UKERC
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UKERC Decision Making

Rethinking energy participation as relational and systemic

Scoping note

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The UK Energy Research Centre

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The Decision Making Theme of UKERC

The Challenges in Energy System Decision-Making theme is comprised of three distinct but interconnected sub-themes:

1. *Governance and key challenges at the system level:* analysing the interactions of system-level decisions and those of distributed actors, including through use of methods for appraising and making decisions in complex systems.

2. *Key challenges in understanding actor decision-making:* improving our understanding of how distributed actor decisions impact on energy systems, through routine practices, investment decisions and in system balancing.

3. *Systemic interactions:* exploring key interactions of decision-making in energy systems with other natural and infrastructure systems.

The combination of the three sub-themes provides an innovative approach to studying whole systems decision-making by studying the crucial interplay of decision-making by those actors who have responsibility for the national energy system, but also by distributed actors within that system and by actors in other related systems.

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1. Introduction

In this UK Energy Research Centre (UKERC) project[1] we are developing new perspectives on energy participation and societal engagement with energy systems. The project is rethinking participation in energy transitions from a relational and systemic perspective, through drawing on cutting-edge social science insights, some of which currently lie outside of the energy field. This initial scoping report lays out the conceptual justification and framework for a forthcoming systematic review, which will then inform the design of experimental participation processes around UK energy transitions in the final part of the project.

This research is needed for many reasons but two in particular stand out, relating to the changing character of energy challenges. First is the rising importance of societal dimensions and accounting for the roles of citizens in tackling energy issues. Where once citizens would have been primarily viewed as passive consumers removed from the energy system, concern is increasingly orientated to the societal dimensions of energy transitions and the relations between energy and people (e.g. Butler, et al., 2014; DECC, 2014; Miller et al., 2013; Milne, 2011; Pidgeon et al. 2014; Sovacool, 2014; Winskel et al., 2015). With worries about the challenges raised by multiple over-lapping energy crises (e.g. Chevalier & Geoffron, 2013), diverse expressions of public dissent and dissatisfaction around energy decisions at multiple levels (e.g. Barry, 2013; Laird, 2013; North, 2011; Seyfang et al., 2010), and increased government interest in techniques to change people's energy behaviours or understand their opinions (e.g. Owens & Driffill, 2008), what publics think, know, say and do has become a central concern of energy research and policy.

Second, at the same time it has become increasingly apparent that energy research and policy has to urgently move beyond siloed and compartmentalised approaches – that attend to aspects of energy supply, demand, distribution or governance in isolation – towards a 'whole systems' perspective that can account for interrelations and independencies across energy systems and scales of decision-making (Skea, 2006; Skea et al, 2011; Hammond & Pearson, 2013). This is crucial in an era of low carbon energy transitions where energy systems are becoming more distributed and interconnected, not just within nation states but also in terms of global networks and flows. This kind of 'joined-up' thinking – as reflected in the setting up of the UK Energy Research Centre itself and other large projects like the ESRC-funded Nexus network which makes connections between water, energy, food and the environment – is pushing the challenges of interdisciplinary and transdisciplinary working to its limits, demanding new relationships within and between the physical, natural and social sciences, and with wider society.

[1] This Project 5.1 on 'Systemic Participation and Decision-making in Energy Transitions' forms part of UKERC's third phase of work, under Theme 5: key challenges in UK energy system decision-making.

It is the coming together of these dual pressures - the need to account for societal dimensions of energy issues and the need for a more systemic approach - that forms the distinctive rationale for this project. In short, the project starts out from a contention that dominant approaches to public and societal engagement with energy transitions are struggling, and in some cases failing, to address these two imperatives. When it comes to accounting for the social, 'the public interest', or practices through which people imagine, know and act in relation to energy systems, dominant approaches – in the form of deliberative processes, public opinion surveys, behaviour-change interventions, and so on – tend to adopt fixed or pre-given meanings of what it means to participate which underplay and fail to represent the diverse, complex and continually emerging ways in which people are engaging with energy transitions in material and on-going ways. There is a need for approaches to energy participation which can take account of this complexity and dynamic nature of public engagement, instead of creating static representations which do not fully reflect the situated realities on the ground (Asdal & Marres, 2014; Chilvers & Longhurst, 2012; Chilvers & Pallett, 2015; Marres, 2012; Walker & Cass, 2007).

Yet, even if this is overcome, meeting the aforementioned systemic imperative is currently being undermined by the siloed and compartmentalised approach taken by most approaches to energy engagement. In this respect, while the natural and physical sciences and some interdisciplinary modelling approaches have been more comfortable pushing forward a whole systems approach to energy research (e.g. Foxon, 2013; Pye et al., 2015), on the subject of societal engagement with energy systems dominant social science approaches remain fragmented, each attending to specific parts of 'the system' through their theoretical orientations, methods and forms of empirical evidence. For example, behaviour change studies tend to centre on the workplace, the home and efforts to reduce energy demand; public opinion research and deliberative democracy approaches focus on sites of invited public deliberation and questions of 'social acceptability' that feed in to government and industry decision-making; whereas social movement studies and transitions management approaches respectively hone in on sites of protest/activism and sites of technological innovation. Such compartmentalisation is undermining the ability of social science work on societal engagement with energy to address systemic imperatives and constructively contribute to interdisciplinary and transdisiplinary energy research and policy.

So in order to meet the challenges set out above there is a need to develop approaches that better attend to the construction, complexities, and emergent forms of energy participation, and the ways they form part of diverse and interrelating ecologies of participation that make up (and influence) wider energy systems. One possible response is to call for the simultaneous use of multiple approaches to societal engagement with energy or to integrate them in some way (see for example: Whitmarsh et al. 2011; Wilson & Chatterton, 2011). From the perspective of this project the problem is much more deep-seated than this. It lies

in the observation that most dominant approaches to societal engagement in energy-related issues have a **residual realist** understanding of the public and participation – that is to say they adopt pre-given models of *who* participates (in terms of interested publics, consumers, innocent citizens, and so on), *what* is at issue (i.e. the energy-related issues in question, most often framed by incumbent science and policy institutions), and the *how* of participation itself (i.e. the specific format of participation - such as an opinion survey, deliberative process, or social marketing process) (cf. Wynne, 2006, 2007; Chilvers & Kearnes, 2015). Publics are viewed as existing in an external natural state, waiting to be known and moved through social science methods. Participation is seen as occurring in isolated one-off events. This diverts attention from the ways in which energy publics and forms of energy participation are constructed, in particular settings, for particular ends (cf. Irwin, 2006). This is not to say that such approaches cannot provide useful evidence for policy and society. But when it comes to meeting the above challenges of social representation and systemic interdependencies they are found wanting.

In this project we bring in two novel perspectives from the social sciences in order to address these challenges and radically rethink what it means to participate in energy transitions. We draw on and synthesise cutting edge thinking about practices of public engagement with science, technology and the environment - some of which lies outside of the energy field - which is taking forward **relational** and **systemic** approaches to participation (e.g. Callon et al. 2009; Chilvers & Kearnes, 2015; Jasanoff, 2011; Marres, 2012; Shove et al. 2012; Watson, 2012). Relational perspectives see energy participation (in terms of the who, what and how of participation) as emergent and constructed through the performance of collective participatory practices. They provide the resources to open up to the diversities, complexities and multiple productions of participatory practices across energy systems. Systemic approaches to participation – which are in themselves nascent, and in some respects developed for the first time in this project – allow actors to move beyond a narrow imagination of participation as one-off events linked to energy policy to conceive of interrelating 'ecologies of participation' that make up wider energy systems and political constitutions (Chilvers & Kearnes, 2015).

2. A comparative review of approaches for understanding and intervening in energy participation

In order to lay the foundations for the next stages of the project, this initial scoping report is based on a wide ranging, but highly selective, comparative review of approaches to

understanding and intervening in public engagement with energy transitions. We make a distinction between three the main ways of understanding and accounting for energy participation introduced above, namely: *residual realist* approaches which see publics and modes of participation as static and pre-given; *relational* approaches which see publics and participation as continually emerging through the performance of complex and shifting collective practices; and *systemic-relational* approaches, which take account of multiple interrelating ecologies of energy participation in different contexts and settings, and how they relate to the stabilities of wider systems and constitutions. In this section we summarise highlights of the reviews for each category of approach, with reference to the more detailed reviews and evidence provided in the Appendices to this report. A summary comparison of the key assumptions and distinctions between the three approaches is provided in Table 1 and referred to in the following passages.

Table 1. Key features of residual realist, relational and systemic approaches to energy participation.

	Residual realist	**Relational**	**Systemic (relational-ecological)**
Publics are…	Fixed, external, pre-given	Emergent, socio-material, situated	Multiple, multivalent, interdependent
Publics act as/through…	Autonomous individuals	Heterogeneous collective practices	Multiple interrelating collectivities
Participation is…	Isolated, one-off, discrete events	Co-produced, experimental	Ecological, diverse, interconnected
Object(s) of participation…	Closed, specific, pre-given	Open, emergent, overflowing	Multiple, entangled
Relation between participation and change	Linear, cause-effect	Non-linear, recursive	The outcome of multiple swarming vitalities
The problem of participation is one of…	Extension	Relevance	Reflexively steering
'Good' participation is…	Inclusive, representative, independent	Reflexive, anticipatory	Responsive, responsible, constitutional

Residual realist approaches to energy participation

Dominant approaches to public engagement around energy generally have a focus on consumers, and many have a specific concern with behaviour change whether that is through market mechanisms, social marketing approaches, or 'nudges'. Centrally

orchestrated consultations and public attitudes surveys are the most commonly used methods for eliciting public views on pre-defined policy issues. However, in a number of cases these methods are also supported by more participatory or deliberative processes, engaging with a smaller number of citizens.

Though these approaches are perhaps surprisingly diverse, they share several important and potentially limiting characteristics, in the ways in which they have currently been put into practice around energy policy. First, though they result from different conceptual origins, under the terms of this review we establish that all exhibit a residual realist understanding of participation and the public seeing both as pre-given, external to the energy system, and existing in a natural state waiting to be known and moved by social science methods (cf. Chilvers and Pallett, 2015). Secondly, all of these approaches conceptualise participation and engagement as discrete, one-off events, which only occur at particular sites and at particular times in energy systems. Each approach, in a different way, thus closes down meanings and imaginations of what it means to participate in energy transitions, and limits the potential representations of publics and possible visions of energy futures. Thirdly, the ways in which these approaches are often performed in energy research and policy largely upholds a *centralized* and *top-down* model of the energy system (Stirling, 2014), whereby realist forms of energy participation are used either explicitly or implicitly to gain public views that feed into decisions made by so called 'high-level' actors in government and industry, or to change public behaviours to bring them into line with dominant policy framings.

