland said they know little or nothing about CCS compared to the British sample (53% vs. 48%), marginally fewer Scottish respondents reported never having heard of CCS compared to the British sample (37% vs. 42%). There is however no difference in support for CCS across the samples (37% supported, 20% opposed).

## Additional Note – Scotland-specific findings from deliberative workshops

As part of the wider project, deliberative workshops were conducted. Public deliberation, such as occurred in this project, can offer significant insight into how energy transition issues may be received in different contexts, and assist in opening up technical debates to a broader range of values and perspectives than would otherwise be possible. From a qualitative research perspective, we were particularly interested in the detailed values, framings and everyday experiences that form the understandings through which people make sense of the issues associated with energy system change – things which are not always easy to uncover using simple survey or other more numerical techniques. Furthermore, public deliberation not only allows plural viewpoints to come to the forefront, but can also build dialogical and democratic skills more generally amongst participants. As such, our deliberative workshops were designed to enable the 'average citizen' to engage meaningfully with the complexities and uncertainties associated with future-oriented decision-making such as that associated with energy system change.

The workshops were held in 6 locations across the UK. Two of these locations were in Scotland – Edinburgh and south of Glasgow in a rural location near Whitelee wind farm. The qualitative workshop data was analysed as part of the project but was not specifically analysed for this report. Nonetheless this Additional Note serves to illustrate some emerging and relevant themes from this analysis.

Specifically, the wider project argues that public perspectives on energy transitions are embedded in a host of existing experiences and socio-cultural contexts that influence people's responses and preferences. One such influencing factor might be the specific experiences, politics, cultures, and histories of a given place, which Scotland represents. It is therefore conceivable that our Scottish participants bring specific experiences and sets of ideas with them when engaging with notions on energy futures. These experiences and ideas may subsequently affect their perspectives on what constitutes a desirable and achievable pathway to a sustainable energy future. For example, the importance of place and perceived suitability of a proposed change (e.g. technological development or change of lifestyle) was an important aspect within people's discussions of energy transitions. Although not limited to supply technologies, this theme emerged most clearly in Scotland around CCS and renewable energy technologies. With regards to CCS many participants expressed concerns that Scotland would be viewed unfavourably for hosting storage facilities, or that it would place an unfair burden on the country (in comparison to England receiving the benefits). This concern was rooted in past experiences where participants called upon unfavourable experiences around nuclear waste, and stories of toxic waste dumping stemming from the London Olympic Games.

As such, some developments as part of energy transitions might increase the already perceived marginalization of Scotland. Having said that, other proposed changes were viewed positively and as having the potential to develop the country in a desirable way. For example, the technological development of wave and wind power was seen as a means of stimulating Scottish industry and jobs and generating perceptions of Scotland as a European force. As such, in our participants' views, it is vital to capture these opportunities that arise from energy transitions.

<u>Illustrative quotations from the workshop participants</u>

"I really don't think we want to be the dustbin of the world for that kind of thing…[several lines omitted]…keeping all this carbon for the rest of the world (Glasgow)."

"If we get it at the beginning, we could be selling the [wind and wave] technology to the rest of Europe (Edinburgh)."

"Wave power and wind power, these are the big thing now for Scotland, they are massive [murmurs of agreement from others] so I don't know what England is doing but we into it big time….Now the [wave] technology is not complete or anything but they think they could take over Europe that's what Alex Salmond [Scottish First Minister at the time] is talking about." (Edinburgh)

"If the wind turbines are for Scotland, let Scotland make them. Not Japan or Canada or Timbuktu." (Glasgow)

For further information see:

