Public Values for Energy Futures: Framing, Indeterminacy and Policy Making

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Abstract

In the UK there are strong policy imperatives to transition toward low carbon energy systems but how and in what ways such transitional processes might be realised remains highly uncertain. One key area of uncertainty pertains to public attitudes and acceptability. Though there is wide-ranging research relevant to public acceptability, very little work has unpacked the multiple questions concerning how policy-makers can grapple with and mitigate related uncertainties in efforts to enact energy systems change. In this paper, public acceptability is identified as an indeterminate form of uncertainty that presents particular challenges for policy making. We build on our existing research into public values for energy system change to explore how the outcomes of the project can be applied in thinking through the uncertainties associated with public acceptability. Notably, we illustrate how the public values identified through our research bring into view alternative and quite different problem and solution framings to those currently evident within UK policy. We argue that engagement with a wide range of different framings can offer a basis for better understanding and anticipating public responses to energy system change, ultimately aiding in managing the complex set of uncertainties associated with public acceptability.

Key words: Public Acceptability, Uncertainty, Energy Policy, Energy transitions

1. Introduction

> '…the UK can move to a sustainable low carbon economy without sacrificing living standards… However, it will require the public to accept new infrastructure and

> changes to the way in which we heat homes, and to be prepared to invest in energy efficiency…' (Department of Energy and Climate Change, DECC, 2011: 12)

In current UK policy it is recognised that major energy system change is required to meet the 2050 80% climate change target and carbon budgets enshrined in the Climate Change Act (2008). Transitions are identified as entailing multiple different forms of uncertainty with one such set of uncertainties pertaining to public acceptability. Here, as the above quote indicates, the uncertainties concern how publics are likely to respond to and engage with system changes. In this paper, we build on our prior research into public values for energy system change to explore how understanding these values is useful for thinking about uncertainties associated with public acceptability in the context of transitions.

The previous research, on which this paper builds, developed a synthesis analysis combining qualitative and quantitative datasets in order to reveal the core values that underlie public perspectives on energy system transformation (see Parkhill et al., 2013). The broad premise for this work was that the examination of public perspectives on complex socio-technical issues requires understanding of what underpins people's views; that is, it requires insight into the more *general* positions that underlie *particular* concerns (e.g. Wynne, 1996; Macnaghten, 2010). The term 'values' was used in the research to refer to these more general concerns which underlay specific responses and denote them as representing salient cultural resources (Douglas and Wildavsky, 1982) that people draw upon in forming their preferences.

To illustrate by reference to this previous research, we found that a strong public preference for solar energy was underpinned by a perception that it is 'renewable' 'fair', 'just' and

'clean'. We argued that what is important in terms of public preferences, then, is *why* they favour something, rather than *what* it is they favour, because were solar energy deployed in a way inconsistent with these underlying beliefs, it would likely no longer be supported or acceptable. In essence, we asserted that characterising and understanding the kinds of values people draw on when evaluating a technology or aspect of energy transitions provides more meaningful insight than simply knowing what public attitudes are at a given point in time. These arguments around public values have been delineated in detail elsewhere (see Parkhill et al., 2013; Demski et al. 2015).

In this article, we now take this further setting out subsequent analysis undertaken to explore how the derived values set could be applied in managing uncertainties inherent to public acceptability within energy policy decision-making. Specifically, we discuss the uncertainties decision-makers face with regards to how publics will respond to energy system transitions and illustrate how applying our understanding of public values can help with anticipating and managing responses.

Through the paper, we will build on existing analyses of knowledge practices (e.g. Leach et al. 2010) to argue that public acceptability represents a form of indeterminate uncertainty where (necessarily) incomplete knowledge means that responses can never be predicted or known fully in advance. In such contexts multiple authors have argued that conventional expert-led approaches are limited and alternatives to understanding and decision-making are required to anticipate outcomes and build resilience with regards to uncertainty (Jasanoff, 2003; Jasanoff and Kim 2013; Leach et al. 2007, 2010; Stirling et al. 2007). Central to creating alternative approaches is an understanding of the ways that different people and groups value different aspects of systems, goals or outcomes, and frame the issues in

fundamentally different ways (Leach et al. 2010; Jasanoff, 2003; see also Bickerstaff et al. 2008; Butler et al. 2013).

We apply the outcomes of our previous research to show that in the context of current UK energy policy relatively narrow framings result in a narrower range of options being considered, which do not reflect the complex and dynamic realities associated with public acceptability. In this way, we illustrate how the public values derived from our research offer a basis for an approach that can be used to interrogate different framings and contingencies, build understanding of likely public responses, and ultimately, anticipate outcomes with regards to public acceptability of energy system change.

