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Transforming the UK Energy System: Public Values, Attitudes and Acceptability

Synthesis Report

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Executive Summary

This report sets out key insights and findings from the UKERC research project: **Transforming the UK Energy System – Public Values, Attitudes and Acceptability**.

Current policy debates and energy scenarios for the UK highlight the different possible ways of transforming the energy system in order to meet long-term national policy goals, including those of building a low carbon economy, achieving energy security and affordability, and mitigating environmental impacts. Although there has been much previous research on what publics think about specific ways of producing or consuming energy, we know far less about public perceptions, attitudes and values when elicited in relation to whole energy system change as an interconnected set of transformations in the systems of supply, demand, infrastructure and human behaviour. Greater understanding of public acceptability of whole energy system change will present both opportunities, and also highlight challenges, for the delivery of UK energy policy and transitions.

The research had three empirical phases: interviews with key stakeholders, a series of six in-depth deliberative workshops held with publics in England, Scotland and Wales, and a nationally representative survey (Great Britain, n=2,441). This report represents a synthesis of key findings drawn from the two core datasets relating to public perceptions and preferences i.e. the workshops and the survey.

The core conclusion from the research is that the British public wants and expects change with regard to how energy is supplied, used and governed. Members of the public are positive about the need for energy system change and they do not prioritise the demand side over the supply side, or vice versa, as being in greater need of change. Within this, the research has illuminated a wide range of novel insights on public attitudes regarding: energy policy drivers; elements of energy system change; and the underlying values and principles that people draw on when engaging with this issue.

Views on current energy policy drivers

There are three key issues currently driving UK energy policy; climate change, energy security, and affordability.

Climate change, affordability and energy security are important as meta-narratives but are not related to expressed preferences about energy system change in straight-forward linear ways. For example, scepticism toward climate change does not prevent publics from engaging with specific aspects of energy system change, such as electrification. This is partly because motivations underlying public reasons for wanting change do not align in direct ways with those underpinning policy, though they are closely related; i.e. climate change is transmuted into a more general concern about environment and sustainability.

Public perceptions with regard to climate change are consistent with previous and long-standing work on public understanding of this issue, with the majority of respondents expressing concern and agreeing that climate change is at least in part caused by human activity. However, the results also indicate a very wide variation in individual responses to the issue, from different forms of uncertainty and scepticism to very high levels of concern.

While 'energy security' as a term was not salient to people the range of concerns that it encompassed (geopolitical issues, energy shortages, black outs, unaffordable prices) did evoke strong reactions. Energy security is particularly closely linked in public perceptions to affordability because it relates to concerns about personally not being able to access energy services, while concern about national level insecurity in supplies of fossil fuels was seen as a symptom of the problems of fossil fuel dependency.

Cost is very important for people in their evaluation of different options with regard to energy system change. Though personal cost is often discussed in terms of energy bills, the findings show that for publics it is more about affordability than lowest cost possible. The cheapest option is not necessarily preferred if that option comes with other undesired attributes e.g. fossil fuel reliance. Public concern about cost is related to multiple dimensions of the issue, incorporating consideration of things like long-term stability versus fluctuation in costs, existing market structures and notions of getting a 'fair deal', trust in energy companies, and perceptions of energy as a basic need. It is particularly important to pay attention to this multi-dimensionality, as there is a danger of offering simplistic interpretations of public acceptability as relating solely to the issue of higher or lower bills/costs.

Though personal cost is often discussed in terms of energy bills, the findings show that for publics it is more about affordability than lowest cost possible.

Attitudes towards specific aspects of energy system change

Alongside the keen desire for system change, there are a set of clear public preferences for particular energy system elements that people feel should be integral to future energy pathways. On the supply-side this is characterised by a strong commitment to ***renewable forms*** of energy production and ***a corresponding shift away from fossil fuels***. On the demand-side it relates to the development of technology and infrastructures (e.g. public transport, demand management, electric vehicle charging points) to support changes in lifestyles, with an overall goal of ***improvement in energy efficiency*** and ***reductions in energy demand***.

Other supply technologies which feature prominently in many existing policy scenarios, including new nuclear power, biofuels, and carbon capture and storage (CCS) elicited more ambivalent and uncertain responses from our participants. For these technologies acceptability is typically conditional upon other aspects of system change being realised. Biofuels and CCS also hold existing associations with fossil fuels, and as such appear, to many, as incompatible with the broader public vision for change. We have characterised this view of such technologies as one of 'non-transition'.

Whilst overall there is recognition of and support for changes on the demand side, public acceptability of specific aspects of change are more ambivalent. For example, proposed electric heating systems and vehicles are not perceived as matching the performance of current models (e.g. for heating – gas central heating systems being controllable and responsive; for transportation – the range and power of petroleum based vehicles). This is particularly the case for electric heating where current electric systems (e.g. storage heaters) are viewed as undesirable. The public is unfamiliar with other forms of electric heating including district heating or ground source heat pumps.

In terms of demand-side management, we find that people are broadly willing to share their energy use data although many are likely to want conditions placed on this. Demand management that allows householders some level of control is more preferable to remote interference, and the degree of acceptability is dependent upon the nature of the intervention proposed. As with some of the supply-side technologies, this points to the critical need to understand the contexts surrounding energy transitions and the conditions people place upon acceptability.

Overall, publics engaged with interconnectivity between the energy system and wider economic and social 'systems'. As such, we highlight that in engaging with the issues, publics go beyond energy system elements to discuss wider societal change.

Underlying social values that guide evaluations

Members of the public recognise, and are broadly positive about, the need for change at a system level. Our participants also saw the present need for change as an opportunity to 'do it right' – to make it a worthwhile change.

There is, however, a need to look beyond public preferences because these are likely to change depending on context, particularly considering highly unfamiliar issues where perceptions and preferences are not yet fully formed.

As such, we examine the values and principles that people draw on to guide decisions and engagement with regards to energy system change, and go on to present a social value system derived from examination across the datasets. This social value system represents the range of values that underpin people's preferences and perceptions with regard to energy system change. As such, these are not values held by any one individual, nor are they universally held by all, rather they represent prevalent identifiable cultural resources that people draw upon in forming their preferences for different aspects of energy system change. The value system gives insight into how publics think things should be with regards to energy system change.

These include principles in relation to:

Efficiency and not wasting – in sum, being more efficient (doing more with less) and minimising waste and overall energy usage is almost universally seen as positive.

Protection of the environment and nature – in sum, being environmentally conscious and respectful of nature through minimising intrusive and destructive processes.

The interplay between values and a need to consider how the world actually is, how we experience things, and in what context we find ourselves is considered important for public preference formation. It is through a combination of these factors that a form of pragmatism arises in public views.

Ensuring security through reliability, affordability, availability and safety – 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 and 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 stipulate that acceptability of any particular aspect of energy system transformations will, in part, be conditional upon how well it fits into this value system.

We also show how tensions exist between values (how people think things should be), and world views (experiences or perceptions of how things currently are). We note that publics perceive change to be incremental and as occurring over a long time period, particularly change of the scale required. Responsibilities for change are split across different energy system actors including publics, energy companies and government. However, ultimately publics see government as centrally responsible for enabling delivery of transitions in ways commensurate with public values. Values also interconnect with people's life experiences and social commitments (e.g. their relationships with others, their form of work). As such, preferences for particular long-term trajectories are continually negotiated in terms of people's everyday experiences.

The interplay between values and a need to consider how the world actually is, how we experience things, and in what context we find ourselves is considered important for public preference formation. It is through a combination of these factors that a form of pragmatism arises in public views. Nonetheless we maintain that values remain as most important and that meaningful public acceptability is conditional upon them.

We conclude that public acceptability may only be achieved if it is rooted, in a significant way, in the described value system. Publics are unlikely to settle for a form of change that does not show signs of commitment to the longer-term trajectories commensurate with these values. If actors do not consider and take into account public values in their decision-making, resistance to energy system transformations or conflict over particular issues is more likely to result. However, pursuing energy system changes in ways that are in keeping with longer-term trajectories aligned with public values could form the basis of a social contract for change.

This conclusion leads to four further key messages:

1. ***Publics are willing and fully capable of engaging critically with energy system transformation. Despite the complexity of the research topic publics gave considered responses and as a result offered important insights into their values, attitudes and acceptability.*** Policy-makers are advised to provide public engagement opportunities to ensure different perspectives and knowledges are brought to bear on energy system transitions as contexts change.
2.. ***Actors involved in energy system transitions need to treat public viewpoints with integrity valuing the contribution they make to envisioning transitions.*** Preferences should not be viewed as something to manipulate and actors should engage meaningfully with the values set out here.
3.. ***Policy-makers and other actors involved in energy system transformation need to make clear how current and proposed changes to the energy system fit within a long-term trajectory.*** This includes developing a coherent policy strategy that interconnects different policy areas and scales.
4. ***Actors involved in energy system change need to ensure that their actions are transparent and mirror rhetoric.*** In the case of government this includes the actions of the whole institution, as well as the individual behaviour of high profile political actors. For industry, this includes making clear how proposals for change (e.g. assisting consumers in reducing their energy use) fit with their business models.

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Overview

This report sets out key findings and messages from the project **Transforming the UK energy system – Public values, attitudes and acceptability** funded by the UK Energy Research Centre. Its primary aim is to contribute a rigorous and systematic picture of public perspectives and acceptability with regard to future energy system change.

This report is aimed at both the research community and relevant stakeholders across industry, policy, and third sector who would find insights regarding public perspectives beneficial for their work.

Introduction

Multiple long-term national policy goals, including the transition to a low carbon economy, energy security and affordability, and mitigating wider environmental impacts, bring imperatives to transform energy systems. Significant interrelated transformations in the way the UK supplies, manages and consumes its energy will be essential if these aims are to be attained (1,2,3). This major process of transformation entails considerable uncertainties and contingencies. One aspect of change about which there are wide ranging uncertainties is that of public perspectives and engagement. Public values, attitudes and acceptability will be of critical importance in processes of whole energy systems transformation, with the potential to present both opportunities and challenges for the delivery of energy policy and change across multiple areas. Understanding what the public thinks about whole energy system transformation could provide a basis for improved dialogue, more robust decision making, and for anticipating possible points of conflict.

A key means for informing decision-making about energy system change is through scenario development. Much of this scenario work has been undertaken through expert modelling or through stakeholder engagement processes, meaning that energy system visions are principally derived from these actors' perspectives. Where social dimensions are included it is often in ways that involve simplified assumptions which are only loosely connected to empirical research (4). As a consequence, though wider publics are deeply implicated in multiple aspects of the ways that energy systems are configured (e.g. as consumers and producers of energy, as citizens with voting powers, as active protesters or proponents of energy infrastructures), their perspectives on system transitions are not well documented or understood. There has been previous research on what the public thinks about particular ways of producing energy and about different aspects of energy consumption (5), but we know far less about public perceptions, attitudes and values when framed in terms of whole energy system change; that is, the combined range of future transformations in energy demand and supply currently under consideration. The project intends to bridge this gap by examining public perspectives using a 'whole-systems' approach (see Box 1).

The key objective of this report is to characterise public values, perspectives and acceptability with regards to whole energy system change.

Box 1. What do we mean by 'whole energy system'?

We refer to interconnected dimensions of energy system change including but not limited to:

- Energy supply resources and technologies (e.g. fossil fuels, renewables)
- Energy demand technologies and behaviours (e.g. smart meters, demand side management, transport, heating, leisure activities)
- Infrastructure (e.g. power stations, storage, transport)
- Regulation and policies (including cost and process on how to bring about change)
- Different actors/institutions (including private companies/industry, government, consumers, civil society)

These elements of the energy system are connected across different geographic and temporal scales.

Beyond the energy system

The energy system is often considered as an independent entity, but of course it is intimately intertwined with other economic and social 'systems'.

Throughout the following sections it will become evident that public perspectives not only acknowledge this interconnectivity but actively draw on wider social ideas and experiences to inform their responses in terms of energy system change.

In addition we want to highlight that publics go beyond energy system elements to discuss wider societal change.

Multiple long-term national policy goals, including the transition to a low carbon economy, energy security and affordability, and mitigating wider environmental impacts, bring imperatives to transform energy systems.

Research Methods

The objective of this project has been investigated through three interlinked empirical research phases (see Box 2) – interviews with key stakeholders, a series of six in-depth deliberative workshops held with publics in England, Scotland and Wales, and a nationally representative survey (Great Britain, n=2,441). This report represents a synthesis of key findings drawn from the two core datasets relating to public perceptions and preferences i.e. the workshops and the survey.

The findings of both of these research phases have been analysed and published in separate reports (6,7). This current report, however, does not simply summarise the different findings emerging from these individual research phases, rather it presents a synthesis analysis that has been conducted to highlight key messages that emerge as a result of combining both datasets.

For both the deliberative workshops and the survey, participants were introduced to the idea of whole energy system change and to the My2050 scenario building tool.[1] Participants were also provided with further information derived from expertise within the research team, wider expert consultation, the stakeholder interviews undertaken as part of phase 1, and analysis of existing scenarios. Extensive piloting was undertaken for the two main phases of research in order to develop understanding of the kind of information that was important for people to be able to engage meaningfully with the issues.

The specific methodological arrangements pertaining to the deliberative workshops and the national survey are summarised in Box 2. However further details about each methodology (e.g. sampling strategies, procedures) can be found in the relevant reports for each research phase (6,7).

It is also important to stress that although we primarily discuss and illustrate the data as stemming from the qualitative and quantitative research phases (i.e. the deliberative workshops and the survey respectively), each of these datasets are highly diverse within themselves. The survey for example contains both general questionnaire responses, the My2050 tool responses, and it also includes national and theoretical sub-sampling. Similarly, in the deliberative workshops, different parts of the day were used to engage participants with energy system change in diverse ways, for example through the use of the My2050 tool, or different future scenario vignettes. The synthesis analysis that we present here arises out of a consideration of public responses to ***all of these*** different aspects of the methods.

The analytic process has been an iterative one involving examining and re-examining, comparing and dissecting data via discussions amongst the research team as a whole. Often qualitative and quantitative datasets are combined where the quantitative data tells us something about what people think (e.g. preferences) and the qualitative data provides insight into why people think this way. Although there is an element of this type of analysis utilised in the findings presented in this report, we go further to combine datasets in other ways. For example, different methodological approaches can consider the same issue from different perspectives and hence consistency across datasets speaks to the strength of a particular finding. Similarly divergences and differences can highlight particular complexities and uncertainties within public perspectives.

