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

Working Paper

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UKERC is undertaking two flagship projects to draw together research undertaken during Phase II of the programme. This working paper is an output of the Energy Strategy under Uncertainty flagship project which aims:

- To generate, synthesise and communicate evidence about the range and nature of the risks and uncertainties facing UK energy policy and the achievement of its goals relating to climate change, energy security and affordability.
- To identify, using rigorous methods, strategies for mitigating risks and managing uncertainties for both public policymakers and private sector strategists.

The project includes five work streams: i) Conceptual framing, modelling and communication, ii) Energy supply and network infrastructure, iii) Energy demand, iv) Environment and resources and v) Empirical synthesis. This working paper is part of the output from the Environment and resources work stream.

Executive Summary

In the UK there are strong policy imperatives to transition toward low-carbon energy systems. The Carbon Plan (DECC, 2011) represents the current key policy document that sets out the UK Government's proposals for energy system change necessary to meet the carbon budgets enshrined in the Climate Change Act (2008); within this document public attitudes and acceptability are identified as key uncertainties with regard to the development of future energy systems. In particular, it is highlighted that there is little agreement over how to transform the energy system in order to meet climate change targets.

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 (see Parkhill *et al.* 2013) to explore how the outcomes of the project can be applied in thinking through the uncertainties associated with public perspectives.

To inform our analysis, we draw on concepts of uncertainty and framing arising from the work of Leach *et al.* (2010) whereby they argue for the importance of engaging with a wide range of different framings in order to better anticipate inevitable shocks that arise from systemic uncertainties. We highlight how the range of public values identified through our research bring into view alternative and quite different problem and solution framings to those currently evident within UK policy.

In concluding, we argue that incorporating insights into public values within policy 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.

Contents

1. Introduction

In the 2011 Carbon Plan the UK Government set out pathways for major energy system change required to meet the 2050 80% climate change target and carbon budgets enshrined in the Climate Change Act (2008). Within this document transitions are recognised as entailing multiple different forms of uncertainty. One such set of uncertainties is identified as pertaining to public attitudes and acceptability. In particular, the notion that there appears to be little agreement over how to meet climate change targets is highlighted and the need to achieve a coalition for change between publics, government and industry to deal with this uncertainty is signalled as highly important (Department of Energy and Climate Change, DECC, 2011).

Despite recognition of the need for public support, the envisioned pathways within the Carbon Plan are constructed from the perspective of experts and policy makers with only relatively limited reflection on the current state of public views. Significant uncertainties thus remain regarding 'public pathways' for energy system change, the extent to which these are commensurate with policy visions, and what the implications of contrasting perspectives might be in creating a coalition for change.

This paper builds on our research into public values for energy system change to explore how the approach and outcomes of the project can be applied in thinking about uncertainties associated with public responses and engagement in the context of system transitions currently proposed within UK policy. Here we use the term 'values' to refer to the 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 our 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 argue 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.

Recent analyses have highlighted the limitations of conventional expert-led approaches to decision-making in situations where indeterminate uncertainty and incomplete knowledge can be recognized to prevail (Leach *et al.* 2010). Key to the argument we put forward in this paper is that public acceptability represents a form of indeterminate uncertainty where incomplete knowledge means that responses that can never be predicted or known fully in advance. This is not to say, however, that nothing can be known about public acceptability but that an alternative approach to understanding and decision-making is required to anticipate and build resilience with regards to inevitable shocks related to public acceptability outcomes.

Central to creating such an alternative approach is an understanding of the ways that different people and groups value different aspects of systems and goals or outcomes, and frame the issues in fundamentally different ways (Leach *et al.* 2010; see also Miller, 2000; Bickerstaff *et al.* 2008; Butler *et al.* 2013). In the context of current UK energy policy relatively narrow framings result in a narrower range of options being considered, reducing the ability for responses to account for the complex and dynamic realities associated with public acceptability. Here, we will argue that a focus on public values can provide a basis for an approach that can be used to interrogate different framings and contingencies, building understanding of a wider range of problem framings and responses and thus bringing improved potential for tackling inherent uncertainties.

The research, on which this paper builds, developed a synthesis analysis revealing the core values and framings that underlie public perspectives on energy system transformation (see Parkhill *et al.* 2013). This project involved three interlinked phases of empirical research. First, energy system scenario analysis and interviews with key stakeholders 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/).

