From local to global value:

The transformational nature of community energy

Submitted by Iain Soutar to the University of Exeter

as a thesis for the degree of Doctor of Philosophy in Geography

November 2015

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

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Abstract

The UK energy system has in the past been characterised by the ownership and control of large-scale supply technologies by corporate entities. It has become apparent however that such structures are ill suited to addressing contemporary energy challenges of decarbonisation, energy security and affordability. Moreover, their resistance to change means that the current system is fundamentally inconsistent with the need for energy system change.

The advent of affordable renewable energy however, particularly at small-scale, offers new prospects for addressing these energy challenges. In particular, they present an opportunity for greater societal engagement in the energy system, not least as owners and managers of energy assets, but also as stakeholders with interest and influence in the energy system more generally. Within the context of greater citizen engagement in energy, community energy has developed in the UK as an organised means for "collective action to purchase, manage and generate energy" (DECC, 2014b). Such collective action is complimented by progressively broad engagement by individuals in the energy system as investors and prosumers, rather than solely consumers. This thesis responds to a need to better understand the role and value of community energy, and wider societal engagement more generally, within the wider energy system.

Taking a mixed-methods approach, this thesis contends that community energy has the potential to have significant impacts at both local and national scales. Social, economic and environmental impacts of a specific community energy project are evidenced to illustrate the breadth and scale of potential impacts at the local level. Broader analysis of the community energy movement, and of 'small-scale energy' more generally is suggestive of the potential for such approaches to be transformative in terms of overcoming system inertia. In particular, the energy system is undergoing a process of democratisation, whereby power, wealth and value is gradually distributed among society. A key role for policymakers then is to consider the strategic importance of democratisation.

Table of Contents

List of Figures

List of tables

List of Abbreviations

BERR	Department for Business, Enterprise and Regulatory Reform
CE	Community energy
CERT	Carbon Emissions Reduction Target
CHP	Combined Heat and Power
DECC	Department of Energy and Climate Change
DTI	Department of Trade and Industry
EC	European Community
EISD	Energy Indicators for Sustainable Development
EMR	Electricity Market Reform
FiT	Feed in Tariff
GDHI	Gross Domestic Household Income
GDP	Gross Domestic Product

GHG	Greenhouse Gas
GVA	Gross Value Added
kW	Kilowatt
kWh	Kilowatt Hour
LLSOA	Lower-Layer Super Output Area
MCA	Multi-Criteria Analysis
MLSOA	Middle-Layer Super Output Area
MLP	Multi-Level Perspective
MW	Megawatt
NTBM	Non-Traditional Business Model
NFFO	Non-Fossil Fuel Obligation
PEEP	Pro-Market Energy Policy Paradigm
PV	Photovoltaic
RE	Renewable Energy
RHI	Renewable Heat Incentive
RO	Renewables Obligation
SNM	Strategic Niche Management
SO	Supplier Obligation
TIC	Techno-Institutional Complex
UNFCCC	United Nations Framework Convention on Climate Change
WREN	Wadebridge Renewable Energy Network

Acknowledgements

This research would simply not have been possible without the support of WREN, who welcomed me into their group from the beginning and showed interest and support in this work throughout. Stephen, David and Jerry in particular were incredibly encouraging and patient in giving up their time and energy, and for that I am indebted.

I also owe thanks to all those participants who donated their precious time to participate in the study, as householders, businesses, community group members, and others.

It has been a fantastic experience to work with Catherine Mitchell, to whom I owe a great deal of gratitude for all the guidance, insights, inspiration and encouragement over the last few years, as well as the opportunities she has given me over that time. I consider myself especially lucky to be part of the Energy Policy Group, and owe thanks to everyone for making it a stimulating and welcoming place to work.

Of course, all of this would have been all the more intolerable without the presence of Nic, Rory and Kip, who have not only provided much-needed perspective, but unending love, support and laughter. Thank you all.

1 The road now taken?

“What scale is appropriate? It depends on what we are trying to do.”

(E.M. Schumacher, 1973)

Although brief, this quote from E.F. Schumacher’s Small is Beautiful captures the essence of this thesis. Schumacher’s publication contributed to emergent discussions around sustainable development, questioning in particular the meaning of ‘growth’ and the notion of societal ‘success’. Primarily though, the collection of essays challenged the assumption that for industries and firms (as well as nations), bigger is always better. Forty years on, these assumptions are still being questioned, not least in the world of energy, the principal domain of this thesis. It is here, in the questioning of the “universal idolatry of giantism”, (Ibid) that this work is situated.

Following Edison and Insul’s ‘system building’ push for the widespread adoption of electrified networks (Hughes, 1983), the inexorable trajectory of the last 100 years have been towards larger, more centralised networks connecting more consumers, with associated economies of scale (Ibid). The drivers of this development were simple, and remained unchanged for decades: demand for greater and more reliable connectivity to the electricity network, and at least cost.

For around the last 25 years however, both the rules of the game have changed, and the things ‘we are trying to do’ have evolved. Along with our continued demand for reliable, low cost electricity, contemporary awareness of the influence of our energy system on the environment means that we are also increasingly expectant that the production of our energy is clean, safe and secure, and its delivery unhindered. Furthermore, the ongoing development of new energy technologies means that the norms around who has the right to decide about, own, and draw value from energy infrastructure are being challenged. While energy has always been political, the heightened potential around societal involvement is arguably resulting in a deeper and more profound form of politicisation. It is around these overarching themes that the context of this thesis is set.

Shortly after the release of Schumacher's book, another publication drew specific attention to the societal implications of the energy decisions of government. Amory Lovins' essay 'Energy Strategy: *The Road Not Taken'* was a critique of the continued expansion of large-scale centralised supply technologies (particularly nuclear) in the U.S. (Lovins, 1976, Lovins, 1977). For Lovins, following such a *hard energy path* represented an enormous missed opportunity in terms of avoiding both the unnecessary capital costs and waste associated with conventional forms of energy production and consumption. The alternative, a *soft energy path*, characterised by renewables and energy efficiency, would avoid these negative impacts and instead be far more aligned with societal values. The main thrust of Lovins' work was twofold. First, although the familiar, well-trodden path would be "convincingly familiar" for policymakers (Lovins, 1976), a determined shift to a new path would be rewarded with social, environmental and economic benefits. And second, the existence of a divergent path represented a deliberate choice for policymakers, meaning that the hard energy path was far from inevitable.

As it happens, the following decades of energy production and consumption in the U.S were far more aligned to Lovins' 1976 *soft energy path*, albeit with less renewables and more nuclear than Lovins had considered desirable (EIA, 2011). While this may be considered an achievement of progress, the social, environmental and economic context of the political and societal debates around energy are continually evolving. This means that debates around what is the 'most suitable' energy system, in terms of meeting not only cost but also other societal objectives such as equity and fairness, are continually being refocused.

Specifically, the last few decades have brought emerging consensus around the science of climate change, even if the social, environmental and economic consequences are less certain (IPCC, 2014). A new assortment of technologies, including energy technologies (but also information and communication technologies) are enabling a shift in the relationships between people and energy (Mason, 2015); And the centralised energy infrastructures with which we become reliant are reaching the end of their lifespan, meaning replacement capacity, in whatever form that may take, needs to be deployed. Such factors are focusing attention on the importance of a new set of societal values around 'what we are trying to do' in terms of our energy system.

The convergence of these pressures means that today's decision makers find themselves again at a crossroads, and the costs and benefits of a softer energy path, versus the status quo, is the subject of much debate within policy, academia and contemporary society. This time however, the stakes are higher, not only because the trajectory chosen will determine our ability to minimise the costs of global climate change, but also because it will shape our potential societal progress more generally, through for example the extent to which costs and benefits are shared between us, and between this generation and the next.

Electricity infrastructure in the UK is dominated by large, centralised thermal generation, the value of which is retained by a small number of firms and whose dominance is perpetuated by an out-dated set of governance arrangements (HM Treasury and DECC, 2010, Mitchell, 2008, Mitchell, 2013). Moreover, society's role in the energy system has traditionally been one of passive consumption (Watson, 2004, Devine-Wright, 2007), which does little to signal demand for change in the market-driven energy system, meaning that the entire energy system is characterised by inertia (Mitchell, 2014a, Marechal and Lazaric, 2010, Soutar, 2015). As such, changing to an alternative path represents a significant change in direction, not only for policymakers, but also for actors throughout the energy system.

The emergence of community energy (CE), as "collective action to purchase, manage and generate energy" (DECC, 2014b) represent one such alternative path. Such approaches typically favour small-scale, locally sited technologies over conventional technologies. While not necessarily opposing fossil fuel-based technologies (For example, community-based Combined Heat and Power (CHP) may still employ gas as an energy source), this change in focus has been made possible in part by the emergence of affordable RE technologies, and as such, provide a route for localised deployment and ownership of such technologies. They also provide opportunities for managing energy demand, an area that has proved challenging within the framework of the existing energy system.

While DECC's definition of CE (as outlined in the previous paragraph) seeks to capture both formal and informal *collective* action around energy, it is recognised that such groups cannot be isolated from the activities of *individuals* within wider communities or populations. CE groups usually comprise local members of the community, and the success of CE projects is often dependent on the ability of local populations to support, buy in to, and invest in CE groups such that projects can be enabled or constrained by wider communities. Moreover, CE represents but one strand of a wider movement of individuals, networks and businesses being more engaged with the energy system. As such, this thesis has a primary focus on the CE movement of collectives, but also considers the role of the wider energy 'community'. Thus, from now on this thesis takes *community energy* to mean collective efforts and *citizen-led* energy to include CE as well as the aggregated activities of individuals.

This thesis is concerned with furthering our understanding around the role of citizen-led energy as one alternative approach to established norms. As such, the research echoes that of Lovins and Schumacher in both interrogating the logic behind centralised energy systems and reappraising the opportunities of small-scale, localised systems.

1.1 Understanding energy transitions

The following research question forms the foundation for this thesis: *What is the value of community energy in the UK*? From that broad, overarching question come three more specific lines of inquiry:

a) What impact can community and citizen-led energy have on local energy systems?
b) How do social dimensions of community energy relate to its value?

c) In what ways does the community energy movement, and citizen-oriented energy more widely impact upon the wider UK energy system?

In addressing these research questions, this thesis brings together several themes pertinent to the understanding of energy system change.

The first theme this thesis addresses, and one that carries through the entire thesis, is that of the interplay between incumbency and innovation in the energy system. The community energy movement describes the aggregated efforts of a growing set of grassroots actors seeking to manage, own, reduce energy locally, and by doing so counter the norms of the established energy system. As well as affecting local energy economies, the wider development and growth of the sector is of potential consequence to the broader energy system.

Meanwhile, as already alluded to, the current energy system is characterised by an inflexible set of technological, economic and institutional structures and norms, which are both self-reinforcing and resistant to pressure from competing structures. Examining the role of community energy within the wider energy system therefore requires building an understanding of circumstances of, and relationship between, inertia in incumbency and the dynamism of subaltern interests. However, many analyses focus either on the development of niche innovations, or on lock-in to incumbent structures. By employing and building upon established theories around sociotechnical transitions, this thesis seeks to develop a more coherent and dynamic understanding of the interplay between established systems and emergent social and technological innovations.

Secondly, this thesis is strongly underpinned by the recognition that climate and energy challenges are not simply technological or economic challenges, but are also social in nature. This is not to say that the technical and economic aspects of problems and solutions to challenges are not important: Technological developments and associated improvements in economics are clearly key drivers of energy transitions. However, this thesis seeks to highlight the importance of the social, particularly in the context of the *current* energy transition at multiple levels. In terms of individuals and communities for example, this thesis provides evidence to support calls for a collective renegotiation around new sets of values and norms; acceptance, support and adoption of new technological innovations; and the aggregation and organisation of individuals within and among grassroots CE groups. In terms of policymaking, it calls for acknowledgement and deliberative action to overcome system inertia, political reflexivity towards societal values, and a realignment of regulations and institutions to better align with these values (Soutar, 2015, Mitchell et al., 2015).

Moreover, the outcomes, as well as the processes of community energy are inherently social in nature. Technical and economic feasibility is clearly important for renewable energy developments to make sense, but the selection of a specific technology in CE projects is less often cited in terms of the scale of economic returns than it is to its ability to help address *social* objectives, such as the redistribution of energy supply revenues to local communities. In this sense, the importance of economics is heavily weighted towards distributional, rather than absolute benefits for profit maximisation. Also central to CE is the potential for other (non-monetary) value streams, such as the creation of more legitimate forms of governance.

While an understanding of community energy hinges then on understanding social aspects of community energy, the current political and academic overemphasis on the technologies and economics of energy means that the importance of society in negotiating and shaping energy system change can be overlooked. This thesis seeks to play a part in readdressing that balance.

This thesis is mindful that the role of community energy will depend to a large extent on how the attributes and opportunities it offers are understood, realised and valued, in different ways, by different sets of actors throughout the energy system. For example, the value of community energy practitioners as trusted intermediaries for householders must be considered alongside the ability of the sector to deliver local economic resilience, and within the context of its wider contribution towards processes of energy system transformation. Different stakeholders can of course be expected to weight these factors differently, depending on individual interests, and it is on the richness of roles and expectations of CE that this thesis seeks to reflect.

Finally, if we hope to steer ongoing transformative changes in the energy system to societal objective we must first understand the agents, dynamics and consequences of such a shift. While existing literatures exploring sociotechnical transition are well aligned with transformational pathways, these are often theoretical, abstracted and conceptual, and as such rarely link analysis of specific activities on-the-ground to transformational pathways. This thesis seeks to address this by considering the importance of community energy at the local level alongside how the drivers, diversity and dynamism of the wider community energy movement contribute to the realisation of broader societal objectives.

1.2 Structure of the thesis

Including this introduction, this thesis is comprised of ten chapters, and is structured as follows.

A comprehensive review of the literature in **Chapter two** provides the overall rationale for the thesis. The contemporary energy system is characterised by a new set of pressures relating to climate change, energy security and affordability. It is apparent that the energy system as it is currently set up is not just incapable, but fundamentally incompatible with being able to address these challenges. Indeed, overcoming the inertia characteristic of the system can be considered a challenge in itself, and suggests the need for fundamental and structural changes across the whole energy system.

Involving a different set of technologies, scales, and actors however presents the potential for addressing these contemporary energy challenges, including overcoming inertia. In contrast to conventional centralised technologies, networks and modes of governance, distributed production of energy comprising renewable energy technologies in particular represents a *small-*

scale approach to energy, which offers quite different prospects in terms of distribution of costs and benefits, shifts in governance, managing demand, public engagement, and broader evolutionary change within the energy system. While a nascent community energy sector in the UK is highlighting the potential of an alternative energy approach, there is a real and urgent need to build a better understanding of the merits of this approach.

Chapter three examines two countries, Germany and Denmark, which are frequently cited as having strong citizen-oriented and community energy sectors, which is often attributed to sympathetic domestic policy frameworks. Renewable energy deployment in both countries is strong both in absolute terms and relative to domestic electricity consumption, while the ownership of such infrastructure is heavily weighted towards individual and communities. Cultural aspects relating to public attitudes to nuclear and renewables, and of existing traditions around community ownership and governance are considered to have been central to the development of community energy within supportive policy frameworks.

Chapter four provides an overview of the methods used to address the research objectives, with two specific loci of interest, a) the impacts of a community energy initiative on a specific local energy system and b) the impact of broader sector-wide changes resulting from aggregation of community energy efforts. A two-tiered approach is favoured, whereby insights into the micro-scale dynamics of community group development and practice can be considered alongside macro-scale evolution of the broader community energy movement as a whole. A household survey thus compliments a desk based study and stakeholder interviews to give a rounded picture of the evolution of the movement. Reflection on subjective and objective notions of ‘success’ from the perspective of different community energy stakeholders supports the use of a combination of quantitative and qualitative analysis.

Chapters five, six and **seven** present results from the research. In establishing a baseline for a local energy system, **Chapter 5** highlights several potential opportunities and barriers to community energy in the town of Wadebridge. The size of the study site relative to other community energy projects means variability in local housing stock, access to gas, socioeconomics and demographics present both challenges and opportunities for change. Local support for renewable technologies, particularly at small-scales is matched by support for local ownership, particularly where local benefits can be realised.

Chapter six seeks to analyse the impacts of WREN's activities, which can be understood according to multidimensional, distributional and temporal aspects of community energy. Multidimensionality acknowledges the importance of a whole-systems approach, which simultaneously accounts for physical, social and economic dimensions of change. The distribution of impacts are considered key to understanding equity and justice as social elements central to community energy, while temporal variations in impact relate to the interplay between objective-based and system-based change. WREN has demonstrated considerable impact in directly and indirectly influencing local RE deployment (particularly small-scale PV and domestic heat), playing an important role in implementing national demand reduction programmes, and paving the way for more fundamental changes in terms of local supply.

Chapter seven contains a deeper exploration of the relationship between the development of WREN and people-oriented capitals. Local human and social capitals have proved instrumental in the establishment and evolution of WREN, and indeed is considered central to CE more widely. Specifically, human capital in the form of knowledge, expertise, determination and vision has provided a nucleus around which collective action can coalesce. Such social networking around collective values and interests contributes to *bonding capital*, which strengthens as a result of working together. Bridging capital is employed with reference to the expansion of WREN's activities beyond the core membership group, playing an important part in legitimising efforts. An extension of this is a discussion of WREN's ability to deploy linking capital to establish useful relationships with influential individuals and organisations to further their goals, both locally and further afield.

Moving on from the individual case study perspective, **Chapter eight** refocuses the discussion on the evolution of community energy in the UK more broadly. It demonstrates how the aggregated impact of local expectations, networks and learning is contributing to sector-wide change, and how the formal community energy sector has influenced adoption of key principles and approaches by other regime actors. As well as describing energy system in transition however, the evolution of community energy can also be described as transformative in that it is affecting the fundamental structure of the energy system, including technologies, actors, and the relationship between them.

Chapter nine progresses from a sociotechnical transition-perspective of community energy to considering the transformational potential of the movement. A new set of technologies and stakeholders are changing the rules of the energy system from one which relies on economies of scale to one in which network economies are more important. The energy system is thus undergoing a process of democratisation, whereby assets, wealth and thus value are shifting from a small number of private actors to a large, distributed and diverse network of actors. In contrast to large-scale energy systems, small-scale energy is demonstrating the ability to respond to societal needs, engaging new actors, and challenging institutional and cognitive norms, and as such are considered central to overcoming system inertia. As far as energy system transformation is needed, this suggests a key role for policy in engaging society in the energy system.