We offer a more detailed analysis and comparison of what we call residual realist approaches in **Appendix A**. Approaches included in our initial review include: public attitudes (psychology), deliberative democracy, behaviour change (economics), behaviour change, (psychology and behavioural economics), social movements, transitions management, and media studies. A comparative summary of key features of these residual-realist approaches is given in Table 3 (Appendix A) with respect to their assumptions about the who, what, how, why, and where of participation.

Relational practice-oriented approaches

Rather than seeing publics merely as collections of individuals, as residual realist perspectives do, relational practice-oriented perspectives instead view public engagements with energy-related issues as always occurring through the performance of heterogeneous collective practices. Even a single person never participates alone, but always through collective practices comprising networked relations with material elements, infrastructures, technologies, knowledges, meanings, other people, policy instruments and so on. Under this view key dimensions of energy participation, including public identities and form of

participation itself, are constructed through the performance of participatory practices rather than being simply assumed and pre-given. For example, authors have variously explored the ways in which the what (e.g. the issues under discussion - see Irwin, 2001; Marres, 2007), the who (the participating publics or participants - e.g. Braun & Schultz, 2010; Irwin & Wynne, 1996), and the how (the method or organisational form - e.g. Laurent, 201; Lezaun & Soneryd, 2007) of participation are shaped and brought into being through collective participatory practices. Taking this view radically opens up what participation is and could be, allowing the symmetrical identification of diverse participatory practices – ranging from sites of activism and political protest, government consultations, to everyday practices, consumption and more – rather than assigning very specific definitions of participation a priori as residual realist approaches do.

Appendix B offers a more in depth analysis and comparison of different relational approaches to understanding and intervening in participation with science and technology. Some of these approaches are mainly analytical, focusing on understanding the dynamics of (energy) participation. Science and technology studies (STS) approaches to participation, growing out of developments in actor network theory (including object-oriented approaches, technologies of participation, ethno-epistemic assemblages), have taken practices of public involvement in issues relating to science and the environment as their focus, each offering slightly different explanations over what brings participatory collectives into being (Chilvers & Longhurst, 2014). Social practice theory (SPT), which has become quite well established as a relational approach in energy research (and to a lesser extent policy), has focused for the most part on everyday social practices which use energy (Shove & Walker, 2014). The focus has not been on practices of public engagement per se, but this does not mean the practices that form the object of study in SPT could not be framed in this way. Exploration of the synergies and creative tensions between STS and SPT approaches to energy participation stands to be a fertile area of development within this project and beyond.

Some relational approaches are more interventionist in emphasis, bringing forward new ways of doing energy participation in more experimental, anticipatory and reflexive ways. The partial and indicative range of approaches included in our review include: collective experimentation, speculative design, and Deliberative Mapping, Though these have differences in emphasis and focus, relational approaches to doing participation all acknowledge and are reflexive about how forms of mediation – whether by a researcher, engagement practitioner, policy-maker or any other actor – actively construct and shape emergent participatory practices and their products (in terms of who participates, how, and what is at issue), often in unintended ways.

Systemic-relational approaches

Relational approaches to participation help us to understand the diverse and emergent collective practices through which publics participate in energy transitions in particular settings, most often through discrete case studies. So while they achieve major breakthroughs in attending to the emergent, complex and fluid nature of energy publics and participation – and thus have the potential to better account for the societal dimensions of energy-related issues – relational approaches have to date been less good at addressing the systemic imperative outlined in the introduction. Practices of participation in energy (or anything else for that matter) never occur in isolation. They are always entangled with, are shaped by, and shape other collective practices and the energy systems or political constitutions in which they are situated (Barry, 2012; Chilvers & Longhurst, 2012; Marres, 2007). The second innovation that this review advances is to incorporate recent developments that are seeking to build more systemic perspectives on participation and societal engagement in socio-technical change. Here we draw upon co-productionist scholarship in STS (Jasanoff 2004), work on the democratic implications of socio-technical system transitions (e.g. Hendriks, 2009; Laird, 2013), new thinking on systems of practice (Watson, 2012), and deliberative systems (Parkinson & Mansbridge 2012).

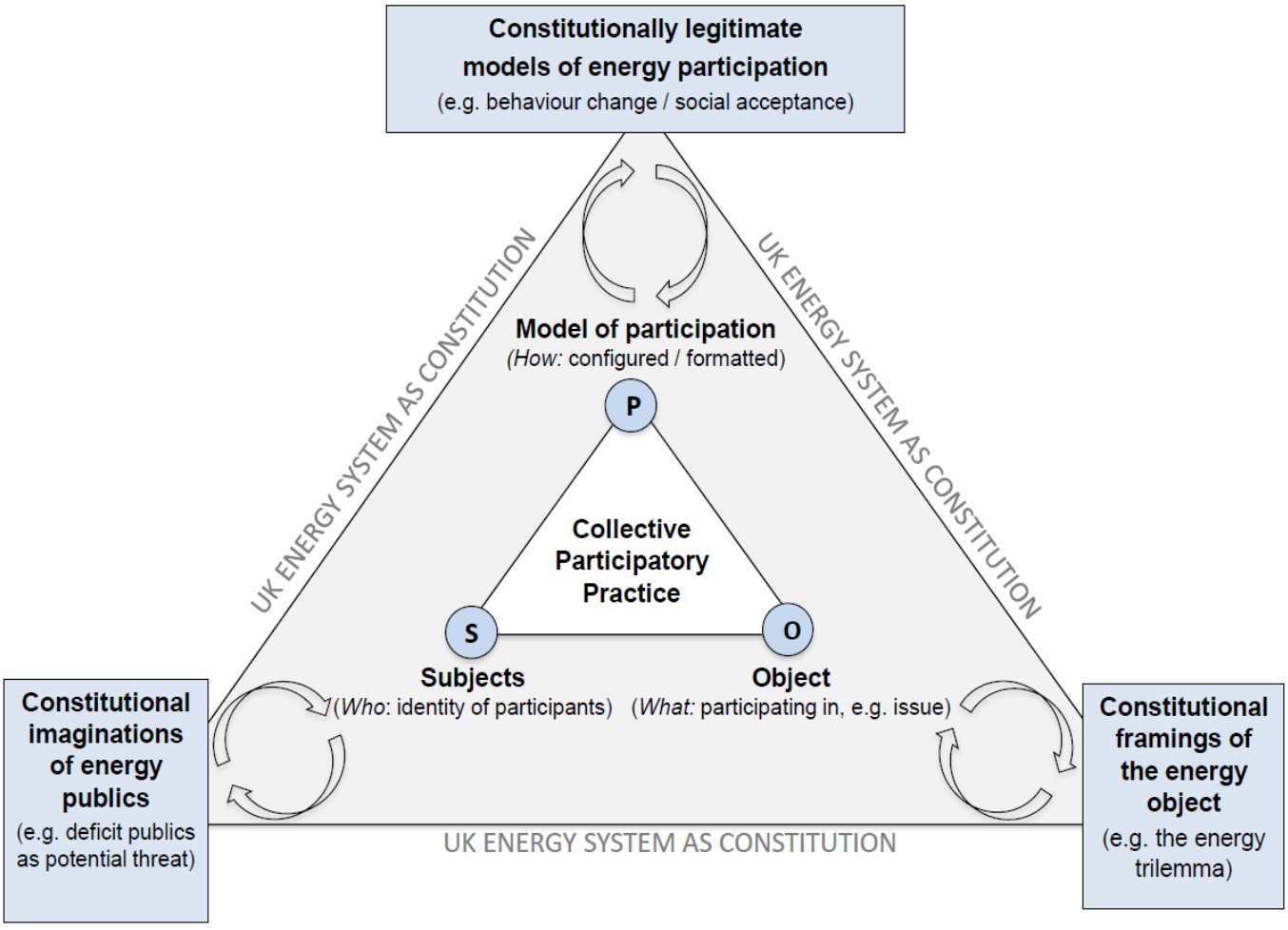
Such work is moving beyond understanding the co-production of collective participatory practices in particular 'events' or at particular sites within systems. Rather it attempts to understand the interrelations between ecologies of participation and their co-production (how they shape and are shaped by) the orders and constitutions of which they form part (whether we conceptualise these as energy systems, issue spaces, political situations, nation states, landscapes, organizations, or other potential containers) (Chilvers & Kearnes, 2015). The relational-ecological vision we propose still encompasses the normativities and collective practices of engagement we have described related to the realist perspectives above, as well as those that overflow from these approaches. In **Appendix C** we show our analysis and comparison of different systemic and constitutional approaches to energy participation to justify our choice of a relational co-productionist framework as the basis for our analysis.

3. Developing a relational co-productionist framework for energy participation

On the basis of the above reviews, in this project we will develop a relational co-productionist framework for understanding and intervening in energy participation. This framework builds on and further develops the co-productionist approach to participation developed by Chilvers and Kearnes (2015). This approach brings together relational

understandings of participation as diverse practices in the making (outlined in above and Appendix B) and conceptualises their co-production and dynamic interplay in relation to stabilities of the energy systems that they form part of (what we term the constitution[2], drawing on systemic-constitutional approaches from STS as described above and in Appendix C). An initial illustration of this framework is provided in Figure 1.

Figure 1: A framework for understanding the co-production of situated collective participatory practices and the UK energy system as constitution.



The small triangle at the centre of the diagram represents situated collective participatory practices through which publics engage with the energy system. Following the review of relational STS approaches to participation in Appendix B, the centre triangle signifies diverse

[2] By constitution in this instance we mean the ways in which relations between citizens, science and the state in particular democratic settings are held together in constitutional configurations – comprising, for example, established institutions, laws, economic arrangements, infrastructures, policy cultures, as well as all other collectives that make up the constitution being studied – which are historically contingent, highly durable, yet subject to moments of transformative change (see Jasanoff, 2011).

forms of participation, which are both shaped by and are productive (have effects) in relation to: (i) the ***object or issue of participation*** (as emphasised in STS object-oriented perspectives, e.g. Marres, 2007); (ii) the ***model of participation*** (as emphasised by STS technologies of participation perspectives, e.g. Lezaun & Soneryd, 2007; Laurent, 2011); and (iii) forms of human mediation, the ***construction of subjects*** and public identities (as emphasised by more organic or 'bottom up' readings of participatory action, e.g. Irwin & Michael, 2003; Felt & Fochler, 2010).

All forms of participation, represented by the middle triangle in Figure 1, are made up of elements on these three key dimensions (P, S and O). For example, the performance of a deliberative participatory practice centred around the issue of fracking would comprise a co-production of heterogeneous elements, including existing deliberative techniques, methods and devices like a citizens' panel model (*model of participation*), the enrolment and disciplining of participants that can engage in 'good public talk', like innocent citizens with no prior knowledge of the issue (*subjects of participation*), and material elements such as discursive framings of the fracking issue or hydraulic fracturing technologies (the *object(s) of participation*). In turn, the performances of participatory practices are productive on these three dimensions (i.e. P, S and O). Each situated participatory practice will produce particular models of participation, construct public identities, and definitions, visions or commitments relating to the issue in question (which become fixed through the analysis, reporting and publicity of the deliberative event, which – to follow the example through – allows the views and framings of 'fracking publics' to circulate around the world and be taken up as evidence). Each collective participatory practice within a wider system (denoted by the small triangle in Figure 1) will always be different. This is because what gets produced depends on the particular material settings, knowledges, devices, meanings, and configurations of human and non-human actors that make up a collective participatory practice.