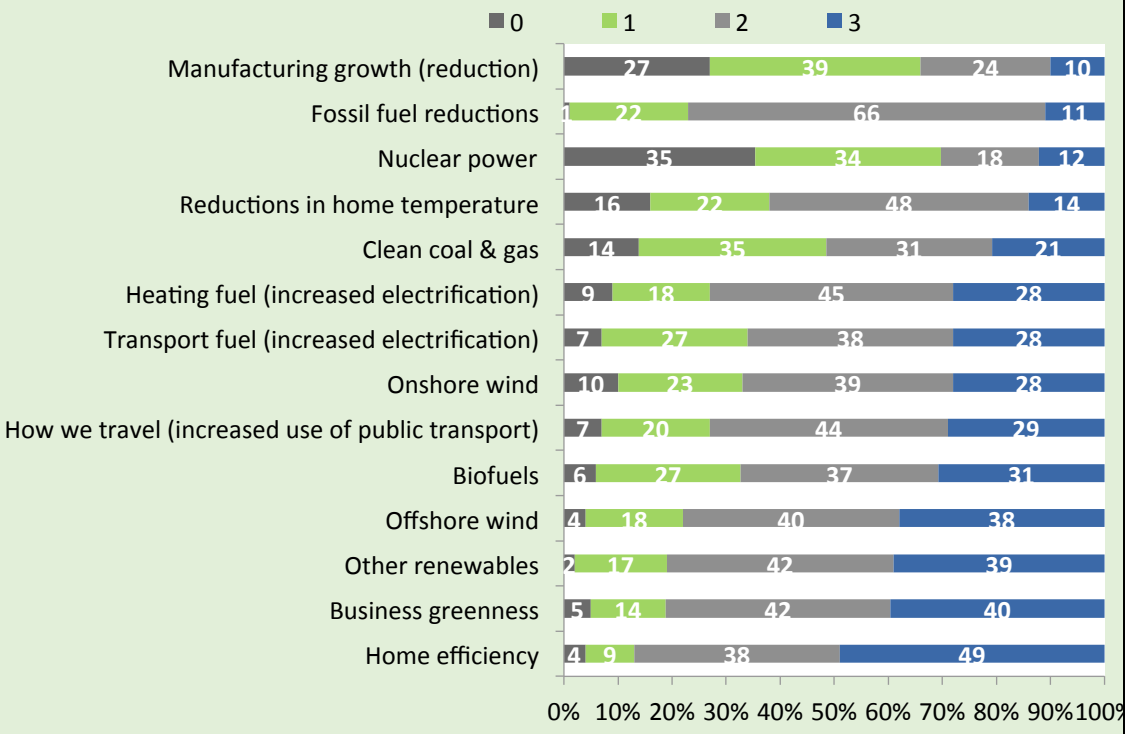
Butler et al. (2013). *Transforming the UK Energy System: Public Values, Attitudes and Acceptability - Deliberating energy system transitions in the UK*. Project Report. London: UKERC.

Parkhill et al. (2013). *Transforming the UK Energy System: Public Values, Attitudes and Acceptability - Synthesis Report*. Project Report. London: UKERC.

## Additional Note – Scotland-specific findings from the my2050 tool

A methodological innovation adopted in both the workshops and the online survey was the use of the my2050 tool (see: my2050.decc.gov.uk), an interactive online resource which allows participants to build their own energy future for the UK as a whole while meeting the UK's 2050 carbon target. This had been developed previously by the UK Department of Energy and Climate Change and Sciencewise-ERC as a simplified version of a more complex energy pathways calculator.

Although a more detailed analysis is beyond the scope of this report, we include the frequency of responses to each of the 14 sliders that make up the my2050 tool for the Scotland survey sample (n=502). Each of the options could be included at four different levels (0 – no or lowest inclusion in energy future to 3 – Highest inclusion level). The graph shows the percentage of respondents that chose a given level for each of the options. Numbers may not add up to 100 percent because of rounding.




For a comparison, the equivalent data for the British sample can be found in the publication listed below. No major differences are observed with regards to my2050 responses comparing the Scottish and British samples, with two exceptions. Higher numbers of Scottish respondents chose to include no nuclear in their pathway (level 0 - 35% vs. 30%). Similarly, reductions in home temperature were included by more respondents from Scotland (level 2 – 48% vs. 43%). More advanced analysis, may however, reveal further differences.

For further information see:

Demski et al. (2017). Effects of exemplar scenarios on public preferences for energy futures using the my2050 scenario-building tool. *Nature Energy,* 2, 17027.

### Further considerations

Examining the survey findings for our Scottish sample and comparing these to the responses by the British sample, only a few clear differences emerge. The most notable differences relate to the role of nuclear power in energy futures, where those in Scotland were less inclined to support nuclear inclusion. Other than that, the respondents from Scotland also seemed more cautious about new technologies and associated practices around electrification and demand-side management.