Chapter ten concludes this thesis by summarising the research and relates the insights developed therein to the original research questions. The ability of community energy to positively impact upon local communities is complimented by creating the conditions for more fundamental transformative change. The key implications for policy are a) that while it is unlikely that transformational change can be managed, it can be nurtured and b) that since transformational change is a necessity, embracing the opportunities created by such change should be prioritised. This chapter is concluded by reflecting on the contribution of the thesis to the research community and highlights further avenues for research.

2 The role of scale in overcoming contemporary energy challenges

The global challenges of climate change and energy security, combined with the need to update domestic energy infrastructure, means that UK energy policy is at something of a crossroads. However, it is becoming bleakly apparent that the current energy system is ill-suited to addressing these challenges: it is clear that the established fossil-fuel based technologies that have contributed to climate change and energy security concerns cannot continue to play a large role in a future energy system. More fundamentally however, the current energy system is characterised by a structural resistance to change, and it is overcoming such inertia that represents the single greatest challenge of energy policy today.

The emergence of small-scale and particularly low carbon sources of energy provide opportunities for meeting these contemporary energy challenges, as well as helping to overcome systemic inertia. The nature, scale, and geography of alternative technologies are well suited to addressing key energy policy objectives of ensuring clean, secure and affordable energy. On a more fundamental level, the advent and adoption of such technologies is fundamentally changing the structure of the energy system by facilitating stronger relationships with individuals and communities as both shareholders and stakeholders of the energy system.

Perceived failings of the current energy system to deliver societal benefits, and emergent opportunities to counteract this with small-scale technologies has meant that citizens are becoming more and more engaged in the UK energy system. While community energy in particular represents a potentially valuable framework for driving, funding and implementing local energy system change, its contribution in the wider energy system is being constrained somewhat, particularly because it reflects a set of actors, approaches and values that are outside of the norms of the established energy system. Specifically, the value of business plans offered by many CE groups is less immediately obvious to a political system more familiar with delivering energy policy via more traditional market actors, at greater speed, and with less apparent need for societal engagement. As such, political and societal support for community energy has so far been limited.

Based on this narrative, this chapter presents a comprehensive review of the literature that provides context and rationale for this thesis.

2.1 New objectives, new decisions

The UK's energy system is at something of a crossroads. Climate change and shifts in global energy consumption are presenting two key challenges to the country: reducing the carbon intensity of the energy system and increasing domestic energy security. The importance of addressing these long-term challenges, whilst maintaining affordability of energy supply for consumers, was first communicated in the government's 2007 Energy White Paper (BERR, 2007). Addressing any one of those issues would be difficult in its own right, but addressing them all simultaneously represents an unprecedented challenge in the scale, depth and immediacy of the situation for policymakers as well as society at large.

Moreover, a significant proportion of the UK's current energy infrastructure is coming to the end of its functional lifetime, hastening the need to make decisions around the next round of infrastructure investments (DECC, 2011b, Ofgem, 2010). In very coarse terms, the first option might be to renew the existing fleet of energy producing and generating plant with similar technologies but updated technical standards and increased efficiencies. This might represent the employment of existing fuels, supply chains and supply networks, albeit with modern technical components, such as in a new generation of nuclear power or gas turbine plants. While the familiarity of such changes might be appealing to politicians (and perhaps part of society), such incremental change could only go so far in tackling the energy challenges, particularly those relating to climate change, and would perpetuate exposure to volatile fossil fuel prices with implications for energy costs.

A second option is to fill the capacity gaps left by closing generation plants with alternative technologies more fundamentally suited to addressing contemporary energy challenges. Importantly, this option would take advantage of renewable sources of energy, which, by their nature dramatically reduce the contribution of the energy production to carbon emissions. The scale and relative immaturity of some such technologies means that the upfront capital costs of this option can be relatively high in the short term, although their minimal operational costs (due to the use of free, renewable sources) mean they are relatively insulated from variations in global fossil fuel prices. Depending on the technology used, such a path would also employ both existing supply networks as well as require their updating.

Clearly, these options represent two extreme ends of a continuum, and the path currently taken is a combination of the repurposing and renewal of existing technologies and networks with the introduction of new technologies and networks. However, each path along that continuum represents vastly different propositions in terms of our ability to address the energy challenges outlined above; the costs involved and value created, both for this, and for future generations; and consequently, for our ability to meet broader societal objectives. It is clear then that careful consideration needs to be continually taken with respect to the pathway we, as society, want to take, as well as to the steps we take to move towards and along that pathway.

Financial assistance to increase the deployment of renewable energy technologies have been in place for around 25 years, but while significant progress has been made to this end, there remain doubts around whether the scale and speed of such progress is enough to meet EU targets (European Commission, 2015). Furthermore, the energy supply system is only part of the wider energy system, and the nature, scale and immediacy of the interconnected energy challenges requires a systems-wide approach; that is, meeting the challenge requires changes not only to supply, but also to consumption, and necessitates learning from and adaptation of technological, economic, societal and institutional systems (UKERC, 2009, Droege, 2009, HM Government, 2009a, Stern, 2006, Foxon et al., 2009, Jackson, 2009).

Further, it is becoming acknowledged that current governance arrangements and associated institutions are ill-suited to the energy challenges of today. Rather, the rules, incentives and institutions currently in place do not facilitate innovation needed to meet the various energy challenges, are disengaging of consumers, are ill-suited to the integration of modern technologies, and failing the interests of society by virtue of the lack of a legitimate, transparent and dynamic framework upon which change can occur (Lockwood, 2013, Mitchell, 2014a, Mitchell et al., 2015). These arguments are at the heart of the need for a fundamental policy paradigm shift within energy (Mitchell, 2008, Kuzemko, 2013, Kern et al., 2014).

As the following section explores, the current energy system design is ill suited to meeting the key objectives of energy policy, and making only incremental changes to the fundamental structure of the system is unlikely to get us very far. Furthermore, for reasons that will be explored, the energy system can be considered 'path dependent': that is, any decisions made about future pathways are very much constrained by the current path, and it can be costly (in financial, political and psychological terms) for those with influence in the energy system to divert from what is held to be familiar. As such, inertia is a key characteristic of both the components of the energy system (business models, institutions, forms of governance, consumer norms etc.) as well as of the system as a whole.

This has two key implications. Firstly, the decisions that take us down a given pathway cannot be taken lightly. They require careful consideration of the economic, social and environmental costs and benefits of a huge range of decisions relevant to the functioning of the energy system. Secondly, system complexity and path dependency means that it is both difficult but vital to make decisions while focusing on the pathway society wants to take, rather than the one it appears to already be stumbling along. It is in this context of the need for deliberative decision making that the current research is placed.

2.2 Inadequacies of the current energy system

The headline challenges for UK energy policy, to provide clean, secure and affordable energy are consequences of both external and internal factors. While exogenous factors (e.g. shifts in global energy consumption of developing countries impacting on global energy prices and emissions) of course provide part of the rationale for energy system change, endogenous factors cannot be overlooked. For example, the fossil fuel based energy system in the UK has been a major contributor to domestic emissions, and thus to climate change (HM Government, 2009a). Similarly, a reliance on fossil fuel-based infrastructure means that we have become increasingly reliant on fuel imports, often from fragile economies, which has affected our energy security (Wicks, 2009, Kuzemko and Bradshaw, 2013). Affordability is in part influenced by global factors (such as wholesale costs of gas, for example), but again, these external factors are of importance only because of the dependence on fossil fuels in this country (Ofgem, 2012, Wicks, 2009, Mitchell et al., 2013). Thus, while the big issues of climate change and energy security are often framed as external forces (Kuzemko, 2013), they are influenced in large part by the characteristics of the system in place today (Mitchell et al., 2013).

For these reasons, it is highly unlikely that UK energy policy challenges can be addressed with the same technologies that played have created them. This section discusses the inadequacies of a centralised, fossil-fuel-based energy system in dealing with the contemporary energy policy challenges.

2.2.1 Climate change

There is now widespread scientific consensus that the climate warming is unequivocal and that it is “extremely likely” (> 95 per cent probability) that most of this warming is due to anthropogenic GHG emission increases (IPCC, 2013). There is growing evidence of the impact of climate change on natural and human systems, with potentially profound implications for ecosystems and the human livelihoods they support (IPCC, 2014). As such evidence mounts, climate change has been described by world leaders as the biggest threat to humanity (Ki-Moon, 2014, Obama, 2014).

The potential economic implications of climate change impacts were highlighted in the Stern Review, commissioned by the Government in 2006. Stern described climate change as “the greatest and widest-ranging market failure ever seen (Stern, 2006), highlighting that impacts are likely to cost a significant proportion of GDP, that these would be distributed towards poorer nations, and are likely to accelerate as climate change progresses (Ibid; OECD, 2008, IPCC, 2014). Addressing climate change sooner rather than later thus carries benefits that outweigh the costs (Stern, 2006, Ackerman and Stanton, 2006).

The United Nations Framework Convention on Climate Change (UNFCCC) was established in Rio de Janeiro in 1992 to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC, 1992). This led to the 1997 Kyoto Protocol, which sets binding GHG emissions targets for developed countries. Under this, the UK as member of the European Union committed to reducing GHG emissions by 12.5 per cent in the first commitment period from 1990 to 2012, and 20 per cent by 2020 (Defra, 2006).

The vast majority of total GHG emissions in the UK are derived from the production and consumption of energy, with the energy sector (including transport) contributing to 84 per cent of all GHG emissions in 2010 (DECC, 2012c). This means that for the UK at least, the climate change challenge of reducing greenhouse gas emissions is directly related to the manner in which we produce and consume energy. This of course implies that those factors contributing to the problem can form part of the solution (Scrase and MacKerron, 2009).

The passing of the Climate Change Act in 2008 established an overarching commitment by the UK to reduce emissions by 80 per cent by 2050, relative to 1990 levels (HM Government, 2008). The Act established a framework for setting an “economically credible” emissions reductions path, gave ministers powers to introduce mechanisms to achieve targets, and established the Committee on Climate Change to oversee carbon budgets and policies (*Ibid*).

The role of the energy system in reducing emissions is profound. Electricity generation is the single largest contributor to UK emissions, making up around a third of total GHG emissions in 2006 (WWF, 2006). Decarbonisation of the economy is thus reliant on decarbonising the electricity sector. In addressing the energy challenges, a central policy strand has thus been to increase the proportion of energy coming from renewable energy (RE) resources, with the 2009 Renewables Directive (EC, 2009) committing the UK to a 15 per cent target by 2020 (HM Government, 2009b). To that end, the UK government is seeking to deploy RE technologies through a suite of policy instruments and at a range of scales. Moreover, although the primary rationale for RE policy measures is to help reduce GHG emissions to comply with EU and associated UK legislation, it has been acknowledged that such an approach is also aligned with other energy policy objectives, namely energy security and technological innovation (DECC, 2011, DECC, 2010), as well as industrial policy objective of industry and job creation (EC, 2009, DECC, 2011d, DECC, 2010a).

In part resulting from RE policies, and in part due to reductions in consumption caused by the economic downturn and improved energy efficiency, the contribution of the power sector to total emissions dropped to around a quarter in 2014, allowing the first carbon budget (and EU Kyoto target) to be met comfortably (CCC, 2015). Deployment of renewables over the last decade has been promising, particularly when the low baseline relative to other EU countries is considered. However, there remains considerable uncertainty over the continuation of investment up to 2020 and beyond (CCC, 2014), a situation compounded by the stagnation of two key elements of decarbonisation programme: the development of Carbon Capture and Storage (CCS)[1], and the deployment of a new generation of nuclear power stations (CCC, 2015, CCC, 2014). At the time of writing, the realisation of these two strands appears more at threat than ever (Neslen, 2015, Financial Times, 2015), making the unsuitability of fossil fuel based infrastructure even more apparent.

2.2.2 Energy security

Energy security concerns in UK policy have risen up the political agenda in the last decade, influenced by depleting North Sea oil and gas production, blackouts in power systems around the world, rising global energy prices, geopolitical concerns, and fuel protests (Mitchell et al., 2013). The UK in 2013 changed from a net exporter to a net importer of primary fuel types, the first time it had been since the 1970s prior to the exploitation of North Sea oil and gas developments. Though import dependency itself may not be an issue, its political salience is enhanced by ongoing concerns about the stability of importing countries (Wicks, 2009, Mitchell et al., 2013). Meanwhile, the need for the current ageing fleet of generation infrastructure to be replaced provides an additional dimension to the need to maintain accessibility of affordable supply (Ofgem, 2010, DECC, 2011b).

This political salience of energy security has, and continues to be, centred on the economic (and thus political) imperatives of "keeping the lights on" in terms of maintaining a functioning economy. This could either be manifested in a physical *shock* to supply over a short term (such as interference in transit routes), or a more structural, long-term *stress* to supply (caused perhaps through gas price volatility affecting inflation and consumer prices (DECC, 2012a). Either way, the political consequences of threats to national prosperity are likely to be damaging, making appealing the prospect of having more 'home-grown' energy in the mix (Wicks, 2009).

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[1] There are also ongoing developments in Carbon Capture and Recycling (CCR) technologies which produce usable CO_2 for industry (Gale, 2015)

The interconnectivities of the UK energy system, and of energy systems elsewhere ensure that energy security is a property of the energy system, rather than of a single component (i.e. electricity supply infrastructure) (Mitchell et al., 2013). While particular components of the system might be regarded as being less or more 'secure', the overall security of energy services for society is dependent on the interactions between all of the elements of the system (Ibid), meaning that addressing energy security necessitates action across the entire energy system, rather than just to discrete elements, such as more favourable foreign relations.

The dominance of centralised fossil fuel-based infrastructure over alternative forms of energy production means that the system is particularly vulnerable to disruption to supply networks, which are increasingly outside of domestic control and subject to wider geopolitical forces, giving rise to the threat of both shocks and stresses relating to the vagaries of global politics and energy consumption trends (Kuzemko and Bradshaw, 2013). Furthermore, the scale of centralised energy supply networks in the UK means that disruptions to single components or particularly supply sources (such as freight driver strikes and blockades) or distribution nodes can potentially impact large sections of the UK energy system (Sovacool, 2010).

Of more fundamental relevance is how the institutional properties of the energy system, including governance, have impacted upon system security. It is clear now that assumptions in the 1980s and 1990s that energy security would be a natural outcome of marketization, privatisation and liberalisation of energy were flawed (European Commission, 2011). This realisation can in part be attributed to variations in state control (and often ownership) over energy companies across different nations, and the incompatibility of energy governance approaches across nations (Kuzemko and Bradshaw, 2013).

2.2.3 Affordability

Conceptually, affordability of energy can be considered a form of energy security (Mitchell et al., 2013), with the actor taken as households or individuals rather than the state (or region). Threats to affordability can then appear in the form of reduced spending power, or the increased costs of heating and lighting as key energy services.

Although the importance of domestic energy efficiency had been recognised since the late 1970s, it wasn't until the advent of the New Labour Government in 1997 that affordability featured as an explicit strand within energy policy rather than as assumed outcome of free markets (Boardman, 1991, Kern et al., 2014). The commitment to liberalisation in general continued during this period, although the focus, particularly in the first term of government, was making it work better to serve social objectives (Pearson and Watson, 2012), with Energy Minister John Battle emphasising the "commitment to competition and determination to ensure that the unbundling of costs does not hit hardest those least able to pay" (Battle, 1997). For example, in their first year, the government introduced winter fuel payments, a windfall tax for utilities, and reduced VAT on domestic fuel bills, and paved the way for the publication of the government's first Fuel Poverty Strategy in 2001 (Pearson and Watson, 2012). Unlike climate change and energy security policy, affordability policy under New Labour can thus be explicitly characterised with social objectives of human health and wellbeing (Liddell, 2008, Hills, 2012).

Beyond the policy focus on affordability directly, climate change and security interventions are of course inextricably tied to affordability. Since such policies are passed onto consumers through bills, our ability to follow a given energy transition will be determined by the willingness and ability of society to pay for the requisite changes to the energy system (Pollitt, 2010), the distribution of which is unevenly distributed across society (Mitchell et al., 2012). Outside of 'affordability policy', the assumption that liberalisation would maintain affordability (by driving competition) has in recent years been acknowledged as false (HM Treasury and DECC, 2010), calling into question the suitability of energy regulation as it is currently set up (Mitchell, 2014a).

There is however some evidence that affordability has been repoliticised in recent years in terms of increasing discussion within civil society and the media around rising energy bills and potentially excessive profits of energy utilities. This has culminated in a series of policy interventions in recent years, including Energy and Climate Change Select Committee inquiry on energy prices and vertical integration (ECCC, 2013), the development of the first fuel poverty strategy in over a decade (DECC, 2015a), and a referral (by the Gas and Electricity Markets Authority as Ofgem's governing body) to the Competition and Markets Authority (CMA) over possible distortions of competition within the UK energy market.

2.3 Inertia as the fourth objective

The three energy challenges outlined in the previous section are only part of the picture. This thesis contends that there is a fourth challenge; that of overcoming the inertia that perpetuates the current, failing system that locks out the emergence of alternative pathways. As this thesis contends, the underlying problem is that the technologies, markets, institutions, governance, and consumers are highly entrenched in their own right, as well as in relation to one another. Not only then is perpetuation of the current centralised, large scale energy system inappropriate for meeting the three energy challenges, it is structurally resistant to the introduction of an alternative system. In this sense, the challenge is not simply in addressing objectives, but in changing the fundamental structure of the system to make it more able to address such objectives.

2.3.1 Timescales of incumbency and change

The timescales that both characterise energy systems and that are required for overcoming contemporary challenges are of relevance here. The architecture of the energy system as we know it in the UK was set up in a different era, to meet a quite different set of objectives than those faced today: The majority of the UK's current fossil-fuel-based generation infrastructure, for example was set up in the 1970s and 80s, during in a period of abundant and inexpensive fossil fuels supply. Energy infrastructures were typically large scale, reflecting the relative ease of scaling up from smaller thermal technologies without prohibitive capital costs and economies of scale were possible with the availability of transportable, storable, and easy to handle fuels. The siting of coal-powered generation plants near areas already exploited for coal resources, prior to cultural understanding of climate change, meant that decisions relating to generation were rarely as politically contentious as they are nowadays. As Liebreich points out, in the past "there were no discussions about the relative aesthetics of open-cast coal mines and gas fields" (Liebreich, 2015).

In addition, in the 1970s and 80s, the threat and implications of unchecked climate change was yet to be acknowledged, as was the impact of carbon emissions on climate change, and the global power balance was characterised by the relatively simple bipolar axis of the Cold War (Mitchell et al., 2013). All of these circumstances ensured that expanding fossil-fuel extraction and generation could meet rising demand for energy services. Without (knowledge of) the threats of climate change or energy security, and with low fuel prices, energy was treated as a simple commodity (Kuzemko, 2013) rather than the means to deliver a public good. As a result, society has become accustomed and conditioned to having abundant, cheap, energy services with relatively unconstrained availability and consumption, and with no real drive to become engaged in energy beyond the consumption of energy as a commodity.