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. The insights regarding public values derived from this research thus extended beyond examination of preferences offering a deeper level of insight that can be utilised as a basis for understanding *emergent* public responses and engagement. Though the research did reveal preferences and identify the key system elements more likely to provoke public contestation (e.g. fossil fuels, CCS), by setting out public values for system change the project went beyond this to

[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.

deliver insight into the deeper ideals and concerns that underpin processes of preference formation. Planning will always involve uncertainties, especially when dealing with complex, dynamic systems in which multiple actors and contingencies are involved. However, we assert that understanding public values for energy system change brings possibilities for interpreting, explaining and potentially anticipating public responses as they evolve and unfold over time.

In this paper we examine in greater depth how insights into public values can help policy-makers in understanding and engaging with uncertainties associated with public acceptability for energy system change. In the following we first set out key aspects of policy engagement with public acceptability and current policy approaches to managing uncertainty in this context. We then move to discuss how we might conceptualise uncertainty with regards to public acceptability before going on to illustrate the utility of a values based approach for engaging with uncertainties associated with public acceptability and support. We conclude by critically examining notions of public acceptability, and assumptions that appear to underlay some existing approaches to engagement. We propose that uncertainties relating to public acceptability may be engaged with more effectively by giving attention to core underlying public values in the construction of both energy system problems and solutions. Moreover, we argue that understanding public values is likely to be central to achieving a coalition for change as a potentially important part of delivering transitions.

2. Policy in Conditions of Uncertainty: Scenarios and visions for energy system change

> *"This plan shows that the UK can move to a sustainable low-carbon economy without sacrificing living standards, but by investing in new cars, power stations and buildings. 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 that will save money over time." (DECC, 2011)*

Within the 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). The key drivers for energy system transitions are characterised as 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 responses and engagement). Cost optimisation also sits at the heart of the government's proposed approach to transitions, which focuses on the development of effective market competition between low-carbon options.

> *"While the overall direction is clear, major uncertainties remain over both the most cost effective mix of technologies and the pace of transition. The Government is committed to ensuring that the low-carbon technologies with the lowest costs will win the largest market share." (DECC, 2011)*

There is recognition that government intervention will be required in order to bring low-carbon technological options into competition with one another, 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 intervention 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 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 and high reductions in demand achieved through greater efficiency and the introduction of heat pumps and networks, electric vehicles and so forth on the demand side. The exact share of these different elements is of course extremely variable 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.

> *"Attempting to pick a single pathway to 2050 by relying on a single model is neither possible nor a helpful guide in the face of great uncertainty. But it does give insight into the most cost effective way to achieve the low-carbon transition, illustrating the technologies likely to contribute to reducing emissions, and the most cost effective timing for their deployment." (DECC, 2011)*

The 'core' MARKAL run produced a cost optimised scenario for 2050 that 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% (26-43% to achieve 80% target) 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 the through 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 as CCS is retrofitted through 2025-2030 being developed for commercial deployment within the current decade and early 2020s (DECC, 2012; CCC, 2013). Gas is expected to continue to dominate the market for heating until 2030 as penetration of low-carbon heat technologies develops (DECC, 2012; CCC, 2013). 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. bioenergy, wind, solar and other RETS, nuclear and fossil fuels with CCS. In general questions are identified as remaining 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 Carbon Capture and Storage (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 garner support or increase the likelihood of 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 a key area of remaining uncertainty (Eyre *et al.* 2011). A key way of addressing this uncertainty is to run alternative scenario pathways to the core cost optimised pathway. 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. This represents an important means of engaging with uncertainty, however, we argue that such an approach does not by itself provide a basis for grappling with the complexity and contingency that is endemic to understanding 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). This process of establishing a coalition is likely to be particularly difficult without more in-depth forms of engagement with public views.

This policy background represents, then, the context for our argument and forms an important precursor to the following discussion. As we move forward now we take as our starting point discussion of how we can best conceptualise the form of uncertainty that arises in the area of public acceptability in order to facilitate further analysis.