In the following, we first discuss how we are conceptualising uncertainty with regards to public acceptability setting out our arguments regarding the indeterminate nature of uncertainties in this area. We then briefly outline the research methods and outcomes reported elsewhere (Parkhill et al., 2013; Demski et al. 2015) as a basis for the subsequent analysis and discussion. In the core analysis section, we first outline existing UK policy framings and approaches to uncertainty with regards to energy system transitions, before moving to illustrate the utility of the public values we have set out for engaging with uncertainties associated with public acceptability. We propose that the values derived from our previous research can be used to address uncertainty about public acceptability by reinterpreting understandings of problems and solutions through a public lens. We conclude by critically reflecting on current notions of public acceptability, and assumptions that appear to underlie some existing approaches to public engagement within energy policy.

2. Conceptualising Uncertainty: Public acceptability and indeterminacy

Uncertainty has been defined and conceptualised in a number of different ways ranging from statistical and modelling based approaches, which generally focus on a quantification of uncertainty, through to typologies and definitions that lend themselves more to qualitative analysis (Adam and Groves, 2008; Pidgeon et al., 1992; Stirling, 2008). Given the nature of this paper, we focus on approaches that aim to define uncertainty, offering typologies and broader conceptual tools for thinking about uncertainty in complex policy contexts (Jasanoff, 2003; Jasanoff and Kim, 2013; Leach et al. 2007, 2010; Stirling et al. 2007; Wynne, 1992).

Several authors have defined uncertainty in comparison to other categories of knowledge (for example, see Callon et al. 2009; Jasanoff, 2003; Knight, 1921; Leach et al. 2010; Smithson, 1989; Wynne 1992). Most of these authors in different ways have distinguished between *risk* and *uncertainty,* as well as delineating further distinctions with regards to different forms of uncertainty, for instance *ignorance* versus *indeterminacy* (Wynne, 1992), *epistemic* versus *aleatory* uncertainty (Knight, 1921). *Risk,* in general, is defined as referring to a knowledge context where relevant factors are well known and can be reliably quantified, as can the chances of different outcomes. *Uncertainty* by contrast tends to be treated as more varied within different categorisations. For some, uncertainty represents a distinct knowledge category to be contrasted with ignorance or indeterminacy (e.g. see Leach et al. 2010; Wynne, 1992). For others uncertainty takes on different forms and is differentiated according to the extent to which it can be reduced or ameliorated (e.g. Knight, 1921; Callon et al. 2009). These different approaches produce similar categorisations for interpreting uncertainty, with most making distinctions between endemic forms of uncertainty and *irreducible* or *indeterminate* uncertainties.

Endemic forms of uncertainty pertain to *insufficiencies* of models, *necessities* to set boundaries thus exogenizing and making invisible certain possibilities, *inaccuracy* of measurements, and other issues that systemically generate *ignorance* as a function of constructing knowledge (Collingridge, 1980; Wynne, 1992; Hallegatte et al, 2012; Smithson, 1989). This form of uncertainty only becomes problematic when commitments to act are built on the knowledge as if the endemic limitations (e.g. boundary setting) that result in ignorance do not exist (Wynne, 1992).

Irreducible or indeterminate uncertainties refer to contexts where the causal chains and networks are inherently open and as a consequence there is no scientific means of establishing causality. Moreover, the factors and parameters salient to the emergent outcomes are largely unknown and unpredictable; they do not merely lack definition in a cause and effect system but are open-ended in the sense that outcomes depend on how a whole range intermediate actors will behave (Wynne, 1992; see also Butler, 2008). Put another way, the uncertainties associated are irreducible due to the nature of complex systems: they arise from fundamentally complex or arbitrary behaviour (Hallegatte, 2012). This severely limits the ability to generate probabilistic estimates of future(s) on which decisions can be based.

We argue here that public acceptability belongs to the category of indeterminacy or irreducible uncertainty because the factors that influence public responses do not merely lack definition within a cause-effect system but interact dynamically with multiple other developments and occurrences. It will, in essence, never be possible to define all of the factors affecting public responses in any given context because the social world is inherently complex and not causally determined. Nor will it be possible to generate probabilistic

estimates of outcomes (in this case of public responses) because the multiple relevant factors at play interact dynamically and are dependent on the particular social context.