While the interconnected systems of technology, delivery and consumption have thus become established over a number of decades, the advent of a new set of energy challenges requires change to occur over a comparatively short timescale (Fouquet and Pearson, 2012). It requires the rapid adoption of (often) immature technologies, acceleration in innovation, and relatively quick shifts in individual and collective behaviours and lifestyles. It seems clear then the inertia that characterises the current energy system is a fundamental issue that warrants specific attention. This section seeks to address this.

2.3.2 Questioning the inevitability of a fossil-fuel based system

The hypothesis that a large-scale energy system is not an inevitability is not new. With relevance to energy studies, E.F. Schumacher in the seminal *Small* *is Beautiful* (1973) challenges the established orthodoxy of economies of scale, arguing that while large scale processes may be economically more efficient, it risks side-lining those objectives (e.g. justice, harmony, beauty and health) that are less valued, but arguably more important in terms of overall societal welfare.

Around the same time Amory Lovins conceptualised appropriately-scaled and decentralised energy technologies as an alternative 'soft energy path', to the conventional 'hard energy path' of centralised thermal generation (Lovins, 1977). Lovins' writings came at a time of increasing dependence on centralised generation and the notions of paths emphasised that choice is explicit, that is, a centralised 'hard' path is not inevitability. Furthermore, while each option is likely to necessitate change, choosing a hard path would entail social change that "are apt to be less pleasant, less plausible, less compatible with social diversity and freedom of choice, and less consistent with traditional values" (Ibid).

These core publications present the basic principles upon which small-scale energy in this thesis is conceptualised. Firstly, they challenge the neoclassical premise that cost minimisation should override other societal objectives: while striving for economies of scale can be desirable in many industrial processes, the relationship between the energy system and society (particularly in relation to pollution externalities) compel us to satisfy needs beyond cost minimisation.

Secondly, there is the suggestion that there is no middle way, and 'choosing' (either actively or passively) a centralised route can inhibit the attainment of the alternative, "both by starving its components into garbled and incoherent fragments and by changing social structures and values in a way that makes the innovations of a soft path more painful to envisage and to achieve" (Lovins, 1976). Small-scale energy can thus be considered both an end (in terms of the wide range of benefits it can deliver) as well as a means (in terms of alternative technologies, politics and philosophies) through which to get there.

While these publications gained traction among proponents of a different pathway, it is only recently that the benefits of such a pathway have made their way into the mainstream. With hindsight, they appear prophetic, especially given the infancy and low rates of deployment of the alternative technologies they promote, but also because of the dominance of the conventional energy system at the time. Now that such technologies are forcing their way into the mainstream and pushing out incumbent technologies, there the pressure to step away from a large-scale energy path is increasing.

It is in this vein that Michael Liebrich recalls the quote often (mis)attributed to Gandhi that "First they ignore you, then they laugh at you, then they fight you, then you win" in relation to the clean energy pushback (Liebreich, 2011, Klein, 1918).

2.3.3 Conceptualising lock in

Analyses of the processes of technological, institutional and cultural 'lock-in' are well established within the literature, particularly with respect to low carbon transitions (e.g. Unruh (2000)). These forces of inertia work together to present significant barriers to addressing the various energy challenges to such an extent that overcoming these barriers could be considered a challenge in its own right.

The heavily interlinked system of technologies, organisations, society and governing institutions, termed the Techno-Institutional Complex (TIC), can thus be understood as a stable configuration of technological infrastructures and the organizations and institutions that create diffuse and employ them (Unruh, 2000). The energy system can thus be regarded as an example of such a system.

The field of *Science, Technology and Society* (STS) studies hypothesises that technology co-exists and co-evolves with society, and that specific technologies become established because they are 'socio-technical configurations that work' (Rip and Kemp, 1998). Although focusing on technology, this concept rejects any form of *technological determinism* (the linear notion that technology moves forward and society adapts), and instead posits that technologies influence and are influenced by the social, economic and cultural contexts in which they develop (Rip and Kemp, 1998). Technological innovation thus arises as a result of the interactions of a given technology within the context of existing markets, institutional and regulatory factors, and expectations of consumers, to that extent that its development is said to be 'path dependent' (David, 1985), with regard to the existing TIC.

In particular, path dependency and the embedded nature of TICs within complex systems (such as the energy system) acts to favour incumbent technologies and supporting organisational, societal and governing structures over new technologies and new structures. To the extent that technologies, institutions and society becomes locked in to a specific TIC – in this case, the large scale centralised energy system (Arthur, 1988, Foxon, 2002). The mechanisms behind such forces are now briefly explored.

2.3.4 Technological lock-in

Stability within the dominant energy system TIC arises from a combination of forces that conspire to perpetuate fossil-fuel based infrastructures despite the presence of alternatives, a situation which has been described as 'carbon lock-in' (Unruh, 2000). Firstly, as already touched upon, path dependency relates to the selection of particular designs through a chance set of circumstances relating to timing, strategy and historic circumstances, rather than superiority (Arthur, 1988). The temporal dimension is central here: large, centralised fossil fuel-based technologies offered an appropriate solution for the needs of a historic energy system, but are ill-suited to today's challenges.

Several factors, including adaptive expectations, scale economies, learning economies and network economies contribute to increasing economic returns to scale reduces the cost of technologies as adoption increases, creating competitive advantages. Under conditions of path dependency (i.e. with the right timing/historic conditions), exploiting these increasing returns to scale through development and commercialisation can result in market domination and lock-in to specific technologies (Unruh, 2000). With particular relevance for this thesis, network effects, as the embedded nature of interconnected technologies, explains the coevolution of large scale fossil-fuel based technologies with centralised, radial, inflexible transmission and distribution networks through the establishment of within-industry cooperation and standards (Mitchell et al., 2014, Mitchell, 2011), norms of financing (Reed, 2013), and a specific set of institutions and skills that perpetuate knowledge, skills and resources needed to maintain a particular system (Unruh, 2000).

2.3.5 Institutional lock-in

The coevolution of TICs means that embedded technological are supported and reinforced by lock-in of an to the institutional structures that employ them. Piersen (2000) argues that collective action, the high density of institutions, asymmetries of power and the complexity and opacity of politics means that a potentially wide range of social outcomes can result from relatively small or contingent events within the development of political institutions (Foxon, 2002). Acknowledging the developing relationship between technologies and the social, economic and cultural contexts in which they are situated is thus key to understanding both lock-in and the potential for overcoming lock-in (Foxon, 2002, Rip and Kemp, 1998).

Institutional lock-in in this sense however can be extended beyond the traditional notions of firms or other organisations to encompass the “rules of the game”, particularly with respect to energy governance. Since privatisation, the current UK energy system has largely been facilitated by liberalised energy markets, within what can be described as a Regulatory State Paradigm, characterised by light-touch independent regulation of market-led solutions (Mitchell, 2008, Kuzemko, 2013). The rules and norms of governing have therefore been shaped by neoliberal assumptions around energy as a commodity and the role of a regulated private sector in helping address the energy policy objectives. Of course, these rules are enshrined in a set of institutions including Government departments and regulatory bodies (e.g. DECC, Ofgem).

2.3.6 Cultural lock-in

While the sociotechnical change literature often focuses on relationships between technologies and institutions, the role of end users in sustaining lock in is an important dimension. As Unruh (2000) states, “the social co-evolution with technology can have pervasive and lasting influence on individual preferences. From this perspective, expectations and preferences co-evolve with, and become adapted to, the dominant technological system in an endogenous path-dependent manner”. Society both affects and is affected by coevolving technologies: Society ‘picks’ technologies to fit in with their needs, and in turn the emerging dominance of systems becomes integrated into society through the adaptation of preferences, expectations and routines (Unruh, 2000, Unruh, 2002, Perez, 1985, Hughes, 1983).

Although these analyses often refer to macro-level societal actions, this broad view of societal preferences has been complimented in the literature by contributions from sociology and psychology. Here, the nuances of convenience, habit and responses to norms and contexts to the individual’s experience have been used to characterise “consumer lock in” in relation to consumption (Jackson and Michaelis, 2003, Shove, 2003, Shove and Warde, 1997, Gronow and Warde., 2001). For example, energy end-use technologies (which have coevolved alongside supply and distribution technologies) have had profound impacts on activities in everyday life including cooking, leisure, transport etc. (Nye, 1990).

This has several implications for policy: Although markets are often assumed to offer freedom of choice to consumers, consumer lock-in implies limits to the agency of individuals, which of course suggests a greater role for government in facilitating change (Jackson and Michaelis, 2003). This role must acknowledge that energy users are more than mere consumers, and have a more nuanced appreciation of the dynamic and shifting relationship between individuals and the ways in which they use energy (Devine-Wright, 2007).

One example of the complexity of individuals as energy consumers, and a profound example of consumer lock-in, is that of sticky customers in the electricity market. Since privatisation of the industry in 1990, almost 40 per cent of customers had not switched from the incumbent regional supplier, and most of those that have switched only do so rarely (Ofgem, 2014c). Low switching rates (and thus low competition) in turn affect energy system innovation, as new entrants find it difficult to access new customers, and incumbents are not encouraged to offer new or better services (Mitchell et al., 2014). Such a situation calls for a greater appreciation of the factors in and opportunities for overcoming lock-in of this type.

2.4 Alternative prospects of a different approach to energy

In broad terms, an alternative pathway to the current centralised energy system based on large-scale fossil-fuel generation can be represented by a more decentralised non-fossil fuel system at the smaller end of the scale. By virtue of the nature, scale, and geography of an emerging set of technologies, such an alternative pathway offers a new set of prospects around how the energy system is able to deal with contemporary energy challenges, including that of overcoming inertia. The availability of an alternative pathway particularly as it becomes better understood calls into question the inevitability of the status quo, and can be seen to be challenging prevailing policy direction in the UK.

What are the key aspects of an alternative pathway? Such a question has been at the heart of much debate, and is of consequence for the perception, analysis and treatment of such approaches within both academia and policymaking (Pepermans et al., 2005). At the coarsest level, an alternative energy pathway simply represents a set of technologies whose nature, scale and geography is the antithesis of the conventional energy system. However, such a conceptualisation is ignorant of the breadth and diversity of technologies and scales within, all of which have the potential to offer different value prospects to society. A remote 20MW wind farm, for example has the potential to offer very different prospects (positive and negative) than a single 500kW turbine local to a population in terms of network integration implications, investment required, policy support, planning, and the potential for different ownership models. While both projects thus might be considered cleaner, smaller-scale and decentralised *compared to conventional energy technologies*, there is clear merit in understanding how such approaches translate into value for different stakeholders. This section dissects the meaning of an alternative energy pathway and presents the relative benefits and disbenefits therein, with specific relevance to the contemporary energy challenges.

2.4.1 Conceptualising an alternative pathway

There has been some disagreement in the literature over what constitutes decentralised energy, with definitions differing between countries and contexts, and shifting over time (Woodman and Baker, 2008). Pepermans et al. (2005) documents various attempts to define distributed (electricity) generation (DG), which are based variously on voltage levels (CIRED, 1999, Dondi et al., 2002, Chambers, 2001, Lasseter, 1998), directness of supply to consumers, centrality of planning or dispatch or degree of independence from the distribution network itself (CIRED, 1999, Dondi et al., 2002). Other more flexible definitions are based around proximity to load or for specific consumer needs (Dondi et al., 2002, IEA and OECD, 2002). Ackermann (2001) aims to provide a more precise definition through analysis of the main issues of purpose, location, rating, area, technology, environmental impact, mode of operation, ownership and penetration, offering a definition of DG as 'distributed networks, or on the customer side of the network' (Ackermann et al., 2001). Even within UK government, definitions of 'distributed energy' have variously excluded (Ofgem and BERR, 2008) or included heat (BERR, 2008), the latter emphasising the importance of proximity of supply.

2.4.2 Emissions reduction

In terms of reducing GHG emission, introducing RE technologies clearly offsets the need to supply the same energy from fossil fuel sources. Although renewable forms of power generation release some emissions during production and installation stages of developments, fossil fuel plants release emissions in throughout operational phases, giving them total emissions of up to 100 times the magnitude of renewables, depending on technology (Evans et al., 2009).

A key argument for the deployment of small-scale RE in particular is that it increases overall RE capacity, thus contributing to RE and emissions targets (Hain et al., 2005). The wide variety of scales over which RE can be deployed means that technologies can be sited in many more sites than large-scale centralised thermal plant, such as on domestic or commercial rooftops, or embedded in or around towns and communities, which in turn opens opportunities for a much larger and more diverse ownership base than is possible with remote, centralised infrastructures. Furthermore, there is evidence that deployment of renewables among populations can be self-reinforcing, encouraging adoption through peer effects (Bale et al., McMichael and Shipworth, 2013).

2.4.3 Energy security

A key driver for RE deployment is that it reduced dependence on imported fossil fuels and provides insulation against both the vagaries of the global fossil fuel market and sudden supply disruptions (Grubb et al., 2006). Although the intermittency of RE sources means that they are potentially sources of insecurity individually, increased deployment of decentralised, diverse RE sources gives enhanced system security through both more diverse supply chains and enhances resilience against interruptions to any one source, particularly when considered in light of developments in demand reduction, load flattening, and increased flexibility in both the demand and the supply side (Grubb et al., 2006, Hoggett, 2013, Jansen, 2015, Mitchell, 2015b, Mitchell, 2015a). The benefits of distributed RE is discussed in further detail in relation to network management in Section 2.5.5.

2.4.4 Affordability

The cost and revenue structure of large-scale, centralised fossil fuel-based energy production varies massively from smaller scale, distributed, renewable and alternatives. The former are typically characterised by relatively low capital costs and high, and variable fuel costs. Relatively low capital costs are possible when deployed at scale because of the scale inherent in thermal generation, although fuel costs, as discussed, are exposed to the vagaries of uncertain and fluctuating global commodity markets. With much of the UK's thermal-based energy infrastructure coming to the end of its operational lifetime (Ofgem, 2010), RE is considered as a cost effective hedge against fuel volatility.

The impact of RE adoption on energy costs, and thus affordability has been subject to much debate. In the UK, costs are supported by a range of incentives operating at different scales, funded by bill-payers. The impact of renewables support on energy bills has been relatively low: In the period 2004-11, electricity prices increased by 79 per cent, six per cent of which is attributed to renewables support and a further nine per cent to carbon price support (CCC, 2011). Up to 2020, further net increases of around 29 per cent to overall energy bills are projected, ten per cent of which will be due to RE investments and carbon price (Figure 2.1). Cost projections past 2020 are however subject to considerable uncertainty, particularly around the actual mix of renewables on the system and the associated carbon price costs (Ibid). Beyond 2030, and assuming high overall RE capacity and continued RE cost reductions from learning in deployment, bills are expected to fall (Ibid).

Nonetheless, for some, and depending on the form of ownership, support for RE adoption represents a regressive tax whose revenues only accrue to those with the resources to invest, and particularly harms the most vulnerable of billpayers (Monbiot, 2010, FPAG, 2009). For this reason, and because of rising household energy costs, the cost of RE deployment as a contributing factor has been the subject of much debate. It is thus while affordability is somewhat sidelined relative to other policy issues, its relationship to other objectives means that it is unavoidably salient (Kern et al., 2014). Apparently seeking to distance himself from any components of energy bills that might be avoidable, the Prime Minister in date was reported as stating that he wanted to "get rid of the green crap" (Platt, 2014).

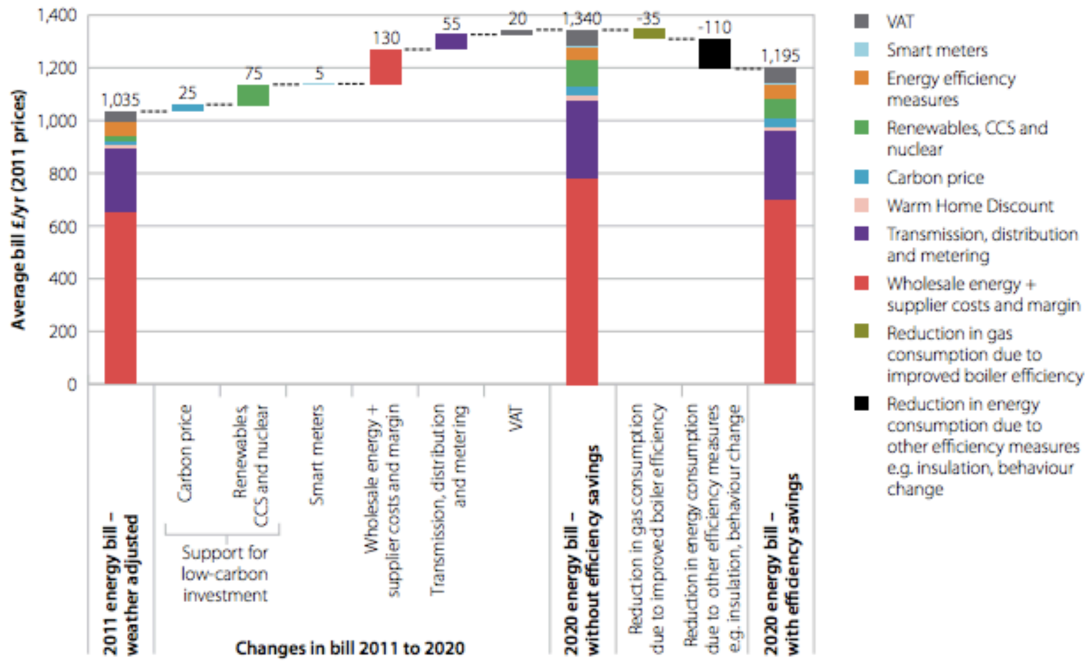

Figure 2.1 Components of average domestic energy price

Source: CCC (2011)

However, in light of the updating required of energy infrastructure, and particularly of the need to decarbonise energy, some costs are inevitable. While it is of course unfortunate that changes need to be implemented urgently (particularly for the governments whose decision to do so may be unpopular among some of the electorate), this is an unavoidable consequence of both historic underinvestment in energy infrastructure, and the perpetuation of a governance framework that failed to encourage competition and innovation to the desired degree.