3. Conceptualising Uncertainty: Public values, uncertainty 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 (Pidgeon *et al.*, 1992; Adam and Groves, 2008; 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. We draw, in particular, on Brian Wynne's (1992) distinction between different forms of uncertainty and on the work of the Sussex STEPS centre – Social, Technological and Environmental Pathways to Sustainability (see Leach *et al.* 2007; Stirling *et al.* 2007; Leach *et al.* 2010), applying these ideas together with our own research into public values to set out conceptual foundations for the subsequent analysis.

Several authors have defined uncertainty in comparison to other categories of knowledge (for example, see Smithson, 1989; Wynne 1992; Callon *et al.* 2009). In Wynne's (1992) work he develops such an approach distinguishing between risk and uncertainty but also incorporating categories of ignorance and indeterminacy. For Wynne, as for others, risk refers to a knowledge context where 'the system is well known and the chances of different outcomes can be quantified by structured analysis of mechanisms and probabilities' (1992: 114).

Uncertainty refers to contexts where the system parameters are known but not the probability distributions. Ignorance refers to an endemic form of uncertainty which pertains to the necessity to set boundaries around the questions that are asked the uncertainties that are examined meaning that some uncertainties are always exogenized and thus become invisible (Wynne, 1992 – see also Collingridge, 1980; Smithson, 1989). Wynne suggests, however, that this only becomes problematic when commitments to act are built on knowledge as if the endemic limitations that result in ignorance do not exist (1992: 114).

Indeterminacy is for Wynne also fundamentally related to the process of knowledge production and refers to a context where the causal chains and networks are inherently open but decision-making proceeds as if they are not; as if it is still possible to diminish uncertainty through further knowledge creation. In the case of indeterminacy causation, proof and choice all arise as problematic as 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; also Butler, 2008). 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 in that the responses of publics do not merely lack definition within a cause-effect system but interact dynamically with multiple other developments and occurrences. 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. We suggest here that focusing on broad public values for energy system change rather than specific responses provides the basis for such an approach. Values are defined in the research as broad 'cultural resources' (Douglas and Wildavsky, 1982) that people draw upon in formulating their preferences and responses (see Demski *et al.*, in preparation). Once the pertinent values for any particular issue are understood they can be utilised to interrogate the different ways in which they are likely to interact with other developments and processes in combination.

In their work addressing decision-making under conditions of uncertainty, Leach *et al.* (2007; 2010) have argued that conventional approaches are often poorly adapted to account for the challenges associated with complex dynamic systems where indeterminacy can be inherent. They point to the frequent focus on risk that tends to result in other forms of uncertainty being obscured and to emphasis being placed on attempts to control short term shocks, rather than adapting to short and long term changes by building resilience and robustness. For Leach *et al.* central to creating an alternative approach to decision making with 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 values are taken into account, analyses and responses are constrained from the outset – their very design and organisation means that system dynamics, uncertainty, and multiple perspectives and goals are not sufficiently considered and addressed. This results in too narrow a range of options being considered and reduces the ability for responses to be properly tailored to inevitable changes and surprises that will emerge over time (see Leach *et al.* 2007; Stirling *et al.* 2007). These ideas have particular resonance for the following analysis where we will we argue for the need to incorporate and address public values as a precursor for engaging with uncertainty about public acceptability and a necessary process to developing a coalition for change. We suggest that the notion of building a coalition for change could be seen as representing a basis for resilience and robustness but that the conditions and approaches necessary to develop such a basis are not yet evident within political and policy cultures.

In the following we argue that insight into different value sets brings possibilities for anticipating surprises and engaging with uncertainties. This is because values, unlike

more specific preferences, provide a basis for careful reflection on different forms of change, in different contexts and, crucially, with different forms of interconnection, rather than offering a determinate prescription of what the public response will be to any one change. In the following analysis we aim to illustrate this by using the value set identified in the research to explore public acceptability issues with regards to current policy plans and approaches. As highlighted above, important for this is the concept of framing as different understandings of system dynamics and the different aspects of a system that are valued produce different problem framings and, subsequently, different solutions (Leach *et al.*, 2007).

4. Understanding Emergent Un/certainties: Values and Framing in Public and Policy Energy Futures

As highlighted in the introduction a central focus of the research which we will draw on in this analysis was to go beyond a description of public preferences and views to understand the core values that underlay public responses to proposed energy system change.