However, overall the pattern of findings for the two survey samples is broadly similar, especially when it comes to agreeing with the need for changes to the energy system more generally. Similarly, the direction of change is also broadly consistent across both samples, for example an increase in renewable energy was strongly favoured by respondents from both samples.

Given this, we would like to emphasize that the survey findings above should be interpreted in line with the overall findings and conclusions from the wider UKERC Energy Systems Change Project[33]. Within this wider project synthesis analysis we find a surprising consistency of views – centred on a desire to move away from fossil fuels and reduce wasted energy, as part of a long-term strategy. As part of this analysis, we collated a set of considerations thought to be important by our respondents when deciding on future energy systems. These represent the range of values that underpin people's preferences and perceptions and give insight to how publics think things should be with regards to energy system change in terms of both processes and outcomes. These values are:

- *Efficiency and not wasting* – in sum, being more efficient (doing more with less) and minimising waste and overall energy usage. This is almost universally seen as positive.
- *Protection of environment and nature* – in sum, being environmentally conscious and respectful of nature through minimising intrusive and destructive processes.
- *Ensuring security and stability* – in sum, making sure the energy system is safe, reliable and accessible to citizens, both in terms of personal affordability and national availability.
- *Autonomy and power* – in sum, being mindful of the importance of autonomy and freedom both at national and personal levels.
- *Social justice and fairness* – in sum, developing energy systems in ways that are open, transparent, fair, and attentive to the effects on people's abilities to lead healthy lives.
- *Improvement and quality* – in sum, thinking in terms of long term trajectories, ensuring changes represent improvement and considering their implications for quality of life.

We therefore also urge the reader to consider the broader public values for energy system change that emerged as part of a wider project analysis, in addition to the survey findings specifically analysed in this report.

## PART 3 - Recommendations for further research and analysis

In this last part of our report, we briefly describe elements and aspects of energy transitions that were not covered in the UKERC Energy System Change Project, or that have emerged since the data collection took place. These represent potential areas that could benefit from further research, analysis and public engagement.

We start with a list of issues which have emerged, or might emerge as important, with regards to energy transitions more generally, and in relation to public perceptions and engagement specifically, or issues which were touched upon but not covered in depth in our original project. All of these issues are, of course, relevant beyond Scotland.

- Energy storage technologies are emerging and becoming increasingly important in discussions around future energy systems. These technologies will become important as more renewable energy capacity is added to the grid (as is happening increasingly in Scotland) and electrification of the heat and transport sectors occurs. Energy storage encompasses a wide range of technologies and scales, but there is very little public engagement evidence or research. Ongoing research includes the Consortium for Modelling and Analysis of Decentralised *Energy Storage* (C-MADEnS) project at Leeds University, which will conduct focus groups and a national survey for domestic technologies. At Manchester University the My-Store project also has a focus upon the public and energy storage. Finally, at Cardiff University we are engaged in an ongoing national EPSRC project (RESTLESS, coordinated by UCL, with Strathclyde, Edinburgh and others) which will engage members of the public during 2017, with at least on workshop planned for Scotland.
- Other technologies for which further deliberative research might be warranted, as highlighted in the original UKERC Energy Systems project, include the role of bioenergy / biofuels, as well as the rapidly changing landscape of demand-side management options - the latter especially in relation to the emergence of innovative community or city-wide energy initiatives, as well as the smart meter roll-out. Although demand-side did feature extensively in the UKERC Energy System Change project, and other research on both areas already exists, these require a more detailed analysis due to the wide range of potential future novel pathways currently being opened up.

- Wider aspects of a future energy strategy will also need to include lifestyle implications of the shift to large-scale electrification and associated technologies, as well as more hard to change aspects of lifestyles such as transportation patterns (especially flying, or car use in rural areas).

- Implications of public views of proposed infrastructure changes to support increased renewables – for example increased transmission infrastructures (cf. the Beauly-Denny controversy) to connect different parts of the system/regions[34]. Also of interest are the implications for people and communities of deploying novel multi-vector energy systems; that is, technical visions of novel systems for linking natural gas, renewable electricity, hydrogen, and biofuels networks.