We have analysed the datasets to develop a synthesis that best explains the data as a whole, and provides a coherent account of public responses to energy system change.

All findings, insights, and key messages reported in the following sections are therefore firmly grounded in these empirical datasets produced as part of the research phases. Statistics and quotations are provided to illustrate and add clarity to key points in this report. All statistics used throughout this report are from the representative national survey and all quotes are from the in-depth public deliberative workshops.

[1]The My2050 tool is a simplified representation of the UK energy system, which allows users to explore different supply and demand-side options in order to reduce the UK's carbon emissions by 80% compared to 1990. It was developed by the digital democracy company Delib for the UK Department of Energy and Climate Change and Sciencwise-ERC. The tool is publically available here: www.my2050.decc.gov.uk.

Box 2. Wider project objectives and methods

1. Identify the degrees of public acceptability of whole energy system transformation, in particular identifying important trade-offs.
2. Build knowledge and understanding of public attitudes, values and acceptability in order to support development of sustainable transitions in the energy sector.
3. Create qualitative and quantitative datasets for examination of the perspectives of varied publics across the UK on whole energy system transitions.
4. Develop and utilise innovative methodological approaches for examining public values, attitudes and acceptability.

Phase 1: Stakeholder Interviews

Interviews with energy system stakeholders were conducted to discuss key decisions and trade-offs with respect to future energy pathways, what role scenarios play in deciding on energy futures, and what the role of the public is when thinking through different energy futures.

Phase 2: Public workshops – Deliberating energy futures

- Six workshops each with 11-12 participants were held in the capital cities of London, Edinburgh and Cardiff, and three locations selected as sites of specific interest with regard to energy – Methyr Tydfill (coal), Cumbria (nuclear) and areas south of Glasgow (wind).
- Each workshop met for a full day to discuss whole energy system transitions. In small groups discussions were facilitated using the My2050 tool. Through this process they were encouraged to create their own 2050 scenarios. Further dialogue was prompted using vignettes detailing "a day in the life" of an ordinary person living in different energy futures.

See report: Butler, C., Parkhill, K.A. and Pidgeon, N. (2013) ***Deliberating energy system transitions in the UK – Transforming the UK Energy System: Public Values, Attitudes and Acceptability*** **(UKERC, London).**

Phase 3: National online survey (n=2,441)

- This phase examined public perceptions and acceptability of key issues within energy system change using a survey sample representative of the GB population, including national samples in Wales and Scotland.
- As part of this survey, respondents were asked to submit their own energy futures using the My2050 tool. The impact of engaging with this tool was examined, as well as the effect of using different versions of the tool.

See report: Demski, C. Spence, A. and Pidgeon, N. (2013) ***Summary findings of a survey conducted in August 2012 – Transforming the UK Energy System: Public Values, Attitudes and Acceptability*** **(UKERC, London).**

The key objective of this report is to charactise public values, perspectives and acceptability with regards to whole energy system change.

Overview of the Report

This report is separated into 4 parts.

PART 1 provides a concise but comprehensive summary of our research findings on public perceptions and preferences for different aspects of energy system change. Section one presents views on supply-side change, section two discusses public perspectives on demand-side change, and section three focuses on perceptions with regards to institutions and responsibility for change.

PART 2 takes us beyond perceptions to examine the core values that underpin preferences. Here we stipulate that although preferences exist, these are constructed out of a deeper value system which people draw upon to guide their decisions and engagement with energy system change. Emergent from our datasets we identify and discuss elements of that value system and how this underpins people's responses to different components and aspects of energy system change.

PART 3 moves to situate values in relation to other factors that are of importance in the formation of public responses. This includes discussion of how publics think the world is, as opposed to how they think it should be. This leads on to a discussion of the implications for realising change.

PART 4 presents the discussion and conclusion. Section one summarises core messages arising from the analysis and engages with contemporary debates around scenario development, communication, and social contracts. Section two offers final conclusions and key messages for policy. We also offer reflections arising from the project on future research directions.



Public Preferences and Acceptability of Energy System Change – A Comprehensive Summary

1

This section focuses on our findings regarding WHAT the British public thinks i.e. preferences, perceptions, attitudes and acceptability of different energy system options. It is important to note that survey responses from the My2050 tool (see Figure 1) are combined with evidence derived from the deliberative workshops and from the wider survey to arrive at the findings presented.

Key Finding

The British public wants and expects change with regard to how energy is supplied, used and governed.

Our research shows that members of the public recognise, and are positive about, the need for energy system change. They do not prioritise the demand over the supply side, or vice versa, in terms of being a greater priority for change.

They regard the energy system as dynamic in nature and constantly changing. If changes are going to occur anyway, members of the public saw this as an opportunity to 'do it right' – to make it a worthwhile change.

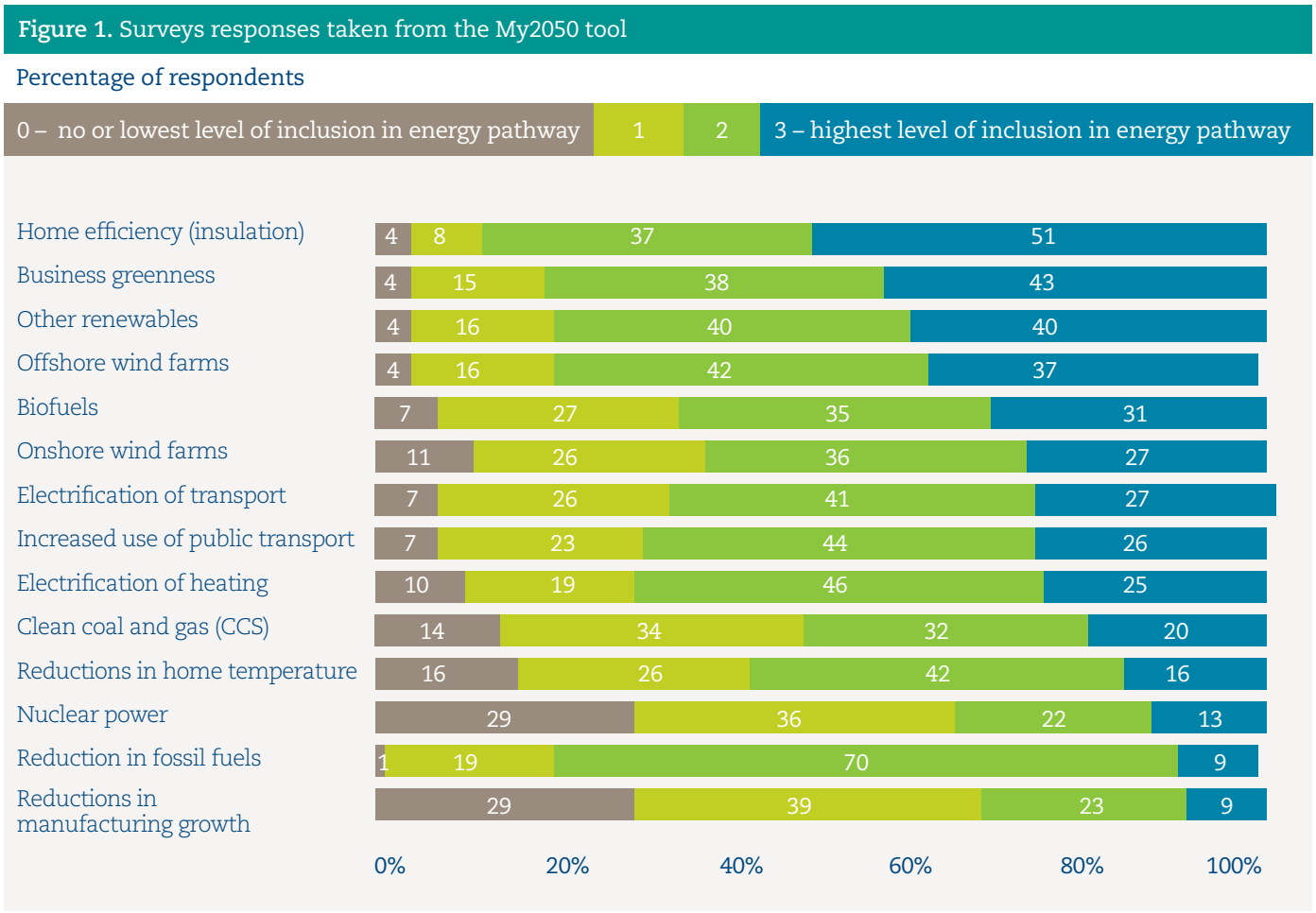
1.0 Supply

Public perceptions of the different options for supplying energy in the UK are clear for some technologies and less clear and more uncertain for others. We start with public perceptions towards fossil fuels and renewable energy, where clear public preferences exist. The options which are characterised by greater uncertainty in public perceptions are presented subsequently.

Fossil Fuels (coal, oil, gas)

- The British public wants to see a reduction in fossil fuel use over the next few decades with a substantial majority believing that a future energy system primarily reliant on fossil fuels is unacceptable. There is very little variability in this opinion reflecting a core aspiration to transition away from fossil fuel energy to renewable forms. We note that 80% of respondents significantly reduced fossil fuels (selecting either levels 2 or 3 in the online tool) in their My2050 pathways (see Figure 1).
- Fossil fuels are seen as polluting, archaic, finite and particularly in the case of oil are associated with global conflicts. There is some evidence that these concerns extend to unconventional fossil fuels such as shale gas.

Figure 1. Surveys responses taken from the My2050 tool



This graph depicts responses to the DECC My2050 tool from the core survey sample (n=1,800). As part of the survey, each respondent created their own 2050 energy pathway using 14 options (listed on y-axis). Each option could be included in the final energy pathway at 4 levels where higher levels indicate a greater role in the energy pathway. The graph shows the percentage of respondents that chose a given level for each of the 14 options. Numbers may not add to 100 percent because of rounding.

79% believe the UK should reduce its use of fossil fuels.

- Gas shows some nuances in terms of public preferences, where it is evaluated more positively than oil and coal, particularly in the context of personal use of gas central heating.

Renewable Energy

- Among the British public we find a strong preference for a shift to renewable energy systems and a corresponding move away from fossil fuels. This is a relatively clear and stable preference in the sense that renewables are always the preferred way of supplying energy for a large majority of people. Nearly 80% of respondents included high levels of offshore wind energy and other renewables in their My2050 pathways (see Figure 1).
- The early-stage of development for some of the technology is understood. However, there is a sense of frustration that renewable energy technologies have not been developed or deployed further.

> ***Male:*** *Hydro carbons should not be used – not as a source of energy. Burning stuff to make energy is the wrong thing to do.*

Solar, Marine and Hydro-electric Power

- There is significant interest in tidal, wave, and solar energy; these are highly favoured forms of electricity production.
- Marine energy is perceived as unobtrusive and a particularly plentiful resource for the UK.
- For solar energy, there is recognition of large scale deployment in the form of 'farms', yet the more pervasive conception is of solar PV at the household level.
- Solar energy is highly favourable and positively associated with clean energy futures.

> ***Moderator:*** *What sort of energy sources would you like us to pursue for the future? So how do we want to generate our energy?*
>
> ***Male P1:*** *Wind turbines*
> ***Male P2:*** *Waves*
> ***Male P3:*** *Solar*
> ***Female P1:*** *Wood*
> ***Female P2:*** *Wind*
> ***Female P3:*** *I think with the wind and stuff, anything to do with the weather, we get enough of it here.*

Wind Energy

- Wind energy is viewed favourably by a majority of the British public, in line with a desire to move to a renewable energy system. As such, wind energy plays a key role in public energy pathways with significant support for both onshore and offshore wind farms (also see Figure 1).
- We find higher levels of support for offshore wind farms compared to onshore wind farms.
- Publics recognise that wind energy is a technology ready to be deployed at scale. Findings also indicate under-estimation of the extent to which wind energy can contribute to electricity generation in the UK.
- There are mixed views on whether wind farms spoil the landscape, or are good for nearby communities.
- In line with other research, our findings indicate that support for wind energy cannot be taken-for-granted. There is a need to pay close attention to the siting of wind farms, e.g. in terms of locations, ownership, and fair process (8).

Biomass/Biofuels

- Perceptions of biomass/biofuels are more complex than perceptions towards other renewable energy technologies, partly owing to their being less familiar and more diverse; i.e. including different types, from energy crops to anaerobic digesters, and different scales, from biomass power stations to biomass boilers in the home. As a result, public perceptions are more ambiguous, changeable, and dependent on the specific form of biomass considered. For example, we find greater desirability for biofuel-from-waste compared to energy crops. Equally on a small scale (e.g. biomass boilers in the home) it is perceived positively.
- Generally, biomass is viewed favourably by the public but somewhat less so than other renewable technologies. It is less closely associated with the central perceived characteristics of renewable energy (i.e. clean, infinite) and more closely associated with attributes of other fuels that are burnt (i.e. fossil fuels causing pollution). As a result it is often characterised by publics as a 'non-transition'. This is particularly the case for biofuels.

- There is some evidence to indicate that biofuels are preferred over oil. Nevertheless large-scale use of grown-for-purpose biofuels is not seen as a key part of sustainable energy futures. This is because people believe that at such a scale associated risks of land-use conflicts and global governance are heightened.

> ***Female:*** *I think it's because in my mind, I think burning rain forests and burning trees or whatever, so it is that association, and even though you're replanting, and they are only planted for that reason, I'm still like… it doesn't sound healthy.*

Carbon Capture and Storage (CCS) and Fossil Fuels

- Publics are very unfamiliar with CCS technologies, with most people having no or very little knowledge.
- In terms of using CCS in the energy system, public opinions are variable (see Figure 1) partly due to its unfamiliarity.

42% **of respondents say they have never heard of CCS and a further 26% know next to nothing about it.**

- Whilst it is not true to say that publics are against CCS, we find significant concerns about its use. Negative attitudes towards CCS stems from the belief that it is not representative of progress; it is seen as a continuation of unsustainable practices associated with fossil fuels (i.e. this is another instance of perceived 'non-transition').
- CCS for industry has more traction with publics as this is connected with a perceived necessity for fossil fuel use within certain industries i.e. there is no alternative for certain types of industry, yet for producing electricity there are.