2.5 Overcoming inertia: the role of small-scale

While overcoming system inertia has apparently been of little interest to the UK government, there is evidence that the ongoing development of renewable energy within the energy system is itself challenging and disrupting the mainstream energy system as we know it. In contrast to the majority of countries where energy was privatised in the 1990s, a limited few (Denmark, Germany, California) have introduced policies, which have collectively enabled a ‘disruptive’[2] shift in the way their energy system operates (Mitchell et al., 2014). While the UK’s attitude to, and policy support for small-scale energy is lagging behind these frontrunners, there is still some evidence that some subtle structural shifts are taking place through the RE deployment that is happening.

The dominance of the large-scale centralised energy system has been traditionally reinforced by the economies of scale afforded by affordable and secure supply fuels, and monolithic modes of governance enabled by disengaged publics. However, it is becoming apparent that the emergence and development of small-scale infrastructures are well suited to overcoming this inertia, by virtue of their cost structures, affordability, and overall democratising effect they have on society. With respect to the need to overcome inertia, this section shows that in the words of Lovins, these new technologies are proving themselves as ‘appropriate’ for the needs of society.

2.5.1 Improved cost structures

One key factor in the disruptive potential of RE is that it represents a different set of values to the system than fossil-fuel generation does. Within conventional electricity markets, energy is bought by suppliers in order of the marginal cost of generation, with the cheapest forms being utilised first and more expensive forms later (Ray et al., 2010). Since RE technologies have very low or zero marginal costs, energy from those sources is used preferentially, with higher marginal cost plants pushed progressively out of the market due to the ‘merit order effect’ (Ray et al., 2010, Mitchell, 2014b). As

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[2] Mitchell et al (2014) define ‘disruption’ as a “rapid change in the characteristics of an electricity system, which has its own momentum…and which leads to different operating and management processes, which in turn enables different social, economic and technical outcomes”.

markets becoming more and more saturated with RE, fossil fuel plants are becoming less profitable, potentially threatening the business plans and strategies on which that type of plant is based (Buchan, 2012). Exceedingly high penetration of RE, and particularly solar, in Germany is a major factor in the ongoing collapse of utility business models in Germany (Schuppe, 2015a), raising the prospect of a similar situation occurring in the UK (Mitchell et al., 2014).

2.5.2 Technological learning and economies of scale

While developing a base of renewable energy infrastructure comes at a cost (as discussed above), the relative infancy of many RE technologies (compared to more established forms) means that innovation through technological learning is expected to deliver significant reductions in energy production costs (Foxon et al., 2005). The argument here is that cost reductions and quality improvements can be brought forward through a process of "learning-by-doing", whereby improvements in production processes, labour efficiencies and new processes drive down unit cost with both positive private and public and benefits (Arrow, 1962, BCG, 1972).

For RE technologies, cost reduction rates have varied considerably across technology type and scale, reflecting varying rates of adoption, stages of maturity, capital intensity and market dilution (Müller et al., 2011). Global deployment of renewables in general has greatly enhanced the competitiveness, particularly in the case of solar, the cost of which in the UK has plummeted in recent years as a result of both global and local learning (Figure 2.2) (Department of Commerce, 2012, Kay, 2015).

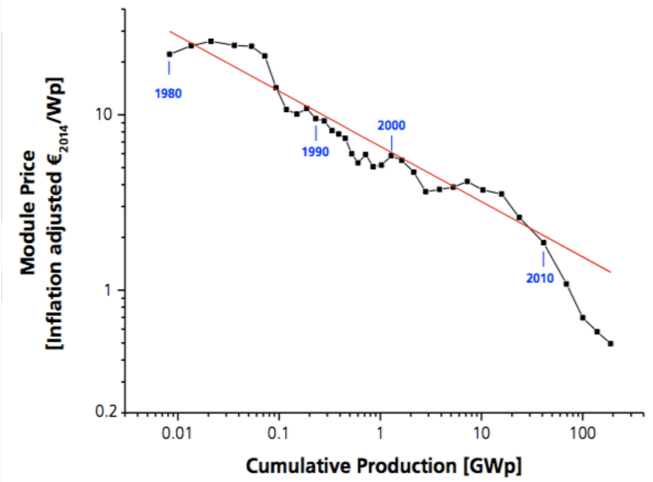


Figure 2.2 Learning curve for all commercially available PV, 1980-2014
Source: Fraunhofer ISE (2015)

Deployment costs of RE vary as a function of scale. Larger commercial installations typically benefit from economies of scale at the plant level, since installing many wind turbines in one location, for example reduces cost per output through bulk-buying, and aggregating installation, planning and connection costs, reducing the total cost of installation per unit output (Wiser and Bolinger, 2011). At the other end of the scale, investment into a smaller development involving one or two turbines may be ostensibly more suitable for small-scale actors (individuals, community groups), although the lack of economies of scale such as those related to network connection costs, may prove prohibitive (Simonds and Hall, 2013).

In contrast to large-scale fossil fuel or nuclear installations, the economies of scale achieved by RE at the production level are profound. Developing a single 500 MW gas power plant, for example, provides one opportunity for learning, whereas a comparable increase in onshore wind deployment would involve the production and installation of several hundred turbines (or several million solar PV panels), providing much greater opportunity for learning by doing, increased labour efficiencies, and process innovations. Consequently, the potential for cost reductions with smaller-scale technologies far exceeds that for large-scale technologies.

In addition to scale economy benefits, the small-scale and modular nature of solar PV means that the relative simplicity of supply chains is inherently flexible with respect to energy system disruptions. Being small-scale and highly modular means that it can be deployed rapidly in a range of applications and scales. The supply chains of solar PV installations (compared to nuclear power installation, for example) are relatively simple, particularly in the latter stages of the PV supply chain where modules are assembled and systems installed (Hoggett, 2014). The flexibility, adaptability and resilience of supply chains for small-scale technologies means that they are both inherently more secure and thus better suited to respond to ongoing changes within energy systems (Ibid), particularly when compared to large, inflexible technologies with complex supply chains and highly specialised components.

The scale, flexibility and modularity of small-scale technologies help to explain both dramatic reductions in solar PV unit prices in recent years (Fraunhofer ISE, 2015) and indeed, rates of UK adoption far exceeded government expectations (DECC, 2014d). Deploying renewables thus has a positive feedback effect on helping to drive down costs, increasing the affordability of such technologies over time.

2.5.3 More diverse ownership

Because renewables can be deployed at a completely different scale to conventional plants, lower costs and the relative ease of installation means that energy production technologies are suddenly affordable to many more actors, thus paving the way for farmers, businesses and individuals, either directly or through forms of collective ownership to become shareholders of energy assets. Although social and environmental rationales are likely to be important factors in deciding about investing in microgeneration (Walker, 2008b, Walker and Devine-Wright, 2008, CES, 2009, Houghton, 2009, Houghton, 2010, Roberts, 2009), the importance of economic motivations have been well documented (Hain et al., 2005, TLT, 2007, Walker, 2008b, CES, 2009, Warren and McFadyen, 2010).

Ownership of microgeneration, i.e. rooftop PV can take a number of forms: they can be owned outright by the occupier (or landlord if it is a rented property); developer or utility-owned, or community-group-owned. Each model offers reduced electricity costs for the householder, but offers different prospects in terms of whether FiT payments accrue directly to householders, to communities, or to commercial enterprises, and thus redistributes value in different ways depending on the model employed.

With larger-scale RE technologies, emergent forms of collective ownership are further opening up opportunities for individuals and communities to invest in RE installations, at different scales. DECC (DECC, 2015c) sets out four main models of ownership relevant under the FiT scheme:

- **100 % community ownership** by a legally-constituted community organisation, aided with funding through a variety of financial models, including equity investments by business angels, venture capital, bank debt, share offers and/or crowd funding;
- **Joint ventures** between community groups and non-community operators, such as a development company or local authority. Ownership and management of the project is split between partners, with developers providing experience and competency as well as carrying risk at the project's early stages, in return for the community group providing value in terms of community buy-in and collaboration;
- **Shared revenue**, in which the community group secures the rights to a virtual revenue stream, calculated on the basis of a specified proportion of the installation's output, less agreed operating costs and generally less virtual debt service.
- **Split ownership**, in which the community group owns a proportion of a development's physical assets, for example, one or two turbines from a larger development.

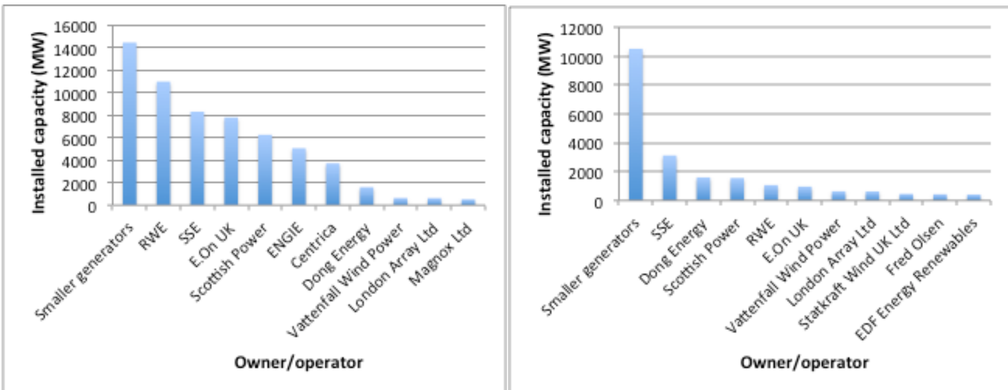
The suitability of each form of ownership depends on a number of factors, including the existence, nature and timing of the relationship between community groups and developers, and the availability of capital from different sources. The degree of community ownership clearly has implications for both the risk carried by the community group, and the potential for revenues and associated social benefits.

The degree of community ownership clearly has profound implications for both the feasibility and attractiveness of projects. While partnering with a developer may be seen (by some community groups) to be against the ethos of the group, developers are clearly valued in the financial and management benefits they can bring to projects. Capital costs can be prohibitive for community groups, and development of rural areas is often challenged by difficulties and costs involved in grid connections, which have been found to vary considerably among community energy projects (Simonds and Hall, 2013).

Although broadening the diversity of shareholders owning energy assets (outright or in shares) beyond corporate interests is beneficial for a number of reasons, the complexity and cost of RE projects has proved to be prohibitive for such actors, particularly at the scale of community energy. This is particularly the case at the start of RE projects, where upfront costs can be considerable (Walker, 2008b). Pre-development costs alone reflect legal and regulatory obligations associated with siting large pieces of infrastructure, including site surveys, engineering assessments, environmental impact assessments, legal fees and public consultation (Hoggett, 2010, Hain et al., 2005, Woodman and Baker, 2008). The uncertainty around getting projects through this initial stage, the costs of doing so, and the lack of cash flow at this stage means that finance is considered ‘at risk’ and as such is both difficult to obtain and represents a key barrier to community energy schemes (Hoggett, 2010).

Fundamentally though, local ownership (even in part) of renewable assets means that the benefits, as well as costs are held locally, rather than in wholly-developer led projects where financial benefits accrue only to developers and creditors. Opening RE investment up to a greater diversity of shareholders greatly increases the availability of capital for deployment, and shares both risk and value over a wider range of actors.

The distributed nature of RE technologies, particularly at smaller scales has introduced a far more diverse range of ownership, and thus greater competition in the generation market than possible with conventional energy production. Figure 2.3 illustrates that when all generation capacity is taken into account, smaller generators only own around 22 per cent of total generating capacity (a), whereas they own almost half of all RE generating capacity (b)[3].



(a) (b)

Figure 2.3 (a) Share of total UK electricity generation and (b) share of renewable generation, 2014

Source: DECC (2015b)

A combination of the introduction of the small-scale (<5MW) feed-in-tariff (FiT) and concurrent reductions in the unit costs of small-scale RE technologies has resulted in significant growth at the small end of the scale. For example, the small-scale PV sector in particular experienced significant growth in the early 2010s, with around half of total PV capacity and 98 per cent of PV plant

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[3] Only those companies owning the ten largest portfolios are shown here for clarity. Smaller generators are those not deemed to be one of the UK's 38 'Major Power Producers' under DECC's definition.

sites contributed by small-scale generators (householders, businesses and communities) (DECC, 2014c). The affordability of small-scale RE units and the means through which to connect and generate revenue from them has opened up the possibilities of previously disengaged actors to play a role in the energy system in ways that simply were not possible before.

Additionally, since the public can play multiple roles and engagements (an individual can be a micro-generator while supporting community projects), small-scale RE deployment has the potential to foster what has been termed ’energy citizenship’ to describe the heightened information, literacy and empowerment, together stimulating an active rather than passive relationship with energy (Dobbyn and Thomas, 2005, Devine-Wright, 2007, Morris, 2001, Bergman and Eyre, 2011). Through empowering individuals and communities to understand, own and manage local energy systems, the expansion of small-scale energy technologies can thus be seen to have a democratising effect on energy supply, where the needs and desires of society are more closely knitted to the design and operation of the energy system in which they are embedded.

2.5.4 Managing demand

Although the dominance of large utilities as the principal agents through which consumers relate to energy policy has meant that up until recently, government policies for reducing energy demand have been delivered by energy supply companies through ‘Supplier Obligations’ (SOs), the development of alternative, appropriately scaled technologies however is offering different, and more effective means through which demand reduction can be addressed.

Without much of an alternative against which to compare, some have suggested that SO-led approaches have been successful in increasing domestic efficiency (Rosenow, 2012). There does however remain doubt as to whether they can be as effective as an approach facilitated by small-scale technologies, and the new forms of relationships they afford with society. Fundamentally, the use of large-scale suppliers as intermediaries introduces a potential market failure by way of the ‘principal-agent’ problem: the inevitable conflict of interests between the principal (the Government, who wants to reduce demand) and agents (utilities, whose *raison d’etre* is to derive profits from increased demand). Aside from introducing a market distortion, such policies also potentially confuse messages, leaving energy consumers without psychological, social or economic motivation to reduce their demand (Parag and Darby, 2009).

Several studies have explored the potential benefits to demand reduction afforded by a new, decentralised renewable system. With respect to microgeneration adoption, studies of the impact on absolute demand are rather inconclusive, with some authors reporting reductions in consumption (Keirstead, 2007), no change (Erge et al., 2001) and some even finding increases, especially among both high-consumption households (Haas et al., 1999) and ‘passive adopters’ (Dobbyn and Thomas, 2005).

However, installation of domestic RE has in some cases been found to stimulate simultaneous deployment of efficiency measures (Haas et al., 1999, MTP, 2005), which further increases the potential for reduced demand. Additionally, several studies have linked PV installation to heightened awareness with regard to changing consumption patterns to times of peak generation, aided by simultaneous installation of monitoring devices (Keirstead, 2007, Schweizer-Reis et al., 2000, Jenny et al., 2006, Bahaj and James, 2007). In other words, while the installation of renewables *alone* may or may not have effects on absolute consumption, increased integration of renewables into the system, and aligned with consumer lifestyles is likely to have a profound effect on managing demand peaks. Demand management has the same intended effect of reducing overall demand in that it increases system efficiency, removing the need for redundancy in generation systems, and reducing additional system costs associated with balancing supply with demand (Strbac, 2008).

In terms of the behavioural change aspects of demand reduction, few studies have analysed the role of community-based interventions on domestic energy use (Hargreaves et al., 2008, CSE and CDX, 2007), and Büchs et al. (2012) note that the case-study nature of most studies makes it difficult to generalise these influences. In a rather more robust analysis by Bardsley et al. (2013), where interventions were controlled for, community intervention (attending a single event for householders) was found to modestly reduce electricity consumption in participants versus control households. These studies all suggest that the degree of direct contact with individuals is a key factor in encouraging behavioural change. Such contact is of course more likely to occur in community-led initiatives than through SO-led programmes.

2.5.5 Network and market integrated generation

Increasing penetration of RE provides several challenges and opportunities for system operators relating to integration, decentralisation, and remoteness (Gross et al., 2003). Networks in the UK has been designed with centralised fossil fuels in mind, and as such are both radial and passive, posing challenges to the integration of intermittent, distributed generation plants (Bayod-Rújula, 2009). While small amounts of RE can be deployed without considerable impact to grid stability (Gross et al., 2003), PIU (2001), (PB Power, 1999, Lopes et al., 2007, Pepermans et al., 2005, Hain et al., 2005), increasing amounts can affect the power flow, voltage profile and fault level of a specific network, and necessitate grid reinforcement (Simonds and Hall, 2013, Hain et al., 2005, Lopes et al., 2007).

Furthermore, the capacity of the network to cope with intermittency can indeed be increased by larger geographical dispersion of intermittent inputs, more variation between inputs, and better matching of local demand with local supply (Grubb, 1991, Hain et al., 2005, Lopes et al., 2007). Such characteristics are more likely to be obtained with a large number of dispersed small generators than a small number of larger generators.

Aside from integration issues, near-site generation reduces the amount of power required from centralised plant, and thus reduces power losses and associated costs incurred through transmission and distribution over distances (IEA, 2008, Borges and Falcão, 2006). Further, there is some evidence that DE generation can be used strategically to provide peaking power at times of high demand, maintaining overall power quality and reducing peak power costs (Bluestein, 2000, Pepermans et al., 2005).

Whereas RE thus previously represented a threat to the stability to existing networks, steadily increasing penetration of RE has meant that focus has shifted towards the need for new forms of energy networks, which deal with the realities of the changing system. For example, in situations with high and diverse RE generation, the need for significant baseload to deal with intermittency is now being questioned (Jansen, 2015).

Supportive of this shift is the coevolution alongside RE of an ecosystem of both consumer-side innovations (such as smart-meters, smart-appliances and increased domestic efficiency) and system optimisation strategies (such as storage (at domestic, community and utility levels), demand response, flexible generation, and cross-technology options (combining storage and renewables, say) (SETIS, 2014). These developments, themselves necessitated by increasing RE penetration, are challenging the traditional approach of designing supply arrangements to meet demand, instead offering the potential to reduce, flatten and flex demand to match a desirable supply portfolio (Mitchell, 2015b, Mitchell, 2015a).

2.5.6 Shifts in governance

One key benefit of small-scale energy generation is that it permits the engagement of a far greater number of stakeholders than is likely under the large-scale centralised convention. Governance, as "the myriad processes through which a group of people set and enforce the rules needed to enable that group to achieve desired outcomes" (Florini and Sovacool, 2009) occurs only in part *within* Government. Energy governance thus refers to a wide range of actors, including Government (as policymakers) and Ofgem (as energy market regulators), but also the suppliers and consumers within wider society who help to shape and enable energy policy objectives.

Despite the role of a diverse set of actors on the energy system, influence is overwhelmingly weighted toward a very small number of privately owned actors. At the start of this thesis, the incumbent's (the so-called *Big Six*) share of domestic energy supply market was around 99 per cent (Ofgem, 2008)[4].