This does not mean, however, that nothing can be known about public acceptability in any given context but that the approach to engaging with uncertainty in this area must deliver a basis for interrogation and exploration of multiple different contingencies. In this way a wider sense of the dimensions of incomplete knowledge can be created helping avoid the dangers of applying illusory, control-based approaches (e.g. probabilistic risk analysis) to complex dynamic realities (Leach et al, 2010).

Leach et al. argue that central to creating an alternative approach to decision making under conditions of indeterminate uncertainty is an understanding of the ways that different people and groups value different aspects of systems and goals or outcomes, framing the issues in fundamentally different ways. In contexts where only a narrow range of possible framings are taken into account, analyses and responses are constrained from the outset - too narrow a range of options are considered reducing the ability for pathways to be properly tailored to inevitable changes and surprises that will emerge over time (see Leach et al. 2007; Stirling et al. 2007). These arguments are echoed in other bodies of work such as science and technologies studies (e.g. Jasanoff, 2003) and in the developing arena of responsible innovation (Owen, Besssent, Heinz, 2013), which argue for the need to open up technical assessments to wider social scrutiny and engagement. We are suggesting here that such approaches for tackling uncertainty can have particular applications in policy engagement with public acceptability.

We argue that our research into public values for energy system change is well placed to be applied in elaborating the framings that publics bring to questions of transition and in highlighting alternative pathways. By bringing into view such pathways and exploring the ways in which they contrast with policy pathways, insight into public responses can be garnered that can help to anticipate likely areas of contestation and opportunity. In the following, we will unpack these arguments against the backdrop of current approaches to managing uncertainty within UK energy policy. First, we briefly introduce the research and findings (including the value-set derived from our research) as context for the analysis that will be presented in this paper.

4. Research Background and Approach: Pubic Values for Energy System Change

The project involved three interlinked phases of empirical research. First, energy system scenario and policy analysis along with stakeholder interviews, were undertaken to form an understanding of policy and expert perspectives on energy system change. Second, in order to develop insight into public values for energy system change, two major phases of research were undertaken with members of the British public. Specifically, a series of in-depth deliberative workshops held with publics in England, Scotland and Wales (participant n=68), and a nationally representative online survey (Great Britain, participant n=2,441). Both of these phases of research utilised an energy system scenario tool as a basis for engaging members of the public with the notion of whole energy system change – namely the DECC my2050 tool[1]. The my2050 tool represents a simplified version of the UK's energy system and interactively shows the impact of different system changes on carbon emissions targets and energy security aims (see http://my2050.decc.gov.uk/).

[1] The my2050 tool 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.

A synthesis analysis was undertaken for the deliberative workshops and survey data in order to develop insights that best explained the data as a whole, and provided a coherent account of public responses to energy system change. This was an iterative process involving examining and re-examining, comparing and dissecting data via discussions amongst the research team. The findings with regards to public values were the result of closely examining both the similarities and differences within and between the datasets. Though the research did reveal preferences and identify the key system elements more likely to provoke public contestation (e.g. fossil fuels, Carbon Capture and Storage CCS), by setting out public values for system change the project went beyond this to deliver insight into the deeper ideals and concerns that underpin processes of preference formation. The public values pertaining to energy system change identified from our datasets thus represent a set of general positions that underlay the particular concerns that people held (see Butler et al. 2013b; Parkhill et al. 2013; Pidgeon et al., 2014).

Values that were identified as core to the formulation of public views about energy system change can be summarised as follows: *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 environment and nature* - in sum, being environmentally conscious and respectful of nature through minimising intrusive and destructive processes. Ensuring *security and stability* - in sum, making sure the energy system is safe, reliable and accessible to citizens, both in terms of personal affordability and national availability. *Autonomy and power* - in sum, being mindful of the importance of autonomy and freedom both at national and personal levels. *Social justice* and *fairness* - in sum, developing energy systems in ways that are open, transparent, fair, and attentive to the

effects on people's abilities to lead healthy lives. *Improvement and quality* - in sum, thinking in terms of long term trajectories, ensuring changes represent improvement and considering their implications for quality of life (see Parkhill et al, 2013; Demski et al. 2015). These represent the range of values that underpin people's preferences and perceptions and give insight to how publics think things *should be* with regards to energy system change in terms of both processes and outcomes. They are, therefore, normative and pertain to desirable system change, rather than beliefs about how the world is or 'world views' (see Parkhill et al. 2013; Demski et al. 2015).