In examining public perspectives on complex socio-technical issues it is widely acknowledged that there is a need to examine what underpins people's views as it gives insight into the more general positions that underlie particular concerns. Put another way, if one is to understand emergent public attitudes, it is necessary to pay attention to the 'underlying frameworks and dynamics that are likely to structure their development and evolution' (Macnaghten, 2010, p.24). 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.

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 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 (see Parkhill *et al.* 2013; Demski *et al.* in preparation).

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. They are not values held necessarily by any one individual,

nor universally by all, rather they represent, as highlighted earlier, prevalent identifiable cultural resources (Douglas and Wildavsky, 1982) that people draw upon in forming their preferences for different aspects of energy system change.

The normative basis of the values means that they give insight into both how public(s) view the problem of energy system change and how they view the solutions. They thus offer an alternative set of framings to those central to expert and policy perspectives on system change. In the following analysis we first focus on examining the implications of the value system for problem framings. We compare the values derived from our research with the public against the current policy problem framings in order to show how drawing in these values highlights a much wider frame for engaging with system dynamics and uncertainties and thus considering possible responses.

Through the following discussion we use some illustrative data points in the form of quotes and statistics from the deliberative workshops and survey undertaken for the research (see the introduction to the paper for discussion of the methods). The full empirical basis for the value-set found within the research is reported elsewhere (see Parkhill *et al.* 2013; Demski *et al.* in preparation). Here the intention is to explore 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.

In policy we find clearly defined concerns about climate change, energy security, and cost effectiveness focused on specific aspects of these issues as outlined earlier (e.g. meeting the UKs 80% reduction target for 2050). In engaging publics with the prospect of energy system transitions as they are currently formulated within policy, they bring a much wider range of issues to the fore. These are reflected in the values described above and include issues such as the way that the energy system is at present privately owned and financed, operating within a market system which is seen as failing to operate properly on its own terms.

> *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 relate 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), these matters are not regarded as central to that which should be addressed through energy system transformation. 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. The issue that arises with the narrower problem framings found in policy contexts is that the capacity for considering a fuller range of responses and for anticipating inevitable shocks within public responses is considerably reduced.

Energy security is also incorporated in public framings as is 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 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, for the public, 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 on securing national supplies (e.g. of fossil fuels).

Second, cost is of high concern for publics but this is not related to 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"*

In this sense public formulations of the *problem* that necessitates energy system change do converge with policy framings but only in a quite limited way. In terms of perspectives on responses and solutions public visions also 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 views and policy framings. In terms of supply, publics favour greater levels of RETs and lower fossil fuels and remain at best uncertain about the development and use of CCS. This is explicable when we look back at the problem framings - since climate change forms only one small part of public views on what requires changing, CCS does not work to address the problem framing as it arises from publics. There are also differences in terms of nuclear energy, which forms a much smaller part of public scenarios than the main policy scenario. In particular our evidence indicates that support is only likely to extend to replacement rather than expansion (see Demski *et al.* 2013).

Publics are also open to reductions in demand but they do highlight the need for policy support in line with current policy discourse. Different however, 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.

The nature of problem framings has clear implications for the solutions that are proposed. For example, 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 environmental degradation, CCS no longer constitutes a solution as the other forms of environmental degradation associated with fossils fuels continue to be an issue. 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 issues that were central to public framings relating to perceptions of the relationship between private, public 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. As such there are interconnections between the uncertainties that are present in energy governance (e.g. which kinds of policy are developed) and those concerning public acceptability. For instance, a policy that introduces market reforms which address the issues publics view as existing within current energy markets could represent an important step in building public support and addressing uncertainty about public acceptability.

A final important area of divergence between public values and policy framings 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 responses (and therefore social uncertainties) arise precisely because people do not just care about one or two things, but an interlinked set of concerns that draw in a range of societal, environmental and technical issues. Although one or two concerns may be particularly salient at a point in time or context (e.g. energy price increases), these do not make the others unimportant. This dynamic and contingent nature of public responses is central to the emergent indeterminacy that can be seen to characterise public acceptability.

In this context, the notion of a long-term vision gives the space 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 kinds of change that is commensurate with public values.

Public configurations of the challenge in this regard did not focus on time points, such as 2050, but on the core challenge 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).

Pragmatic views arising from people's understanding of how the world currently is mean that within longer term trajectories there is, however, room for use of technologies and approaches that are less desirable but this is likely to fall apart where no long term vision is evident. This raises a particularly difficult challenge 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.