What is important about the central triangle in Figure 1, then, is that it does not predefine the who, what and how of participation, but rather is seeks empirical understanding in every instance of how these dimensions are made through the performance of collective practices. Its analytical value is to open up to the shear diversity of participatory practices through which publics engage in energy transitions, and allows them to be directly compared to each other. The number of ways in which UK publics engage with or are entangled in energy transitions on any given day is seemingly innumerable.[3] The central triangle in Figure 1 offers a symmetrical framework for exploring the construction and production of diverse forms of participation that exist in a given setting, such as an energy system. It allows us to

[3] Spanning information campaigns, through their roles as energy consumers, behaviour change programmes, social marketing initiatives, everyday practices that use energy, social media, eco-homes, interactions with smart energy technologies, community energy schemes, consultation processes, opinion polls, planning processes, infrastructure siting, activism and protest, public demonstrations, lobbying, investment decisions, the co-design of energy technologies, open innovation processes, hacker spaces, and so on.

introduce an open and agnostic ***definition of public participation as heterogeneous collective practices through which publics engage in addressing collective public problems (in this case 'energy-related' issues), whether deliberately or tacitly, which actively produces meanings, knowings, doings and/or forms of social organization.*** As we go on to explain, this becomes a key the unit of analysis in our systemic review, which will develop case studies of diverse 'collective participatory practices' across the UK energy system. Thus the relational practice-oriented approaches we have described provide the basis for a systematic review and symmetrical comparison, but they very much represent a 'flat' ontology, which pays less attention to broader stabilities and processes.

This is where the outside triangle of Figure 1 comes into play, which is the second important unit of analysis in our framework and project. Whereas the inner triangle represents the performance of diverse practices of participation, the outer triangle represents the inherent stabilities of the UK energy system which act upon, channel and shape emergent participatory practices (but are also recursively effected by these distributed agencies). The purpose of the outside triangle in Figure 1, representing the UK energy system as constitution, is to explain the co-production of situated participatory practices in relation to the constitutional stabilities of the UK energy system that they form part of.[4] In other words, how diverse situated participatory practices are shaped by – and in turn shape – UK system-wide stabilities with respect to the most commonly identified objects, models, and subjects of energy participation.

The relational co-productionist framework identified in Figure 1 therefore requires us to lay out a basic understanding of the broader constitutional stabilities that we understand the participatory collectives under study to be interacting with, though this picture will be refined and added to throughout the systematic review and later empirical work in this project. With reference to ***constitutional framings of the energy object*** (see figure 1), a clear dominant framing of the energy system or problem in the UK is in the terms of the energy trilemma of climate change, energy security, and inequality (e.g. UKERC 2014; Watson et al., 2014). This way of thinking clearly influences the framing of energy issues in the dominant realist approaches to participation described above (cf. Owens & Driffill, 2008), which tend to be focused on one or more aspects of this trilemma.

In terms of ***constitutionally legitimate models of energy participation*** (located in the top corner of Figure 1) Owens and Driffill (2008) and Shove (2010) have noted the dominance of

[4] In this sense we have described how systemic-constitutional understandings of energy participation contribute novel insights on the spaces and conditions beyond individual events of participation that shape their performance, as well as drawing out the interrelating ecologies of different energy participation processes. In line with the systems of practice and relational STS approaches set out above and in Appendix C, we recognise this relationship between participation processes and broader spaces and conditions as a recursive and co-productive relationship, constantly being remade and contested through practice, where each has the potential to reshape the other.

behaviour-change approaches in UK Government engagements with citizens around energy, arguing that this vision potentially precludes other forms of engagement and ways of viewing citizens. More recently Jones et al. (2013) have described the emergence of a specifically paternalist mode of behaviour-change – including 'nudge' approaches – in UK policy-making in energy policy as well as other domains, starting with New Labour and being strongly adopted by the coalition and conservative Governments from 2010 onwards.

The planning system is also a significant mechanism for citizen engagement around the energy system with regards both to the siting and adoption of different energy generation technologies, as well as the broader infrastructures sustaining the energy system. Several authors have shown how planning procedures and actors adopt particular assumptions or imaginaries of the public, for example as NIMBYs, which influences how they interact with citizens and make decisions (e.g. Barnett et al., 2010; Cotton & Devine-Wright, 2010; Walker et al., 2010; Walker & Cass, 2007). Furthermore, processes of devolution in Wales, Scotland and Northern Ireland have had further implications for energy planning, requiring complex overlapping participatory processes at various scales. However, whilst devolved administrations have in some cases attempted to create radically different goals and procedures within their energy planning systems, these changes have been limited to some extent by UK-wide systems of planning and subsidy (Cowell et al. 2015).

Deliberative democratic methods of engagement remain significant in UK Government decision-making around the energy system, in particular those undertaken by Government departments with support from the Sciencewise programme (cf. Pallett & Chilvers, 2013) or Research Councils (e.g. Chilvers et al. 2005). The framing of these approaches, usually in terms of behaviour change, attitudes or acceptance, reflects overflows from other dominant approaches to energy participation; though there are also unacknowledged connections between such processes and public protests and controversies such as those around shale gas extraction.

In terms of ***constitutional imaginaries of energy publics*** the conventional role available to citizens in deliberative participation processes has been variously described as the 'innocent citizen' (Irwin 2001) or the idiot (Lezaun & Soneryd 2007; Horst & Michael 2011), assuming the involvement of citizens with no prior knowledge of or opinions related to the issue under discussion. The so-called deficit model has been critiqued and disavowed since the early 1990s for presenting a false model of the public as having no knowledge or prior understandings of scientific issues, and a simplistic understanding of behaviour change by assuming that the public would support Government decisions once they had a better understanding of 'the facts' (e.g. Wynne, 1993). However, it has been argued that the deficit-model is so entrenched in the scientific and political establishment that it gets continually re-invented, for example as a deficit of public trust or understanding of scientific methods (Wynne, 2006). Relatedly, Welsh and Wynne (2013) have described a more general

imaginary of the public in the UK as a threat to Government security, accompanied by the increasing surveillance and policing of participatory collectives such as protests. They argue that this is implicitly linked to concerns about dangers to the authority of science itself, which is an important source of Government legitimacy. This argument begins to explain why certain participatory collectives are not listened to (cf. Dobson, 2014) or remain out of sight of formal institutional acknowledgement, highlighting the politically charged nature of our project in revealing diversities of energy participation and developing a more systemic understanding.

At this point, an important reflection is that the framework explained in this section provides us with a very different take on 'systemic participation' than that put forward by the realist perspectives outlined above. Rather that seeing systemic participation as the invited participation of small groups of deliberative citizens in discrete events to debate and envision the energy system (which then feeds into decisions made by governing actors), our framework offers a radically distributed model of the energy system, where everyone and everything contributes to its stabilities and emergences, with respect to visions, knowledges, social organization, and trajectories of change. Given that this is a project for UKERC with a UK focus, we take the nation-state here as the primary container of the ***energy system as constitution***. In doing this, however, we also acknowledge the existence of multiple cross-cutting material, regulatory and imaginative spaces operating both 'above' and 'below' the level of the state - from decision-making institutions like the EU (e.g. Jasanoff, 2005b), to flows of energy related materials (e.g. Barry, 2013) and framings of the energy problem (e.g. Barry, 2012), or even clusters of particularly dominant models or 'technologies of participation' (cf. Lezaun & Soneryd, 2007) – which represent other important spaces of participatory coherence which intermingle with(in) the UK energy constitution.

This review represents the first time that UKERC and the broader energy research field have addressed what it means to conceive if participation from a 'whole systems' perspective. Taking the lens of participation and engagement allows us to adopt a symmetrical and systemic approach – without the project becoming an unmanageably large study of all social practices that make up the energy system. Our project also provides a broader framework for other projects in UKERC Theme 5 to relate to and fit within. In contrast to other projects within theme 5 we do not adopt a straight-forward decision-making framing, as we wish to emphasise the diversity of ways people can participate in the energy system beyond formal decision-making contexts.

The vision of whole-system participation we outline here, moves us from understanding participation as a 'problem of extension' where the burden is placed on publics to engage with, change, get in line, or respond to trajectories and definitions of 'the energy transition' defined by others (most often institutional authorities, whether that be science, the state or

industry). It recasts the challenge as a 'problem of relevance' where the problem is one of incumbent institutions (and to some extent publics themselves) accounting for the relevance of diverse and already existing forms of participation and engagement that make up the energy system and its future (cf. Marres, 2012; Wynne, 2007). In short, the move is from seeing systemic participation as simply about eliciting public views on energy systems in invited events, to seeing it as a challenge of mapping the diversities, relations and productions of already existing forms of participation across energy systems. This shift of emphasis, to recognise distributed agencies in the form of collective participatory practices, potentially provides the basis for breakthroughs in how we tackle issues of equity, inclusion, institutional responsiveness, and social change, with regards to participation in whole energy systems.

4. Systematic review

Theme 5 of the UK Energy Research Centre's third phase of work focuses on key challenges in UK energy system decision-making and includes three main subthemes; namely, i) energy system governance and deliberation, ii) decision-making by individual energy system actors, and iii) the implications of systemic interactions for decision-making processes. In this project 5.1, within this broad theme, we *aim to explore conceptually, methodologically and empirically what it means to think about public participation and engagement in energy transitions from a relational 'whole systems' perspective.* The project has two parts:

1. A **systematic review** of the diverse forms of participation and public engagement in UK energy system transitions in terms of their co-production, systemic relations and productive effects;
2. To undertake new empirical research in the form of one or more **participatory experiments** to map distributed appraisals of UK energy transitions.

This scoping note has set out the basis for the systematic review. An overview of the systematic review process is provided in Table 2.

Table 2. Overview of the systematic review process (adapted from the typical process for UKERC systematic reviews).

Review Stage	Actions
1. Scoping the key issues and framing of the review (March – June)	• Conduct initial review of the literature • Articulate analytical framework and questions • Write scoping note
2. Solicit feedback and expert input (July)	• Appoint expert panel • Solicit feedback on scoping note and review plans
3. Finalise review criteria and collate literature (July)	• Finalise definition of screening criteria and questions for the systematic review • Collate corpus of literature and evidence for the systematic review
4. Synthesis, analysis and prepare draft report (July-October)	• Finalise selection of evidence and case studies through applying screening criteria • Detailed and transparent analysis of empirical evidence
5. Peer review and feedback (November)	• Gain peer review and feedback from expert panel and wider community
6. Publish and promote (December)	• Finalise design of report, publish and promote through launch activities

An organising principle of our systematic review is to attend to *diversity*. We are interested in mapping diverse collective practices of energy participation across the UK energy system and in each case establishing how they form, what they produce, how they interrelate and link up with the wider system as constitution.