Where the previous analysis identified *what* values publics bring to bear on thinking through energy system change, here we introduce further original analysis undertaken to illustrate *how* these values might be useful in guiding energy policy with regards to public acceptability. Systematic and detailed review of current energy policy was undertaken to discern policy pathways and identify key framings. In this, the concept of framing refers to the particular contextual assumptions, as well as the forms of interpretation that different groups bring to a problem, shaping how is bounded and understood. Framings thus constitute storylines or narratives about the problem of energy system change; how it has arisen, why it matters, and what to do about it (see Bickerstaff et al. 2008; Jasanoff, 2003; Leach et al. 2010). This was then qualitatively examined against the public values comparing and contrasting in order to reveal where and how policy and publics framings meet and diverge.

In the following, we first provide a brief overview of current UK policy and approaches to managing uncertainty relating to public acceptability. We then move to discuss the policy framings in relation to the public values, focusing on differences and similarities in framings across policy and publics. We show how the values can be used to highlight a much wider

range of framings that can provide a basis for stronger engagement with system dynamics and uncertainties pertaining to public acceptability than is currently evident within policy.

Through the discussion we use some illustrative data points in the form of quotes and statistics from the deliberative workshops and survey undertaken for the research. The full empirical basis for the value-set found within the research is reported elsewhere (see Butler et al. 2013b; Parkhill et al., 2013; Demski et al. 2013). Here, the intention is to illustrate the application of the value-set as an outcome of the research for thinking about uncertainty pertaining to public acceptability in whole energy system change.

5. Understanding Emergent Un/certainties: Framings in Public and Policy Energy Futures

5.1 UK Energy Policy under Conditions of Uncertainty

Within the 2011 Carbon Plan the UK Government sets out its key policy scenario and approach to delivering energy system transition, identifying the significance of public support for the successful delivery of many core elements of change (DECC, 2011). We suggest that current UK policy problematizes and frames the concept of energy system change in a clearly defined and relatively narrow way. The key drivers for energy system transitions being *climate change* and specifically the carbon targets as defined within the Climate Change Act (2008), *energy security* characterised in terms of national security of supply, and *cost effectiveness* which is to be attained through market mechanisms. The imperatives for transitions are thus situated in these terms with implications for the proposed solutions. For example, the importance of cost effectiveness means that a cost optimised scenario forms the primary focus of policy despite the inclusion of other scenarios (not cost optimised) to account for other aspects of uncertainty, such as in public acceptability (DECC, 2011).

Cost optimisation also sits at the heart of the government's proposed approach to the *process* of transition, which focuses on market competition and a commitment 'to ensuring that the low carbon technologies with the lowest costs will win the largest market share' (DECC, 2011: 9). There is recognition that government intervention will be required in order to bring low carbon technological options into competition with other energy sources, since the current market will ultimately favour unabated fossil fuels as long as carbon is not taken into account in an effective way. For this reason the government proposes intervening up to 2020 to bring Carbon Capture and Storage (CCS), Renewable Energy Technologies (RETs) and nuclear energy into effective market competition. In this sense the government does not set out any firm vision for change, such as 80% renewable energy by 2050 – as is the case within the German *Energiewende* (Bundesregierung Deutschland, 2010) – because they believe that, ultimately, the market will decide the share of any particular low carbon technological option.

The major tenets of the Carbon Plan are thus formulated as being nuclear, fossil fuels (principally gas) with CCS, and RETs on the supply side, along with high reductions in demand. The exact share of these different elements is, of course, extremely variable and highly uncertain but in order to offer some indication of a cost-effective route to change MARKAL modelling is employed to produce a plausible scenario to 2050.

The 'core' MARKAL run produced a cost optimised scenario that can meet the 2050 carbon target, which in essence entails 33 Giga Watts (GW) of nuclear energy, 28 GW of fossil fuels with CCS, and 45 GW of RETs including bioenergy. This supply side scenario is combined with 50% reductions in demand on 2011 levels to be achieved through the development of heat pumps and heat networks, energy efficiency (e.g. insulation), battery electric and fuel

cell vehicles, and reduced use of private vehicles. Though this is stated as representing only one scenario for change it is translated into more concrete form through the carbon budgets, which detail key abatement scenarios through particular time points (e.g. 2023 -2027). The carbon budgets provide benchmarks towards the 2050 target in order to ensure that regular progress is being made and provide a level of predictability for UK firms and households to plan and invest for a low-carbon economy (Committee on Climate Change, CCC, 2014). Currently the UK is in its second carbon budget period (2013-2017) but abatement scenarios that follow through the lines of the Carbon Plan are in place up to the 4th carbon budget (2023-2027).