5. Concluding Discussion: Developing a publically acceptable energy future

The analysis here is indicative of a far narrower set of framings within policy than those that arise from public perspectives. This corresponds with arguments central to the work of Leach *et al.* (2010; 2007) that there is a pervasive tendency – supported by professional, institutional and political pressures – for powerful actors and institutions to '*close down* around particular framings, committing to particular pathways that emphasise maintaining stability and control' (Leach *et al.*, 2010). In this respect Leach *et al.* (2010) argue that addressing the full implications of dynamics and incomplete knowledge or indeterminacy requires an '*opening up* to methods and practices that involve flexibility, diversity, adaptation, learning and reflexivity, and an alternative politics of sustainability that highlights and supports alternative pathways'. Building from this set of assertions, we argue that such an 'opening up', which makes room for a greater level of reflexivity about and inclusion of different framings within policy, is likely to be central to the success of policy-making in terms of its ability to be responsive to uncertainties concerning public perspectives and acceptability.

In this regard we suggest that by incorporating understanding of the deeper values that people draw on to formulate their views about system change within policy development a much wider framing of the salient issues and thus responses becomes visible. This offers at least two key important possibilities for enhancing capacities to engage with uncertainties associated with public views and acceptability.

First, it offers possibilities with regards to *anticipating* shocks and uncertainties with regards to the evolution of public views as things change and emerge in any given context. While examining public preferences gives insight into key aspects of change that are largely favoured by publics (i.e. significant development of renewable energy technologies, combined with a move away from fossil fuels, and reductions in energy demand), we know that there remains significant contingency around how developments play out in particular contexts; for example with regard to local contestation about infrastructure development or the enactment of behavioural change in the area of energy demand reduction. The value system can be used as a basis for both understanding why contestation has arisen around any particular set of developments and thus allow for greater purchase on how to resolve conflicts.

Second, and, perhaps more importantly, the values system provides possibilities for *engaging* with uncertainties by offering insights important for developing a coalition for change. In contrast to the previous point this represents a more proactive form of

utility for public values and responses. We argue development of such 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 configurations of energy markets, affordability, other environmental concerns and so forth. In building from this basis in terms of problem framing, there is likely to be a far greater set of opportunities for convergence on possible solutions. Constructing a long term notion of where change is heading requires agreement on what needs to be changed in the first instance and agreeing on the definition of the imperative 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, 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, that to develop something akin to public acceptability requires engagement with a much wider set of both problem and solution framings. Rather than addressing the issue as one building of 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 in the first instance 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 options. 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 publics now in open and inclusive processes that allow for the interrogation of different approaches to change is likely to be of high importance for acceptability of these more contentious options.

In line with much previous work we have argued that when applied to social and policy problems, framing 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 Jasanoff and Wynne, 1998; Stirling *et al.* 2007; Bickerstaff *et al.* 2008). This has particular implications in the context of energy system change because the nature of problem framing differs

considerably between policy and publics. Drawing on Leach *et al.* (2010), 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. We argue that the values we have set out through our research offer a basis for such opening up if they are given proper consideration within both the constitution of problem framings and the subsequent responses. This could provide a basis for a coalition for change which could, in turn, open up possibilities for compromise within public responses with, for example, less desirable aspects of system change (such as some continuation of fossil fuels within the system) becoming more acceptable in a context where there is a greater sense that the full range of responses and concerns are being considered, and where there is a clear long-term vision for change around which diverse publics can coalesce.

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. In concluding we thus argue that a deeper level of engagement with public perspectives on energy system change is required in order to address the dynamic, indeterminate uncertainties that surround how public(s) will relate and respond to transitions. We suggest that by engaging more fully with public perspectives on system change the possibilities for developing public support, and realising a more sustainable future energy system, could be significantly enhanced.

References

Bickerstaff, K. Lorenzoni, I. Pidgeon, N.F. Poortinga, W. and Simmons, P. (2008). Reframing nuclear power in the UK energy debate: nuclear power, climate change mitigation and radioactive waste. *Public Understanding of Science*, 17: 145-169.