There is widespread consensus that such market concentration, unbundling and private ownership have been barriers to overcoming system inertia, particularly because of a focus on short term profitability over longer term innovation through for example R&D (Jamasb and Pollitt, 2008, Lockwood, 2013, Defeuilley and Furtado, 2000). Government failure has also been the focus of blame, in terms of reduced Government R&D spending (which stimulates private spending) as well as the inability to put in place effective, fit for purpose regulation (HM Treasury and DECC, 2010, Jamasb and Pollitt, 2008).

Secondly, there are suspicions that rather than competing, there has in fact been tacit collusion among the supply arms of the Big Six to protect customer bases and profits (Ofgem, 2014a). This collusion is also suspected to extend to *within* utilities, with vertical integration hindering competition, a situation that is reinforced by utilities' resistance to unbundling (Pollitt, 2008). The Competition and Markets Authority (CMA, 2015), however, have recently rejected such assertions.

Lastly and most directly of relevance to the issue of governance is that energy suppliers are the chief delivery agents for the majority of energy policy mechanisms. RE development (through the Renewables Obligation (RO) and now Contracts for Differences (CfD)) and demand reduction policy alike (through the Green Deal and smart meter deployment, for example) are delivered by those same utilities that are resistant to change. The principal-agent problem (outlined above in relation to demand reduction) might be extendable to *any* diversification of business plans (including compelling

[4] Over the course of this research the market share of non-incumbents increased from 1 per cent to around 7.5 per cent (Cornwall Energy 2014)

deployment of renewables) beyond extracting profit from conventional power generation.

The impact of the emergence of small-scale energy on energy governance is the subject of a growing body of literature, the assumption being that increasing amounts of small-scale energy implies a greater number of actors than under large-scale centralised systems, which itself changes the structure of governing actors. In 2013 this provided the impetus for the Government stating that the Big Six should be replaced by the “Big 60,000” – a reference to the potential for a large increase in stakeholders made up of companies, communities, public and third sector organisations (Barker, 2013). The emergence of policy rhetoric around community energy, and the publication of the Government’s first Community Energy Strategy is evidence in itself of a change in governance through the involvement of a hitherto absent sector of interested individuals and organisations as stakeholders. The degree to which the emergence of those new actors will hold influence in the overall energy policy landscape remains to be seen.

2.5.7 Scale within energy policy

Centralisation was a likely consequence of the historic abundance of fossil fuels, and energy policy in the UK developed in this context. Prior to the Second World War, coal dominated as the primary source of energy, used for domestic heating, as a key fuel for electricity, and for manufacturing ‘town gas’ for street, factory and eventually domestic lighting, with supply undertaken by privately or municipally owned coalmines, electricity plants and gas providers.

The post-war Atlee Government was brought in under promises of social justice following the hardships of war, and a desire to consolidate planning (and ensure security, safety and standards) under conditions of austerity drove the nationalisation of major industries and utilities, including the coal, gas and electricity industries in 1947, 1948 and 1957 respectively. The creation of the Atomic Energy Authority in 1957, to develop civil nuclear power alongside a military capability, completed the nationalisation of the UK’s energy industries. For the energy system of this era, the technologies involved necessitated economies of scale, centralisation and safety that could be managed under a nationalised system (Ibid).

The 1980s however saw the attempted depoliticisation of energy under the market ideaology of Thatcherism through the gradual privatisation of the energy industries: gas in 1986, electricity in 1990, coal in 1994 and nuclear in 1996. While theoretically opening ownership up, this simply marked a transfer of power from the state to a few large companies (Mitchell, 2013). Bolstered by a programme of domestic exploration and development in the 1970s, oil and gas began to dominate as principal fuel sources for the electricity sector, while the inefficiencies of the coal industry seeded its demise under Thatcher. The development of oil and gas regulation during liberalisation can thus be seen in the context of the political need to protect the interests of customers – and thus the structures and technologies it was designed to 'fit' (Mitchell, 2013).

2.5.8 Scale within renewable energy policy

While government policy for RE indicates increasing attention being paid to the merits of alternative and decentralised technologies, it is only recently that the merits of small-scale technologies have been acknowledged. Before privatisation of the electricity industry in 1990, renewable development was centred on research and development (R&D). This, Mitchell (1995) states, focused primarily on large (>3MW) demonstration projects "capable of bulk energy generation" (NAO (1994) in Mitchell (1995)). Following privatisation, the 1990 Non-Fossil Fuel Obligation (NFFO) was the first instance of directed support for RE, although the overriding driver for the policy was to provide support to the State-owned nuclear industry (Mitchell and Connor, 2004). That said, in terms of renewables, the NFFO ostensibly favoured smaller-scale generators, with early rounds ('Orders') of the mechanism (NFFO1 and NFFO2) providing support for 300-750kW wind projects. Mitchell (1995) however states that it in effect was penalising of both small-scale and independently owned projects: the former were typically more expensive while the latter found it hard to obtain finance (Mitchell, 1994, Mitchell, 1995). From the third and subsequent Orders (NFFO3-NFFO5) differential support was introduced for a sub-band of wind to reflect these cost differences, and there is evidence that these rounds helped to galvanise the growth of small-scale (<1MW capacity) in the mid to late 1990s (Mitchell and Connor, 2004).

The mechanism that followed the NFFO was the Renewables Obligation (RO). Beginning in 2002, the mechanism was initially seen as more aligned with market ideals, though its complexity and preferential support for cheapest technologies was considered a barrier to both small technologies and new entrants (Gross and Heptonstall, 2010, Mitchell and Connor, 2004). The RO was characterised by a strategic emphasis of competition with a belief that the government should not be 'picking winners' between the technologies available. Such a position was criticised as being a barrier to technological diversity (Ibid), inherently risky (Margolis and Kammen, 1999) as well as lacking in political transparency (Watson, 2008).

In response to these criticisms, the government in 2009 introduced banded support to encourage less mature technologies with higher associated development costs and risk (DECC, 2010b). While there was some implicit differentiation of scale (i.e. through differentiating between onshore and offshore wind, which differ by scale by their nature), there was no attention paid to different scales within technology bands (Woodman and Mitchell, 2011).

The introduction of a FiT in 2010 represented a breakthrough in terms of support for small-scale energy electricity generation, and paved the way for a dramatic increase in small-scale deployment. This was intended to remove existing barriers for technologies under 5MW, including high transaction costs and investment risks under the RO (Woodman and Mitchell, 2011, BERR, 2008). A campaign to introduce a FiT began in 2007 and soon found traction with several organisations including Friends of the Earth, the Renewable Energy Association, Greenpeace. The Labour MP Alan Simpson worked to push through legislative provision for a FiT within the newly created 2008 Energy Act, soon after the formation of DECC (Aldridge, 2013).

These policies (and the FiT specifically) have enabled considerable growth in the deployment of small-scale RE technologies in recent years (Aldridge, 2013). This has further facilitated a great leap in terms of engaging new actors, including individuals, businesses, local authorities and communities (Nolden, 2013, Seyfang et al., 2013). In the solar sector, where deployment has been limited by financial barriers, (rather than planning, for example), the FiT has been hugely successful in driving innovation within the sector (Aldridge, 2013).

However, while the success of some policies in addressing components of the energy trilemma are celebrated by government, little if any attention has been given to the transformational potential of small-scale energy within policy circles. Indeed, as Liebreich (2011) points out, energy incumbents are no longer ‘ignoring’ nor ‘laughing’ at the efforts of small-scale: they are fighting them. For other situations overseas, the opportunities presented by the growth of small-scale has begun to be grasped by incumbents, such as in New York, where action is underway to embrace and take advantage of the benefits of integrated small-scale technologies and help reforge a more harmonic relationship between society and the energy system that serves it (Mitchell, 2014c). As the next section demonstrates, such progress is yet to be experienced in the UK.

2.6 UK community energy: emergence and constraint

One facet of small-scale energy, community energy, has developed relatively swiftly over the last few years. Although the concept is somewhat disputed (Databuild and Energy Saving Trust, 2013, Databuild and Energy Saving Trust, 2014), in general it refers to “collective action to purchase, manage and generate energy” (DECC, 2014b). Such approaches have evolved alongside technological and policy developments, and while the sector appears to be growing strongly, there remains a need to better understand and communicate its value and potential.

2.6.1 The evolution of community-based energy in the UK

Although the emergence of CE in the UK can be traced back to the 1970s, activity was limited to a few pioneering organisations outside of the mainstream energy supply system (Walker et al., 2007, Hargreaves et al., 2013). Walker (2007) documents the evolution of a succession of Government initiatives to support from the early 2000s which provided information, advice, training, project development and capital grants for CE projects. These programmes followed emerging rhetoric emphasising both the benefits of more localised energy generation and the involvement of local people in the energy system (Ibid) throughout the 1990 and early 2000s. Of particular note was the attention paid to local energy within the 2003 White Paper “Our Energy Future”, which, for the first time officially advocated moving forward with more local models of energy generation (DTI, 2003, Walker et al., 2007).

Recent years have seen the expansion of CE initiatives in the UK. Practitioners cite a range of economic, social and environmental motives. Economic rationale include income generation, reducing energy costs, tackling fuel poverty, and contributing to local skills and employment (Walker and Devine-Wright, 2008, Hain et al., 2005, Warren and McFadyen, 2010, TLT, 2007, Adams and Berry, 2008, Evans, 2006, Seyfang et al., 2013). Social rationale cited by groups include increasing social cohesion, inclusion and improving education (Walker, 2008b, Wüstenhagen et al., 2007, Walker et al., 2010, Seyfang et al., 2013), and increasing support for both existing and future projects (Adams and Berry, 2008, Houghton, 2010, Evans, 2006).

Additional social impacts relate to enhancing the political processes around energy, including community power and control over local energy systems, and influencing wider energy policy (Seyfang et al., 2013, Walker and Devine-Wright, 2008, Walker, 2008a, Walker, 2008b). These rationales are often underpinned by environmental agendas associated with addressing global and local issues of climate change through emissions reduction(Houghton, 2010, Warren and McFadyen, 2010, Roberts, 2009, Seyfang et al., 2013).

Of course, since community energy initiatives are in general associated with renewable forms of generation, at either the domestic or distribution scale, the benefits (and challenges) of community energy can be directly related to those issues discussed in the previous section, including implementation costs, prospects for managing demand, and, obviously, opportunities for collective ownership.

Despite the variety of drivers cited by individuals, the uptake of CE in recent years does however appear to take advantage of the financial opportunities afforded by government support, such as the small-scale FiT. While this would appear to provide evidence of a successful government policy, several authors report the evolution of the FiT (as summarised in Section 2.3.3) as primarily driven from pressure from grassroots practitioners and advocates (Aldridge, 2013).

Several studies have sought to quantify the current scale and scope of CE. Recent evidence gathered as preparation for the DECC's Community Energy Strategy estimated that at least 5000 community groups have "considered, commenced, or completed energy projects in the UK since 2008, of which at least 347[5] were found to be active in 2013 in terms of having active projects in delivery or in the pipeline (Databuild and Energy Saving Trust, 2014). It is noted however that since no comprehensive database of activity exists, the true scale may well be larger (Seyfang et al., 2013, Databuild and Energy Saving Trust, 2014). This, and other studies, highlight that the sector is characterised by a diverse set of actors, structures, objectives, activities and contexts, which make it difficult to generalise about specific features (Databuild and Energy Saving Trust, 2014, Seyfang et al., 2013, Hielscher, 2011, Hielscher et al., 2011).

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[5] Databuild (2014) note that this number is likely to be much higher given limitations in data collection

More broadly, over 785,000 small (<50kW) solar PV installations had been installed on homes and businesses as of October 2015, making up 97 per cent of all installations, including larger commercial developments (DECC, 2015d), representing significant engagement with the energy system by individuals and businesses and contributing significantly to total RE deployment (DECC, 2015b).

2.6.2 Relating community energy to wider societal change

As the community energy movement exists as a formalised network of collectives within civil society, the wider role of citizens in enabling, constraining and negotiating change must also be considered. Drawing linkages between the aggregated outcomes of the actions of individuals, and the collective actions of communities is of consequence to both academic and policy understandings of the value of small-scale energy approaches.

The importance of social agency for energy transitions is in general underrepresented, both within academia and within policymaking, with far greater attention being given to the role of technology and economics (Sovacool, 2014, Cooper, 2013). One consequence of this is until recently, social agency in energy transitions was assumed to be of relevance only in terms of the individual, rational responses and preferences as ‘consumers’ in the idealised setting of an energy market (Seyfang et al., 2010). However, the emergence of grassroots movements such as Transition Towns or community energy more broadly has emphasised the potential for social movements to enable significant systems change. As Hargreaves et al state, “behaviour change will likely occur in the context of changing values, lifestyles, and cultural norms modulated through social contexts, including social movements” (Seyfang et al., 2010, Heiskanen et al., 2010, Middlemiss and Parrish, 2010).

While this modulation of societal values, lifestyles and norms from civil society forms the main subject for analysis in this thesis, the roles of civil society within energy transitions extends beyond community energy or even ‘grassroots innovations’ more broadly (Smith, 2012a). As well as providing the resources for the formation of innovative ideas and practices (expressed through the creation of CE groups, for example), the way in which broader civil society relates to the values and actions of these groups shapes their legitimacy. Additionally, Seyfang (2010) highlight two more roles for civil society in a) unsettling incumbent regimes through lobbying and protests and b) as representing and constituting cultural broad trends through which societal values are expressed.

So, while the emergence of a formalised community energy movement establishes a conceptually discrete subject for study (and policy intervention), this thesis contends that the broader context of societal values, lifestyle and norms is inseparable from such a movement. For example, an individual's decision to invest in domestic renewables may be manifested as a private investment on one's home, or as an aggregative component within a collective investment within the local community. Both situations are of consequence for both the development of small-scale energy and the implications for the wider energy system, and in such situations, the separation of collective, from individual endeavour thus makes little sense.

2.6.3 Building a case for CE development

At this relatively early stage in the development of CE, there has emerged a need for evidence of its value to support continued development. This is relevant for CE practitioners themselves, who need to be able to demonstrate local benefits to potential beneficiaries in host communities, as well as demonstrate their potential contribution to the wider energy system (Hargreaves, 2012, DECC, 2011a). This latter point resonates with assertions from commentators that the government could, and should be doing more to support the sector (Roberts, 2011)

Several pieces of work have reviewed the existing evidence base for community energy (Databuild and Energy Saving Trust, 2013, DECC, 2013b) as well as the methodologies employed within these analyses (CISE, 2011, Databuild and Energy Saving Trust, 2013). Several barriers to the development of robust evidence bases can be discussed in this context.

Firstly, a lack of evidence is perhaps unavoidable given the infancy of CE as a collective movement. What constitutes the term ‘community energy’ itself has been subject to discussion (Walker and Devine-Wright, 2008, Seyfang et al., 2013, Hoffman and High-Pippert, 2005), making it difficult to ascertain what the CE sector *is*, led alone what its impact is.

Secondly, since CE initiatives are often concerned with social (e.g. cohesion, inclusion, learning) as well as economic and resource benefits, understanding the benefits therein requires qualitative as well as quantitative assessments. The infancy of the sector again means that there is a lack of standardised methodologies for carrying out such analyses, and as such many are ad-hoc, based on assumptions and rely on anecdotal evidence. Even for quantitative evidence-building, the difficulty in accessing key pieces of data such as utility bills hindered progress (CISE, 2011).

Thirdly, the difficulties in carrying out robust analyses is further compounded by the fact that the community energy groups tend to be characterised by resource scarcity, both in terms of financial and human capital. Robust assessments can necessitate employing a wide range of methodologies and community groups often have neither the time nor capacity to spare, and to do so would removing their focus from core project management activities (CISE, 2011, Haggett et al., 2013) and thus be counterproductive in the short term.

Fourth, and related to this, is the fact that the multiple benefits arising from community energy groups’ activities is often assumed, and understood anecdotally throughout the sector. This is perhaps in part related to the flow of social benefits one gets simply from being involved in a project. Even before tangible outcomes emerge, intangible outcomes (such as involvement and community cohesion) are more likely to be readily felt by practitioners. These however are more difficult to measure and communicate as readily.

Lastly, as well as relying on subjectivity inherent in qualitative assessments, CISE (2011) found that most assessments were either carried out by groups themselves or by interest groups, further increasing the potential for *research bias,* whereby analysts tend to affect results to portray CE in a more positive light than would perhaps be the case under more objective analysis (Databuild and Energy Saving Trust, 2013). While this is perhaps expected to a degree (CE initiatives are undoubtedly under pressure to demonstrate value to funding bodies, policymakers and society), it risks undermining robust analysis of the sector as a whole. Nevertheless, academic analyses, while ideally under more restraint to avoid bias, can still be expected to exhibit some bias given the normative nature of energy policy.

These factors combined mean that evidence building around the impact of CE has until now been ad-hoc. Further, the variability among both projects and methods means that observations of single cases exist as standalone analyses, with little supplementary thought about what they mean for the sector as a whole. In addition, those studies that do consider sector-wide impacts tend to focus on a specific set of impacts (e.g. immediate impacts to host communities) rather than a broader set of impacts encompassing, for example, the wider energy system.

2.7 Summary

This chapter highlighted the inadequacies of the current energy system for addressing contemporary energy and climate change challenges, and outlined how an emergent alternative system is better suited to these ends.

Climate change, energy security and affordability were identified as key policy rationale for energy system change, although it is contended that in order to address these, it is the fourth issue of inertia that provides the most challenging obstacle in today's energy system. Technological, institutional and cultural lock in to the current energy system is explained as consequences of drives for economies of scale made possible by the use of fossil fuels as a dominant fuel source.

However, the establishment of alternative energy sources in the energy system is challenging the inevitability of a system based on large-scale centralised fossil-fuel-based plants. Such technologies, whose nature, scale and geography are fundamentally more suited to addressing our contemporary energy challenges, including overcoming inertia.

In terms of overcoming inertia, the cost structure of renewables as compared to fossil fuels is pricing the latter out of energy markets; technologies can be scaled such that they can be installed, owned and managed by individuals and collectives; their evolution alongside an ecosystem of smart infrastructure provides opportunities for system efficiencies; these factors are in turn facilitating more pluralistic governance in terms of increasing roles for individuals and communities as shareholders and stakeholders in the new energy system. In summary, if we want to take an alternative energy path to one reliant on fossil fuels, then it appears that it should contain a significant proportion of small-scale technologies, since it is those that help to overcome system inertia.