> ***Male:*** *We have been using oil and gas and coal for years and years and years and we all know is it creates smog and all the rest of it… It (CCS) is a cleaner version of that, but the issue is… we are still using materials that will disappear if we carrying on the way we're using them.*

Nuclear Power

- Unconditional acceptance of nuclear power as a form of electricity production is generally found to be low among the British public with concerns expressed in relation to the disposal of radioactive waste and risk of accidents.
- There is greater support for replacement of existing facilities than for expansion. In the case of replacement, nuclear is seen as a temporary 'stop-gap' whilst renewable energy technologies are developed and deployed. Although some support for nuclear power in future energy systems is evident, a majority of people oppose nuclear power in their area.

66% **of respondents agreed with the statement 'I am willing to accept some nuclear power as long as we also focus on increasing renewable energy sources'.**

61% **agree that promoting renewable energy sources, such as solar and wind power, is a better way of tackling climate change than nuclear power.**

- The public is undecided on whether nuclear power should play a part in Britain's energy mix (see Figure 1). Notably, acceptance is higher if nuclear power is placed in the context of an overall energy mix that also includes renewable energy.
- Depending on how nuclear power is framed, public acceptability can increase (e.g. if framed as tackling climate change and energy security) but it can also decrease (e.g. when placed in contrast with renewables).

32% **do not think existing nuclear power stations should be replaced and a quarter (26%) favour replacement over expansion.**

2.0 Demand

Public perspectives on reducing energy demand are, at a general level, very positive. The public would like to see reductions in energy use or at least no further increases in levels of energy consumption. This is a core aspiration for publics within energy system transitions and is indicative of recognition and support for changes on the demand side. We start with public perceptions of reductions in energy use more generally before moving to focus on heat, transport, and demand management as major aspects of energy use and demand side change.

Personal Energy Use Reduction

- Publics recognise their own roles in reducing energy use. A majority of people are interested in energy information, are willing to think more about their energy use and believe that additional information would help them reduce their energy usage.
- This is juxtaposed with public perceptions that they have relatively low ability to affect the things which shape consumption more widely such as electricity use in public spaces and buildings, and standby functions on electronic goods. In essence many feel that they can only do small things though they do not necessarily underestimate the value of such 'little' actions.

81% **of respondents want to reduce their energy use.**

- Publics perceive a lot of wasted and unnecessary energy use, a particular salient example being lit-up empty office buildings at night.
- Certain aspects of change for energy use reduction provoked strong resistance, for example reducing personal transport use, flying less and eating less meat.
- In terms of one-off purchases for energy reduction, such as new appliances or insulation, our evidence points to the importance of intermediate actors and companies (e.g. plumbers, insulation companies) in the uptake of certain pieces of kit or approaches.

> ***Female:*** *We looked at all sorts of things, we looked at ground pumps... and all these wonderful systems and we asked about 9 heating engineers round and... basically you couldn't find anyone to do anything at all so... we ended up with the bog-standard combi-boiler.*

Heating

Heating accounts for 79% of energy use in British homes and 81% of this demand is met with gas-fired boilers (9). Two challenges thus exist in relation to heat transitions; one being to reduce usage and the other being to move away from our reliance on gas for heating.

Reducing Demand for Heat

- Publics engage with heat principally through their perceptions of bodily comfort rather than by actual thermostatic temperatures. Comfort levels are extremely variable from person to person and therefore unlikely to be changed through blanket approaches.

> ***Male:*** *We are all looking to make savings ... but what drives it is feeling comfortable. I personally wouldn't turn off the heating for an hour in the evening and sit there cold just to save a bit I wouldn't be comfortable so if it means leaving it at 20 degrees, that is what I will do.*

- Though insulation was viewed generally positively, turning down heating was on the whole not considered to be an option for most participants who already felt that they were only using their heating when it was needed and at temperatures that were comfortable for them.
- Measures that reduce energy demand are not thought about in isolation but they are considered as part of a whole range of other household issues. For example, loft insulation is considered in relation with other uses of loft space, e.g. as storage. Whilst double glazing is associated with improved security and reduced noise, as well as improved thermal comfort.

Moving Away from Gas-fuelled Heat Systems

- Central to anticipating future public responses to transitions away from gas central heating is an understanding of people's experiences and views of current systems of provision. Gas central heating is viewed as highly controllable, responsive, safe, effective and cheap – although recent gas price rises mean this latter view may be beginning to change.
- Electric heating in general was widely associated with Economy 7 storage heaters which, unlike gas, were viewed as expensive, providing an undesirable type of dry heat, and ineffective, particularly because of the lack of responsiveness and control.

> ***Female:*** *I had that [electric heating] in a previous home and I thought that was terrible, it wasn't cost effective, it wasn't quick enough…The gas is effective, quick and that is what you need in this day and age, to use what you need.*

- In general, other forms of electric heating systems such as ground-source heat pumps and district heating are relatively unknown. Anything other than in-home, individually controllable heating systems was unfamiliar.

42% **of respondents are willing to use electric heating systems. This substantially increases when electric systems are posed as able to match the performance of current systems (61%) and if presented as cheaper (85%).**

- The research findings indicate that if cost and performance aspects of new electric heating systems are perceived to be in line with current heating systems then a majority would consider using these. Although for some this is also dependent on how the electricity is produced i.e. whether or not it is produced from renewables or fossils fuels.
- Open fires hold appeal as alternative forms of heat for their aesthetic qualities as well as heat provision. These are generally viewed as options that can be combined with central heating to achieve high levels of comfort.

Transport

Energy for transport represents 41% of final energy consumption in the UK and most of this is still met through use of oil based fuels (9). Similarly to heating, transport thus poses dual challenges of reducing usage while also moving away from reliance on oil based fuels and technologies. Proposed alternatives include electrification, greater use of bio-fuels, and hydrogen.

Reducing Energy Demand in Transport

- Reduced usage in the transport sector was perceived positively. 70% of respondents included high increases in use of public transport in their My2050 pathways (see Figure 1). There were, however, more reservations about the possibilities for reducing demand in transport. In particular, personal forms of transport were regarded as offering greater convenience, comfort and as providing a mode of travel that was better than other available alternatives, such as public transport.
- Many of the things that shape why people travel in the ways that they do were perceived as beyond their control, such as safe cycling routes, reliable, cheap public transport, options for home working.

> ***Female:*** *I drive to work and it is 3 miles away... it is all through country lanes and there isn't any transport... then I drop my daughter at school so I need the car to get to these places because the public transport would have to go into town and out again and that would take forever.*

Flight Travel

- Reducing flying is an aspect of travel that provokes particularly strong resistance. It is important to note that this differed considerably depending on whether flying was for business or for leisure. Though travelling for business was viewed as important in some instances, there was a general sense that flights for business should be significantly reduced. In contrast, notions of reducing flights for leisure travel were strongly resisted.

> ***Male:*** *I think it's [stopping flying] a backwards step and I know that's really controversial and stuff but I think for me you know living and exploring and pushing boundaries is something that's really important to what makes us who we are.*

Moving Away from Oil-based Fuels for Transport

- Electric cars are familiar and views are well established. Unlike the heating sector, perceptions of electric cars are generally favourable. This means that some of the challenges in moving to electric vehicles are likely to be less substantial than those in heat.
- Perceptions of electric cars included concern about vehicle range and performance but in general if performance, price and infrastructure support could be brought to similar levels to those associated with petrol and diesel vehicles, people were positive about the prospect of transitioning.

53% **of respondents indicate willingness to use electric vehicles. This is higher (75%) if performance matches that of conventional models.**

- In general, electric cars are strongly associated with being green and environmentally 'good'.
- On the whole hydrogen was regarded positively though for many it is not particularly salient and often participants did not realise hydrogen vehicles are already in operation.

> ***Male:*** *If they could get an electric car to that stage where you could get electric cars at the same performance as diesel and petrol then I would [purchase one] definitely, but not at the moment.*

Electrification

- Common to the use of electricity for both transport and heating is that electric alternatives are perceived as not matching existing technologies in performance, accessibility, and affordability. There are also concerns centred on the difficulty of ensuring supporting infrastructure and skills are put in place (e.g. EV charging points; car mechanics, heating engineers).
- There appears to be a more considerable challenge in developing awareness of different heat technologies compared to electrification in transport where awareness and connections to pro-environmental action are relatively strong.

Demand-side Management

Demand-side management (DSM) encapsulates various different elements and potential changes to how we engage with energy, from smart meters and variable energy tariffs, to new appliances and active demand shifting on behalf of the householder. Many of these things are highly uncertain and unfamiliar to the UK public.

Sharing Energy Usage Information

- People are broadly willing to share their energy use data although a significant proportion of respondents had concerns about this, indicating that willingness to share data is likely to be conditional. We also find a substantial proportion of people that are not willing to share their energy data with anyone.
- Attitudes toward data sharing are very dependent on who the data is shared with, their motives, what data is used for, and who stands to benefit. For example, if data sharing is with a more trusted organisation and people can see clear benefits for them or the country as a whole they are more likely to find it acceptable.
- Our data indicates that more people are willing to share their data with energy companies than government. This may be, in part, reflective of the existing situation where we already share data with energy companies.

- Our findings also show that energy companies are distrusted and often viewed negatively. As such, the actual implementation of data sharing processes is likely to be affected by these existing perceptions of energy companies. For example, if energy companies are believed to receive the bulk of the benefits from shared data (e.g. through reduced costs to them) they may be expected to pass these cost savings on to consumers. If they are perceived not to be doing so, this is likely to deepen distrust and reduce the likelihood of further co-operation.

22% **are not willing to share their smart meter data with their electricity supplier.**

Remote Control and Automation of Household Appliances

- Interference with energy use in the home was generally viewed negatively. It was linked to notions about the home being a private space that should be free from outside control. Measures that were perceived to erode the power and control of householders within their homes frequently met with resistance.
- Though overall, interference with energy use (e.g. through automation or remote control) was viewed negatively this did not necessarily apply to all forms and arrangements. Specific responses to different configurations of DSM elements depend on a variety of factors.
- On balance, technological automation (e.g. appliances automatically turning off after a period of standby) is more acceptable than remote interference by another party. It is important that householders were afforded autonomy and the ability to over-ride automation or remote interference.
- Perceived loss of control is particularly important with regards to acceptance of DSM arrangements that involve health-related issues (e.g. food storage in fridges and freezers). Other DSM scenarios are considered undesirable because they involve a perceived loss or deterioration of comfort, for example, altering the length and timing of showering.
- The preferred method of demand management was one that would allow householders to maintain a level of control. Interventions that assisted people in shifting their own energy use patterns were viewed positively.

> ***Female:*** *The point of government isn't to control it's to guide. The day that someone sitting in Parliament says when you can do your washing, is the day I reckon we should probably leave. Even if it is for the best of everybody.*

3.0 Institutions, Responsibility and Change

Policy Reasons for Change

- Concern about climate change, energy security issues and affordability are high. In particular, concern about implications of these issues should they not be addressed (e.g. energy shortages, floods and land abandonment) is very high.
- Motivations underlying publics' reasons for wanting change do not align in direct ways with those underpinning policy (i.e. climate change, energy security, affordability), though they are closely related. For example, climate change is transmuted into a more general concern about environment and sustainability.
- Climate change, affordability and energy security are important as meta-narratives but are not related to expressed preferences about energy system change in straight-forward linear ways. For example, scepticism toward climate change does not prevent publics from engaging with specific aspects of energy system change such as electrification.
- Affordability gets ranked as the most important concern in the survey but it is important to be aware that it is qualitatively different to climate change in ways that mean it is not always directly comparable, i.e. affordability is located as a personal issue where climate change is a more general national scale concern often located in the longer term future.

Concern about Climate Change

- Public perceptions with regard to climate change are consistent with previous and long-standing work on public understanding of this issue, with the majority of respondents expressing concern and agreeing that climate change is at least in part caused by human activity. However, the results also indicate a very wide variation in individual responses to the issue, from different forms of uncertainty and scepticism to very high levels of concern (10,11).

74% **of respondents are very or fairly concerned about climate change.**

- 'Carbon' or 'low carbon' as ways of characterising different aspects of the energy system (e.g. fossil fuels, renewable energy) are not particularly salient terms but that is not to say that they are not important in a more general sense. Publics relate to the idea of carbon emissions through more general notions of environmental degradation, cleanliness and pollution (12). These offer public frames through which carbon emissions are interpreted i.e. emissions are understood to be bad even if the specifics of the science are not particularly salient or well understood.

Concern about Energy Security

- Energy security as a term was not salient to people but the range of concerns that it encompasses (e.g. geopolitical issues, energy shortages, black outs, unaffordable prices) did evoke strong reactions (13). Though there was concern about national level security and supplies of fossil fuels, there was a much stronger focus on the services that energy supports and personal access to energy.

82% **of the British public have strong concerns about the UK becoming too dependent on energy from other countries. Respondents were also concerned about having no alternatives in place when fossil fuels run out (84%), and the possibility of a national petrol shortage (73%) and frequent power cuts (63%).**

- Energy security is closely linked in public perceptions to affordability i.e. because it relates to concerns about not being able to access energy services.
- When energy security concerns were located at a national level, the key issues related to insecurity of fossil fuel supplies. This perception of fossil fuels being insecure represented just one in a wider range of problems that are seen as related to fossil fuel dependency.

Public Views on 'Cost' and Affordability

- 'Cost' is unsurprisingly very important to British publics when evaluating different options with regard to energy system change. This includes cost conceptualised at more national levels (e.g. cost for the nation) and at personal levels (most often discussed are energy bills but this also includes purchasing and investment costs). It further includes concern about 'running costs' associated with energy systems and capital costs in terms of investment for system transitions.
- Public concern about cost is related to multiple dimensions of the issue and is not solely focussed on higher or lower bills. For example, public views about cost incorporate consideration of things like long-term stability versus fluctuation in costs, existing market structures and notions of getting a 'fair deal', trust in energy companies, and particular perceptions of energy, i.e. as a basic need (14). It is particularly important to pay attention to this multi-dimensionality as there is a danger of simplistic interpretation with regard to public responses to questions about cost; i.e. interpreting concern as relating only to higher or lower bills/costs.