The focus of our review will be on a series of cases of collective participatory practice, identified through a systematic review search. We will conduct our search using electronic databases of the academic peer reviewed literature (e.g. Web of Knowledge, Scopus), employing specific search strings which draw on advice and feedback received from the expert panel. We will begin with the initial search terms of 'energy + public + participation', each of which represent the three corners of the triangle in our relational framework presented in Figure 1. These three dimensions become objects of inquiry as we ask how they emerge and are co-constructed through different processes. Synonyms for each of these terms will be derived with reference to our initial reviews summarised in Tables 3 (Appendix A) and 4 (Appendix B), producing further combinations, e.g. 'renewable energy + activist + social movement', 'smart + consumer + behaviour change' or 'energy policy + citizen + deliberation'. This will allow us to open up and explore diversity on the three dimensions of collective participatory practice that the project is interested in.

We will use this search methodology to build a corpus of energy participation case studies to form the basis of our review. Papers will be further screened according to three criteria:

- first, the amount of empirical evidence presented – in order to allow for in-depth (re)analysis;
- second, the quality of the paper – judged in terms of whether it has been peer-reviewed and the way its methodology has been detailed; and
- third, to achieve as great a possible diversity of different energy participation processes in the corpus.

Though quality is a key screening criterion, it will be important to include grey literature at least in the initial corpus, in order reflect the diversity of current research and practices. Furthermore, we may also need to access additional grey literature to gain a fuller understanding of processes which have been studied in the academic literature. This literature and documentary evidence will be sought in consultation with the expert panel and through supplementary Google searches.

We will analyse around 40 case studies, depending on the size and the diversity of the corpus we generate in the initial stages of the review. Our analysis of each case study will be guided by key questions that we aim to address with this systematic review:

1. **How do diverse collective participatory practices come about what do they produce?** Here we are interested in the factors contributing to the emergence and justification of participatory practices in the UK energy system and what they co-produce in terms of:
    a. Issue framings and visions of the energy system,
    b. Material commitments,
    c. Public identities, and
    d. Models of participation.
2. **How are collective participatory practices entangled and interrelating?** Here we the are interested connections between ecologies of participation including the potential 'containers' of participatory practices, such as groupings of technologies of participation or particular issue spaces, as well as broader patterns or connections which may be identified.
3. **How do collective participatory practices interact with features of the wider energy system as constitution?** Here we are interested in the mutual constitution of situated participatory practices and the energy system itself.

Appendix A: Residual realist understandings of energy participation

Our analysis shows that many dominant approaches to understanding energy publics and energy participation reflect residual realist assumptions about the public and the nature of democracy, in the ways in which they are put into practice around the energy system. That is not to claim that these approaches are wholly realist, in fact many of the approaches we discuss – aside from behaviour change economics and some branches of behaviour change psychology – are constructivist in orientation. Rather, these approaches take for granted the who (the participating subjects) and the how (model) of public engagement with energy, presuming these categories to be fixed and pre-given, rather than actively constructed through the performance of participation.

Crucially, by adopting realist assumptions about publics and participation such approaches fail to take account of the diversity of energy publics and modes of participating, by unreflexively producing the public they expect to encounter through the design of the process itself and by excluding other actors (cf. Wynne, 2006). This construction or imagining of particular kinds of publics has been noted in the STS literature across a range of public engagement settings (e.g. Braun & Schultz, 2010; Irwin, 2001), and has been significant in the energy field in studies of wind farm siting controversies which have countered the simplistic narrative of NIMBYism (e.g. Barnett et al., 2010; Cotton & Devine-Wright, 2010; Devine-Wright, 2011; Walker & Cass, 2007). Thus, whilst realist approaches to energy publics and participation reflect an increasing range of settings and modes of participation, they still represent a limited number of roles for citizens and participation with regards to the energy system, and are further limited by the strength of their framing assumptions about the nature of the public – for example as rational self-interested consumers or as obstinate NIMBYs. Increasingly, empirical evidence from more relational approaches to studying participation discussed in Appendix B (below) indicates that energy publics take much more diverse and shifting forms than accounted for in realist approaches.

Table 3 provides an illustrative, rather than comprehensive, overview of some of the dominant residual realist approaches to energy participation that we have analysed. Each approach is described below in more detail. We highlight in particular their fixed visions of the who (publics), the what (issues and objects) and the how (models) of participation, but also demonstrate the relationship between these elements and particular rationales for energy participation, and specific sites in the energy system that form the focus of each approach. We recognise that some studies categorised under the different approaches we have put forward will not fit these descriptions, and indeed it would be possible to identify further approaches to energy publics and participation which could also be characterised as producing a realist vision.

Table 3. Summary of residual realist approaches to energy participation

	Who (Subjects of participation)	What (Objects of participation)	How (Models of participation)	Why (Purposes of participation)	Where (Sites of participation)	Key examples (references)
Public attitudes (psychology)	Large, demographically representative sample of 'the public'	Institutionally pre-framed energy issue (according to government, industry, science)	Stating fixed attitudes through survey instruments, questionnaires, etc.	To understand public concerns about science and policy to identify information needs and gain public acceptance	Aggregated populous	Corner et al. 2011; DECC, 2015
Deliberative democracy	'Innocent citizens', participants capable of ideal speech	Pre-framed issue, most often institutionally mediated	Invited, deliberative, 'mini-public', consensual	To feed into formal decision-making	Formal decision-making points	Butler et al 2013; Stagl, 2005; Sciencewise website
Behaviour change (economics)	Rational individuals, consumers	Individual energy-use behaviour (efficiency or conservation)	Deficit model, individuals driven by information and market mechanisms	To encourage rational individual decisions to use less energy	Consumption behaviours/ the market	UK Government Green Deal
Behaviour change (psychology and behavioural economics)	Predictably irrational individuals/social groups, consumers	Individual energy-use behaviour (efficiency or conservation)	Individuals driven by attitudes, values, emotion, social norms, context and habits	To encourage predictably irrational individual decisions to use less energy	Consumption behaviours	Dolan et al 2010; Jackson 2005; Thaler and Sunstein 2008
Social movements	Active citizens	Symbolic public issue	Agonistic, organic, uninvited	Broader social goals	Beyond formal institutions; sites of public protest, demonstration and activism	Saunders & Price, 2009
Transitions management	Stakeholders, forerunners	Future visions of the energy transition, regional-scale management plans	Invited, dialogic, based on fixed interest groups	To feed into transition management plans	Emphasis on material infrastructures and technologies	Loorbach 2010
Media studies	(Passive) audiences	Print/online media	Media as key interests shaping public views and actions	To inform and persuade	Wider public sphere / discourse	Romanach et al 2015; Kim & Kim 2014

Public attitude surveys

Public attitude surveys have been widely used by policy-makers and academics to understand public views of energy, for example relating to nuclear power (e.g. Corner et al., 2011; Mah et al., 2014), biofuels (e.g. Cope et al., 2011; Delshad & Raymond, 2013), wind energy (e.g. Karydis, 2013; Kontogianni, et al., 2014), and climate change skepticism (e.g. Engels et al., 2013). Furthermore, the Department for Energy and Climate Change (DECC) currently tracks public attitudes to different aspects of the energy system, including energy bills, energy security and different energy technologies, on a quarterly basis (DECC, 2015). This approach entails recruiting a demographically and statistically representative sample of the population and asking them a consistent set of questions – primarily multiple choice – to elicit their attitudes on certain topics. These results are analysed using statistical methods in order to ascertain levels of public support or concern around certain issues, or increasingly to identify through more complex methods particular groupings of the population in terms of the relationships between particular demographic characteristics and their attitudes. Thus the public this approach envisions is an aggregated population, made up of autonomous individuals differentiated by demographic characteristics, such as gender, age and level of education. Furthermore, the participants in these surveys are viewed as holding static opinions and attitudes to be elicited through research, rather than attitudes which may shift over time, in different contexts, or in relation to the manner of elicitation (cf. Asdal & Marres, 2014; Desrosières, 1991). As this is a top-down method of engagement that allows for little dialogue between the questioner and the questioned, the objects of this form of participation will always be energy issues as defined by incumbent institutions in (social) science, government, industry and/or the media.

Whilst public opinion surveys have in many instances been used successfully to bring public voices in to energy debates, for example around fracking or domestic energy providers, alone they can provide a partial and unreflexive representation of 'the public'. The model of participation adopted is predicated on participants stating fixed attitudes in response to questioning, reflecting no contingency or uncertainty, and being unable to record any challenges to this initial framing or understanding of participation (cf. Wynne, 2007). The purpose of this method is clearly to record public attitudes at one point in time, but attitudes surveys are also used implicitly to attempt to identify potential areas of future controversy in policy decisions and emerging technologies, predicated on the assumption of reasonably stable public views which straight-forwardly influence behaviours and actions (cf. Shove, 2010). Public attitudes surveys do not necessarily focus on one particular part of the energy system – for example, infrastructure or the home – however, they implicitly focus on accessing the public sphere or public discourse, imagined as being separate to the technological and policy elements of the energy system.

Deliberative democratic processes

Deliberative democratic approaches to energy participation have been increasingly adopted by UK policy-makers (cf. Irwin, 2006; Miller, 2001). For example, public participation processes are carried out with reference to the acceptability of particular energy technologies (Lock et al. 2014; Einsiedel et al. 2013; Turcanu et al. 2014), as well as broader questions about the energy system (e.g. Butler et al., 2013; Pidgeon et al., 2014). Scholars also continue to develop new methods for ensuring high quality deliberation, drawing increasingly on digital technologies (e.g. Dvarioniene et al., 2015; Wiese, et al., 2014). Furthermore, the UK Government-funded Sciencewise programme has conducted public dialogue processes on a range of energy-related questions, including the 2050 decarbonisation targets (Sciencewise n.d.) and shale gas extraction (TNS BMRB 2014). Instead of attempting to engage a large sample of the population these approaches focus on achieving a depth of dialogue and deliberation, enabling a small number of participants to learn from experts and from each other during the process and thus potentially to shift their attitudes and contribute new ideas on the topic under discussion. Thus they envision a public able to engage in complex reasoned argument, in contrast to public opinion surveys. However, participants are generally limited to being what has been characterized as 'innocent' or disinterested citizens, i.e. parties with no prior knowledge of or interest in the issue under discussion, precluding the participation of groups like environmental activists or so-called NIMBYs (cf. Irwin, 2001). Such processes are focused on topics defined not only by government interests, but also tend to be linked to specific decisions or decision-making contexts, limiting the ability of the participants to challenge the framing. This also means that these public inputs do not take place at any point in the energy system, but rather are limited to discursive spaces of public deliberation that feed into formal decision moments. A key factor in determining the credibility and legitimacy of such processes comes down to establishing a level of agreement between the participants at the end of the process, reflecting a consensual rather than agonistic vision of democratic practice (cf. Tewdwr-Jones & Allmendinger, 1998).