The emergence of a community energy movement in the UK is introduced as one response to both the inadequacies of the current energy system, and the opportunities presented by a new system better aligned with societal values. The values, norms and activities within CE are embedded in and grow out of civil society, and while the movement is typically regarded as conceptually and physically distinct from broader values activities throughout civil society, they are very closely linked and should be analysed as such.

However, energy policy in this country has so far been slow to fully acknowledge either the inadequacies of large-scale, or the opportunities of small-scale energy. This has in part been blamed on the lack of evidence around the value of the latter. It is around the supposed lack of evidence of the value of small-scale, and particularly community-led energy that this thesis is situated.

This chapter has focused entirely on the energy challenges and proposed solutions of the UK. However, looking to other countries highlights that while many of the same challenges are common, the solutions taken can be widely different. The next chapter outlines the experiences of two other countries, Denmark and Germany, in adopting high degrees of community energy within their respective energy systems.

3 Overseas community energy exemplars

There exist many comparisons of the UK experience of community energy (and inclusive energy more broadly) with other countries whose sectors are perceived to have been more successful. Two such countries are Denmark and Germany, and both have been cited extensively in attempts to demonstrate the potential for CE to become more mainstream in the UK. This argument is based on the assumption that the UK could emulate Germany and Denmark in creating the right policy environment that doing so would bring similar benefits, and that energy policy in the UK could learn from these international experiences. This chapter picks apart how the current energy system in these two examples came about, with particular emphasis on those changes affecting community energy.

In order to understand how the community energy sectors in these countries developed, it is important to reflect on the wider energy system and policy contexts within which these sectors have coevolved. Community energy does not develop in a vacuum. Rather, the managing, purchasing and generation of energy by individuals and communities is enabled or constrained by a wide range of factors including the maturity of the wider RE sector (which affects the availability and cost of generation technologies), the presence or absence of markets for communities and individuals to become shareholders (including the availability of capital), planning regimes (which may or may not reflect a desire to decentralise both energy and energy governance), the legality of cooperative ownership of assets (and associated levels of bureaucracy) and cultural dimensions embodying sprits of entrepreneurship and cooperative action. Clearly, many of these factors are embodied in the development of policies within each country, but might also be reflected in more fundamental ideologies behind energy policy more generally in these countries, including the dominant political paradigm.

This chapter stops short of offering a robust analysis of whether such case studies mean that similar progress could be made in the UK. Such a discussion would necessitate an in-depth analysis of the various roles of historic, political, economic and cultural contexts that have enabled or constrained both RE development as well as more inclusive energy systems. As such, robust analysis of this kind is beyond the scope of this thesis. While these descriptive accounts are necessarily ignorant of a more complete set of circumstances and decisions (that might give a truer account), highlighting key factors offers a pragmatic alternative.

The chapter proceeds by considering community energy in both Denmark and Germany. A timeline of key elements in the development of CE in each country is presented in turn.

3.1 RE penetration and ownership in UK, Denmark and Germany

Community energy covers a multitude of community-led activities around energy making it difficult to compare like with like across different countries. Focusing on a specific sector can therefore be useful in highlighting differences in progress. To this end, Figure 3.1 illustrates cumulative wind capacity and the contribution of wind to electricity demand, and Figure 3.2 details the ownership of wind by each country. Focusing on wind in particular is useful as it encompasses a range of scales (and costs) relevant to individuals and communities. These figures provide some context for the discussion in this section.

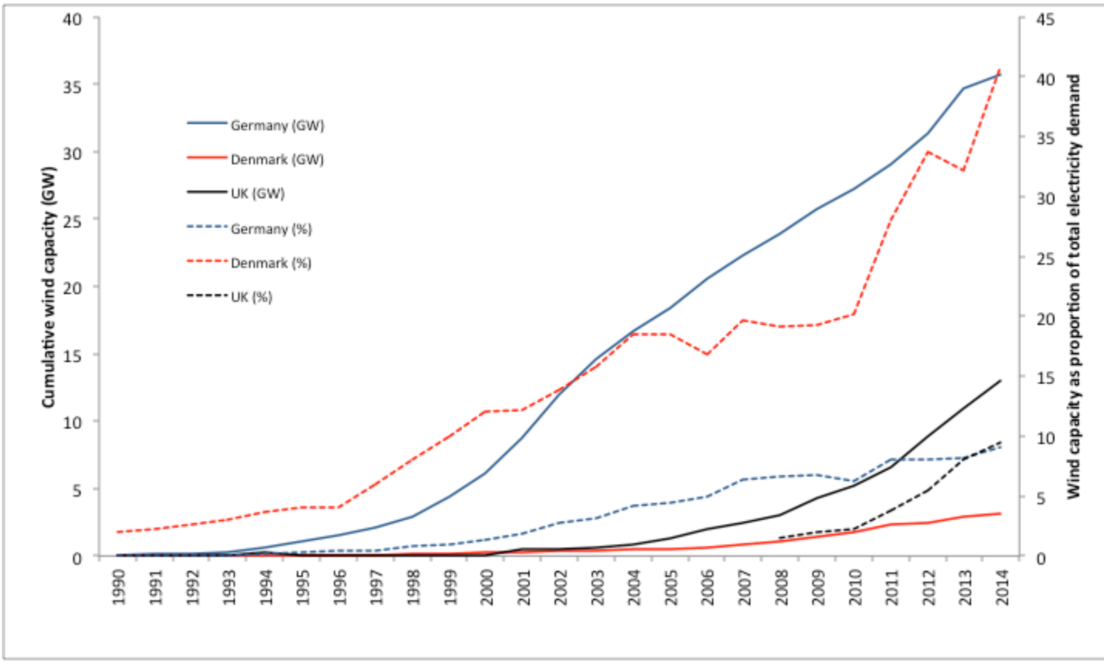

Figure 3.1 Cumulative wind capacity in Germany, Denmark and the UK

Source: DECC (2015b), Spliid (2014), Keiler and Häuser (2014)

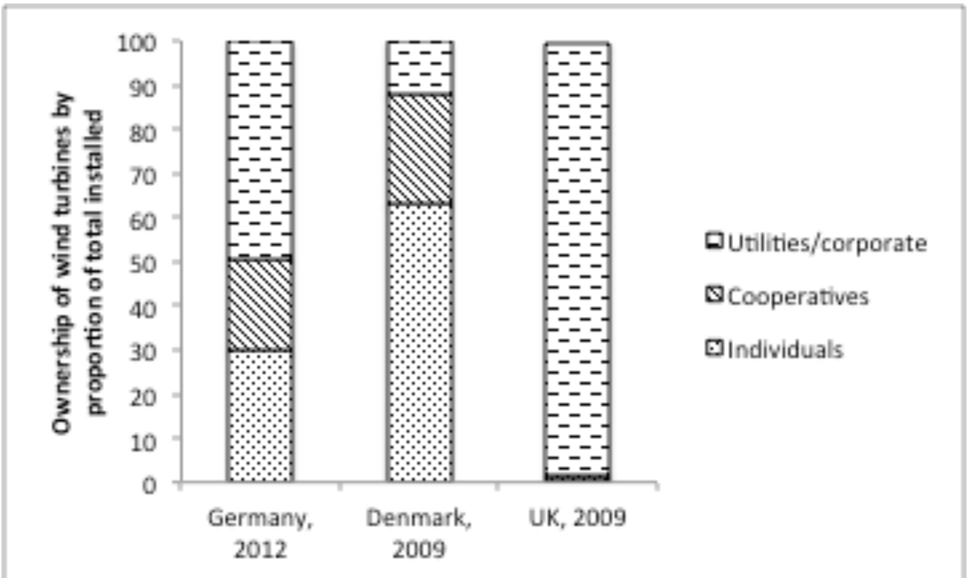

Figure 3.2 Ownership of wind turbines by country

Sources: (Energinet.dk, 2009, Brophy Haney and Pollitt, 2010)

In absolute terms, Germany is third only to China and the United States in terms of installed wind capacity. Growth of wind in the UK has been relatively slow over the same period, but has hastened over the last 10 years, with offshore installations contributing around a third to total capacity. In relative terms, wind penetration in Denmark 2014 was around 40 per cent of total electricity demand, a higher proportion than anywhere else in the world. While wind capacity in both Germany and the UK reached around 10 per cent of demand in 2014, a point that Denmark had reached 15 years previously.

Figure 3.1 illustrates the different mixes of wind installation ownership in Germany, Denmark and the UK. Almost half of wind turbines in Germany in 2005 was owned by either cooperative 'bürgerwindparks' or private individuals (typically farmers) (Toke et al., 2008). Coops in this sense refer to local, participative schemes run as social rather than profit-maximising purposes. The remainder (corporate in Figure 3.1) are made up of a mix of hybrid forms of ownership, typically consisting of a private limited partnership (Kommanditgesellschaft / KG) for each development with a limited liability company (GmbH) serving as full partner for multiple projects (Bolinger, 2001), reducing startup costs. This form may also entail local ownership through public share offers, though since minimum investment levels are typically high, this usually comprises only 20 - 30 per cent of all partners (Ibid).

Bollinger notes however that the current blend of wind ownership in Germany has shifted dramatically since 1990, when the majority were owned by sole proprietors in the shape of individual farmers, reflecting both the commercialisation of wind and the increase in project size. (Ibid).

Compared to Germany, a far greater proportion (around 88 per cent in 2012 of wind in Denmark is citizen-led, owned by either private individuals (typically farmers) or cooperatives. That said, Bollinger points out that the latter are not technically cooperatives, but are contractual partnerships between consumers who pool capital (Ibid). While ownership restrictions originally encouraged local ownership (to within 3km in the early 1980s), these rules have been progressively relaxed to permit others, including outside of the country, to invest (Ibid).

By contrast to Germany and Denmark, commercial enterprises dominate ownership of (mostly large-scale) wind turbines in the UK (Brophy Haney and

Pollitt, 2010). Even including solar and small-scale hydro schemes, total individual and community ownership of renewables in 2013 was still estimated to be less than half a per cent (Harnmeijer et al., 2012).

3.2 Community energy in Denmark

3.2.1 Danish industrial policy

With limited domestic energy sources, and over 90 per cent of energy based on imported oil in 1973, the oil crises of the 1970s had a profound effect on Danish energy policy (IRENA, 2012). The first two Danish energy plans (Dansk Energipolitik and Energieplan81) in 1976 and 1981 thus focused on security of supply by using domestic sources of coal and renewables. The role of nuclear in the Danish energy system had at the time been the subject of prolonged political and public debate, and while the potential benefits in terms of energy security were appealing, a coalition of “green, left, and rural communities” argued for an alternative vision of more decentralised model of energy based on RE (Cumbers, 2013). This came to a head in 1985, when the Danish parliament agreed on a moratorium on nuclear from energy planning (IRENA, 2012).

Domestic experimentation with early wind turbines in the 1970s was largely focused around private individuals adopting technologies locally without government support (Bolinger, 2001). Such pioneers can perhaps be considered manifestations of a broad base of supportive actors in the 1970s, including anti-nuclear activists, and organisations and networks supporting the efforts of wind turbine manufacturers and entrepreneurs (Toke et al., 2008, Jørgensen and Karnøe, 1995).

Without nuclear or oil as options, energy plans focused on developing the country’s burgeoning wind sector alongside energy efficiency programmes and decentralised CHP plants (Toke et al., 2008). While Denmark had been experimenting with wind turbines for many decades[6], the 1973 oil crisis provided an opportunity for further experimentation with, and mass manufacturing of turbines for the domestic market. Initially modestly in scale (15-30kW), hub height, rotor diameter and subsequent power production grew steadily from then on (Sørensen, 1995). Government-funded R&D in the 1970s was considered instrumental to this phase (IRENA, 2012).

Development of turbine manufacturing sector, and concurrent growth in global markets in the early 1980s, particularly in California, provided an opportunity for Denmark to establish itself as an exporter, making a significant contribution to technological learning (Krohn, 2000). These early experiences proved instrumental in developing the 'Danish Concept'[7] as an increasingly established and eventually dominant turbine design (Maegaard et al., 2013).

3.2.2 Renewables policy

By 1985, however, exports to California were waning, although momentum in Danish turbine manufacturing sector was maintained by the 1985 "100MW Agreement" target by 1990, a doubling of capacity at the time (Lauber, 2005), supported by capital grants. Given that the Government had at the same time ruled to prohibit nuclear, this provided both a specific objective and a means through which to achieve it. Independent investors partnering with communities were offered priority access to the grid, which was itself reinforced to cope with additional wind deployment, policies that at once de-risked investments, created grassroots support, and enabled sector growth to build a reputation for reliable performance (Smith, 2012b). Momentum around wind deployment strengthened in 1990, when another agreement with utilities was put in place to deliver another 100 MW by 1995, alongside the

[6] Indeed, experimentation in early wind technology meant that wind was competitive with coal-based power for the first few decades of the 1900s (Sørensen, 1995).

[7] The 'Danish Concept' is characterized by a three-bladed upwind horizontal axis turbine, with fixed speed operation and direct grid connection rules.

announcements of the intention to deploy 1500 MW by 2005, covering 10 per cent of electricity production[8] (Danish Energy Authority, 1990).

After a period in the early 2000s, during which Danish energy policy was considered particularly unambitious, confidence in the wind market was bolstered by the publication of the government's Energy Strategy 2050. Among other things, this proposed RE targets of 30 per cent by 2020 (with 50 per cent of electricity coming from wind), towards a target of being 100 per cent reliant on RE for electricity and heat by 2035, and all sectors by 2050 (DEA, 2012). Alongside this is a strategy to ensure such aspirations can be integrated into an 'intelligent energy system' comprising smart grids, flexible demand and storage (Danish Ministry of Climate, 2013).

3.2.3 Planning and ownership

The strong grassroots foundations of wind energy in Denmark form the basis of the early policy focus on local projects. Lucas (1985) suggests that Danish traditions around cooperative and decentralised governance were central in the development of the country's energy system. Such traditions resulted in the country's electrification being driven by capital from municipalities and farming cooperatives, rather than private enterprises, and as such, rather than being considered as providing a private good, electrification was primarily considered a social good for supporting individuals, cooperatives and municipal enterprises (Lucas, 1985, Hadjilambrinos, 2000). Since then, many Danish public utilities have remained under the control of regional counties, municipalities and rural regions (*kommunes*), localising asset values within the communities that depend on them.

Subsequently, until the late 1980s, the overwhelming majority of wind turbines were owned by private individuals, either as individuals or through cooperatives (Bolinger, 2001). This momentum was carried through when

[8] In actual fact, this target as exceeded by a factor of two by 2003, or 19 per cent of production (Meyer, 2007)

Government support was introduced, which encouraged local private ownership through selective subsidies and ownership restrictions (Olesen et al., 2004, Andersen, 1998). For some, maximizing ownership by locals amounts to ensuring that local communities are compensated for the positive externalities of wind turbines, which accrue at national rather than local levels (Ibid).

From 1994, Danish municipalities were obliged to allocate areas for wind power development, an arrangement aided by an obligation to involve counties, local NGOs and utilities throughout the planning process (Toke et al., 2008). This last point is considered by Toke to be central in achieving buy-in and building consensus around plans from an early stage.

Several benefits stem from the fact that the Danish wind industry was at first focused on the development of small-scale turbines. The majority of early turbines deployed into the 1980s were rarely larger than 30kW, meaning they could be installed in small plots of land without unduly affecting many other landowners, and could be financed by individuals or small groups of people. These combined factors had the effect of facilitated high rates of learning, reducing unit costs, and minimized public opposition to create broad acceptance of the industry (Smith, 2012b, Toke et al., 2008).

3.2.4 Danish policymaking and regulation

The strength and direction of Danish government policy towards progressive energy system is explained by Lockwood (2015) in relation to the policy-making processed and regulatory framework in place, at least since 2000. Structurally, Denmark is similar in some ways to the UK, for example in terms of having independent economic regulation, a combined energy and climate ministry, with policies negotiated between government and opposition parties (Ibid). However, several key differences separate their abilities to make progressive energy decisions: in contrast to the UK, pragmatism, compromise and consensus underpin Denmark’s decision-making processes, principles upheld by the coalition politics and proportional representation characteristic of Denmark, and detailed analysis of policy and technology options are carried within the energy agency, rather than the regulatory body, which has limited need to interpret policies or power to make trade-offs (Lockwood, 2015, Lijphart, 1984, Campbell and Hall, 2006). Together, such processes still contribute to inertia, but is wholly more credible and consensus led than the processes in place in the UK (Lockwood, 2015).

3.2.5 Summary

Denmark's success with developing community energy can be traced to a few key points. Firstly, Denmark's tradition in turbine manufacturing, subsequently supported by considerable R&D support made it an early leader in developing and manufacturing the technology for both domestic and international markets, with profound implications for technological learning as well as building local supply chains and associated economic impact. This, amid both the populist anti-nuclear movement and burgeoning alternative technology support network provided the political legitimacy to decisively prohibit nuclear, providing continued focus and direction for renewables (especially wind) industries. Third, market support for the growth of the sector was consistent over perhaps 20 years, providing market security to would-be investors.

3.3 Community energy in Germany

3.3.1 Early German renewable energy policy

Germany's energy system in the 1970s and 80s was centred on coal and nuclear. However, building on the momentum of a strong environmental movement arising from the recent acid rain controversy, the Chernobyl accident in 1986 had the effect of galvanising strong and lasting public opinion against nuclear (IRENA, 2012, Boehmer-Christiansen and Skea, 1991, Jahn, 1992). This built on the existing momentum for environmental issues arising from acid rain controversy in the early 1980s.

In turn, this directed political consensus towards the need for more renewables, which was manifested in a cross-party Parliamentary Resolution in 1988 calling for increased R&D (Scheer in Jacobsson and Bergek (2004)). These events provided the foundations for the 1991 Electricity Feed-In Act

(EFL), which guaranteed grid connection and established a FiT for independent (less than 25 per cent owned publicly or by utilities) RE generators (Sijm, 2002).

The EFL, combined with a favourable planning framework, and low interest rates for turbine investments, enabled a doubling of installed wind capacity annually between 1990-95 (Bruns et al., 2010, Sijm, 2002, Runci, 2005). The EFL was not without its critics, with German utilities arguing that tariff spending resulted in competitive distortions brought about by apparently undue subsidies incompatible with EU state aid rules (Sijm, 2002). An emphasis on wind in terms of relatively high and stable tariffs was meanwhile considered as detriment to the growth of other RE sources such as solar and hydro (Ibid).

For these, and other reasons, the EFL was revised into the Renewable Energies Law (REL) in 2000. The Renewable Energy Sources Act (Das Erneuerbare-Energien-Gesetz or EEG) linked FiT to generation costs rather than to average retail prices, provided support to a more diverse range of RE sources (included utility-owned generators) and shared costs between all utilities irrespective of the distribution of FiTs between them (Sijm, 2002). Linking FiTs to generation costs removed price risks for generators, which disadvantages smaller, more risk-averse generators (Mitchell et al., 2006).