> ***Female:*** *I generally worry about the price because the way things are going, is like you know you wake up the following day and the energy company will just tell me that there will be an increase in price, and there is nothing you can do about it.*

- Getting cost "right" both in terms of capital and running costs is a minimum requirement for multiple aspects of transition that rely on consumer purchases of some kind (e.g. electric heat pumps, public transport costs). However, it is not the only thing that matters – performance, comfort, status, convenience and so forth are important for uptake. Recognition of and strategies to address such 'other' factors is required as these will not for most be simply traded off against 'low' cost.
- Personal cost is often discussed in terms of energy bills; however it is more about affordability rather than lowest cost possible. The cheapest option is not necessarily preferred if that option comes with a lot of negatives e.g. fossil fuel reliance.

78% **of respondents are fairly or very concerned that petrol will become unaffordable for them within the next 10-20 years.**

(De)centralisation

- Our findings have generally focused on centralised energy systems, in part due to utilisation of the My2050 tool where it is depicted in this way. We did not explicitly ask or probe our respondents about their views on decentralised energy systems.
- We do, however, find that different forms of microgeneration technologies (e.g. solar energy, wood burners) were generally viewed favourably, in part because they provide a way to supply and control energy in the home.

Perspectives on Ways of Bringing about Change

- Public views on how to bring about change entail reference to a wide range of possibilities. These included voluntary measures, regulation, coercion and force, restrictions, incentives, grants and promotion/ guidance measures. It was rare that any one option was viewed as adequate – in most cases a combination was anticipated to be necessary.
- Force and penalties are seen as a potentially necessary part of the solution but there was also caution about overuse of these approaches. Restricting options, such as recent measures to prevent the sale of incandescent bulbs, were viewed positively as they gave clear messages about what is inappropriate.
- We find incentives were viewed positively as a way of encouraging change. An example of best practice was the reward of a lower car tax for buying a smaller sized, more efficient vehicle. In general financial incentives were preferable to penalties (e.g. lower public transport costs would be preferred over higher parking costs for personal transport).

The Role of Information and Education in Change

- The role of education and information in stimulating change is viewed as important by publics. Our findings indicate that this is not necessarily about provision of more information or indicative of a need for greater understanding. Instead, it incorporates the belief that the imperatives for energy system change are not present within daily life. This points to a need for sustained, repeated, and sometimes subtle promotion of how things should be changed.

> ***Male:*** *It's things like the number of people that watch things like Coronation Street and Eastenders... if those makers inserted certain things in there like when they get up and turn the light switch off... you're not being told to do something you just recognise something.*

Manufacturing and Growth

- Publics express concern about the impacts of energy system change on manufacturing and are keen that it should not be reduced due to concerns about economic implications (also see Figure 1).
- This represented an area where the difficulties of transitioning were most apparent – participants associated growth in manufacturing with jobs and economic stability yet, at the same time, viewed the current culture of consumerism as "wasteful" and inherently problematic.
- Public views on carbon capture and storage (CCS) technologies on the supply side are, at times, connected with concerns around jobs and manufacturing. In particular, there is a recognition that some industries are not able to move away from fossil fuel sources of energy (e.g. the steel industry), yet there is a desire to minimise the environmental impact of the industry. As such, CCS for industry is perceived to potentially help mitigate environmental impacts whilst avoiding dire consequences for jobs (i.e. through the closure of certain industries).

Views on Actors/Institutions and Responsibility

- Publics do not locate responsibility for the enactment and delivery of energy system change with any one group. Instead, publics perceive the configuration of responsibility for change as residing across government, energy companies, and individuals.

Individuals

- The public view themselves as a having responsibilities in terms of energy system change across all dimensions of transitions, from reducing demand and keeping costs low, to supporting public spending on new infrastructure for transitions. They viewed their role as ultimately limited though; many of the decisions associated with change were viewed as outside of their direct control being taken within institutions, companies and governments.

Energy Companies

- We find that energy companies were viewed as taking only limited responsibility for transitions but they were perceived as having key responsibilities, particularly with regard to financing transitions.

> ***Female:*** *Electricity companies obviously... have some ownership of it as they have had so many years of profit making and offering us gas and electric, definitely they have to take some responsibility.*

- There was a strong sense that energy companies should take greater responsibility because they are believed to have been key (financial) beneficiaries of the existing energy system. There was emphasis placed on the significance of companies making different investment decisions and reinvesting profits, rather than raising bills.

Government

- Our findings show that the government's role was perceived as incorporating responsibilities for developing an overall vision to work towards. This included creating the policies and structures needed to encourage change (e.g. improving public transport) and being clear with regard to the available options.

54% **of respondents think National Government(s) are mainly responsible for ensuring appropriate changes are made to the UK energy system over the next 40 years.**

- Though responsibilities for energy systems transitions were located across industry, publics, and government, we also found that ultimately responsibility was often located with government. This is connected to a perception that energy companies cannot be held accountable in the same way that government can, i.e. through the electoral voting system. In addition, there is also a perception that publics do not have the power and capacity to enact change on the scale needed.
- Publics do perceive a reciprocal relationship between themselves and other actors in energy system change. For example, people are willing to engage and consider using more public transport if there is seen to be a reciprocal commitment to improve services in terms of cost, availability, accessibility and quality.

4.0 From Preferences to Values

PART 1 has provided a summary of public preferences, views and characterisations of energy systems and other aspects of concern pertinent to transitions. Here we have been concerned to set out what people think about different aspects and elements, for example regarding wind energy or energy companies. Within this, some clear preferences are evident (i.e. a move away from fossil fuels towards renewable energy, and efficiency and demand reduction improvements), whereas views on other aspects of system change are much more unfamiliar and contested (e.g. the role of CCS or demand management).

In PART 2 we go on to consider what underlies these preferences in order to provide insight into how public views are formulated. Here we stipulate that the preferences outlined are rooted in, and at times constructed out of, deeper value systems or more general principles. It is these values and principles that people draw on to guide decisions and engagement with regards to energy system change.

Understanding what underpins preferences is of particular importance because public perceptions and acceptability are highly complex. Preferences may shift and change depending on the context and how something is understood (e.g. if demand management is seen as enabling renewable energy development or as a device for increasing energy companies profits). This is especially important with regards to unfamiliar issues or concerns that are of relatively low-salience in everyday life. Views and opinions on these types of issues are formed and formulated through a process of connecting up new information and experiences with existing values and ideas. It is to an examination of these that we now turn.



Values for Energy System Change

2

1.0 The Importance of Values

In this part of the report we begin by drawing together the preferences outlined in PART 1 into a broad vision for energy system change. As a starting point, it is important to note that the public vision of the future energy system is one that contributes to a broader vision of a sustainable future. There are clear preferences for particular energy system elements that are integral to most public future energy pathways. On the supply-side this is characterised by a ***strong commitment to renewable forms*** of energy production and a ***corresponding shift away from fossil fuels***. On the demand-side it relates to the development of technology and infrastructures (e.g. public transport, demand management, electric vehicle charging points) to support changes in lifestyles. There should be an overall ***improvement in energy efficiency*** and ***reductions in energy demand***. These energy system options represent major parts of the pathways envisioned by members of the UK public for 2050 and beyond. As such, in the short-medium term, public acceptability of low-carbon transitions is likely to be contingent on evidence of long-term trajectories toward this broader vision of a sustainable future.

On the surface the vision outlined above appears to be principally focussed on different technologies or elements of the system. However, we assert that public preferences for certain technologies and ways of doing are deeply rooted in the values people desire the energy system to either represent or, at the very least, not threaten. A key difference between preferences and values is that whilst preferences are, at times, malleable due to changing contexts or different frames of reference, values are much less so. The receptiveness of public preferences to change is particularly important when considering topics that may be of low salience to the public, are new and emergent or where views or opinions are not yet fully formed. This is particularly the case for examining public perspectives about energy systems of the future.

This is not to say that preferences are irrelevant, but rather to highlight the worth in examining the values and principles that underpin them. Such an examination can also provide important insights as to why preferences might change. The implication of exploring values is that different configurations or pathways of the energy system should be developed that will incorporate the desired values, principles and ideals publics have. Ultimately, then, the public vision is not solely about technology; it is also about values (see Box 3 for an illustrative example). When thinking of how to engender and enact whole energy system transformations it is essential that social policies are created which 'are responsive to citizens' values' (15). Whilst this would not necessarily guarantee support for proposed changes, it is likely that proposing changes that are not commensurate with citizens' values may incite resistance.

We unpack, in the first instance, what we mean by 'values' through a brief engagement with the values literatures. Second, we will discuss the values, principles and ideals our analysis of both the qualitative and quantitative datasets has revealed to be important for public perceptions and preferences regarding the future energy system.

Box 3. The relationship between values and technology – solar energy

To illustrate what it means to consider public perspectives in terms of values we use the example of solar energy. Our findings show that there is a strong public preference for solar energy in the supply-side of our energy system. We also know that this is because it is perceived by people to be 'renewable' 'fair', 'just' and 'clean'. Accordingly, we assert that if a solar power development supplying the UK but residing in North Africa was revealed as causing local environmental contamination and land-use territorial disputes, this would not fit the public preference for solar energy. This is not because it is no longer renewable but because in this instance it would no longer be seen as 'fair', 'just' or 'clean'. As such, importance is attached to the inclusion of renewable, clean, fair and just elements in future energy systems, not solar energy technology *per se*.

Unpacking Values

Values are 'bandied around' in many spheres ranging from academic, to popular culture and political (15). Definitions of values are contested across spheres and disciplinary domains leading to the need for meaning and use to be made clear by the user (16). In the case of this report we operationalise the following definition of values:

DEFINITION: Values are guiding principles for people, groups and other social entities.

In this sense, values are relatively durable, going beyond the stipulation of a preference; they are 'measures not of individual preference but an index of support for a morally right or just society' (17,18). As such, values are rooted in ethics and morals. Therefore values cannot simply be traded-off; instead the trading-off of values requires a careful negotiation of moral principles (17). Indeed, it is less the case that values are traded-off and more that some values are brought to bear under specific

circumstances, whilst others are called upon much more frequently (15). Equally some values are shared socially, whilst others are personal and allow us to distinguish ourselves, indeed our very identity, from that of others in social life (15,17,19). Yet values are not free-floating and do not exist independently of one another, they are bound together, some more tightly than others. A useful concept for thinking through the set of values an individual holds in its totality is that of a 'value system' - the individual's organised set of values (19).

Whilst the discussion thus far has pertained to the values held by an individual, the aim of this section is to use some of the ideas presented here to explore the wider 'social' value system associated with desirable future energy systems. This social value system represents the range of values people draw upon in forming their preferences and perceptions with regard to energy system change. As such, the value system connects to and facilitates the presentation of a broader vision for energy system change. What follows is an exploration of the values – the guiding principles – publics use for evaluating options related to energy system transformation. The values were derived from an examination across the whole datasets and, as such, these are not values held by any one individual; rather they are prevalent identifiable cultural resources that people drew upon in forming their preferences for different aspects of energy system change (20). In combination the values set out here offer means for explaining the observed data in terms of preferences and perceptions, i.e. they give a basis for insight into why people's preferences are the way they are.

Box 4. Getting at values

Values are difficult to observe. Within the data analysed, at times they were explicitly stated by participants (e.g. waste), while on other occasions they have been inferred and explored through an interpretive process by the research team (e.g. social justice). To ensure the interpretations of the values are **meaningful, consistency** has been checked within and across all datasets. In addition, a **rigorous analysis** has occurred through the interrogation of interpretations through intensive research team discussions to ensure that all aspects of the data and public perceptions were considered and represented.

2.0 Values and principles for energy system change

In this section we provide a summary of all values and principles that have emerged out of our analysis.

At the beginning of this report we outlined a key finding showing that publics want and expect change, which is linked to the notion that change is ongoing. If change is inevitable, publics saw an opportunity to shape change positively, particularly because there was strong concern about the consequences of doing nothing. This positive vision for change emerges out of the values discussed below. It is important to note that this represents what people want and how they think things should be (e.g. the energy system "ought to" protect the environment), rather than how things currently are. This value system therefore represents ideals and principles which underpin a normative vision for change. The value system that we set out here can provide a basis for energy system change that engages with, and is responsive to, public concerns.

It is important to stress that the values have been derived from a complete analysis of all data and represent the combined outcome of this wider analysis. As such no one specific data point is able to illustrate all aspects of a particular value under discussion. Throughout the following sections we have, however, provided evidence in the form of quotes and statistics to give examples at particular points in the text.

Table 1. Summary of core public values pertaining to energy system change

Principle /Value		Description
Reduced energy *use* overall Reduced use of *finite* resources		Reducing overall energy usage while simultaneously reducing the use of finite resources (as compared to the current state) will have positive consequences in terms of attaining the values outlined below.
Efficient and not wasteful	**Avoiding Waste** **Efficiency** **Capturing opportunities**	A system that does not involve wasting and/or produces waste products and that is efficient. A system that does not waste opportunities arising from energy system change, and capitalises on the resources and capacities ` of the UK.
Environment and nature	**Environmental protection** **Nature and naturalness**	A system that uses and produces energy in an environmentally conscious way and does not unnecessarily interfere with or harm nature.
Secure and stable	**Availability and affordability** **Reliability** **Safety**	A system that ensures access to energy services both in terms of availability and affordability. A system that is reliable and safe both in the production and delivery of energy services.
Autonomy and power	**Autonomy and freedom** **Choice and control**	A system that is developed in ways that do not overly threaten autonomy, infringe upon freedoms, or significantly compromise abilities to control personal aspects of life.
Just and fair	**Social justice** **Fairness, honesty and transparency**	A system that is developed in ways which are mindful of implications for people's abilities to live healthy lives. A system that is fair and inclusive and where all actors are honest and transparent about their actions.
Process and change	**Long-term trajectories** **Interconnected** **Improvement and quality**	A system that is developed with a focus on the long-term trajectories being created; that takes into account system interconnections and interdependencies; and represents improvement both in terms of socio-technological advances and quality of life.

Notes: In the table, the column on the left (Principle/Value) lists the principles and values that make up the value system. Each value or principle is accompanied by a brief description (right column). Naturally all of the values and principles are linked rather than mutually exclusive. As such they are grouped together according to connected meanings. Each set of values is then discussed in more detail alongside the table. It is in this narrative that we explore how these values are interconnected and what aspects of energy system change they relate to (and how).