From looking at both the Carbon Plan and carbon budgets we can see that high levels of fossil fuels remain within the system in 2050. In terms of the timing of CCS deployment, fossil fuels would remain unabated until 2025. CCS is envisaged to be retrofitted from 2025-2030 having been developed for commercial deployment within the current decade and early 2020s (CCC, 2013; DECC, 2012). Gas is expected to continue to dominate the market for heating until 2030 as penetration of low carbon heat technologies develops (CCC, 2013; DECC, 2012).

It is clear that significant public uptake of new transport and heating solutions are essential to meeting the goals, as is public acceptance of the proposed low carbon supply solutions i.e. RETS (including bioenergy and wind), nuclear, and fossil fuels with CCS. In general, the Carbon Plan signals that questions remain around how publics are likely to respond to proposed increases in nuclear energy facilities, whether electric cars and new forms of heating systems will be acceptable, the extent to which increased use of biofuels will be regarded un/favourably, how CCS is likely to be received, and, crucially, which combinations

of system changes are likely to garner the greatest or least support. It is possible, however, to see multiple other inter-related areas of uncertainty that are less technologically focused such as those regarding the public acceptability of different means for financing transitions, governance arrangements, and questions around which approaches to the processes of change are likely to generate support or increase the potential for contestation.

Within policy the extent to which members of the public are likely to accept and enact various aspects of transitions is thus identified as an important area of uncertainty. A key way of addressing this uncertainty is to run alternative scenario pathways to the core cost optimised pathway (see also Eyre et al. 2011). These scenarios incorporate additional assumptions with regard to costs, public responses, and technology development. For example, the alternative scenario entitled "Higher nuclear, less energy efficiency" explores the outcome of CCS not becoming commercially viable, offshore wind and solar showing no significant cost reductions, and low public acceptability of energy efficiency measures. While this represents an important means of engaging with some aspects of uncertainty, we would argue that such an approach does not by itself provide a basis for grappling with the indeterminate uncertainties endemic to public responses and acceptability.

Ultimately, in tackling uncertainties about public acceptability the government highlights the importance of what it terms a coalition for change stating that 'to make this transition, industry, the Government and the public need to be pulling in the same direction' (DECC, 2012). We argue that this process of establishing a coalition is likely to be particularly difficult without engagement with the broader and more diverse set of framings that can be found within public narratives. This policy background represents, then, the context for our argument and forms an important precursor to the following discussion.

5.2. Comparing Public and Policy Framings through Values

5.2.1. The Problem(s) of Energy System Change

As the above discussion indicates, in the UK policy framing there is a quite clearly defined problematization (see Miller and Rose, 2008) which focuses on climate change, energy security, and cost effectiveness formulated in specific ways (e.g. meeting the UKs 80% reduction target for 2050). Through our comparative examination of these policy framings and the values derived from our research, we found that publics incorporated a much wider range of issues within their problem framings. These include concerns about climate change, energy security and cost but also a whole range of other issues. In the following, we work through the key tenets of current UK policy framings and pathways contrasting with public framings that were elicited through our re-examination of the values. We begin with underlying interpretations of the problem of energy system change or, to put it another way, storylines about why is has arisen as a problem and why it matters.

A key area where public and policy framings diverge is related to the nature of the UK energy market. Publics included in their consideration of why the energy system needed to change issues they identified with the existing market system that underpins UK energy production and distribution. In particular, they saw the market system as failing to operate properly on its own terms because they recognised that there were severe limits to their consumer power within current arrangements:

> *Participant 1: ...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*
>
> *Participant 2: 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 particular set of issues relates centrally to the values of *Social Justice and Fairness* and *Autonomy and Power*. Here the problem of energy systems is one which incorporates concern about the particular nature of the market-led system and its perceived under-regulation. It is clear that though cost-effectiveness is central to the policy problem framing and though political discourse, in general, does engage with some aspects of these values (e.g. through strategies to address fuel poverty, or current energy market competition investigations), these matters are not situated as central to that which should be addressed through energy system transition. Within current Coalition policy, at least, the relatively narrowly defined terms for energy system change do not problematize current market arrangements in the ways that publics consistently did.