Behaviour change economics

Until recently, behaviour change economics was the primary if not only approach adopted by the UK Government to understand and orchestrate public engagement (understood broadly) in the energy system. From this perspective, the energy public (the subjects of participation) is seen as an aggregate of individual energy 'end-users' who make more or less rational decisions about how to consume energy through their everyday behaviours. These end-users are assumed to be self-interested, rational utility maximisers who evaluate different ways of behaving against their personal preferences. To do this, they are understood to process information about the costs and benefits of different courses of action in order to come to rational decisions about how to behave (see Wilson and Dowlatabadi 2007; Shwom

and Lorenzen 2012). The object of participation in this perspective is individual energy use behaviours which can take the form of either energy efficiency decisions (e.g. purchasing more efficient appliances or installing insulation) or energy conservation behaviours (e.g. encouraging people to switch lights off) as these are understood to be the principal if not only ways that publics engage with the energy system. The model of participation taken in this approach is premised on intervening in individuals' decision-making processes by either changing the costs of particular behavioural options (e.g. making energy inefficient behaviours more costly) or by providing end-users with more information about the impacts of different courses of action (e.g. educating consumers about the link between energy use, carbon dioxide emissions and climate change). The purpose of this approach is to reduce energy demand by changing market signals such that it becomes rational to engage in energy efficiency or conservation behaviours. Taken together, this approach positions public participation in the energy system as occurring in the market through end-users' consumption behaviours and purchasing decisions. Whilst much has been done to develop beyond this simplistic understanding of behaviour, it still underpins the more consumer-focussed aspects of UK energy policy whether through attempts to provide end-users with more information (e.g. energy labelling of appliances, energy feedback through in-home displays etc.) or to provide financial incentives to adopt particular technologies (e.g. Feed-in-Tariffs, the Green Deal etc.).

Behaviour change psychology

Increasingly, approaches to behaviour change based on social psychology and behavioural economics have gained traction in UK Government policy-making and are shaping understandings of public engagements related to energy. These perspectives expand beyond a view of energy end-users as rational, utility maximisers, seeing them instead as operating with forms of extended rationality, or being 'predictably irrational' (Ariely 2008), as they are influenced in their decision-making by a wide range of non-rational factors and wider contextual cues such as attitudes (Ajzen and Fishbein 1977), values (Stern 2000), social norms (Allcott 2011), or habits (Triandis 1977; and see Jackson 2005 for a review of these approaches). Individual energy end-users thus remain the subjects of participation in this approach although they are now understood as situated within a wider social context. Despite this expansion of subject, the object of participation remains the same in this perspective as in earlier approaches to behaviour change. As before, the focus is on individual energy use decision-making and behaviour to encourage either energy efficiency or conservation. The model of participation expands considerably, however. Far from merely providing information or financial (dis)incentives, the behaviour of predictably irrational energy consumers might be influenced in a very wide range of different ways, from segmenting individuals based on their attitudes or values and targeting social marketing campaigns at them (e.g. McKenzie-Mohr 2000; Barr 2008; DEFRA 2008 etc.), engaging social norms through forms of normative comparison (Allcott 2011), tackling key 'moments of

change' (Thompson et al 2011) to disrupt and re-freeze habitual behaviours, or through changing the 'choice architecture' (Thaler and Sunstein 2008) through multiple means (see Dolan et al 2010 for examples). Across these models, however, the purpose of participation remains consistent and focussed on going with the grain of end-users existing forms of decision-making in order to bring about energy efficiency or conservation behaviours. Thus, rather than seeking to make energy efficiency or conservation behaviours appear more 'rational', in this view the challenge is to make them align better with consumers pre-existing predictable irrationalities. Through its continued focus on behaviour and decision-making, this approach re-affirms a narrow understanding of the sites of public participation in the energy system as occurring only through consumers' behaviours and purchasing decisions in the market. Whilst this approach is being quite widely discussed and celebrated in UK policy circles (e.g. Dolan et al 2010), it has as yet had relatively little impact beyond changing how pre-existing consumer-focussed policies are framed or communicated (e.g. Cabinet Office 2011).

Social movements

Whilst they represent a more radical vision of energy publics and participation – for example, concerned with grassroots initiatives (e.g. Boon & Dieperink, 2014; Ornetzeder & Rohracher, 2013; Yildiz et al., 2015) or forms of direct action and protest (cf. Petrova, 2013) – some studies of social movements and protests could also be characterized as offering a realist perspective, in that this vision can be fixed and essentialist. Energy publics in this approach are conceived of as being active, self-organising citizens, united around a particular symbolic object or issue, such as climate change or a particular piece of energy infrastructure. This organic vision risks obscuring the forces shaping and organising social movements, or an acknowledgement of the overflows between such processes and more formal forms of participation and engagement (cf. Bowman, 2008; North, 2011). Disagreement and debate are emphasized in social movements accounts reflecting an agonistic vision of democratic practice (cf. Mouffe, 2000), and in contrast to the other approaches described above, such studies focus on locations in the energy system outside of formal decision-making and control, such as sites of public protest, demonstration and community-based initiatives.

Transition management

The transition management approach, which has been most commonly adopted around planning decisions at a regional and city level in the Netherlands, has some similarities with deliberative and social movements-based approaches in its vision of the active and engaged participants, with a sustained involvement in decision-making processes (Rotmans & Loorbach 2008; Loorbach 2010). However, in this approach participants are usually understood to be 'stakeholders' with a clear and fixed stake in the project or decision under discussion, as defined by those running the process. This allows for little fluidity in

participants identities and roles during the transition process, and also potentially excludes other actors who might understand the process in a different way and feel they should have a right to make their voices heard (cf. Hendriks, 2009; Smith, 2012). Thus participation is limited to those who are invited into the process, guided by the top-down framing of the process (Laird 2013). Whilst transition management plans usually speak of socio-technical transitions, the focus in these approaches is usually on the material and technical elements of the energy system, rather than on forms of social organisation and policy-making.

Media studies

Studies of public perceptions and responses to issues related to climate change and energy have also been conducted from a media studies approach, concerning the relationship between diverse audiences and the way information is reported and presented in various media. For example, such work has been carried out on the effects of media reporting on public opinion around emerging technologies (e.g. Romanach et al., 2015) or of disasters like the Fukushima nuclear accident (e.g. Perko et al., 2012), or concerning media reporting itself of issues like low carbon housing (e.g. Cherry et al., 2015). Increasingly such methods are also being used to understand public opinion and reporting of information through social media platforms like Twitter (e.g. Kim & Kim, 2014). Some of these studies could be described as reflecting a realist perspective on the public and participation, in that they define fixed characteristics of the audience in question, and make assumptions about the way people make sense of issues discussed in the media. In such studies the public can be characterized as a rather passive audience, merely absorbing the communications of media outlets, rather than playing a role in shaping and interpreting these messages. In common with public attitudes surveys, such studies sometimes use sophisticated statistical methods to produce models of a segmented public defined by fixed demographic characteristics and their responses to particular kinds of media. They view media participation as a practice mainly aimed at informing and persuading, rather than attempting to understand its entanglements with other forms of participation and communication, and other sources of power and authority (cf. Marres, 2012). The focus of such studies is almost exclusively on discourses around energy and climate change in the 'public sphere', rather than on decision-making contexts or the material and technological elements of the energy system.

Summary

As stated in the introduction, this section (that makes up Appendix A of the report) has argued that the dominant modes of engaging with and describing publics in the energy field – and indeed in many other domains – reflect a top-down and centralist vision of the energy system defined by the concerns and visions of powerful actors such as policy-makers and big business. In Table 3, it is only the approach of studying and reporting on social movements which even attempts to challenge this framing. Most importantly, Table 3 demonstrates how these diverse approaches produce realist understandings and

participation and the public, as static and pre-given, external to the energy system, and existing in a natural state. Furthermore, each approach produces a contrasting vision of the public, accompanied by different assumptions about democratic engagement and its purpose, and a focus on different parts of the energy system, limiting opportunities for cross-comparison between these approaches or identifying connections and overflows.

Thus, we can take from this that dominant forms of public engagement in the energy system offer very specific models of what it means to participate in energy transitions, and of the forms taken by different publics. These approaches adopt specific methods and techniques in order to form what are viewed as more accurate and precise representations or mobilisations of energy publics (cf. Asdal & Marres, 2014; Lezaun & Soneryd, 2007). This further compounds the compartmentalised and siloed nature of these different approaches, each attending to different collectives and different parts of the energy system. Therefore instances of public engagement themselves are only ever seen as one-off, discrete situations operating in isolation rather than being interconnected and reflecting interrelating ecologies of energy participation.

We have observed a particular bifurcation between approaches focussed on securing public 'acceptance' of particular projects, decisions or technologies – including public attitudes surveys and deliberative processes – and those attempting to bring about specific kinds of mass behaviour change (cf. Owens & Driffill, 2008) – such as psychological and economic approaches to behaviour change. The vast majority of the research concerned with the public in the energy field can be easily categorised between these two camps, often with little interchange in between. This again demonstrates the limited understandings of what it means to participate reflected in the different approaches described in Table 3.

Our characterisation of these dominant approaches as containing realist assumptions is significant in several ways. First, by viewing the public as a static and pre-given entity, the approaches reviewed in Table 3 posit linear cause-effect relationships between participation and various forms of action. Thus when these approaches are evaluated and studied, the focus is generally on how, for example, deliberative approaches have influenced policy decisions, or whether engagement has led to measurable behaviour change. What is not usually considered is influences going in other directions, for example, how the aim of influencing policy decisions shapes and frames deliberative public engagement processes, or how government interventions treating publics primarily as consumers impact on other forms of public engagement. Secondly, as has been argued above, these approaches produce highly partial and contingent representations of the public – and thus result in highly partial and contingent actions – but they do not exhibit an awareness of these uncertainties, or attempt to anticipate or reflect on them.

Appendix B: Relational understandings of energy participation

In contrast to realist approaches to energy participation, relational approaches view publics and participation as co-produced, material and emergent. These alternative approaches have been developed in disciplines such as Science and Technology Studies (STS), parts of democratic theory, human geography, anthropology and sociology, amongst others. This diverse literature argues that publics do not exist in a natural state waiting to be discovered, but rather they are brought into being through the ways in which we seek to know and move them. In this approach, the key dimensions of participation – including the what (the objects and issues of engagement), the who (the subjects/participants of engagement), and the how of participation (the procedural format or form of social organization) – are seen as being constructed through the performance of participatory practices. Thus they are not taken for granted as pre-given or natural features of engagement processes.