Reduced energy use overall and reduced use of finite resources

Reducing overall energy use and ***dependency on finite resources*** for energy production are overarching principles for energy system change. The findings show clear and strong preferences in this respect. Although both of these principles are closely linked to the other values (for example reducing energy use is closely linked to notions around wasting), they have been included as separate principles because they emerge consistently as vital aspects in any form of energy system change.

73% **of respondents agree that Britain should reduce the amount of energy it uses.**

Crucially, reducing overall energy use and dependency on finite resources are seen as important for attaining all other aspects of desirable change encompassed within the values outlined in Table 1. For example, with regard to using less energy, this is seen to decrease vulnerability in term of shocks to supply and cost of energy. In addition, because it requires the use of fewer resources positive effects are perceived for the natural environment. As such, reducing energy use overall makes changes in other aspects of the system easier. Similarly, reducing high consumption of finite resources is seen to have positive implications for the security and stability of the energy system. Publics see the current dependence on finite fossil fuels as amplifying concerns around cost, reliability, environmental harm, and so on. These are perceived as principally addressable through the use of other types of fuels.

> ***Male:*** *Just because I know that, it just makes me feel a bit safer knowing that it [renewable energy] is always going to be there, whereas when you hear the people, you know, with the doomsday theory that it's [fossil fuels] going to run out and we have nothing left, that would be a worry in the back of my head, because I know that I'll have to deal with it at some point, and I know that my kids will definitely have to deal with it.*

Efficient and not Wasteful

The energy system and its component parts should be as efficient as possible and this is centrally tied to the idea of ***avoiding waste***. The notion of 'wasting' is generally seen as bad and extends beyond 'energy' to include other things like food and time. A core example of where concern about waste underpins public preferences relates to reducing energy use. This is very strongly linked to the perception that energy is currently wasted in many respects. Although publics can differ in terms of what is considered wasteful or unnecessary use, common examples given are leaving lights on and using stand-by functions, and energy use in public and commercial buildings like lights being left on all night. The concerns around wasting energy (or other things) are particularly heightened in the context of wasting something that is finite, most obviously fossil fuels.

> ***Male:*** *If you walk around a major city at night the buildings are ablaze…there's nobody in them but they're all lit and up that's a waste of energy. The London Eye is very pretty lit up but there's no reason to be lit up for that long.*

Somewhat in relation to this, producing waste is viewed negatively by members of the public, and therefore to be avoided. Naturally this involves discussions around nuclear waste, but includes other aspects like carbon emission storage. The idea of producing waste is seen as particularly problematic because the consequences of this waste extend beyond the immediate use purpose, i.e. nuclear waste or carbon storage present ongoing health and environmental hazards that have to be continually managed. Publics have more positive views towards the reuse of waste products, for example biomass from waste products (e.g. chip-fat, food waste) is viewed more favourably than grown-for-purpose energy crops. The idea of a closed-loop or closed-system is evoked in these instances, where the reuse of waste products ensures that negative consequences of waste are reduced or eliminated, and the whole set of processes and uses are interconnected in a cyclical way.

1/3 **of the 73% of respondents that agreed Britain needs to reduce the amount of energy it uses thought that a lot of energy is currently being 'wasted', 'used unnecessarily' and 'taken for granted'.**

The idea of ***efficiency*** is linked to waste in the sense that if you are doing something more efficiently, this should be less wasteful as a result. Efficiency is a concept that emerges frequently within public responses, but it is not always specified or clear that the same thing is meant in all cases. In general, efficiency is viewed as doing or achieving the same thing with less, or putting the same amount in but getting more out. The idea of doing things more efficiently is often linked to technological improvements, but is not limited to this. Furthermore, being more efficient is quite often linked to perceptions of improvement (see Process and Change), where increasing efficiency is seen as a sign of improvement and progression.

> ***Male P1:*** *I mean, electric cars, that whole technology, there's a world waiting isn't there? Why aren't we investing…?*
> ***Male P2:*** *We need to start it off.*
> ***Male P1:*** *Why aren't we investing in it? We should be world leaders in it.*

Finally, this cluster of values also encompasses notions around wasting opportunities that arise as part of energy system change. This can also be phrased more positively in the sense that publics saw a need to ***capture opportunities*** that present themselves. This notion arose particularly in reference to using resources that are naturally abundant in the UK, such as marine energy. Broadening this out further, this was sometimes linked with making sure these opportunities were used to their maximum potential by creating associated jobs and industries, for example green jobs, wind turbine or electric vehicle manufacturing, and leading marine energy development globally.

In sum, being more efficient (doing more with less) and minimising waste and overall energy usage is universally seen as positive, and represents a core principle for energy system change for members of the public.

Environment and Nature

The energy system should be developed in ways that ensure environmental protection and minimal interference with natural processes. These values encompass a desire for there to be limited impacts on the environment and when impacts are unavoidable these should be minimised as much as possible.

Concern about ***environmental protection*** encompasses potential negative impacts on nature, wildlife and ecosystems, but also those associated with environmental harm arising from pollution and other forms of contamination (e.g. oil spills, radioactive waste leakages, disposal of toxic chemicals from appliances). Intimately associated with this value is the need for the energy system to draw upon sources of supply that avoid producing pollutants and are perceived as clean. Linked to this is the view that the energy system should either contribute to, or at the very least avoid detracting from, the general healthiness and wellbeing of society.

> ***Male:*** *…nobody's getting hurt. The planet's not getting hurt. You're using something that is natural.*

In this sense, concerns about environmental protection go beyond nature and wildlife, to become a more holistic umbrella category for issues regarding the relationship between nature and society. It is within this value set that concerns about climate change manifest. However, it is important to note that climate change is seen as one example of environmental degradation, rather than representative of it. As such, concerns about climate change form part of a wider concern about the environment (12,21).

79% **of respondents believe the UK should reduce its use of fossil fuels.**

When asked why, respondents most often mentioned the unsustainable nature of fossil fuels ('finite/running out'; 48%) and environmental harm (including climate change; 36%) as reasons for holding this viewpoint.

Naturalness refers to a value that encompasses ideas around the human-nature relationship. This is linked to environmental concern and arises particularly out of the desire to preserve natural resources, such as fossil fuels, because they are perceived as finite and precious. Interestingly, whilst fossil fuels were imbued with naturalness this is qualitatively different than the same term often applied to renewable energy. In the context of renewable energy, naturalness refers to cleanliness and greenness and is seen as inherently good. Fundamental to this characterisation is that renewable energy is the product of a natural process and does not require extractive industries or other forms of manipulation that

are perceived as intrusive. Instead there is a perception that renewable energy involves tapping into an infinite resource that will continue irrespective of whether or not society makes use of it (e.g. the wind will keep blowing whether or not a wind turbine harnesses it to produce electricity). In addition, there are perceived to be little to no by-products in terms of waste and pollutants (also see Efficient and not Wasteful).

By way of contrast, whilst it was understood that the formation of fossil fuels were the result of a natural process, the timescales in which they form mean that it does not hold the same sense of being an infinite resource. Equally, the manufacturing process necessary to make them into a workable form of power was seen as much more intrusive and artificial, both in terms of raw resource extraction and the need for combustion. These considerations also, in part, underpin perceptions of biomass and biofuels. They are not seen as renewable in the same way as other forms of energy because there is potential for them to be mismanaged, depleted and ultimately cause harm to the environment and society.

> ***Male:*** *…coal and oil is natural but the wind keeps coming and coming… it will always keep giving us wind.*

The distinction between renewable energy and fossil fuels rests on a core view that the relationship between society and nature should be as benign as possible; at best, it should be harmonious and synergistic. Current relationships were perceived to some extent as parasitic in which nature is treated as a resource to be extracted and depleted by society.

In sum, being environmentally conscious and respectful of nature through minimising intrusive and destructive processes is core to public values underpinning desirable energy system change.

Secure and Stable

The energy system should be safe, reliable, and accessible in terms of energy production and consumption. A core part of this value relates to public concern about access to energy services, both in terms of the availability of

energy to support services and their personal ability to afford them. With regard to the latter, though the notion of cheap energy is desirable, the core concern is that energy should always be affordable (see Just and Fair). In this regard, support should be provided to ensure energy is available and accessible for all. Responsibility for this is principally located with government.

Affordability and availability are dimensions of concern about the accessibility of energy services and opportunities for enacting system change. With regards to the accessibility of proposed changes this encompasses issues relating to the availability of skills and services important in energy system change; for example, those who wish to implement an energy intervention such as insulation, solar panels, double-glazing or new heating systems, should be supported to do so. Here support refers not only to affordability and access to investment capital, but also other factors such as the availability of skills and infrastructures, for example accredited suppliers and maintenance providers. The idea of supporting changes by making them accessible is further related to the notion that elements of transition should not be imposed upon people. Rather, they should be supported to enact changes that best suit their contexts; for example it would be inappropriate to apply the same penalties to rural and urban dwellers for using personal transport (see also Just and Fair).

83% **of respondents are fairly or very concerned that in the next 10-20 years electricity and gas will become unaffordable for them.**

This value also encompasses concern about the ***reliability*** and dependability of the system meaning that there should be minimal shocks and stresses. That is, events such as resource scarcity, service interruptions and or cost fluctuations should rarely occur. When shocks and stresses do occur, the system should be able to respond to them and mitigate their effects (22). This is important to people because of the detrimental effects associated with interruptions to supply, both in terms of personal effects (e.g. not being able to heat the home) and national effects (e.g. negative effects on the economy). This desire arises out of recognition that energy is integral to all parts of our society and when a shock occurs it is a threat to every aspect of life. Underlying this aspiration there is an expectation that energy needs will always be met in exchange for publics being good citizens.

The energy system should be ***safe*** with minimal impacts on the health of humans and the local environment. With the former this includes those involved in working within the energy system (e.g. workers at a power station) and those living in close vicinity to any infrastructure (e.g. power stations or pylons). In the event that something does go wrong, it is important that the consequences are relatively small-scale and do not lead to environmental degradation or health impacts. Publics are more concerned about the scale of consequences than the probability of an event. As such limited negative impacts are desired over lower probabilities that negative impacts ever occur. For example, the consequences of a wind turbine breaking down are benign when compared with the potential consequences of a nuclear accident.

52% **of respondents tend to or strongly agree that nuclear power is a hazard to human health. This is contrasted with only 5% of respondents believing the same about wind energy.**

Change also needs to be delivered in safe and secure ways for those involved in enacting transitions. As such, implementing change should not put people or businesses at risk of negative impacts whether they are financial, social, cultural or material. If risk is inherent in the proposed change, measures should be taken to mitigate such risks. An example of such measures is providing an extended warranty for early adopters of fully electric vehicles.

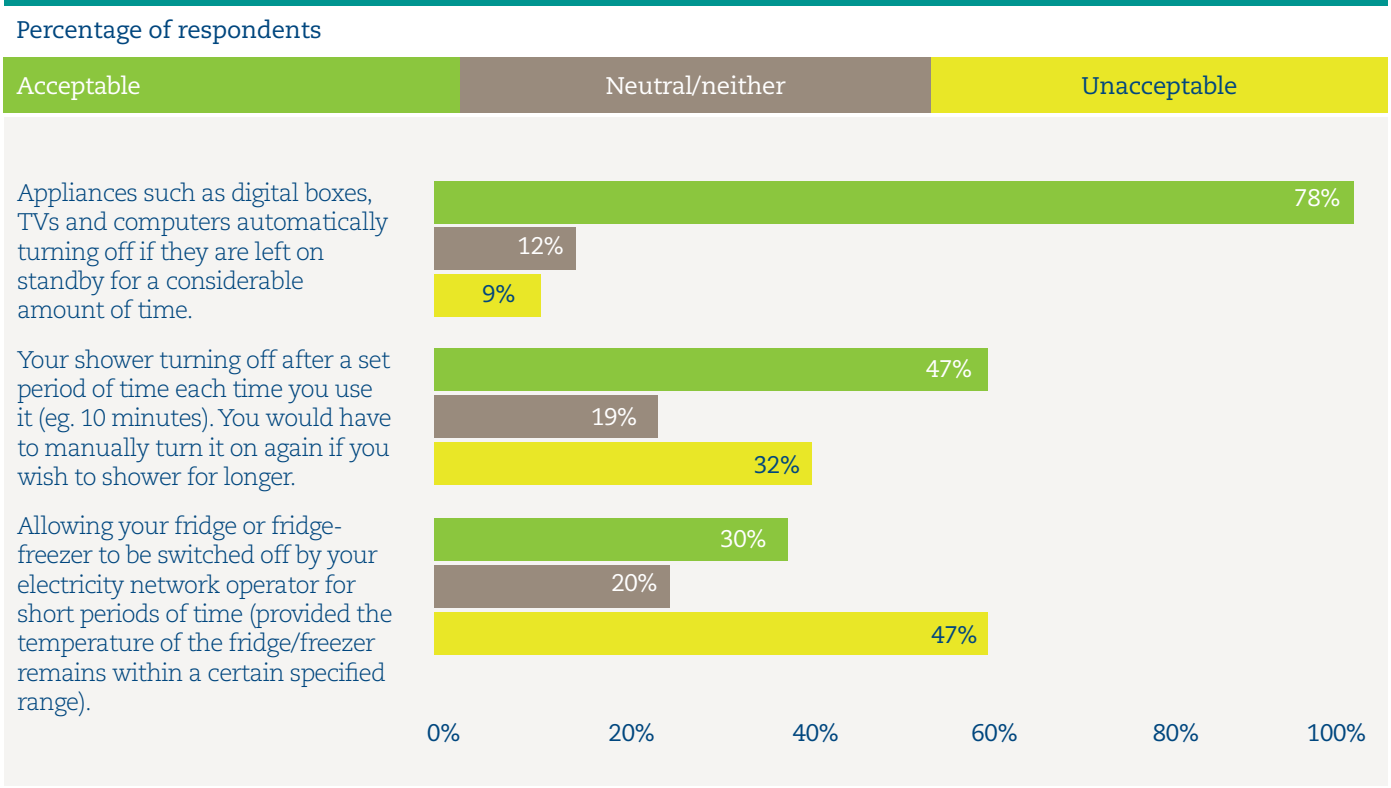
In sum, ensuring that the energy system is safe, reliable and accessible to citizens both in terms of personal affordability and national availability is highly valued by members of the public.