- An important set of questions that arose from our first UKERC project was around the role of costs within energy transitions, how to finance changes and trust in institutions: Who will be paying for desirable energy transitions, through what vehicles (taxes, bills, government and/or company borrowing etc.), and what are the implications of this for the legitimacy of institutions involved and public acceptability of system change? In a new project for UKERC, which is unique as far as we know, our team at Cardiff have been collecting both survey and focus group data (some gathered in Scotland, which could be analysed separately) for analysis during 2017. Related to this point, there are important questions to be explored around social justice and distribution of responsibilities among different energy system actors (citizens and communities, companies, and the devolved and UK governments)[35].

- The 2015 Paris Climate Change accord commits signatories to the goal of net zero emissions sometime after 2050. Assuming that some unabated fossil fuel use will remain (e.g. for aviation), this means that negative emissions technologies[36] may have to be deployed if the UK and Scotland are to meet this target. Potential technologies include large-scale reforestation with biochar manufacture, bioenergy with carbon-capture and storage (BECCS), enhanced weathering, and direct air capture with carbon utilization. NERC are leading a new £8m UK-wide initiative to research the feasibility of a range of such technologies, some with a particular relevance to Scotland – such as BECCS - of which public acceptability research will likely be one component. The Leverhulme Centre for Climate Change Mitigation ($LC^3M$) led by Sheffield University will conduct work on public engagement with enhanced weathering techniques. Although at the very 'upstream' end of the engagement continuum, negative emission technologies are likely to gain in prominence in the UK energy strategy in years to come.

- The potential use of fracking technology for onshore gas and oil exploration is proving a highly contentious issue in the UK and elsewhere. Increasingly public perception research, community engagement and social sciences data is becoming available[37], though there is little Scotland specific data. The Energy System Change Project did not explore the role of fracking, although did present participants with scenarios of continued 'unconventional' fossil fuel exploitation, using deep-sea oil exploration offshore of the UK as its example. When questions were posed to participants about unconventional fossil fuels and the possibility that they may not run out soon, this did not allay concerns. The underlying issue for our participants was that fossil fuels are finite and thus will inevitably run out at some point (even if in the long term future). Unconventional fossil fuels remains an under-explored topic for energy systems public engagement.

- Finally, future scenarios and strategies that envisage systems that are more decentralised should be considered in more detail. These might include different levels from community to city, and regional to devolved nations.

Further research on public perspectives specifically within Scotland could focus upon a more detailed analysis of existing datasets as available, including those from Cardiff (several projects now) plus related research if primary data can be made available; e.g. previous

engagement projects on carbon capture and storage, onshore wind energy, and the climate change public conversation series conducted on behalf of the Scottish Government. Additional issues to explore in new public engagement research, which could also be framed in relation to the new Scottish Energy Strategy, would include:

- The interplay between the envisioned future energy system of Scotland and its interconnections with both the wider UK and other (e.g. Norway) energy systems at the level of both physical infrastructure, operation, economics and governance.

- The impacts of an increased penetration of community energy schemes in Scotland[38], their governance arrangements, and their implications for system architecture (especially with respect to emerging multi-vector proposals, or storage solutions);

- The future role of the existing fossil fuel industry, and the impact of this upon jobs in Scotland - i.e. how will people interpret tradeoffs between their desire for a low-carbon future and different future employment patterns if this potentially means less activity in this sector, as well as proposals for unconventional oil and gas exploration.

- Urban renewal in the major Cities within Scotland around a low carbon future, and associated system level issues (our UKERC project approach and methodology could be readily applied to a City-Region scale), or, conversely, the challenges of decarbonizing rural communities; in both of these the question of decarbonizing heat will be a priority area in order to meet the fourth and especially the fifth carbon budgets

- Carbon capture and storage from gas fired power and industrial emissions. While off the UK government agenda currently, this remains a potential opportunity for Scotland. A related issue is whether there might be any uniquely 'Scottish' challenges and opportunities regarding negative emissions technologies using CCS technology (e.g. reforestation, bioenergy and CCS).

- A final consideration within the Scottish context is the potential development of marine (e.g. wave and tidal) energy. This is an emerging technology sector within Scotland, and one which our respondents viewed favourably, and should therefore be examined in more detail as it develops.

Finally, any new research could usefully start from a review of existing findings and datasets from research and other engagement activities around energy and energy systems recently (or currently) occurring in Scotland, using the UKERC review[39] as its starting point.

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