This approach radically opens up what participation is, was and could be, by not making a priori assumptions about its key features. By asking questions about how the key dimensions of participation and engagement processes are constructed through practice, relational approaches provide a symmetrical framework for analysing the diversities of engagement in energy transitions across the system. This gets beyond the silos and some of the difficulties in comparing between different realist approaches which make very different assumptions about publics and participation, allowing a more symmetrical analysis across different approaches, sites, material settings, and empirical examples.

Table 4 summarises the features of prominent analytic and interventionist relational approaches to energy participation, exploring (like in Table 3, above) how these approaches in their current form relate to the who (publics), the what (issues and objects), the how (models of participation), the why (rationales) and the where (sites) of energy participation. We also highlight the differences in methods used in these different approaches.

Table 4. Summary of relational approaches to analysing and/or intervening in energy participation

	Analytical / interventionist	Who (Subjects of participation)	What (Objects of participation)	How (Models of participation)	Where (Sites of participation)	Methods	Key examples (references)
Object-oriented/ Pragmatist	Analytical	Members of heterogeneous collectives (inc. non-human participants)	Material objects / the issue in question	Networked, socio-material collective practices	Energy issues, technologies/ devices	Qualitative, ethnographic, issue-mapping	Marres, 2007; 2012
Technologies of participation	Analytical	Constructed (mini) publics	Potentially any issue, usually pre-framed	Defined by procedural formats and philosophies of participation	Formal deliberative processes (but potentially anywhere)	Qualitative, ethnographic	Lezaun and Soneryd, 2007
Ethno-epistemic assemblages	Analytical	Members of heterogeneous assemblages (inc. non-human participants)	Evolving, emergent	Organic, agonistic	Outsider, activist, controversies	Qualitative, ethnographic, discourse analysis	Irwin and Michael, 2003
Social movements/protest	Analytical	Communities, imagined publics	Open, evolving	Organic	Grassroots, community initiatives	Qualitative, participatory	North 2011; Devine-Wright 2011
Practice theory	Analytical and Interventionist	Practitioners	Social practices that use energy, ongoing doings	Engagement in social practices	Everyday life, the home	Ethnographic	Gram-Hanssen 2011; Reckwitz 2002; Shove 2003; Strengers 2012
Collective experimentation	Interventionist	Those enrolled in experiment or responding to it (inc. non-humans)	Trial of ideas and forms of organisation	Repeated contested collective experiments	Science policy	Hybrid fora	Callon et al. 2009; Gross, 2010

Speculative design	Interventionist	Intended users	Constructed material object	Creation of new forms of organisation around new material objects	Design, innovation	Human-centred design	Michael 2015, Gabrys 2014, Wilkie et al. 2015
Deliberative mapping	Interventionist	Selected participants	Open, collectively derived	Deliberative	Science, policy	Structured interviews and workshops	Burgess et al. 2007, Bellamy et al. 2014

We identify three main relational analytic approaches to energy participation coming the science and technology studies (STS) literature, each presenting participation as emergent and co-produced, but with emphasis placed on different elements of participation. Whilst there is no absolute distinction between relational approaches which attempt to analyse participation processes and those which attempt to intervene in them – and indeed a co-productionist approach would insist that all approaches do both to an extent – these three STS approaches have an emphasis on analysis as noted in Table 4.

Object-oriented, STS

Object-oriented or pragmatist approaches to energy participation tend to focus on both the construction of issues themselves through and around public participation processes, and the material objects which give rise to or mediate these instances of public involvement. For example, Noortje Marres' 2012 book focuses on the materialisation of everyday energy participation through the technologies of an eco show home, and the particular assumptions, metrics and intentions embodied within them (Marres 2012). Andrew Barry's work examines the emergence of different kinds of publics alongside complex social and material arrangements such as the at times controversial Baku-Tbilisi-Ceyhan oil pipeline (Barry 2001; Barry 2013). These approaches emphasise the networked and socio-material nature of public participation around the energy system, and tend to produce accounts linked to particular energy technologies. These approaches do not only focus on material objects however, but have also emphasised the importance of issues in participatory collectives, and the ways they are articulated and framed. Noortje Marres (2007) has argued that issues co-emerge with constructions of publics, shaping who can be involved and how they may participate. For example, framing a process in terms of the social acceptability of a particular energy technology will entail a very different kind of participation and public to a process framed in terms of the broader UK energy mix.

Technologies of participation, STS

The second set of STS approaches to energy participation place emphasis on the models or technologies (understood as procedures) of participation which are adopted. For example, Javier Lezaun and Linda Soneryd have explored the emergence of deliberative and focus-group based technologies for participation, describing the kinds of publics they imagine and bring into being, as well as their broader effects (e.g. Lezaun & Soneryd, 2007; Lezaun, 2007). Further work has examined how such technologies travel and are interpreted differently in different contexts with consequences for the kinds of participation and publics they foster (Konopásek et al. 2014). Similar approaches have also been adopted in other disciplines such as geography, law and political science, exploring the development and effects of particular methods for engaging publics such as planning policies (e.g. Lee et al., 2012), public opinion surveys (e.g. Moore, 2013), deliberative methods (e.g Dusyk, 2011) or technology assessments and sustainability appraisals (Bauer & Pregernig 2013; Garmendia &

Stagl 2010). As the focus of these approaches has thus far been on the procedures used to bring certain mini-publics into being, these studies have generally focussed on more formal and 'invited' instances of participation around the energy system, linked to formal decision-making. However, in common with the networked vision of the object-oriented approaches described above, these studies begin to highlight and explore overflows between different instances of participation and the contingencies and uncertainties inherent within them.

Ethno-epistemic assemblages, STS

The third set of relational STS approaches to energy participation emphasises the construction and emergence of publics and the subjects of participation processes. This approach is captured in Irwin and Michael's (2003) notion of ethno-epistemic assemblages, which aims to unsettle assumptions of a static homogenous public, which is clearly differentiated from experts and decision-makers. Instead they describe interconnected heterogeneous collectives characterised by unique formations of different actors, discourses and material elements. Some studies emphasise the extent to which publics are constructed and delimited through the design and foundational assumptions of participation processes (e.g. Braun & Schultz, 2010; Irwin, 2001; Michael, 2009), whilst others place more emphasis on the agency of participants and publics themselves to resist the roles that have been ascribed to them (Irwin & Michael 2003; Felt & Fochler 2010).

Social movements/protests

As noted above many studies of community initiatives, social movements and protests related to energy have been conducted in a relational way, which pays attention to and reflects on the models of publics and participation which are being promoted. As Patrick Devine-Wright (2011) argues, the assumption that expressions of public dissent always amount to NIMBYism hugely simplifies the richness of these collectives, and shapes how they are understood by policy- and decision-makers. Similarly, in his examination of climate activism in the UK Peter North (2011) questions the assumptions made both by activists and engaged scholars about the form and effectiveness of the 'contentious politics' these collectives try to bring into being. He argues that this activism operates through an often-unacknowledged diversity of different spaces, scales and tactics, rather than the reified methods often presented.

Practice theory

Although it is not conventionally understood as an approach to public engagement in the energy system, recent work in Social Practice Theory reframes understandings of the place of energy in everyday life and therefore also of how energy publics are made and reproduced. Whilst much of the earlier work in this recent wave of social practice theorising was descriptive and analytical, more recent work has moved towards a more interventionist approach by seeking to offer recommendations for policy makers and others who wish to try

and steer practices in particular directions (e.g. Chatterton 2011; Spurling et al 2013; Shove 2014). Rather than taking the 'public' or even social movements as its focus, SPT focuses resolutely on everyday social practices themselves such as driving, cooking or showering as the core unit of analysis (e.g. Giddens 1984). Through this focus on practices, individuals are recast as 'carriers' of practices who maintain and reproduce practices through their more or less faithful and regular performances of them (Reckwitz 2002). By implication, therefore, energy publics are also recast as collectives of practitioners. Through this move, the focus on energy somewhat disappears as, instead, practice-based publics are understood as engaged first and foremost in a range of perfectly normal social practices – such as cooking or showering – that are made possible by energy (Shove and Walker 2014). Whilst a range of distinct energy-related practices can be identified such as generating one's own electricity or protesting about fracking. in the main practice theory suggests that public engagement with the energy system occurs primarily through people engaging in and thereby (re)producing a range of more mundane and everyday social practices. To date, most energy-related work on practice has focussed on single practices (such as heating/cooling, showering or laundry) occurring in domestic settings (e.g. Shove 2003; Gram-Hanssen 2011; Strengers 2012) through mostly qualitative and ethnographic approaches (e.g. Halkier et al 2011; Hitchings 2012). Attention is increasingly being paid, however, to both applying quantitative methods to practices (e.g. Pullinger et al 2013; Durand-Daubin and Anderson 2014) and to developing a more systemic approach to practices that explores the inter-relationships between practices performed in the home and those that seek to govern them from boardrooms or government offices for example (e.g. Watson 2012). In common with the relational STS approaches to energy participation described above, this recent trend also opens up the possibility of exploring different forms of public engagement as themselves types of practice that each (re)construct publics and forms of participation in different ways.

Summary of relational analytic approaches

The defining characteristic of these relational approaches is that they understand energy publics and practices of participation as being constantly in-the-making rather than pre-given. This leads analysts to ask different kinds of questions about the emergence, stability and effects of different instances of participation, and to always be aware of their connections to other processes and entities. These approaches are united in their interest in how participation brings certain kinds of objects, subjects and procedural formats into being; however, current work still tends to focus on discrete participatory collectives, acknowledging some connections and overflows, but falling short of a truly systemic perspective. The co-productionist, relational framework for studying energy participation - which we advocate and further elaborate in Appendix C - would also be concerned with the recursive relationship between these emergent characteristics and broader extant orders, including the existing energy system and trends in national policy-making.

Whilst we recognise that the concept of participation itself is contested, and we wish to challenge unnecessarily narrow definitions of what it means to participate (as detailed in Appendix A and B), we find it necessary to adopt a working definition of participation in order to delineate the kinds of processes under study. We define public participation as heterogeneous collective practices through which publics engage in addressing collective public problems (in this case 'energy-related' issues), whether deliberately or tacitly, which actively produce meanings, knowings, doings and/or forms of social organization.

There are several relational approaches which have been developed in order to more actively intervene in or create participation processes, though only a subset of these have thus far been attempted with regards to energy-related issues. These approaches draw upon relational arguments in order to inform new ways of doing engagement, which reconfigure participatory practices in ways that are reflexive, experimental, material, anticipatory, and/or speculative. These approaches also rely on different notions of effectiveness and focus their efforts on different elements. For example, the robustness of processes and outcomes is no longer judged on the basis of statistical significance, the achievement of consensus, or the authenticity of the public voices represented, but rather on virtues such as reflexivity, the anticipation of unintended consequences, humility, and the reflection of uncertainties in process reporting.