Autonomy and Power

Changes to the energy system should be undertaken in ways that do not threaten autonomy or significantly compromise control and freedom. Concerns about both are evident at national and personal levels. For example, with regard to the former, public views about national dependency on energy imports and associated risks are, in part, underpinned by concern about autonomy. This does not necessarily mean the energy system should only be reliant on domestic resources, as publics recognise the UK energy system is part of a global network. Rather, forms of supply even where imported should be done so in ways commensurate with other core values, for example Just and Fair, or Efficient and not Wasteful.

Concerns about ***autonomy*** are connected with the desire that no single institution, group or actor should become so powerful that they can monopolise the energy system; and manipulate it to their own advantage. This is in part reflected in negative views about the domination of large energy companies in the UK system. It is also related to favourable views of microgeneration technologies, for example solar PV or wood-burning fires, which are viewed as affording a form of self-sufficiency. In this respect, our preference findings have generally focused on centralised energy systems but from the values attached to microgeneration technologies we can infer that aspects of decentralised energy systems may be seen as (highly) desirable, at least to the extent that they align with these values – i.e. affording self-sufficiency and security.

Figure 2. Acceptability of different demand side management scenarios



Numbers may not add to 100 percent because of rounding and 'don't know' responses.

This value also concerns personal levels of autonomy, freedom, ***choice and control***. This manifests particularly in connection with changes that relate to the household scale or home. For example, in terms of demand-side management there is public support for being enabled to shift personal demand (e.g. advice and information) but less so for imposed and externally controlled changes (see Figure 2). That is not to say that force and regulation should never be used – measured uses of these is supported to help engender changes in social norms (e.g. the carrier bag charge currently being employed in Britain). Another example of the value attached to autonomy arises in relation to the qualification of support for automation, i.e. that the householder must able to manually override system controls. Equally, we found controllability to be a highly favourable attribute of current central heating systems.

In sum, being mindful of the importance of autonomy and freedom both at national and personal levels forms a key component in public visions for energy system change.

> ***Female:*** *I'd quite object if somebody else had that control…I find that a bit draconian actually…It's a bit like George Orwell, that… 'It has decreed you must have' – that really annoys me.*

Just and Fair

Energy system change should be undertaken with consideration for the just and fair distribution of costs and benefits and should not operate to the detriment of people's ability to function as healthy beings (23).

> ***Female P1:*** *Part of the problem is that they have opened up the market place and the market place now dictates what we pay whereas before it was centralised and government-led and a fair price for all, now we swap and the next week they put their prices up and you wish you stayed with that one.*
> ***Female P2:*** *I think it does need to be uniform because at the minute we are playing in a monopoly and we are losing because they are getting mega big bucks from the profits.*

This value encompasses a range of concerns about impacts of different energy system options on people and environment, which in some way relate to ***social justice***. For example, concerns were evident in relation to costs (i.e. social, environmental, financial impacts) of energy systems disproportionately affecting those that were vulnerable or structurally disadvantaged in other ways (e.g. the fuel poor, people living in countries where food shortages might be created or exacerbated through bio-fuel production). Such concerns related not only to people now and in Britain but also to those in distant locales

(e.g. other countries) and in different times (e.g. future generations), bringing to mind issues of intra and inter-generational justice.

One instance of this relates to public perceptions of particular forms of energy as holding potential to generate global conflicts. This, in part, underlies preferences for reductions in use of fossil fuels and connects with uncertainty and concern about bio-energy.

> ***Female:*** *If it is recycled I have no problem with it, but if it is a crop that's specifically grown for fuel then no, not when you've got starving [people in] Ethiopia or wherever else.*
> ***Moderator:*** *But what if it wasn't on food crop land?*
> ***Female:*** *I think the figures would be fudged again because companies want to get wealthy. If everything is fuelled on this thing and then more land is needed… it is too dangerous to go down that route.*

A further example are the issues identified in the distribution of infrastructure i.e. that energy facilities should not disproportionately affect particular locales and give rise to repeated and residual injustices. Connected to this is a view that publics should be informed and engaged in discussions about energy system change; processes of change and decision-making (e.g. about siting of infrastructure) should be inclusive and democratic.

A further element of this value set pertains to questions about who might get left behind as particular technologies, skills sets, and so forth, become obsolete. Here the justice concerns are related to the same core issue about the impacts on people's ability to live healthy lives but refers to energy system elements that are anticipated to be far less significant in the future (e.g. coal). This broad issue underpins public preferences with regard to things like the speed of change. It encompasses a view that transition processes should be undertaken in such a way as to ensure people are able to adapt to changing living contexts and given proper consideration through, for example, support in the developing alternative livelihoods (e.g. retraining for new jobs).

Values around ***fairness, honesty and transparency*** are closely related to these issues but represent more specific concerns which underlay perceptions of energy companies and government as untrustworthy. There is a core belief that institutions related to energy systems should be honest and should be committed to principles of fairness and openness. The concern with transparency arises here from the notion that if there is nothing untoward happening, there should be nothing to hide. This forms a basis for negative perceptions of the seemingly opaque operations of energy companies and governments in existing energy systems (e.g. reasons for price increases were viewed as unclear, energy bills were seen as misleading and confusing).

These concerns also underpin preferences and perceptions with regard to affordability and cost. In particular, views about the distribution of energy system

costs being fair, i.e. those that have benefitted financially from existing systems should have greater responsibility for the financing of transitions. These values were also important in views about energy company profits which were seen as unfair in a context where people were experiencing fuel poverty.

In sum, developing energy systems in ways that are open, transparent and fair and attentive to the effects on people's abilities to lead healthy lives is core to public future visions.

Process and Change

The principles within this category encompass particular understandings of change and how change should happen i.e. in terms of long-term, interconnected thinking and in ways that lead to improvement.

Longer-term processual conceptions of change, rather than time-limited ones, underpinned public views on multiple aspects of system change. In particular views on renewable energy incorporated an underlying characterisation of change as a trajectory. End points then in terms of 2050 or 2100 were not salient as a particular way of thinking about change. Conceptions were instead formulated from a point of thinking about changes as emerging over time.

There was a core concern that the transformations should be thought through in terms of how they are ***interconnected*** with other aspects of energy system change and wider social and economic life. This underlies some of the issues people raise in relation to bio-fuels (e.g. that they would interfere with food supplies if they are not being developed with an understanding of the interconnections and change implications). This connects to a core concern that the possible implications of changes, beyond energy systems *per se*, should be integral to decision-making in this area (e.g. economic, food and water systems). Interactions with cultural systems are also considered here.

> ***Male:*** *Things should be invented and improved.*

Underlying several different preferences is a basic concern that change should lead to ***improvement*** both in terms of socio-technical advances and better quality of life. This connects with the value placed on things like comfort, convenience, control, and freedom. Concerns about some proposed changes, for example around personal transport, emerge because they are seen to threaten these valued aspects of life. This value underpins and helps to explain strong reactions that we found when presenting to people the ideas of eating less meat and flying less, since these represent threats to cultural aspects of UK life that are core to quality – e.g. social interaction, enjoyment, pleasure, relaxation, "experience". Other changes that are seen to pose threats to quality of life and challenge cultural values in some way are likely to meet with similar strong resistance.

The value placed on improvement relates to technological development, particularly around efficiency as an important goal, but also to wider impacts and implications of energy system change in terms of well being. As such, it connects with the view that transitions should be motivated by more than profit-making so as to ensure wider social goals are kept integral to such processes. The scale of energy system change conceived in this way brings into view a broad set of concerns about how transitions should form part of striving for a better world. This is rooted in a core value that the aspiration should be to address problems in ways that represent the beginnings of new trajectories, rather than simply treating the symptoms. This aspiration underpinned some of the concerns that carbon capture and storage and biofuels raised, as it did not represent the kinds of transitions that publics desired. It was therefore configured in public views as a non-transition.

> ***Female:*** *I feel uneasy about it [growing energy crops]… We have a growing population, we haven't got a dying population in the world, people have to live somewhere so that means land is taken up with housing, industries, transport systems, so do we then start buying pieces of land or going to war because we need Africa's bit of land because we're running out of vegetable fuel?*

In sum, thinking in terms of long term trajectories, ensuring changes represent improvement and considering their implications for quality of life are core to public visions of how future energy systems should be developed.

3.0 From Values to Realising Change

The values and principles outlined in section 2 underpin public visions for energy system change; how it ought to occur and what it should be like. These are generalised values derived from the whole dataset and as such do not describe any one person's values at a given time point nor are they universally held by all. Instead, they represent broadly prevalent and recurrent concerns and issues related to particular values, which arose across the datasets.

We stipulate that acceptability of any particular aspect of energy system transformations will, in part, be conditional upon how well it fits with the value-system.

The values set out here in PART 2 can also be used to explain and anticipate public preferences, including potential points of contestation or aspects likely to be supported. This deeper understanding of why people's preferences exist enables a better understanding of how they may develop and change as our energy system changes. Although the values may seem idealistic, they represent core principles to be aspired to and are related to a view of change as occurring over long-term trajectories. It is important to note that thinking in terms of long-term trajectories is in contrast to currently common ways of representing transitions i.e. in terms of particular future time-points.

As it has become evident throughout the previous sections some values/principles are closely linked to specific aspects, elements or technologies, for example development of renewable energy technologies is linked to several of the core values. Others don't fit in a straight-forward way, particularly for more contested aspects of supply (e.g. nuclear power) and more unfamiliar or uncertain elements (e.g. demand side management). However, we assert that the most important message to be taken from this concerns the long-term trajectory toward a system congruent with the values; everything else is negotiated within this longer-term vision and is conditional upon it. For example, whilst a system predicated predominantly on renewable energies is perhaps not feasible as yet, a publically desirable transition could be supported through efforts to show how any intervening developments contribute to this longer-term vision.

When focusing on values in the way we have here, one is oriented to think about how the world should be rather than reflect on or articulate 'the presuppositions about what the world is really like' – i.e. 'worldviews' (24, 25). Additionally, one is not directed to think about social experiences or the context-bound nature of preferences. As such, it is to a discussion of the worldviews of the public, the nature of experiences and context, and how these impact on public perspectives of energy system transformations that we now turn our attention. Through this we show how publics perceive the current situation and how this could affect bringing about a particular vision of change. This includes a role for ***pragmatism*** in achieving forms of desirable change (especially in the short-term), and views on different actors within current energy systems and their ***responsibilities*** in helping bring about change.

Situating Values

3

In this part of the report, we discuss the importance of situating values in relation to other factors which together inform preferences, i.e. experiences, worldviews and context. These are significant as they offer further basis for understanding public responses and how they are likely to manifest in any given real world context.

Important to note here is that tensions can exist between values (how people think things should be), and world views (experiences or perceptions of how things currently are). For example, a person might think energy should be provided as a basic social good but contrast this with their understanding and experience of liberal Capitalist societies and the market-led profit oriented nature of the energy system and energy provision. Publics recognise these tensions both implicitly and explicitly, and it is out of a need to manage, negotiate and balance these that a form of pragmatism arises in public views. This is particularly applicable for elements of energy system change that do not, in a clear way, fall out of the vision or value system (e.g. carbon capture and storage, demand side management).

In addition, the context of particular choices, be it at local levels (e.g. particular places being viewed as appropriate or not) or national scale (e.g. austerity and economic recession), is also important when considering public acceptability of various types of energy system change. We will now unpack these other important factors in the formation of public preferences in turn.

1.0 Worldviews, Experiences and Social Commitments, and Context

Worldviews

We use worldviews to describe public perceptions about reality, i.e. what the world is really like as opposed to how it should be (25,26). Therefore this discussion pertains to public views on the current energy system, its elements and modes of operation, and the implications for bringing about desired forms of change. As such, publics recognise that how the world currently operates is not always in tune with how they believe it should be (the values), and in some cases the current state of things is seen to be on a trajectory far removed from the desired one.

There are two key ways in which public views with regards to how things actually are arise as important for preferences; these are perceptions about how change occurs, and perceptions about different system actors and their ability to bring about change in accordance with the value system.

Perceptions of How Change Occurs

Change is perceived by members of the public as a slow process; this is particularly true with regards to the scale of change implied in energy system transitions scenarios and pathways. For example, the significant changes to infrastructure associated with electrification of transport were perceived as likely to require very long development trajectories. Given this view on how change occurs, publics tended to characterise change in energy systems as incremental, rather than radical. As a consequence of this view of the world, members of the public saw change as occurring over longer timescales than those of currently envisioned transitions (i.e. beyond 2050). This perspective arises out of a conflict between what people think should happen (i.e. radical change of a system) and how they see things currently operating.

Related to this were concerns that energy system change may need to be slower than depicted in some scenarios to help ensure that changes are made in a considerate and coherent way. For example, there was a sense of the importance of maintaining jobs and ensuring work for people through processes of change. This related to conceptions that change would have to be slower than is perhaps desirable to ensure that they do not jeopardise people's livelihoods. In this regard, there is a perceived need to allow time and room for people, places and things like employment opportunities to adapt and change with energy systems.

In addition, there is also a view among members of the public that radical transitions may be difficult owing to the unfamiliar nature of some proposed changes, for example, electrification of heating or automated demand management. This is also linked to beliefs that system actors who could play a role in more radical change were currently unlikely to do so, as for example, when energy companies were in general viewed as likely to stunt or limit change, rather than enable it.

Perceptions of Actors in Energy System Change

This discussion of how members of the public perceive actors in energy system change focuses on the ways that energy companies and government are viewed.

Energy Companies

Publics perceive energy companies to operate in opaque ways. Their primary interactions with energy companies are those associated with receiving bills and sales, including doorstep sales people. Billing information is generally regarded as unclear and offers to change suppliers are often not trusted, particularly in the light of negative experiences with sales people.

In general members of the public do not view the energy market as operating properly – i.e. in terms of ensuring competition and delivering purchasing power to customers. The energy market is viewed as something closer to a monopoly with choice between energy companies making little difference to outcomes in terms of financial cost or service. This results in feelings of relative powerlessness in the face of large energy companies.

The relationship between energy companies and members of the public is one of customer and supplier. Due to this publics do not think that they have recourse to hold energy companies accountable for energy system change or for the implications of not enacting transitions. Closely related to this is that energy companies are seen first and foremost as profit-making entities. Their motivations for acting are thus seen as profit-oriented. Where energy companies are seen to be acting in line with their motives and roles, such as accumulating data on energy usage through smart meters, they are trusted (see earlier discussion). Conversely, when they are not acting in line with their profit motivations (e.g. when they encourage energy saving), suspicion and mistrust arises.