Largely in response to grid constraints faced by burgeoning offshore wind sector, further amendments to the EEG in 2009 required operators to both expand the grid and optimise its management (IRENA, 2012).

3.3.2 Planning

Strong growth of wind developments throughout the 1990s compelled planning authorities to make amendments to regional planning law to better manage the local impacts of sector expansion. Increasing local conflicts around noise, visual and disturbance impacts drove down public acceptance of wind and subsequent restrictive interpretations of nature conservation in consenting procedures (Bruns and Ohlhorst, 2011). The wind lobby successfully argued that strategic intervention was needed to maintain sector growth (Bruns et al., 2010), and influenced an amendment to the German Federal Building Code (BauGB 1996/97). This granted licensing privileges to turbines and other renewable developments, meaning that although municipalities could define “planning reservations” (spatially concentrated wind zones separate from residential zones) for wind within local development plans, there was a default presumption – at the Federal level - in favour of turbines (Bruns et al., 2010).

In part these amendments sought to strengthen the decentralised planning regime through which rural populations, services and economies could be maintained more directly. Schmidt and Buhller suggest that such a local regime was largely a response to political, social and economic pressures brought about by German reunification and economic restructuring (Schmidt and Buehler, 2011).

3.3.3 The Energiewende

The rapid growth of renewable capacities and their contribution to emissions targets throughout the 2000s was galvanised by a reinforcement of RE deployment targets in the publication of the Energiewende (“Energy Concept”) by the German government in 2010. While it was the speed rather than the prospect of nuclear phase out that had been debated for around a decade, the 2011 Fukushima disaster provided an incentive for phase-out by 2022. This provided the foundation for continued RE expansion, increased efficiency measures and pushing ahead with the development of new coal and gas-fired plants to replace declining nuclear baseload (Agora Energiewende, 2015).

The momentum of the German energy policy can be explained in part by coherence with other policy areas and a supportive constituency, and while the relative expense of the Energiewende policies has been criticised, it is still considered politically sustainable (Lockwood, 2014, Agora Energiewende, 2015). Early wind sector development throughout the 1980s was supported strongly by government-funded RD&D (Jacobsson and Lauber, 2006). This provided an impetus for continued strengthening of green industrial policy focusing on developing PV and wind turbine supply chains, particularly in poorer eastern and northern areas (Ibid).

3.3.4 Funding

Another vital element in Germany's RE growth has been the availability of affordable capital, the majority of which is sourced from the Kreditanstalt für Wiederaufbau (KfW) bank. The institution, created as part of the 1948 European Recovery Program (ERP)[9] for the reconstruction of German infrastructure after the Second World War has been an instrumental factor in supporting German energy policy (Schröder et al., 2011). Although the ERP ended in 1953, it was agreed that ERP was to be retained by the German Republic, but maintained as *Special Assets* from which a developmental revolving fund was established (Ibid). As Schröder et al. (2011) discuss, the fact that the funds were originally administered by the Ministry of the Marshall Plan, and was thus separate from the German national budget, meant that their use was not subject to the usual political debate. Furthermore, the nature of the bank meant that it was able to provide long term loans for industries deemed vital for the German recovery, for which conventional banks of the time would not.

Energy supply in the form of both coal and electricity production, along with housing was a primary focus of KfW's business throughout the 1950s (Ibid). The 1973 oil crisis played a large part in reshifting the focus in housing from living space to a reduction in energy demand, with the 1976 Energy Conservation Act (EnEG), which formed the foundation for today's efficiency laws. From the inception of the EFL the KfW, with its emphasis on social and environmental investments, became the primary lender for renewables development, doing so at below-market rates. Small-scale RE deployment in Germany is tied to energy efficiency: German policy requires efficiency

[9] Popularly termed the 'Marshall Plan' after U.S. Secretary of State George Marshall

investments to take place before FiTs can be accessed (Ibid), a situation perhaps encouraged by KfW's experience in financing the latter.

3.3.5 Ownership

However, the supportive constituency behind German renewables is perhaps best explained by the significant role that individuals and communities have in owning energy infrastructures (Figure 3.2). From its outset, the FiT was designed to be low-risk and accessible by small actors, and indeed sought to limit ownership by utilities or public bodies. The focus was expressly on diversification of ownership by permitting householders, farmers, coops, and municipalities to have stakes in the energy system. The driver, then, was on inclusion of a large and varied set of stakeholders, rather than on simply delivering on RE capacity targets.

Pre-privatisation, the Stadtwerke (multi-utility city works) model of utility (energy as well as water supply, sewage and waste management) provision was commonplace, operating under the territoriality (Örtlichkeit) principle under which only local areas were served (Julian 2014). In terms of energy, the role of the Stadtwerke was in the management of local distribution networks and supply to customers. In contrast to the UK, where privatisation centralised the governance of the old regional energy boards into a small number of DNOs, Germany maintained the Stadtwerke model (although removed the territoriality principle) (Ibid). This formed the foundation for a highly decentralised modes of both distribution governance (888 Distribution System Operators) and local supply arrangements (1100 electricity supply companies) (Ibid).

While the Stadtwerke legacy has maintained the disaggregation of suppliers in Germany, several municipalities and communities have sought to relocalise control over both grid infrastructure and supply. Julian (2014) reports that 190 communities had retaken control over local grids, nine of which are cooperatives. Several of the latter (e.g. the communities of Feldheim and Schonau), who already had generation capacity, have also set themselves up as suppliers. Aside from supporting local economies, setting up as a supplier means that such coops are able to discriminate towards local generation of specific forms, as well as address parallel issues such as energy efficiency and demand reduction (Ibid). KPMG stated in 2011 that one third of German cities, municipalities and communities are similarly seeking remunicipalisation of energy supply (KPMG, 2011).

Figure 3.3 shows that as of 2010, almost 40 per cent of renewables in Germany was owned by private individuals, primarily via cooperatives, with farmers owning an additional 11 per cent (Buchan, 2012). This can in part be explained by the inclusive FiT. However, this itself was perhaps encouraged by the long traditions in Germany of collective civil action (Ibid) and agricultural cooperatives (DGRV, 2014, Bijman et al., 2012).

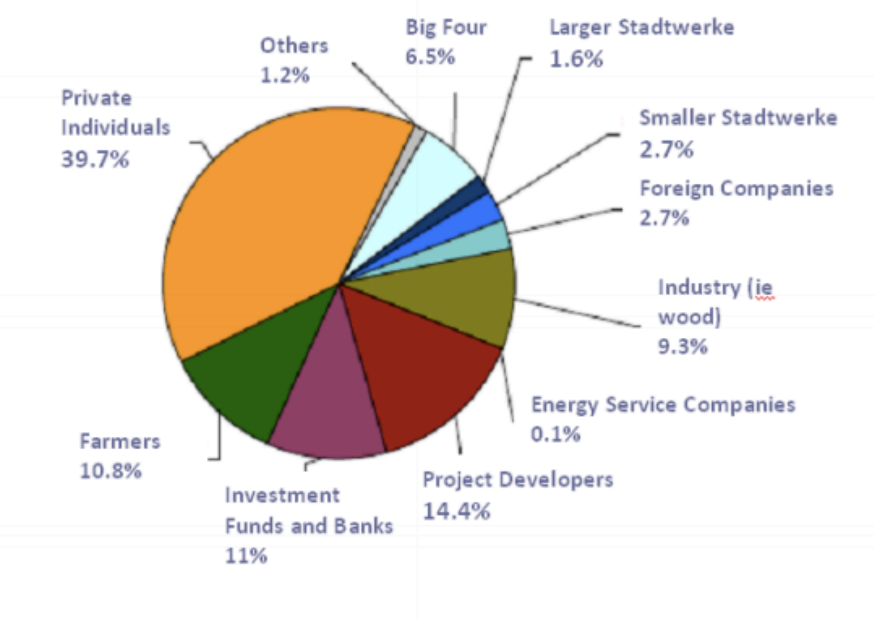

Figure 3.3 Ownership of Renewables in Germany

Source: Buchan, 2012

The strong constituency created by dispersed investors, Lockwood (2014) writes, creates positive ‘policy feedback’ for continued support, which counteracts potential negative feedback associated with cost and landscape concerns.

3.3.6 Summary

The trajectory of Germany’s community energy sector has much in common with Denmarks, with some key exceptions. German RE policy in general has benefitted from continuity of energy policy framework (Fell, 2009, Ragwitz et al., 2007), and recent moratorium on nuclear has provided the decisive policy focus to bolster momentum behind the renewables sector by way of the Energiewende. Like Denmark, support has largely (at least initially) favoured small-scale generation by non-incumbents, though in Germany the focus was on small-scale utilities rather than private individuals. Also with parallels with Denmark is Germany’s interweaving of energy policy with industrial, technology and agricultural policies.

Deep traditions around agricultural cooperatives and maintenance of municipal utilities form the backbone of a strong cooperative energy sector, which contributes to the positive policy feedback encouraged by a diverse, but supportive constituency (Lockwood, 2014).

3.4 Conclusion

This chapter discussed the circumstances around the development of community-owned renewable energy as a key element of the German and Danish energy systems. The high penetration of RE paired with high degrees of individual and community ownership makes them especially interesting from the UK’s perspective, both in terms of the potential for energy system change, and the implications of following alternative energy pathways.

Several factors appear to have contributed to both strong renewables sectors and high degree of ownership by communities and individual. Deep agricultural traditions were particularly important in shaping preferences for wind technology (particularly in Denmark), paving the way for contemporary strengths in wind power manufacturing and supply chains. Strong traditions around cooperative agriculture and industry, supported by local governance also provided the drive and capital for early renewable investments, and were instrumental in directing government support towards such actors, rather than corporate utilities.

Analysis of these community energy exemplars offers several insights related to the potential, practicalities and implications of the UK following a similarly alternative energy pathway. Firstly, while both countries have benefitted from histories and traditions that appear to be sympathetic to small-scale energy (such as norms around cooperatives, established wind turbine supply chains), they have also demonstrated the political will to make long-term strategic decisions facilitative of such pathways, such as nuclear moratoria. Both countries have thus challenged the assumptions that a large-scale energy system is somehow inevitable.

Most importantly however, Denmark and Germany have both challenged assumptions around the potential negative consequences of supporting an alternative energy pathway. German support for the RE industry has been instrumental in driving innovation, both contributing to reductions in RE installation costs and developing an export market for green technologies (Heinrich Böll Stiftung, 2015). The strong supportive constituency created by diverse ownership means that relatively high retail prices in Germany are politically acceptable (Lockwood, 2014). Furthermore, high levels of RE penetration are behind dramatic reductions in electricity wholesale prices, which combined with diverse ownership is challenging the stability of conventional utilities with business models focused on conventional generation (Schuppe, 2015a). Because of the low coal prices relative to gas, one unintended consequence of low electricity wholesales prices has been increased use of coal-fuelled generation, subsequently increasing emissions (Schuppe, 2013), although measures are being taken to counteract this (Schuppe, 2015b). In summary however, both Germany and Denmark are proving that it is possible for small-scale energy can play an important role in meeting conventional energy system goals as well as building a system capable of overcoming inertia.

4 Methods

This section outlines the methods employed in addressing the research objectives. That value of community energy is both multi-dimensional and multi-scalar necessitates a combination of quantitative and qualitative analysis of a specific community energy case study alongside wider reflections of the evolution of community energy more broadly. Such a multi-tiered approach permits insights into the micro-scale dynamics of community group development and practice to be considered alongside macro-scale evolution of the broader community energy movement as a whole.

The chapter commences by giving a brief overview of the context within which this research is set. This sets the scene for the methodological rationale and conceptual framework adopted herein. The use of integrated mixed methods comprising a case study approach alongside broader observations of community energy (in its widest sense) is then discussed. The boundaries of the research is then given with reference to resources, timeframe, and the unfolding policy context within which the research took place. The later sections describe in detail discrete phases of research, a community-wide household survey, a desk based study around energy impact analysis, and semi-structured interviews.

4.1 Research context

The research undertaken here ran from October 2011 through to August 2015. The commencement of the research coincided with the launch of Wadebridge Renewable Energy Network (WREN) a few months previously as a community-led social enterprise in the north of Cornwall. This provided an excellent opportunity to observe the development of the group almost from its point of inception over the next few years.

The period of research was also closely aligned with ongoing developments relevant to the wider evolution of community energy as a movement in the UK. April 2010 saw the commencement of the small-scale FiT, providing the impetus for many individuals, businesses and community groups to participate in generation. The early 2010s were subject to several other developments relating directly to CE, such as reviews to policy mechanisms and levels of support, changes to renewables deployment costs, and wider changes to government rhetoric around the role of small-scale generation in energy system more generally. The early 2010s thus marked a watershed in terms of the momentum of both community energy practice and policy, and the current research is set in this context. Outside of energy policy, ongoing shifts within macroeconomic and political landscape, such as deepening of post-2008 public austerity measures and associated restructuring of public services provided a more general, but still relevant backdrop during the period of research.

While the research project was originally conceived as focusing solely on the value of WREN, it quickly became clear that this would need to be considered within the context of a broader understanding of community energy, as valued by a range of stakeholders. While it is the local value of CE that may be of most importance for practitioners, its wider value to society, business communities, and policymakers will influence the evolution of the movement as a whole. It was thus decided that the research should encompass both local and broader notions of value.

Moreover, throughout the research the closeness of CE groups and wider society became increasingly apparent. In part, this relates to the interdependencies of CE organisations and the populations within which they operate, for example the mutual dependence on resources between groups and civil society. Furthermore, individuals clearly participate in the energy system beyond their role as consumers or their direct interactions with CE groups. Their roles as consumers, prosumers, activists, investors and voters shape the development of 'small-scale energy' more generally (Figure 4.1). For these reasons, this research does not hold community energy as a discrete entity, but rather includes the relevance of citizen-oriented energy activities as expressions of the values and practices of civil society.

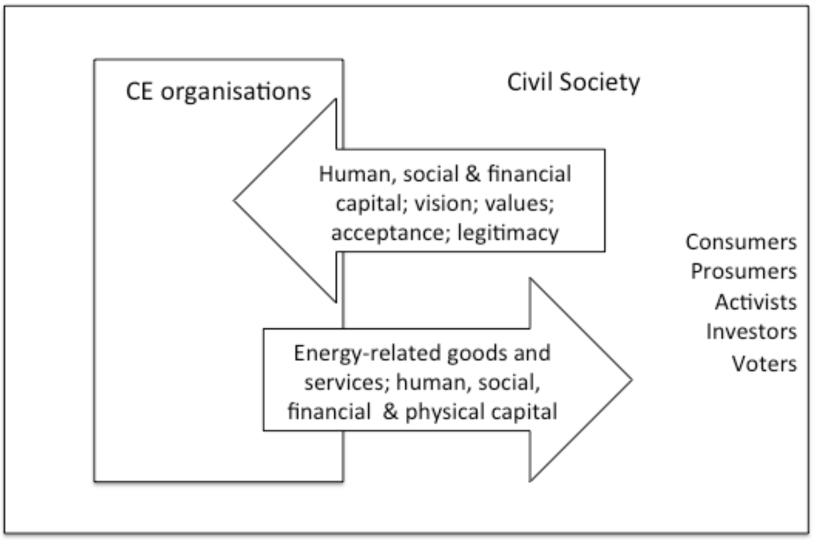

Figure 4.1 The relationship between community energy and civil society
Source: Author's own

4.2 Rationales for research approach

4.2.1 Conceptual framework

As discussed in the previous chapter, this research considers two loci of interest: the processes of change within a particular community energy initiative, and the broader development of UK community energy within which the former is nested. The research approach must therefore be capable of considering both scales of analysis.

Local contexts influence the development of community energy (Raven et al., 2008) by way of determination and expression of local motivations, expectations and visions for individual projects (Seyfang et al., 2013, Raven et al., 2008, Raven and Geels, 2010). Local motivations, expectations and visions are also inextricably linked to the availability of concomitant resources (such as natural, financial, or social capital) either available locally or sourced from elsewhere (Raven et al., 2008).

The ways such factors shape notions of success within projects influences practices, in terms of the way groups approach objectives through specific projects. Furthermore, these factors shape outcomes, in terms of internal perceptions around progress towards preconceived notions of success. WREN’s objectives - Increasing the proportion of locally produced renewable energy, focusing revenues locally, and doing so in a way that engages the whole population - span technical, social and economic dimensions (WREN, 2011, WREN, 2012). As such, understanding WREN necessarily involves understanding the interaction between the initiative and each of these dimensions. Additionally, these dimensions are themselves linked: the ways in which RE technologies are deployed affect local financial flows and their distribution among local people. Established positivist methods of accounting and economic impact analyses are useful here.

In a rather narrow sense then, that local success can be quantitatively measured against well-defined (locally-set) goals suggests that a realist, objective approach might be most relevant here. However, WREN’s third objective: that of ‘engaging’ the local population, is a more subjective issue and the appropriate methodological approach is thus dependent on how ‘engagement’ for example is interpreted. For example, if ‘engagement’ simply is taken to mean even and equitable local diffusion of technologies and associated costs and benefits, then such an outcome can be readily defined and systematically measured.

If ‘engagement’ however encompasses subjective and contended notions such as participation, trust, local deliberation and wider local democratic process (as WREN’s business plans (WREN, 2011, WREN, 2012) suggest), social constructivism might have more to offer than realism. At a broader level, different actors will perceive and experience the impacts of community energy in different ways, suggesting that there is value in an interpretive/constructivist ontology rather than one which assumes homogeneity in experience.

Combining a case-study perspective with broader sectoral change also supports the use of an interpretivist construction of understanding, particularly as it involves the interrogation of the positions of additional system actors, with an increased diversity of perceptions and experiences of community energy. Moreover, to understand how the CE movement has developed over time requires reflecting on how social values associated with CE (and the wider energy system) have evolved over time, which again is supportive of the interpretivist stance taken in this thesis.

Given the subject studies, and methodologies employed here, it is important to reflect briefly on how the values held by the author influenced the research. Firstly, it is worth noting that understandings of energy policy (or indeed any field of public policy) can be sought in terms of both positivist and normative dimensions. Indeed, the range of possible approaches to addressing energy policy issues is vast, as it draws upon the complexities and uncertainties inherent in physical science, political science, and economics (Robert and Zeckhauser, 2011). Moreover, as Robert et al 2011 point out, climate policy (with obvious parallels with energy policy) is overtly political and rife with disagreement, but offers significant returns to providing clarity on those disagreements. As such, scholarly work within energy policy is necessarily situated somewhere along a hypothetical positive-normative continuum, the position on which determining everything, from the framing of the research question and the selection of methodologies, to the analysis and presentation of data and findings.