Publics further situate climate change as just one element within a much wider set of concerns about environment and human/nature relations, as encapsulated in the value *Protection of Environment and Nature*. This value encompasses the notion that the energy system should contribute to (or at least not detract from) the general healthiness and wellbeing of the environment – including society and the biosphere. As such, policy imperatives principally focused on climate change, rather than wider environmental concerns fail to bring into view important – to the public – additional environmental contexts and issues. We argue that as a result, the narrower problem framings found in policy contexts

reduces the capacity for considering a fuller range of responses and for anticipating public responses.

Energy security is also incorporated in public framings alongside cost (effectiveness), though the focus in terms of these issues differs from policy once again in two key ways. First, energy security is situated as part of a set of concerns about *Security and Stability* but in contrast to policy which implicitly locates it at the national level and in terms of energy supply, for the public, energy security is primarily located at the personal level. Specifically, security and stability is connected to the ability to maintain system function – such as taking children to school, eating, going to hospital – while undergoing change (see Leach, 2008). In this regard, it further incorporates issues of cost and energy affordability, i.e. people place emphasis on their ability to afford to use energy and gain access to energy services, rather than only on securing national supplies (e.g. of fossil fuels).

Second, cost is of high concern for publics but this is not related solely to market price and cost effectiveness, rather the issues are situated within the broader frame of affordability. In situating concern about costs in terms of affordability, a wider and different range of solutions to cost issues come into view, such as subsidies for low income households and developments to ensure cost stability over and above lowest cost possible. It is worth adding to this that energy is not currently viewed as particularly affordable, with current energy prices and increasing unaffordability representing a key area of concern for publics (e.g. 73% are (fairly or very) concerned about electricity and gas becoming unaffordable).

> *Participant: 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.*

There are a further set of differences between policy formulation and public framings that emerge around the problem of demand reduction. Though there is congruence around the need to reduce demand (81% of respondents wanted to reduce their energy use), there are differences in terms of how this might be achieved. Specifically, in policy the problem is formulated as one of consumer uptake relating to specific purchasing decisions (e.g. buying electric vehicles), behavioural change and public acceptance of policy and expert prescribed approaches. In public conceptions, by contrast, changes in demand were positioned as requiring a wider sense of the issues and as needing to be situated within a longer-term vision for change. This would provide a basis for locating the calls being made upon citizens to "behave differently" within a broadly formulated narrative about change processes. To illustrate, there was frustration around a lack of communication (both formal and informal) regarding the potential for moves to electrification.

> *Participant: I think [refers to other participant] is right, people are being told different things. I watch a lot of home improvement shows and they always say upgrade the boiler to an energy efficient combi-boiler. If you are trying to encourage people to go to electric shouldn't they be telling them to do that rather than install something which will cost 5-6 grand to have it installed when 20 years down the line you might not have any gas to use it? It is mixed messages getting people to actually understand why they should be doing something with the bigger picture. I doubt most people will actually sit down and talk about it properly, they will just take what they*

think are the facts like in the 70's electric was more expensive but perhaps they don't know.

In this sense public formulations of the *problem* that necessitates energy system change do converge with policy framings but only in a limited way. Centrally, examination of the values highlights a much broader and subtly different set of concerns being brought to bear by publics than those that are central to policy problem framings. This has important implications for the *solutions* that are deemed suitable across policy and public perspectives precisely because 'the activity of problematizing is intrinsically linked to finding ways to remedy it' (Miller and Rose, 2008; 15).

5.2.2 Solutions and Pathways for Energy Futures

In terms of perspectives on responses and solutions, or 'what to do about it', public visions do again converge with policy on some of the key areas, specifically reductions in fossil fuels, increases in RETS (though publics are concerned about the socio-environmental sustainability of biofuels), and the need for reductions in demand. There are also clear differences between public and policy pathways. In terms of supply, publics favour greater levels of RETs, and nuclear energy forms a much smaller part of public scenarios than the main policy scenario – our evidence indicates that support is only likely to extend to replacement rather than expansion. They also favour lower levels of fossil fuels and remain at best ambivalent about the development and use of CCS.

These divergences are explicable when we look back at the problem framings. For example, ambivalence about CCS can be understood when we consider that climate change forms only one small part of public views on what requires changing.. That is to say, when the focus is

on climate change as a problem framing, CCS arguably represents a suitable solution. However, when the problem framing situates climate change as just one element of wider concerns about socio-environmental degradation, CCS no longer constitutes a solution as the other forms of environmental degradation associated with fossils fuels continue to be an issue.