Bundesregierung Deutschland (2010). *Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung [Energy Concept for an Environmentally-Friendly, Reliable, and Affordable Energy Supply]*. Berlin, Deutschland: Bundesministerium für Wirtschaft und Technologie (BMWi) und Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) (Federal Ministry for Economy and Technology, and Federal Ministry for Environment, Conservation, and Reactor Safety).

Butler, C. (2008). Risk and the Future: floods in a changing climate. *Contemporary Social Science: Journal of the Academy of Social Sciences*, *3*(2), 159-171.

Butler, C., Parkhill, K. and Pidgeon, N. (2013). *Transforming the UK Energy System: Public Values, Attitudes and Acceptability – Insights from Qualitative Deliberative Workshops, Full Report.* London, UKERC.

Butler, C., Darby, S., Henfrey, T., Hoggett, R. and Hole, N. (2013). People and Communities in Energy Security in Mitchell C, Watson J, Whiting J (eds.) *New Challenges in Energy Security: the UK in a in a Multi-Polar World*, Basingstoke: Palgrave.

Callon, M. Lascoumes, P. and Barthe, Y. (2009). *Acting in an Uncertain World: An essay on technical democracy*, Massachusetts: MIT Press.

Demski, C., Spence, A. and Pidgeon, N. F. (2013). *Transforming the UK energy system: public values, attitudes and acceptability – summary findings from a survey conducted August 2012.* London: UKERC.

Douglas, M. and Wildavsky, A. (1982). *Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers*, Berkeley: University of California Press.

Committee on Climate Change (2013). *Fourth Carbon Budget: The cost effective path to the 2050 target*, CCC: London.

Department of Energy and Climate Change (2012). *CCS Roadmap: Supporting the development of carbon capture and storage in the UK*, DECC: London.

Department of Energy and Climate Change (2011). *The Carbon Plan: Delivering our Low-carbon Future,* DECC: London.

Eyre, N. Anable, J. Brand, C. Layberry, R. Strachan, N. (2011). The way we live from now on: Lifestyle and energy consumption, in J. Skea, P. Ekins and M. Winskel (eds.) *Energy 2050: Making the Transition to a Secure Low-carbon Energy System,* London: Earthscan .

The Guardian (2014). Fracking opponents are being irrational, says Cameron, Patrick Wintour, 14 January 2014. Available at: www.theguardian.com/politics/2014/jan/14/fracking-opponents-irrational-says-david-cameron

Leach, M. (ed.) (2008). *Reframing Resilience: A Symposium Report*, STEPS Centre Working Paper. Available at: http://steps-centre.org/wpsite/wp-content/uploads/Resilience.pdf

Leach, M. Scoones, I. and Stirling, A. (2010). *Dynamic Sustainabilities: Technology, Environment and Social Justice*, Earthscan: Oxon.

Leach, Melissa, Scoones, Ian and Stirling, Andy (2007). *Pathways to Sustainability: an overview of the STEPS Centre approach.* Documentation. Centre for Social, Technological and Environmental Pathways to Sustainability (STEPS).

Macnaghten, P. (2010). Researching technoscientific concerns in the making: narrative structures, public responses and emerging nanotechnologies. *Environment & Planning A* 42: 23-37.

Parkhill, K., Demski, C., Butler, C., Spence, A., Pidgeon, N. (2013). *Transforming the UK Energy System: Public Values, Attitudes and Acceptability – Synthesis Report,* London, UKERC.

Pidgeon, N.F., Hood, C., Jones, D., Turner, B. and Gibson, R. (1992). Risk perception. Ch 5 of *Risk – Analysis, Perception and Management: Report of a Royal Society Study Group*, London, The Royal Society, 89-134.

Smithson, M. (1989). Ignorance and Uncertainty. Springer-Verlag: Berlin.

Stirling, A. (2008). Science, precaution, and the politics of technological risk. Converging implications in evolutionary and social scientific perspectives. *Annals of the New York Academy of Sciences*, 1128. pp. 95-110.

Stirling, A., Leach, M., Mehta, L., Scoones, I., Smith, A., Stagl, S. and Thompson, J. (2007). *Empowering designs: towards more progressive appraisal of sustainability.* Working Paper. Centre for Social, Technological and Environmental Pathways to Sustainability (STEPS).

Wynne. B. (1992). Uncertainty and environmental learning: Reconceiving science and policy in the preventative paradigm, *Global Environmental Change* 2(2):111-127.