Collective experimentation

Processes of 'collective experimentation' have been developed by advocates of relational STS understandings of participation, attempting not only to experiment with ideas and different understandings of the issue in question, but also with different forms of organisation – introducing reflexivity around the models of participation adopted and the kinds of publics enrolled in these processes. This approach has been most notably trialled by Michel Callon and colleagues (e.g. Callon, 2004; Callon et al., 2009; Rabeharisoa & Callon, 2004) in order to bring about heterogeneous participatory collectives of humans and non-humans – which they refer to as 'hybrid forums' – in various contexts, including the cases of nuclear waste management and of involving patients in muscular dystrophy research and decision-making. A similar approach has been put into practice by Matthias Gross in the context of ecological restoration projects (e.g. Gross, 2005, 2010), evoking an attitude of constant experimentation, monitoring and shifting socio-material organisation. There remain relatively few examples of hybrid forums or collective experimentation in practice, though it has been endorsed in high-profile publications (Felt & Wynne 2007). Practices of collective experimentation have generally been developed with science policy decisions in mind, rather than in relation to other parts of the energy system.

Speculative design

Speculative design is another interventionist method which has been developed out of relational STS arguments, in particular object-oriented approaches. It is a model of designerly practice that attempts to create new objects with close attention paid to the intended users and the modes of social organisation they will be associated with. There are multiple examples of speculative design related to the energy field, in particular concerned with so-called smart technologies for the home and environmental monitoring technologies. Jennifer Gabrys, Mike Michael, Alex Wilkie and other colleagues at Goldsmiths, University of London, have been important figures in the development of these approaches (e.g. Gabrys, 2014; Michael, 2015; Wilkie et al., 2015). This has been done most notably in the 'Energy and Co-designing Communities project' 2009-2012 which developed experimental energy technologies for the home, disrupting the intentions and modes of operating of conventional smart technologies, and in the ongoing 'Citizen sense' project which is developing new technologies for citizens to use in monitoring air pollution and the effects of fracking, intentionally disrupting assumptions about the conduct of activist research and citizen science. Given the design focus of these approaches, they have generally been applied to small-scale electronic technologies, rather than to policy decisions, larger infrastructures or other parts of the energy system.

Deliberative mapping

A third set of approaches which draw upon relational STS arguments has been labelled as deliberative mapping, jointly developed by Jacquie Burgess, Andy Stirling, Gail Davies and colleagues in response to the limitations they experienced using conventional deliberative methods of public participation and methods for appraising technology choice (Burgess et al., 2007; Chilvers & Burgess, 2008; Davies, 2006). Deliberative mapping provides a method for recording and reflecting the diversity of participants' perspectives on the issue under discussion, as well as accommodating the reframing of these issues through the discussion. It also deliberately seeks to challenge the absolute distinction drawn between experts and lay people in such processes by involving both groups and treating them symmetrically. The method has been used in deliberation around a range of issues including biotechnology (e.g. Davies, 2006) and more recently geo-engineering (Bellamy et al. 2014) which included the appraisal of diverse low carbon energy options. However, approaches to deliberative mapping have thus far not exhibited reflexivity about the models of participation adopted, tending to conform to a deliberative approach. Attempting to overcome this brings forward further possible areas of development (Chilvers & Kearnes, 2015).

Summary

Appendix B has detailed emerging relational perspectives on energy publics and participation, which view the key dimensions of participation as being constructed through the performance of participatory practices, which themselves are shaped by and shape

extant orders. These perspectives demonstrate that all forms of participation – no matter how inclusive – are partial, exclusive, and subject to overflows. Relatedly, all forms of participation, from government consultations, to behaviour change programmes and speculative design projects, are multiply productive, producing meanings, knowings, doings and/or forms of social organization. This understanding provides the basis for a symmetrical analysis of the performance of diverse forms of participation, as well as indicating which dimensions participatory practices could be productively reconfigured. These arguments lead us to ask: what are the dimensions of participation? What is produced? And how are these things being shaped by broader processes and containers?

However, the relational approaches detailed here are, for the most part, interested in discrete practices or experiments of participation and focus on particular sites in the energy system; each adopting a particular set of concepts, methods, and alliances. This is illustrated in Table 4 in the 'where' column which indicates the different parts of the energy system that these approaches have tended to focus thus far in their development. Furthermore these different relational approaches, and the kinds of objects and processes they focus on, embody different imaginaries of the future, and specifically different pathways of the energy system. This diversity has not yet been fully acknowledged or theorised.

Appendix C: Systemic and constitutional understandings of energy participation

The final task of this initial review is to synthesize recent developments from both realist and relational understandings of participation which seek move beyond discrete events to conceptualise participation and engagement in socio-material change in a more systemic way. This work is diverse, but tries to move beyond understanding collective participatory practices in particular 'events' or at particular sites in the system. We identify moves in the energy field towards conceptualizing processes of social-technical change in a systemic manner. We also see a parallel 'systemic turn' in studies of public engagement and participation more generally, which increasingly show an interest in studying the wider contexts, ecologies and interconnections of collective participatory practices.

We hope to draw on these diverse systemic approaches in order to move beyond providing an understanding of collective participatory practices in particular 'events' or at particular sites in the system. The approach we develop will allow us to understand the interrelations between ecologies of participation and their co-production (how they shape and are shaped by) the orders and constitutions of which they form part (Chilvers & Kearnes, 2015). Participatory collectives can be seen as existing and interacting with and against a particular energy system or regime (e.g. Loorbach, 2010), an issue-space (e.g. Marres, 2007), a particular political situation (e.g. Barry, 2013), a nation-state (e.g. Jasanoff, 2005a), a landscape (e.g. Krauss, 2010) or organisation (e.g. Dobson, 2014). For the purposes of this report and the immediate interests of UKERC so far we have discussed participation in the context of the energy *system*, though it will become clear below that different kinds of what we have called 'systemic' approaches imagine different containers for publics and participation.

Table 5 identifies several key emerging approaches to understanding (energy) participation in a systemic manner, which are then described in more detail below. We explore the different models of participation reflected in these approaches, as well as comparing their units of analysis and primary containers of participatory collectives, from socio-technical systems, to institutions or issue spaces. Each approach proposes a different relationship between participation and energy system change, and defines its academic and practical value in a different way. Similarly to the relational approaches reviewed in Table 4, each of the approaches uses a different set of methods, associated with its conceptual approach and empirical focus.

Table 5. Summary of systemic approaches to participation

	Models of participation	Interrelating ecologies of…	What participating (with)in – i.e. container	Relation between participation and system/change?	Proposed value of approach	Methods	Key examples (references)
Socio-technical systems/transitions	Deliberative / niche (pre-given, but potentially distributed and diverse)	Multiple participatory processes external to 'the system'	A socio-technical system	Participation is separate from the system but can 'socially shape' and provide inputs to processes of socio-technical change	A means to democratise and deal with the politics of transitions and socio-technical change	Qualitative, deliberative-discursive	Hendricks, 2009; Smith, 2012
Deliberative systems	Deliberative-discursive model (pre-given), ranging from micro to macro deliberation	Multiple deliberative moments	A deliberative system	Assumes a deliberative system that is separate from and influences / impacts political decision-making	Moves beyond narrow one-off deliberation, to evaluate and enhance the effectiveness of whole deliberative systems	Deliberative, largely conceptual / theoretical at present	Mansbridge et al. 2012
Systems of practice	Social practices (relational)	Interrelating social practices	System of multiple interrelating practices	System stability and change continually performed by interacting social practices	Moves beyond SPT focus on everyday lifestyle practices to attend to ecologies of practice that make up whole systems	Descriptive, historical case studies	Schatzki, 2011; Watson, 2012
Institution focused approaches	Listening and responsiveness of governing institutions to diverse engagements	Institutions	Institutional decision contexts	Collective and interrelating participatory practices cross-cutting institutional decision-making processes	Sheds light on which public articulations institutions respond to or ignore, and shifts onus onto institutions to respond (beyond top-down models of participation)	Ethnographic, qualitative	Brown, 2009; Dobson, 2014; Pallett & Chilvers, 2013

Story/narrative-based approaches	Travelling of narratives within and between different collectives	Discourses/ narratives	Storytelling	Narratives travelling and becoming accepted and motivating change within particular collectives	A way to understand behavior change as motivated through collective action, rather than top-down persuasion	Creative	Stories of change project
STS co-productionist	Heterogeneous collectives (relational)	Entangled collectives of public involvement and collectives of other things	(see below)				
> Object-oriented			Issue or controversy space	Heterogeneous participatory collectives make up the issue space in question, which is thus continually emerging	Opens up to diversities of participation, recasts participation as a 'problem of relevance'	Issue mapping, controversy mapping, cultural-historical	Barry, 2013; Marres, 2012; Nadaï et al. 2011
> Constitutional			Constitution	Collective participatory practices are constitutive of science and democracy	Emphasizes the interplay of constitutional formations / political cultures in shaping ecologies of participation (and vice versa)	Constitutional analyses, cultural-historical, interpretive-analytical	Jasanoff, 2004; Wynne, 2015

Socio-technical systems

In the energy field, the use of transitions approaches to understanding and managing energy (e.g. Loorbach, 2010) have been associated with taking a system-wide perspective on the social and material elements of the energy system. Furthermore, whilst transition management is generally characterized as a top-down project which an overriding focus on technical elements, more recent work has emphasized the need to take account of social and participatory democratic elements in this schema (e.g. Hendriks, 2009; Laird, 2013; Smith, 2012). However, these interventions have tended to promote what we have characterized as realist or fixed visions of the public or participation, linked to specific models of democracy like deliberation (Hendriks 2009) or activism (Laird 2013; Smith 2012), rather than attempting a more relational comparative framework. In this approach participation is understood to be taking place against, but separate from, a broader socio-technical system.

Deliberative systems

Deliberative democratic theorists have increasingly seen a focus only on individual participation processes as insufficient, in that it fails to consider the interchange between these individual processes and broader deliberative systems (e.g. Boswell, 2013; Chambers, 2013; Kuyper, 2015; Mansbridge et al., 2012). They argue that the quality of individual cases of deliberation can only be judged with reference to this broader system: i.e. an apparently rigorous and successful deliberative process could potentially have more negative impacts on the broader deliberative system, whereas apparent failed processes still have the potential to influence the overall system in a positive manner, depending on the exact circumstances. The deliberative systems approach pays less attention to the technical elements of the energy system, instead focusing on multiple connected deliberative moments which are again understood to be separate but connected to technical and regulatory elements. This approach also has a clear vision of what constitutes democratic practice, drawing on deliberative democratic principles, which would narrow the potential scope of participatory collectives which could be included in this schema to discursive moments of public talk.