In line with current policy discourse, publics are also favourable toward reductions in demand and they highlight the need for support to achieve this. Where differences arise is the greater emphasis in public visions on regulatory approaches to change, while the policy focus remains on market mechanisms. Market mechanisms were widely held by those involved in our research to be unlikely to achieve the scale of change required because of the high levels of uptake necessary.

> *Participant: There are always going to be a lot of people who don't care about this… they want to get in their car, do what they want to do… it is about educating people, but some people don't want to be educated or don't care, so sometimes you have to force them… incentives and grants are a good idea [though]…*

The nature of problem framings has important implications for the solutions that are proposed. A further example arises with regards to the narrow framing of the problem in terms of climate change, energy security and cost effectiveness. This excludes other issues that were central to public framings, for example, relating to perceptions of the relationship between private, state and civil spheres in the energy sector and responsibility for change. As discussed previously, energy markets were perceived as not operating in the ways that they should. This has implications for the acceptability of some responses in terms of financing

energy system transitions, such as through adding costs on to bills. Participants in the research questioned the fundamental premise that energy system change – a societal good – should be financed through a private mechanism i.e. customer bills. This core concern about the mechanisms through which the energy system is operated and governed, gives rise to a different set of problematizations that have implications for solutions and are also intimately connected with other aspects of system change.

A final important area of divergence between public and policy pathways concerns the process of change itself and how change is undertaken. This connects centrally with the public value of *Improvement and Quality* – embedded within this is a focus on long-term trajectories for change toward systems that are broadly commensurate with the values as an interconnected whole. Public configurations of the challenge, in this regard, did not focus on time points, such as 2050, but on the idea of setting the UK on a *trajectory* toward fundamental change of the kind that is normatively desirable. This was tied to an underlying set of understandings regarding what constituted a 'transition'. Crucially, negative perspectives with regards to CCS and biofuels were often predicated on a view that these were non-transitions in the sense that they did not address the root causes of problems and represented means for sustaining aspects of systems viewed as problematic (e.g. dependency on fossil fuels; global trading of finite and limited resources).

> *Participant: We have been using oil and gas and coal for years and years and we all know it creates smog and all the rest of it… It (CCS) is a cleaner version of that, but the issue is , as far as I see it, we are still using materials that will disappear if we carrying on the way we're using them… it is a difficult one as we are still looking for oil and we may find some big new oil fields that will keep us going for a hundred*

> *years, but we are using the Earth's resources which will run out, so although it's cleaner it feels like it is a short term option… maybe just cleaning up as opposed to let's look at this again and let's look to the future longer term even beyond 2050. It will take a long time to build this infrastructure and all these resources are being eaten whereas there are other energy sources around us which feel a bit longer term, like the sun.*

This notion of a long-term vision is, however, also where the space emerges through which we find latitude for compromise on current and short-medium term system configurations and for addressing the values, which are inherently aspirational. There is significant room for compromise on some of the more challenging aspects of divergence (such as nuclear and to a lesser extent CCS) if these are proposed in the context of a longer term trajectory toward the kind of change that is broadly commensurate with public values (see also Parkhill et al., 2013). Establishing such a long-term vision around which diverse publics can coalesce represents a particularly difficult challenge within the UK context. This is because current UK policy is focused on a market led solution that, by its very nature, does not embed a long term vision for change of a particular kind, rather end points and outcomes are left largely open and for the market to decide.

6. Concluding Discussion and Policy Implications

Through the analysis discussed here, we have opened up understanding of how publics frame energy system change and begun to illustrate how and why public and policy pathways both converge and diverge, as well as highlighting some opportunities to develop constructive compromises. In the discussion which follows we move to unpack what this means for policy engagement with uncertainties relating to public acceptability of energy system transitions.

Overall our analysis is indicative of a far narrower set of framings within policy than those that arise from public perspectives on energy system change. This highlights a closing down within policy around particular framings, with corresponding commitments to particular pathways. Here, we have argued that this is problematic for engaging with the uncertainties associated with public acceptability because it obscures the wider range of framings that are important for UK publics, creating blind spots in the way that the policy-public relationship is understood and managed around energy system issues.

We have highlighted some of the key ways in which publics converge and, crucially, diverge from policy framings, bringing into a view alternative interpretations of the problem and pathways for change. The 'opening up' (Leach et al. 2010) that we have undertaken through this analysis offers in its own right insight important for policy regarding the different ways that publics engage with questions of energy system change. More broadly, however, such an 'opening up' offers a basis for a greater level of reflexivity about and inclusion of different framings within policy. This brings at least two important possibilities for enhancing capacities to engage with uncertainties associated with public acceptability.