71% **of respondents would be willing to share their smart meter information with their electricity supplier but around half of these (35%) would have concerns as well.**

> ***Male:*** *The energy companies are profit making concerns. I don't know what incentive there is for them to encourage people to save energy that reduces their profits… so obviously they are going to be politically campaigning against it, I am sure there are lots of regulations which could come in which would be against their profit which gets stopped.*

The perceived profit-making motives of energy companies also, at times, make people feel vulnerable to exploitation. For example, for those that had concerns about demand management, proposed measures were seen as an intrusive imposition leaving householders vulnerable to potential abuses of power by those in control. Members of the public were particularly concerned about energy companies potentially abusing the situation, for example, by trying to maximise the amount of energy used by consumers.

Though there is significant distrust, doubt and suspicion, we find that energy companies were viewed as having key responsibilities for transitions but as currently taking only very limited responsibility. There was a strong sense that energy companies should take greater action and be more accountable because they are believed to have been key (financial) beneficiaries of the existing energy system.

Government

Publics perceive government as inconsistent when it comes to energy system transitions and as primarily driven by short-term motives relating to the electoral cycle. Government is also regarded with suspicion; this is connected to a perception that the actions of elected parties do not match their pre-electoral promises and commitments. Compared to energy companies, however, they are viewed as accountable to citizens through the voting system.

54% **attribute responsibility to National Government(s) for ensuring that appropriate changes are made to the UK energy system over the next 40 years. 16% find energy companies mainly responsible, and 13% think individuals and their families are mainly responsible.**

Government was viewed as accountable to citizens for ensuring a good quality of life and for addressing major issues such as those associated with energy system transitions. As such, members of the public feel a greater sense of power in their relationship with government than with energy companies.

However, members of the public positioned government as often conveying mixed signals and only taking limited measures to address energy issues. This latter point is not just about policy trajectories but also the individual behaviours of high profile government officials. Indeed, there is a perception that government should lead by example and move beyond what was sometimes perceived as pure rhetoric.

> ***Female:*** *And going back to the point [refers to other participant] made where you've got that political swinging of the pendulum. It is actually knowing well, what else do you want us to do – you keep telling us this but what do you want us to do, come on give us some ideas and let's do something.*

The government was viewed as integral to any energy system transition. Indeed, transitions of the kinds envisioned by publics were perceived as impossible without government intervention. This is related to the views outlined above on markets and energy companies not being an effective mechanism for delivery but also to perceptions of the need for regulation and incentives to drive change. For this reason, government was seen as centrally responsible for enabling delivery of transitions in ways commensurate with public values (see PART 2).

Experiences and Social Commitments

Values interconnect with people's life experiences and social commitments, for example, their relationships with others, their form of work. Essentially in forming preferences people balance what changes might mean for their own lives. As such, preferences for particular long-term trajectories are continually negotiated in terms of people's everyday experiences.

Experiences in everyday life are important ways of relating to and understanding the world around us. It is therefore not surprising that these influence public thoughts and perspectives on different aspects of energy system change. One prominent example is that of gas central heating systems. Although generally speaking publics prefer a move away from fossil fuels including the use of gas, they also consider their own use of gas as a good way of heating the home. As such, gas affords positive experiences (e.g. control, responsiveness, comfort) that are desired even though gas is not desired *per se*.

Another example extends to the use of wood or coal burners, which can create feelings of nostalgia, comfort, cosiness and security; further bringing a sense of familiarity and liking. Whether these are always in tune with preferred long-term trajectories is not guaranteed and therefore this needs to be balanced against more abstract values for energy system change. As such experiences and feelings often interact with the values outlined in PART 2 of the report. These can be anything from security, comfort and nostalgia to more negative forms such as stigma, due to for example, having a power station nearby.

> ***Female:*** *I love my coal fire, especially when it is pouring down rain outside and you come in and you have got your candles on and your lamps on and you've got a coal fire, there is nothing better.*

Closely related to the above are experiences and social interactions with people and places. These experiences and the resulting relationships generate forms of social commitment that intersect with values in the formation of responses. For example, though a member of the public might prefer wind energy as a form of production, their connections with people living in an area where there is a dispute over the development of a particular wind farm may mean they enact a negative response to the form of energy because they place value on that relationship. Equally if a person was negative about wind energy but a friend or family member was living in an area where there was a positive move to develop a wind farm they may respond more favourably in that particular instance. Crucially this possibility for variation in response does not mean that the person has changed their value position but that they have taken account of the importance of their social relationships. In short, social commitments are likely to affect specific responses but not necessarily preferences or values.

Context

Context is of further significance for understanding public perspectives on energy system transformations. This includes context at local levels as well as national or international levels. In terms of local context, this involves a shift from a more abstract way of thinking about the energy system and its desired trajectory to more concrete and specific ways of thinking about changes. Once transmuted to specific contexts a range of considerations come in to play that are only understandable once the particular situation arises. For example, whether particular places are considered to be appropriate or not for a particular form of change will depend on the specific context.

54% **of respondents oppose the building of a new nuclear power station in their area (approximately 5 miles from their home).**

21% **of respondents oppose the building of a new wind farm in their area (approximately 5 miles from their home).**

Views on appropriateness are, however, anchored to values. For example, a proposal might be deemed unsuitable because the decision-making process is viewed as opaque and unfair with respect to local community participation (26). Alternatively, the specific site, compared to another possible site, may be considered unsuitable by members of the public because it interferes with enjoyment of a particularly valued stretch of countryside in terms of recreation and community activities. As such, the values set out in PART 2 when translated to analysis of particular contexts can offer potential for understanding the emergence of contestation.

> ***Female P1:*** *They can be very intrusive, the wind farms if you live in a small community, they can be very intrusive. That's just my idea.*
> ***Female P2:*** *Well I actually think like yourself that the Fenwick Moor is a desolate place and as far as I care, they can put as many wind farms as they like [murmurs of agreement from others].*
> ***Female P1:*** *That's okay on Fenwick Moor, yes but where my relations live it's very intrusive.*

Considerations of local context are not only relevant when thinking about infrastructure siting but also context-specific place characteristics (e.g. different forms of home). Again public views on suitability of particular changes are important here and these emerge out of an interaction between the particular characteristics of a place or position and the relevant values. As an example, asking people who are currently living in rented accommodation to change their boilers is not considered appropriate because they are unable to enact such a change.

> ***Female:*** *...as I say I wouldn't mind putting mine on during the night but just with the fact the girl that stays upstairs has a wee baby about 3, so I wouldn't even dream of putting the washing machine on because it sounds like a rocket taking off at 2 o'clock in the morning…*

The wider social and political context is also critical in influencing specific public responses to proposed system changes. Here we consider social context in the sense of general conditions at a particular point in time, including economic austerity and recession, and their implications for members of the public, such as rising inflation and stagnant wages. The political context is also important and includes considerations like current political will and accompanying policy debate, policies and actions, as well as potential changes within these, for example through a change in government. The narratives and actions of a particular government will provide signals to publics about their motives and commitments to various forms of change. As discussed in the previous section and expanded further in the discussion, this includes consistency between messages and actions, as well as inaction. Finally, specific national and international events are also likely to affect people's responses, a prime example being the accident at the Fukushima Daiichi nuclear power plant in Japan in March 2011.

How these wider political and social contexts and events affect public perceptions at a given time or place are not always predictable or consistent and they can often be temporary. For example, issue importance and salience of environmental issues generally declines in periods of economic downturn but regains importance in times of economic growth (27). Similarly, although public favourability for using nuclear power in the UK decreased after the accident at Fukushima, it has since rebounded to levels similar to those prior to the accident (28). As such, contextual factors can temporarily heighten or suppress specific concerns. It is of course possible that particular extreme events may shift the focus of concerns or change preferences more fundamentally and permanently; for example, a prolonged interruption in electricity supply would likely heighten concerns over the reliability of energy supply and bring it to the forefront of public concerns. We would, however, argue that the values which underpin people's preferences remain relatively stable having been formed over long periods of time and through cumulative life experiences; the effects of events and context of this kind are therefore important but are unlikely on their own to have long term effects in altering core values.

This section has discussed how public views and acceptability are formulated in relation to and can be conditional upon world views, social commitments, experiences and context. We now go on to discuss the conditional nature of public acceptability, and by extension pragmatism, in more detail.

2.0 Pragmatism and Conditionality

So far we have discussed the values that underpin public preferences for future energy pathways, and how public acceptability will, in part, be conditional upon how well specific aspects fit into this identified value system. Although in the first instance this value-based vision might seem idealistic and naive, we also find evidence for something akin to pragmatism within public perspectives.

Pragmatism arises through the interplay between the values (how things should be) and a need to consider how the world actually operates, how we experience things, and in what context we find ourselves (see previous section).

To clarify, PART 2 clearly laid out public perspectives on future energy pathways in terms of a long-term trajectory and vision, rather than short-term thinking. Yet, short-term considerations are then built into this vision through pragmatism and resulting recognition of the need for compromise. These shorter-term solutions are, however, only acceptable providing the longer-term vision is still considered primary; that is to say, publics are unlikely to settle for a form of change that does not show signs of commitment to the longer-term trajectory. Closely related to this is the conditional nature of public acceptability with regards to energy system change.

In essence, conditionality pertains to how things are positioned against other things; central to this is that most public responses will be some form of comparison. This includes comparisons to existing states of things (e.g. new heating system compared against current heating system), and comparisons to other changes and options within energy system transformations. Furthermore, acceptability or support may be contingent on how something is justified (for example, whether it presents a whole or partial solution). This also includes considerations of the distribution of costs and benefits of a particular change (e.g. effect on local communities).

The reasoning and justification of a particular aspect of energy system change is important in determining public responses. This includes consideration of why it should play a role, why it is needed, and whether there are better alternatives. The ambiguous role for carbon capture and storage is a prime example where publics saw some argument to include carbon capture and storage for certain industries because it will reduce environmental impacts where it is more difficult to transition away from fossil fuels in the shorter term. However, the use of carbon capture and storage for power stations was seen as less acceptable because alternatives to fossil fuels in this context are available (e.g. renewable energy forms).

> ***Male:*** *Like steel and all those, I don't think you're ever going to get to the point when you cut out carbon completely, I think you're always going to produce carbon in some form, and what we're trying to do is get it right down as far as we possibly can get it, so if you have reduced coal and gas power stations and things like that, but you still emit some through steel and that, I guess that would just be a case of, if you stored a load of it together underground, how much harm that's gonna cause, compared to if it was allowed to be released into the atmosphere...*

Elements of energy system change may also be connected more directly with other forms of change. An example of this is evident around perceptions of demand side management, which if positioned as part of enabling a mostly renewable energy pathway is viewed more favourably by publics. Similarly, some supply side options (such as nuclear power) might become somewhat more acceptable if a commitment to renewable energy as the primary supply pathway is evident. As such, pragmatic views are evident in this form of conditionality, where some aspects of change might be seen as more acceptable in the short-term while desirable forms of transitions are developed. Important to note is that these short-term solutions are conditional upon longer-term commitments based on the desired trajectory.

Changes to the energy system may also be conditional upon and connected to other issues such as personal and national (economic) well-being. In this sense, acceptability of particular changes to the energy system might be conditional upon consideration of the consequences for different societal groups. Examples include giving certain job sectors enough time and opportunity to adjust and adapt to the change (e.g. retraining of employees).

This last example also highlights the interconnected nature of public values and beliefs, and that changes to one part of the energy system even if commensurate with some values will always be, in part, conditional upon consideration of other principles in the value system. For example, just because something is environmentally benign does not mean it will be acceptable if it is not also judged to be fair, just and suitable to some extent – all of the values are important, and hence they are all conditional upon each other.



Discussion and Conclusion

4

1.0 Characterising Public Values and Acceptability of Whole Energy System Change

This report represents a comprehensive account of public attitudes, values and acceptability with regard to whole energy system change. Through this synthesis analysis, we have characterised public perspectives as rooted in a deeper value system which underpins preferences and acceptability. This way of understanding public preferences leads to a number of insights and implications for energy system stakeholders. Before we unpack these we first provide an overview of the approach taken and the core messages arising from the analysis.

In PART 1 we summarised public preferences and acceptability with regards to three dimensions of energy system change – supply, demand and institutions. This showed a strong desire for renewable forms of supply and a shift away from fossil fuels, together with a corresponding level of support for demand reduction. We then highlighted the need to look beyond preferences because these are likely to change depending on context, particularly when dealing with highly unfamiliar issues where views are not yet fully formed.

PART 2 focussed on unpacking what underpins and connects preferences. Here we presented a 'social' value system representing the range of values that arose as important for publics across our datasets in the formation of preferences. In combination the values offer means for explaining the observed data in terms of preferences and perceptions, i.e. they hold strong explanatory power for interpreting why people's preferences are the way they are. These are not criteria to be checked off *per se*, but they are core to what underlies and is drawn upon by publics in forming their perceptions and preferences for or against different aspects of change.

We stipulate that acceptability of any particular aspect of energy system transformations will, in part, be conditional upon how well it fits into the value system.

We conclude that meaningful public acceptability may only be achieved if it is rooted, in a significant way, in the described value system. Publics are unlikely to settle for a form of change that does not show signs of commitment to the longer-term trajectories commensurate with the values.

We finish our characterisation of public perspectives on whole energy system change by discussing the importance of situating values in relation to other factors that intersect with them to form preferences, i.e. experiences, worldviews and context (PART 3). We highlight how these other factors offer a further basis for understanding public responses and how they are likely to manifest in any given real world context. Important to note here is that tensions can exist between values (how people think things should be), and world views (experiences or perceptions of how things currently are). Publics recognise these tensions both implicitly and explicitly, and it is out of a need to manage, negotiate and balance these that a form of pragmatism arises in public views.

It is vitally important to consider both preferences and values when thinking through public attitudes to whole system change. However, a note of caution should be issued with respect to the role of pragmatism, conditionality and context. Clearly, these aspects of public preference formation are very important, but they cannot and should not be used to manipulate public perceptions. For example, though it is possible that public acceptability may be garnered for installing more fossil fuel power stations, acceptability is unlikely to be sustained or durable without clear signs of movement towards desirable forms of production, i.e. renewable energy. This relates to the problematic nature of conceptualising public acceptability (or energy system change more widely) in terms of simplistic trade-offs.