Systems of practice

As mentioned briefly in Appendix B a small amount of recent work in social practice theory has sought to move beyond a focus on single practices performed in mostly domestic settings and focus instead on the relationships between practices as they extend through space and time to make up particular systems (such as the energy system). Here, work has begun by exploring the nature and density of connections between different practices. Shove et al (2012), for example, distinguish between co-located but loosely connected ‘bundles’ of practice and more densely integrated ‘complexes’ of practice, whilst Watson (2012) notes that practices are interconnected, and therefore influence one another, through

shared elements, shared 'carriers' or performers, and through their arrangement and sequencing across space and time. This emerging approach thus sees the energy system as made up of, stabilised and changed through the dynamic inter-relations between multiple practices. To date, however, there has been little to no new empirical work adopted within this approach. The few examples of this work that do exist – such as Watson's (2012) account of systems of velomobility or Schatzki's (2011) discussion of the coal-based electricity system – draw from literature-review based descriptive case studies.

The Lancaster University-hosted DEMAND centre[5] and the University of Otago Energy Cultures project[6] both attempt – in very different ways – to develop a system-wide approach to understanding energy demand, looking beyond discrete and conventional settings of behaviour change interventions in order to explore stabilities and changes at other scales. Whilst these projects focus predominantly on energy demand rather than on other forms of participation, they have begun to compare different processes relationally and across contrasting contexts using a common framework.

Institution-focused approaches

A set of what could be loosely categorized as institution-focused approaches to systemic participation have emerged from a range of different disciplines. These approaches shift the focus away from specific instances of participation and onto key governing institutions, asking how successfully they have been able to respond to diverse instances of participation in institutional processes and decisions. Mark Brown (2009) gives perhaps the most in-depth elaboration of this approach, by exploring the ways in which governing and scientific institutions represent nature and citizens through what he describes as a complex 'ecology of institutions'. In a similar account, Dobson (2014) asks if institutions are 'listening for democracy', identifying participation as a problem of relevance (as understood in STS relational accounts) rather than one of extension, concerning the need to bring citizens in to decision-making processes (as understood in transitions and deliberative systems approaches). Similarly, Pallett and Chilvers (2013) chart institutional responses within the UK Government to both 'invited' and 'uninvited' forms of participation around climate change, finding overflows and instances of mutual change and influence, as well as identifying the silencing of more radical voices.

Gordon Walker and colleagues have also made a move towards more systemic accounts of energy publics and participation in their work on imaginaries of energy publics. These studies of renewable energy siting and planning conflicts shift the focus away from discrete processes and publics by considering the ways in which powerful actors and institutions imagine the publics they are dealing with – often highly conditioned by assumptions of NIMBYism – and what the broader effects of these imaginaries are on the issues under

[5] http://www.demand.ac.uk/
[6] http://energycultures.org/

discussion (e.g. Barnett et al., 2010; Walker et al., 2010; Walker & Cass, 2007). This approach hints at the forces around participation processes which strongly influence their form and outputs, as well as capturing potential overflows and instances of cross-influence between different participation processes. In the parallel field of planning, similar studies of renewable energy policies and decisions by Richard Cowell and colleagues have empirically observed changes in understandings of the term 'affected communities' amongst policymakers (e.g. Bristow et al., 2012; Cowell et al., 2011). In this work they found that policy actors themselves have increasingly been inclined to broaden their definitions of affected communities in renewable energy policy and siting decisions, to encompass and enable the (formal) participation of a much broader range of energy publics – no longer only limited to those in the immediate affected area.

The increasingly influential concept of 'responsible research and innovation', which has already been taken up in relation to work in the energy field, is also concerned with ideas of institutional responsiveness to diverse voices, especially as it has been formulated by Richard Owen and colleagues (e.g. Owen et al., 2012; Stilgoe et al., 2013). One problem with these approaches is that the primary focus on powerful institutions potentially limits the scope of the participatory collectives which can be studied, as collectives speaking in different registers to these institutions or which have been silenced or obscured by more dominant forms of participation may be excluded.

Story/narrative-based approaches

A project hosted at the Open University called Stories of Change[7] aims to study, compare and potentially mobilize diverse 'communities of interest' around energy drawing on methodologies from the humanities including oral histories and techniques from the creative arts for imagining futures. The focus in this project of stories of change, and on linking insights from the past, present and future of these communities of interest, loosely defined, creates a framework for open and relational comparison of different initiatives, without pre-supposing what counts as energy participation. However, this project has a focus on bringing attention to usually marginalized and overlooked voices, so gives less of an emphasis to more dominant forms of participation in its framework.

The stories of change project demonstrates the potential for narrative and story-based approaches from the humanities to be used to develop a systemic understanding of forms of participation. These approaches largely focus on discursive rather than material dimensions of energy systems, though they often draw on methods from the creative arts in order to decentre and disrupt conventional approaches to participation. The focus on storytelling narrative also allows for the multi-vocality and multi-directionality of such processes, without pre-supposing which account offers a 'true' representation of the various

[7] http://www.open.ac.uk/researchcentres/osrc/research/projects/stories-of-change

participatory collectives at play. However, these approaches generally focus on grassroots initiatives over other collectives.

Object-oriented co-productionist

While approaches to systemic participation in STS have been diverse, we identify two main approaches related to the different relational STS approaches identified in Appendix B. Both approaches emphasize the heterogeneity of participatory collectives, rather than relying on specific definitions of participation or attending to particular parts of the system (as approaches in Appendices A and B tend to). Like the relational approaches discussed above, they also see energy publics and participation as being entangled in other networks and processes, rather than occurring separately to the energy system. The first approach is object-oriented though it is still interested in the constitution of nation states, institutions and other states of affairs. Often the focus of such studies is around particular issue-spaces or controversies (e.g. Barry, 2013; Marres, 2012). Building on her work showing the importance of energy technologies and issues in summoning and shaping the publics of participatory collectives, Noortje Marres (forthcoming) has developed a digital technique called issue-mapping, which uses hyperlinks and hashtags to map a broad issue-space, revealing the different forms of participation and kinds of publics active within that space, and showing linkages and overflows.

Jennifer Gabrys (2014) summarises insights from a variety of projects aiming to 'materialise' energy participation, drawing mainly on approaches from speculative design, object-oriented STS and social practice theory. Through this she develops an argument that all of these interventions are part of a broader process of experimentation, even if they are judged to have failed to move behaviours or initiate genuine participation. For her, the most important contribution such participatory collectives can make is to offer alternatives to or reroute current energy practices, which is something she has attempted to do in both her Energy and Co-designing Communities project, and her current Citizen Sense project, both of which attempt a diversity of novel and design-centred modes of energy participation.

Anthropologists have gone beyond the focus on individual instances of participation, and particular forms of participation, by producing detailed relational accounts of larger energy landscapes and governance regimes, which reflect the diversity of participation processes in these areas, but also hint at broader stabilities or shifts at play. There has been particular interest in describing the material and regulatory features of wind energy landscapes and their relation to various forms of public dissent and formal involvement in decision-making (e.g. Brannstrom et al., 2011; Carlson, 2014; Jami & Walsh, 2014; Krauss, 2010; Ottinger, 2013; Pacheco et al., 2014; Petrova, 2013). These approaches reflect the contingency of the emergence of different kinds of publics within these landscapes, such as community energy groups, investors in wind energy or anti-wind farm protestors, and the context specific nature of these conflicts – overlaid onto existing inequalities and previous decisions and

conflicts, and overlapping with other contemporary processes such as conflicts over national park status (e.g. Krauss, 2010). Thus these accounts demonstrate the co-emergence of various kinds of publics and modes of participation, without suggesting they are fixed or inevitable. Furthermore, comparative work on different kinds of wind energy landscapes has been attempted to demonstrate the differences in the kinds of publics and participation which emerge against different material and regulative regimes (e.g. Dracklé & Krauss, 2011; Nadaï et al., 2011). To a lesser extent similar detailed and relational studies of energy publics in other kinds of energy landscapes have emerged, most notably Barry's account of the transnational Baku-Tbilisi-Ceyhan pipeline and its material and regulatory surroundings (Barry 2013), and Bowness and Hudson's (2013). However, there has been little comparison between such focused relational accounts and accounts of publics and participation with regard to other energy technologies or other parts of the energy system.

Constitutional co-productionist

The second systemic co-productionist approach focuses more on institutional factors and human agency, with an interest in how collectively acceptable forms of public reason solidify and change over time (e.g. Jasanoff, 2012; Wynne, 2015). These approaches have tended to focus on a particular nation-state, or to compare between nation-states, developing an in-depth analysis based on the specificities of national culture and history. The conceptual and methodological resources associated with this approach abound, with studies focused on identifying 'constitutional moments' – periods of reconfiguration of the relations between science, citizens and the state – (e.g. Bhadra, 2013; Jasanoff, 2011a), socio-technical imaginaries – shared visions of the future which are implicated in modes of societal organisation and the design of technical projects – (e.g. Jasanoff & Kim, 2009, 2013), and civic epistemologies – stable features of different national political cultures and collectively accepted 'knowledge ways' (e.g. Jasanoff, 2005a, 2005b).

Timothy Mitchell (2002, 2011) has argued that sources of energy and their associated infrastructures have implications for forms of social organization and democratic governance, positing a relationship of mutual influence between carbon-based energy and the practices and institutions of Western democracy. Similarly, Jasanoff and Kim (2009, 2013) demonstrate the close relationship between the design of technological projects related to nuclear power generation and Germany's 'Energiewende' and desired forms of social organization, captured in their concept of 'socio-technical imaginaries'. They define socio-technical imaginaries as collectively imagined forms of social life and social order which reflected in the design and fulfilment of nation-specific scientific and/or technological projects (Jasanoff & Kim 2009), capturing the impossibility of separating the social and technical elements of energy systems and also highlighting the importance of national differences in how such projects play out.

Conclusion

In this project we will adopt a co-productionist analytical framework for the study of systemic energy participation which is most closely aligned to the STS co-productionist approaches laid out in Table 5, especially the constitutional co-productionist perspective, while working in conjunction with the relational practice-oriented perspective on collective participatory practices detailed in previous sections. In Appendix B we discussed relational approaches to energy participation, providing a definition of collective participatory practices and a framework for comparison across diverse heterogeneous collectives of participation in terms of their construction and productive dimensions. The relational approaches we described provide the basis for a systematic review and symmetrical comparison, but they very much represent a 'flat' ontology, which less attention to broader systemic stabilities and interdependencies. Appendix C has added to this by laying out some different understandings of the spaces and conditions beyond individual events of participation that shape their performance, as well as drawing out the interrelating ecologies of different energy participation practices. In line with the systems of practice and relational STS approaches set out above, we recognise this relationship between participation processes and broader spaces and conditions as a recursive and co-productive relationship, constantly being remade and contested through practice, where each has the potential to reshape the other.

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