First, insights into wider public framings offer possibilities for *anticipating* shocks and uncertainties with regards to the evolution of public views, as things change and emerge in any given context. We know that there is significant contingency around how developments play out in particular contexts; for example, with regards to local contestation about infrastructure development, like fracking, or the enactment of change in the area of energy demand reduction. By understanding where public and policy pathways diverge, provides one

basis from which to interpret why contestation has arisen around any particular set of developments, thus allowing for greater purchase on how to resolve conflicts.

Second, and, perhaps more importantly, the analysis provides possibilities for *engaging* with uncertainties by offering insights important for developing a coalition for change between government and publics (DECC, 2012). In contrast to simply anticipating shocks, informing the development of such a coalition represents a more proactive form of applying the analysis we have presented here. We argue that the creation of a coalition is likely to necessarily involve broadening out from a narrow focus on climate change targets, security of energy supplies, and cost effectiveness to include wider aspects of concern (such as the configuration of energy markets), as well as re-interpreting and re-imagining already acknowledged issues within policy (such as affordability and energy security). Building from a renewed basis in terms of problem framing that accounts for more diverse public values and interpretations, is likely to offer a far greater set of opportunities for convergence on possible solutions. Indeed, constructing a long term notion of where change is heading requires agreement on what needs to be changed in the first instance and on the imperatives driving change. If these broad guiding visions can be put in place then it is likely that greater room for compromise can be found. However, compromise is necessary on both sides – by both political elites and publics. Central to this is a reconfiguration of how public acceptability itself is understood within policy.

Within policy, the understandings of what public acceptability actually means are in themselves extremely narrow, largely focusing on attaining public support for pre-defined and overwhelmingly technological solutions. We argue here, however, rather than addressing the issue of public acceptability as one of building acceptance of and investment in expert

and stakeholder defined pathways, there is a need to engage with public perspectives regarding how the problem itself and the pathways are constituted. The processes associated with understanding, managing and acting to reduce uncertainties with regards to public acceptability, are thus ones that require a different formulation of what public acceptability means; i.e. that it does not simply concern persuading people to accept or support pre-defined problem framings and pathways.

Building from this basis, the task then becomes one of iteratively reformulating problem and solution understandings so that public perspectives are incorporated at the outset and form part of the thinking about pathways toward low carbon systems. This is not to diminish or replace the role of expert understandings but to combine and expand the knowledge bases on which decisions are predicated. Equally, this does not mean that there can be no role for approaches which are less favourable from public perspectives (e.g. CCS) but that engaging with public interpretations in open and inclusive ways that allow for the interrogation of different approaches to change is likely to be of high importance for acceptability of these more contentious options (also see discussion on responsible innovation e.g. Owen et al., 2013).

In line with much previous work, we have argued that framings can not only construct a particular definition of the problem but also, whether explicitly or implicitly, of the kind of solutions that should be adopted. These processes may or may not be strategic, or even intentional, but are fundamentally political in their consequences (see Bickerstaff et al. 2008; Jasanoff and Wynne, 1998; Stirling et al. 2007). This has particular implications in the context of energy system change because the nature of problem framing differs considerably between policy and publics. We have highlighted how opening up framings within policy is

likely to be central to addressing the full implications of dynamics and incomplete knowledge or indeterminacy with regards to public acceptability. Further, we have illustrated how the values set out through our previous research offer a basis for such opening up and argued that this is likely to be required to build a coalition for change which could, in turn, open up possibilities for compromise within public responses. This is because less desirable aspects of system change (such as some continuation of fossil fuels within the system) are likely to be more acceptable in a context where there is a greater sense that the full range of responses and concerns have been considered.

Problematically, at present the current governance context for energy system change does not appear to provide a strong basis for the development of such reflexive and inclusive reinventions. Public views are variously represented in media and political discourse about energy systems as fickle, dogmatic, and irrational (e.g. see Guardian, 2014). This means that engagement with public values and the broader framings that they imply can often be at best very limited and at worst dismissive. Within technological research more broadly, there is perhaps greater cause for optimism in the possibilities for more inclusive, open engagement as the significance of responsible research and innovation, which encapsulates the need for greater reflexivity and inclusivity as outlined above, moves up the agenda of key research funders (see Owen, Besssent, Heinz, 2013). In concluding, we suggest that by engaging more fully with public framings of energy system transitions the possibilities for developing a coalition for change, and realising a more sustainable future energy system, could be significantly enhanced.

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