Trading-off implies that as long as one side of the issue under scrutiny is addressed, the others will no longer matter; one will be traded off against the more important other. For example, if concern about cost and affordability is higher than climate change and energy security, then as long as cost is addressed the other issues can be traded off against achieving this aim. We caution against this way of considering public acceptability issues and propose that something closer to compromise might better characterise the difficulty that 'trade-offs' invoke i.e. that ideal scenarios are not possible and some things will have to be accepted in pursuit of transitions that may not be wholly desirable. This is where understanding the pragmatism evident in public views is important and where the

significance of setting a course for a long-term trajectory toward desirable change becomes most apparent.

We conclude that meaningful public acceptability may only be achieved if it is rooted, in a significant way, in the described value system. Publics are unlikely to settle for a form of change that does not show signs of commitment to the longer-term trajectories commensurate with the values. However, pursuing energy system changes in ways that are in keeping with longer-term trajectories aligned with public values can form the basis of a social contract for change.

Beyond these core messages our findings speak to several important themes relevant to energy system change; these are scenario development, communication, and social contracts.

Public Values and Scenario Development

To date, much of the research thinking through energy system change has tended to coalesce around the development of scenarios through modelling work (29), although some are combined with a narrative to help nestle the technological components into the social, political and cultural fabric of the projected vision (30). Despite the assertion that '[s]cenarios recognize humans as agents and makers of history' (31), a cautioning principle levied against their production and use is that they often do not fully take into account social and cultural dimensions of change. Instead, it is the case that scenarios become too preoccupied with the technical, overlooking that '[s]ocietal forces have a huge effect in forming and conditioning the development of technologies in numerous ways' (32). Where social dimensions are included, they are often done so in a way that 'involves simplifying assumptions with only tenuous connection to actual theories and evidence' (33). This project has aimed, in part, to redress this imbalance through giving members of the public the opportunity to develop their own visions of the future energy system. To our knowledge, this research is the first which has attempted to explore public views on the whole energy system in a way that goes beyond looking at individual elements, to one which explores how they are tied together and, how changes to the system may impact on everyday life.

Examining the values underpinning public preferences has enabled us to identify key durable aspects to the public vision set out in PART 2. More critically for energy system change, the research presented here has shown how values lead to the development of 'a mutually desirable path forward' (34). Additionally, we have avoided the problem of 'freefloating'; where 'scenarios are developed without invoking a conceptual framework of how the world works' (35). Freefloating was avoided by considering the importance of everyday life including the role of contexts (biographical, geographical, social and cultural). Additionally, in PART 3 (Situating Values), we embed how publics envision the energy system ought to be and change ought to be achieved, within wider ideas of how the system is and how change is likely to be achieved.

Whilst not discounting the importance of intervening target dates (e.g. 2030, 2050), the preoccupation of many scenarios with 'milestones' (36), is somewhat at a counterpoint to how publics envision transitions. **For publics, there is a desire for there to be a focus and commitment to a long-term trajectory commensurate with desire for a sustainable energy system.** This does not discount the importance of technical feasibility, rather it orients us to think using much longer temporal viewpoints; pathways to change to which all decisions, policies, developments and proposals should contribute. For example, whilst a system predicated predominantly on renewable energies is perhaps not feasible as yet, a publically desirable transition could be supported through efforts to show how any intervening developments contribute to this longer-term vision.

A final reflection on the role of scenarios is that they can be used to bring about public engagement with approaches to change and move beyond a focus solely on the problems with current energy systems. Instead, publics are oriented to think through possible solutions and ways forward. For many, whilst at times overwhelming this is nevertheless an empowering process. In addition, using scenario building tools such as My2050 allows for the realisation of what is technically possible. For example, those who expressed negativity towards wind energy on the basis of concerns about efficacy, were immediately confronted with the counterpoint to their concerns – i.e. that wind energy can technically provide enough power – through the inclusion of some technical information. However, despite the obvious benefit of this, one also has to be cautious and reflect carefully on the assumptions built into scenarios and scenario building tools, as such (technical) information can also have a powerful framing influence. For example, in the My2050 tool it is extremely difficult to reach the targets without the inclusion of bioenergy. For our research, the particular approaches employed

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(i.e. facilitated deliberation and inclusion of open-ended questions in the survey) allowed for such assumptions to be problematised by participants.

Communication beyond Verbal Cues

Our research also shows that non-verbal cues (37), that is the 'body language' (38) of institutions and actors involved in energy system change can act as powerful means by which imperatives for change can either be enhanced or diluted. This is particularly true for government given the core responsibilities ascribed to governmental organisations by publics. It is essential that the actions of government, in terms of policy, political speeches, and the personal actions of high profile individual politicians correspond with the core messages concerning imperatives for energy system change. If actions do not match rhetoric, the power of the message is likely to be eroded with publics potentially becoming frustrated and less receptive to expressed sentiments regarding the need for change.

Currently there is a sense that government departments work in silos and suffer from institutional inertia (39,40), leading to perceived contradictions in policy direction within and between departments. The implication of this is that tackling whole energy system change requires new 'institutional arrangements' (41) to ensure that all policies contribute to the long-term sustainable vision. New institutional arrangements may also be required to fully incorporate the values publics desire and indeed the public vision for energy system change (42).

Connections also need to be made between national policy objectives related to energy system change and regional, local, and individual concerns. Typically, local state agencies act as intermediaries; local institutions that interpret and ultimately deliver national regulatory priorities (43,44). Whilst this one way top-down approach has been challenged by many scholars, it is clear that with regards to energy system change, publics do desire to see how local policies link up with national policies, and how these together contribute to the long-term trajectory.

In addition, attention needs to be paid to local contexts and how transitions manifest in place. Whilst it may be recognised that energy system transformation will come about in a series of transitions, rather than as one homogenous shift, publics perceive that often proposed changes are not sympathetic or in keeping with either their local spatial contexts and/or their lives; for example, where those living in quite isolated rural areas are discouraged from using their private vehicles but without suitable public transport provision being put in place. The danger of such contextual *faux pas* is that it risks alienating and disempowering publics. Worse still, is the possibility that there will be a growing perception that policy-makers are not giving due consideration to transitions and the ways they will be achieved.

Previously in the report we outlined how scenarios orientate publics to think about solutions, rather than focusing on the imperatives for change. It is our contention that this approach could be an effective communication tool to help create spaces of reflection for engendering change and encouraging publics to think through how to enact possible changes. We have found this approach facilitated the exploration of possibilities and difficulties for enacting change not only at a general level, but also in meaningful ways that relates to publics' real-world contexts.

Public Values, Responsibility and Social Contracts

The concept of 'social contracts' offers a way of understanding what appears to be the consenting relationship between state and civil society. At its core it relates to the ideal that there is some form of agreement as to the rights, responsibilities, duties and obligations of civil populations and the state. For example, citizens provide resources, obey laws, and so forth, and the state protects citizens by maintaining order, regulating property ownership, and so on.

In the context of imperatives for low carbon transitions, the notion of a new social contract has gained increasing salience (45). Central to this work has been recognition of the increasingly important role of private businesses in taking up aspects of provision (energy being a good example) but without the corresponding formal responsibilities embedded within relations between state and citizens. Developments such as this, along with the imperatives posed by socio-environmental issues, have led to calls for a revised social contract; one that incorporates new actors in the explicit and implicit agreements between state and civil society; that affords greater consideration of the natural environment; and that pays greater attention to the disproportionate distribution of resources and capabilities in a globalised world (45).

As highlighted above clear moves to develop energy system change toward trajectories that align broadly with the public values set out in this report can form a basis for the creation of a revised social contract for transition.

Central to discussion of social contracts is responsibility; this is a key aspect of energy system change that interacts with public values. Though we can understand the values that underpin public preferences with regard to energy system change, questions remain around which actors are responsible for ensuring change and the extent to which changes can be made commensurate with public values. For example, which actors are responsible for ensuring fairness, reducing system risks, and so forth and to what extent? How might different system actors be held accountable?

Currently, energy businesses are not conceived as offering a basis for delivering system changes of the kinds desired by publics. Equally, governments are viewed as only making limited efforts in terms of enabling and delivering transitions. The perception of the efforts being made by governments and energy businesses as limited is important because if the roles and responsibilities of these actors are not perceived as being met, it has implications for the extent to which publics are likely to undertake the newly designated obligations that arise for them in transitions.

Crucial to thinking about social contracts is a recognition that transformations of the energy system are likely to intersect with existing social contracts and that change affecting one side of a contract must necessarily take in to consideration the other. For publics, there are some clearly identifiable areas of resistance which can be revealing in terms of existing social contracts. For example, eating less meat and reducing flying provoked strong negative views. Such responses can be seen as connected to the unspoken reciprocal social contracts between state and citizens. That is to say, things connected to food and flying like relaxing, social interaction, holidaying, form core parts of the things people expect in return for their 'good' citizenship – for working, for paying taxes and so on. Responses like these may be indicative of where one side of a social contract is being infringed upon without moves to address the other side (e.g. work and holidays). As such we assert that any proposed changes to the energy system need to take account of existing social contracts and address the impacts to all parties involved in the reciprocal agreement.

Crucial to thinking about social contracts is a recognition that transformations of the energy system are likely to intersect with existing social contracts and that change affecting one side of a contract must necessarily take into consideration the other.

Public distrust of government and energy companies may be particularly problematic for transitions, as these key actors are not trusted to act in ways commensurate with imperatives for change. Moreover, if they do take steps to act in this way they are likely to evoke mistrust because of the legacy that has been created. This directs us to consider a potential need for regulation, oversight, and or change in, for example, the business models of energy companies, to help rebuild relations of trust. For all actors, there is a need to be clear and transparent about the motives and reasons for enacting any given change.

2.0 Key Messages and Future Research Avenues

Key Messages

- **Publics are willing and fully capable of engaging critically with energy system transformation. Despite the complexity of the research topic publics gave considered responses and as a result offered important insights into their values, attitudes and acceptability.** Policy-makers are advised to provide public engagement opportunities to ensure different perspectives and knowledges are brought to bear on energy system transitions as contexts change.
- **Actors involved in energy system transitions need to treat public viewpoints with integrity valuing the contribution they make to envisioning transitions.** Preferences should not be viewed as something to manipulate and actors should engage meaningfully with the values set out here.
- **Policy-makers and other actors involved in energy system transformation need to make clear how current and proposed changes to the energy system fit within a long-term trajectory.** This includes developing a coherent policy strategy that interconnects different policy areas and scales.
- **Actors involved in energy system change need to ensure that their actions are transparent and mirror rhetoric.** In the case of government this includes the actions of the whole institution, as well as the individual behaviour of high profile political actors. For industry, this includes making clear how proposals for change (e.g. assisting consumers in reducing their energy use) fit with their business models.

If actors do not consider and take into account public values in their decision-making, resistance to energy system transformations or conflict over particular issues is more likely to result.

Research Reflections and Future Research Agendas

This research engaged with core challenges relating to the aim of engaging publics with the whole energy system. At the start of this report we outlined what is meant by the whole energy system with components ranging from energy supply resources, to power stations and other forms of supply, to demand practices and different institutions. In tackling this, the use of the My2050 tool and other resources, such as the scenario narratives and open ended questions in the survey, were successful in achieving engagement and in helping to keep the whole energy system in view. However, there were some identifiable aspects of the system and of system change that presented greater difficulty in terms of engagement. In particular, network infrastructure (e.g. electricity transmission networks) and decentralised energy system configurations.

In relation to infrastructural network change, we found that though some elements were spontaneously raised by publics (e.g. the difficulties of transitioning infrastructure to support electric cars), other aspects were more difficult for people to envisage (e.g. changes to the gas network, pylons for electricity, storage and so on). As such, we suggest that this represents an area of public perceptions research that deserves much more scrutiny. There is existing evidence, particularly focussed upon overhead transmission (26), however as yet, this has not been contextualised through a whole systems framing. Given that some of the changes proposed will have major implications for infrastructural arrangements, it is essential that understanding of public perspectives on these is developed; crucially this should be done in a way that situates infrastructure as part of wider system change.

In terms of decentralised energy systems, whilst the research attempted to engage publics on different configurations of the energy system, this proved difficult beyond exploring reactions to aspects of decentralisation, such as producing their own power (e.g. through micro-renewables). It is notable that even this tended to be situated by participants as additional to a centralised infrastructure. This means that we cannot draw any firm conclusions about preferences for higher levels of decentralisation or the broad idea of a decentralised system. The term decentralisation was not brought up spontaneously by participants and it was rare that related notions (such as micro-generation) were raised as an alternative to large scale energy supply. This perhaps reflects the orientation of the My2050 tool towards trajectories of change aligned with the continuation of the current centralised energy system. Equally, it is possible that decentralisation as a system form is not yet in the publics' consciousness when thinking about

energy system transitions, something possibly reflecting the dominant policy narratives on system change. These reflections lead us to suggest that further research is needed which addresses different and alternative system forms, such as decentralised systems, district heating/electricity schemes, and international interconnections. Additionally, there remain a further set of research questions relating to this around ownership of energy system infrastructure and the different possibilities that alternative configurations provide (e.g. community energy projects, private ownership, corporate ownership).

A key area that emerged as significant through the research was the ways our publics engaged with questions of cost and affordability in energy system change. This includes the complicated issues around how we might finance and pay for transitions to 2050 and beyond. Our research has shown that the cheapest option is not necessarily the preferred option, particularly if that option comes with several undesired characteristics. Further, the research has highlighted that there is a danger of simplistically interpreting public responses to cost as only relating to concerns about higher or lower energy bills. While personal cost is often discussed in policy and the media in such terms, this research highlights the importance of affordability to people, rather than lowest cost *per se*. We show that there are multiple dimensions associated with cost, including the desire to get a fair deal, the importance of long-term stability versus fluctuating costs, trust in energy companies, and the perception of energy as a basic need. Though we are able to show that public concern about cost and affordability is multi-dimensional, the research was not designed explicitly with the goal of exploring public perceptions of this element of energy system change. The emergence of this as a key aspect of public concern, in ways which were more complex than we had envisaged originally, means that this an area that would also benefit greatly from further research.

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