If the archetype at end of Robert's continuum is the dispassionate analyst, driven predominantly by facts and models rather than values, the advocate analyst places more emphasis on value-driven policies (Ibid). While some discussions in this thesis (i.e those critiquing the suitability of large-scale centralised infrastructures) are certainly in the voice of the dispassionate analyst, the primary thrust is that of advocacy towards a particular policy direction. This is driven not by insensitivity to facts, but first by the recognition that the energy system can impact upon society, citizens, and households in a number of ways both positively or negatively, and second to the belief that a 'good' energy policy is one that best addresses the interests and values of society, rather than just the interests of incumbents and their shareholders.

Values of any persuasion unavoidably impact upon research. For this research in particular, the adoption (or acknowledgement) of a normative position on what constitutes a ‘progressive’, ‘sustainable’ energy policy was integral to the development of underlying themes of the thesis. A focus on the field of community energy itself arose from an interest in the role of individuals and communities in the energy system, in part because it of the greater potential for justice and equity in decision-making processes, but also because it is directly antithetic to the centralised principles of the ‘old’ energy system. It is in analysing the meanings behind normative assumptions that the research proceeds.

However, it is important to note that these values evolved as the research progressed. For example, as insights emerged from the data, preconceptions around what is ‘sustainable energy’ were challenged and became more nuanced, and this helped to develop nuance around key findings, such as those around the democratisation of energy. Further, the development of such values had additional impact on the research in that they helped to shape concluding discussions the role of policy versus society in shaping the energy system. While the acknowledgement and reflection on personal values have been important processes in terms of demonstrating validity, it can be argued that they are also vital processes in developing a voice within academic and political discussions. Indeed, in the overtly contested and political realm of energy policy, it might be argued that normative discussions around ‘what ought to be’ are at least important as positive questions of ‘what is’. In this sense, idealism and advocacy can be considered at least as valuable as more objective, dispassionate analysis.

4.2.2 Integration of research methods

The exploratory nature of this research calls for an approach which is inductive rather than deductive, employing qualitative as well as quantitative data. Robson uses the term ‘*flexible research designs*’ to descibe a non-prescriptive process of evolving objectives and methods (Robson, 2002). With its focus on establishing “patterns, consistencies and meanings” (Gray, 2004), an inductive approach is well-suited to developing an understanding of transitions, where multiple actors perceive and have bearings upon processes in different ways and to different ends. This approach was deemed most appropriate in addressing the research questions, particularly as they are formulated around potentially contended notions such as ‘value’, and ‘impact’. Indeed, such contention between energy system stakeholders (i.e. between community energy practitioners, civil society, and energy policymakers) is at the heart of the current thesis.

The meaning of ‘value’ and ‘impact’ is also of consequence to the use of mixed methods, as opposed to a purely qualitative or purely quantitative approach. For example, the *value* of community energy to an investor *may* centre around the ability to gain a favourable rate of return, while the value of the movement to a developer may extend beyond profits, towards for example enhancing the reputation of the solar PV sector. Indeed, different community energy practitioners may be interested in extracting different forms of value from their involvement, which might span financial and social motives, as well as focusing variously on the ‘individual’ and the ‘collective’. All research questions are thus addressed by drawing on a blend of qualitative and quantitative methods as appropriate.

4.2.3 Rationale of a case study approach

Case studies are defined by Yin (1994) as “empirical enquiries that investigate a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and contexts are not clearly evident”. As such, a case study analysis of a specific community energy initiative can be useful in drawing insights about more phenomena of community energy, or more generally, grassroots societal innovations. Since community energy exists as a complex system contextualised by the interplay of economics, culture, politics over specific timeframes, experimental approaches are unfeasible here (Gray, 2004). Also of relevance to the current study is the flexibility of case studies in the employment of both qualitative alongside quantitative data.

While an argument could be made for simultaneously examining multiple initiatives (to give a broader, more representative perspective perhaps), Flyvbjerg (2006) refutes the assumptions that for such approaches, more case-studies are always better than one. With reference to Flyvbjerg's (Ibid) discussion of the theory, reliability and validity regarding case study approaches, the following arguments can be made in favour of a singe in-depth case study of the form employed here.

Firstly, despite some assertions to the contrary (e.g. Dogan et al, 1990), a context-dependent understanding of a subject can be more valuable than general, theoretical knowledge. This is especially so within social science, where the complexities of human behaviour render the attainment of predictive theory elusive (Flyvbjerg, 2006). The realm of community energy is inherently social, encompassing knowledge and practice of actors both within and around community energy practice. But, the (social) movement is also part interrelated complex systems comprising technology, economy, institutions and culture, which also coevolve over time. It is as unlikely then that community energy can ever be explained by a simple rule or theory as it could be by analysing a group in isolation. For these reasons, this thesis incorporates a case-based approach alongside observations from the wider sector to ensure that both deep *and* broad insights can be drawn.

The second point concerns the practicality and desirability of generalising from a single case-study. For Giddens (1984), generalisations can only be drawn from case-studies in numbers in order that judgements can be made around typicality. The extent to which this is true, of course, depends on the typicality of the case-study subject in question. Community energy comprises a diversity of formal and informal groups, varying in context, drivers, values, resources and approaches, meaning that 1) there is no 'typical' community energy intitiative, and 2) surveying enough instances to build a 'true' picture of the sector and its evolution would be prohibitively difficult.

In any case, Flyvbjerg notes that *atypicality* can often yield more information in terms of revealing a greater diversity of actors and mechanisms at play.

Certainly the scale and context of the selected case study is such that it does offer diversity, which is valuable in terms of the initiative potentially presenting more opportunities and challenges than other community energy groups. For example, WREN states explicitly the desire to engage with the whole community (WREN, 2011), i.e. a whole town, with diversity in terms of demography, incomes and rurality, at least in comparison to smaller, village-located groups.

Furthermore, in terms of the desirability of generalisation, the value of knowledge is not limited to the identification of instances that represent the wider whole (Flyvbjerg, 2006), insofar as a rich, in-depth understanding of a single CE group can be as valuable (or more so) than a portrayal of the whole movement. Indeed, the use of insights from atypical case-studies for the falsification of propositions is a valuable part of critical reflexivity. As will be explored in later chapters, in depth a case-study of the type employed here can indeed help expound some of the common myths around community energy.

Another possible concern about case studies is that the depth of knowledge they can reveal can make it difficult or impossible to summarise findings into general propositions (Flyvbjerg, 2006, Benhabib, 1990, Roth, 1989, White, 2009). However, and in relation to the points already covered, the reality of community energy is unavoidably complex, and a 'thick' narrative of a specific case can be more valuable than general propositions. The latter seeks to distill complex reality, whilst the former acknowledges that nuance and ambiguity are needed to tell the story. Summarising a community energy project would involve making rash decisions over what elements are important, for example relating to the 'success' of the project, a concept which (as will be seen) is subjective. Also, focusing on headlines risks overlooking minutiae, which in retrospect might turn out to provide the most compelling findings. This is especially relevant if one is interested in the dynamics rather than simply the success of projects. For example, explaining the circumstances around failures provides more insight than summarising successes (Diamond, 1997).

In addition to these rationale, a final reason for selecting it as a case study is one of methodological convenience. Richard Fenno in the Observation, Context and Sequence in the Study of Politics describes how the “immediate proximity to data…produces sensitivities and perspectives which…give observation some ‘value added’” (Fenno Jr, 1986). Here, the author was describing methods of political analysis, but it can be argued that proximate ‘soaking and poking’, as Fenno puts it, is as relevant in the equally political world of community energy. That the research took place in close geographical proximity to WREN meant that these relationships are more accessible than would be the case if studying from afar.

4.2.4 Broader observations of the evolution of community energy

This thesis is centred at the interplay between two subjects of inquiry: that of a single CE group by way of a case study, and that of the broader CE movement. While the former will provide an in-depth account of real world day-to-day CE experiences, the latter is concerned with drawing more transferrable insights from the sector as a whole as well as from wider societal experiences of a more engaged, citizen-oriented energy system. As such, the thesis seeks to capture the aggregative and synergistic impacts of citizen-led energy, including community energy on the energy system.

The intention is not to generalise about CE, not least because a key strength of the movement rests on diversity in values and approaches rather than its standardisation (Seyfang et al., 2014). Rather, the maintaining two distinct, but linked focal points seeks to go some way in capturing the interplay between the individuals and experiences of practitioners at one end of the scale, and the general momentum of the movement at the other.

4.2.5 The multi-level perspective

In order to understand the interplay between community energy and the existing energy system, this thesis draws on the expanding body of work focusing on sociotechnical transition theory, which pulls together insights from science and technology studies (STS) and evolutionary economics, as well as sociology and institutional theory. This emphasises the role of hierarchical social structural factors in both maintaining system inertia and the selective permission of new sociotechnical assemblages to develop (Geels, 2002, Geels, 2005, Kemp et al., 1998, Raven et al., 2008, Bijker, 1995).

In particular, the 'multi-level perspective' (MLP) developed by Geels (2002) describes how niches might be conceptualised alongside regimes within a nested hierarchy (Figure 4.2). Niche innovations, at the micro-level, are novel changes to sociotechnical arrangements carried and developed by a small number of actors in an 'incubation room' outside market selection. Sociotechnical regimes characterise existing technological developments and govern innovation trajectories. The sociotechnical *landscape* at the macro-level describes the exogenous environment (macro-economics, sociocultural patterns, macro-politics) beyond the reach of individual actors.

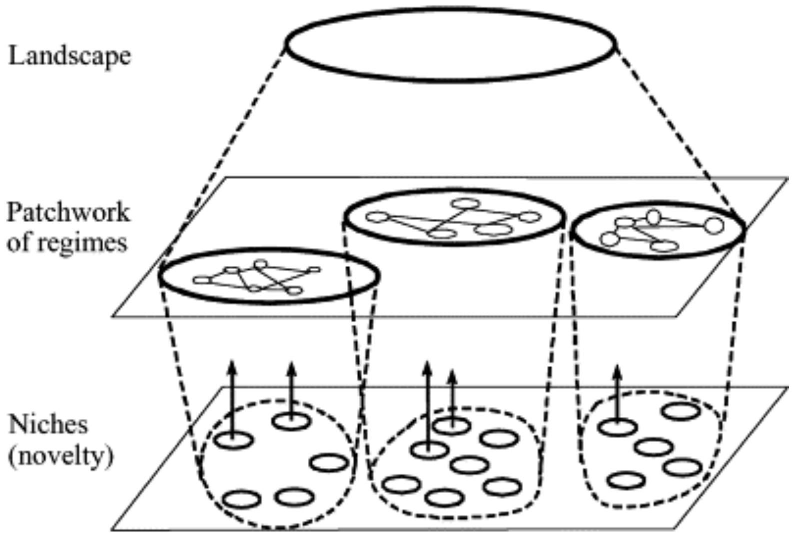

Figure 4.2 Niches, regimes and landscape within a nested hierarchy
Source: Geels (2002)

A key element of the MLP is that new technologies undergo a process of selection (or otherwise) as a result of internal processes within the niche as well as developments at the regime and landscape levels (Geels and Schot, 2007). The dynamic relationship between niches, regime and landscape levels is illustrated in Figure 4.3. At the regime level, incremental changes are possible through ongoing negotiations between technology, policy, industry, markets, science and culture. Tensions between these dimensions (resulting from landscape pressure, for example) weakens the existing regime, and provides opportunities for novelties to break through. Continued development of successful niche innovations through market growth and widespread adoption will eventually result in the niche becoming embedded within the regime level.

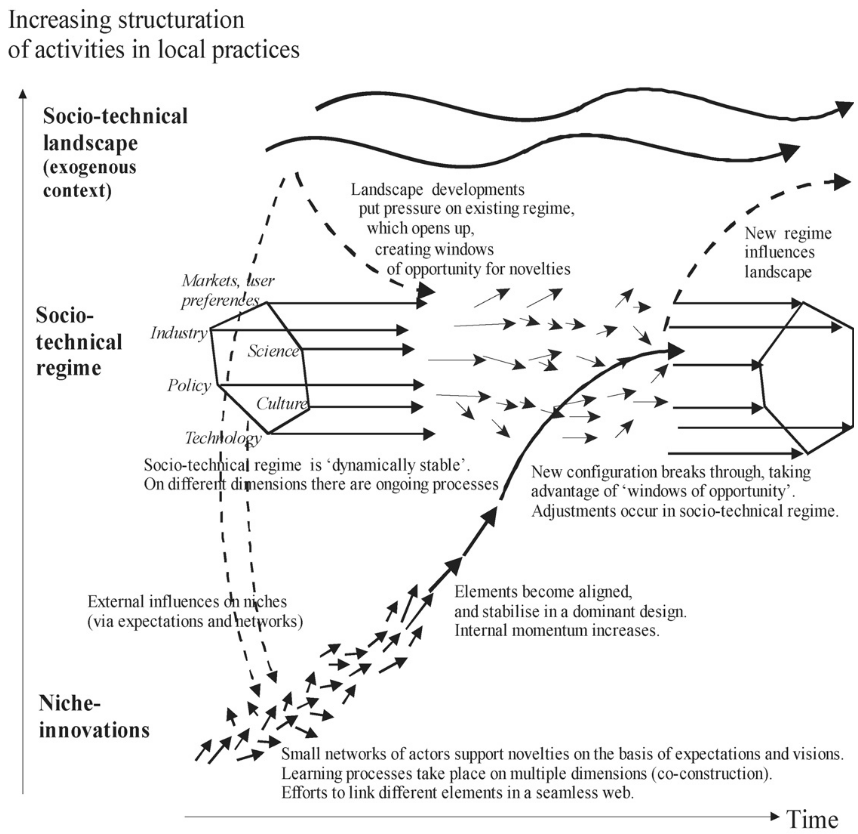

Figure 4.3 A multi-level perspective on transitions

Source: Geels and Schot (2007)

The MLP heuristic thus offers a framework upon which analysis of the coevolution between community energy and the wider energy system can be understood. In operationalizing the MLP however, it is acknowledged that the boundaries placed around this, as with any empirical study have great bearing on how the constituent elements of the MLP (niche, regime etc) interact. As such, this research, like others employing the MLP, is necessarily "partial, situated and temporary" (Scoones et al., 2007, Smith et al., 2010).

4.3 Research boundaries

4.3.1 Definitional issues

The principle research question, *What is the value of community energy in the UK*? of course invites clarification around definitions. Specifically, it is useful to remove the ambiguity around the meaning of ‘community energy’. While these points of clarification may be clarified by selecting terms of reference arbitrarily, appreciation of the subjectivities around these terms is a key step in understanding the potential for scaling up community energy.

‘Community energy’ is a disputed term, meaning different things to different actors. Definitions vary according to understandings of what should qualify as community energy, with particular distinctions drawn between community groups who own (wholly or in part) energy infrastructures and broader initiatives who engage with the energy system in other ways. In a review of evidence exercise for DECC, Databuild Solutions define community energy more succinctly as, “any UK energy project…that [is] led by a community group for the benefit of their community” (Databuild and Energy Saving Trust, 2014, Databuild and Energy Saving Trust, 2013), with terms additionally defined as listed in Table 4.1.

Table 4.1 Definitions used in DECC Community Energy Strategy Review

Term	Definition
Energy project	Any project involving collective action to buy, manage, save or generate energy
Community group	Any citizen group or third sector body with a representative voice. The community group must be responsible and/or accountable for the delivery of an energy project in the UK.
Community	Energy projects included in the

benefit	review must generate a benefit for the community in the form of income or profits alongside other economic or social benefits.

While this kind of definition is relatively broad, the main themes of action, agency, and benefits are central, and the extent to which community energy responds to each of these themes thus form key points of inquiry for this thesis.

However, as highlighted in Section 2.6, although community energy exists as a movement of collective efforts, there is value in considering the interactions of such entities alongside the more nebulous activities across civil society. Community energy can be considered as both a response by, and responsive to civil society in the ways that the former draws on values, resources and legitimacy from the latter. Subsequently, while separating community energy from the aggregated values and activities of individuals is important from a policy perspective, it is somewhat ignorant of the importance of non-CE actors in influencing, accepting and adopting small-scale energy approaches, and thus of participating in energy transitions more widely. For these reasons, this thesis seeks to consider the role of individuals/citizens alongside, and embedded with the more formalised community energy movement.

4.3.2 Primary study area

The primary study area is that of the town of Wadebridge and the surrounding parish communities of St Breock and Egloshayle (Figure 3.1). Although WREN states that the surrounding area (including numerous parishes and the towns of Rock and Padstow) will be involved through ‘collaboration’ (WREN, 2011), the primary focus for intended ‘intense activity and evaluation’ is the former, smaller area.

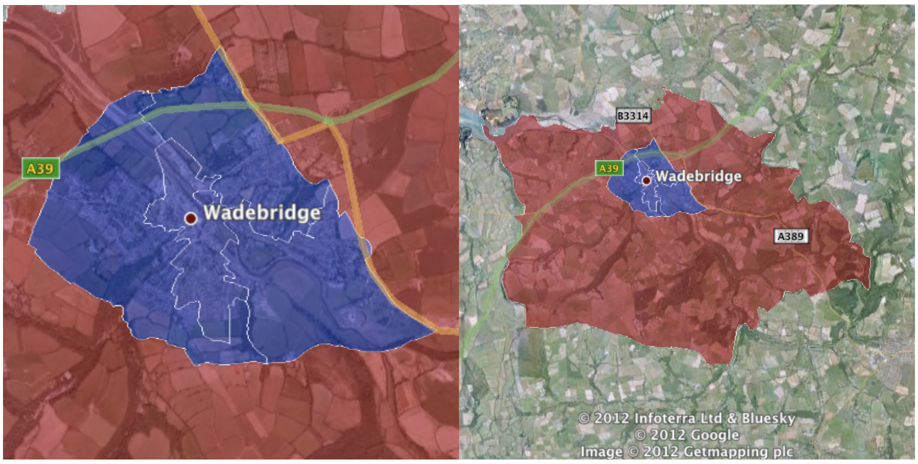

Figure 4.4 Geographical units of the study site

Notes: See: [10]

The areas of interest are delineated by the boundaries of several 'Lower Layer Super Output Zones' (LLSOAs)[11], within the 'North Cornwall' Local Authority 'LAU1' area. Super Output Areas (SOAs) were selected as an appropriate sampling unit for a number of reasons. First, government datasets, including census statistics as well as DECC and Ofgem data on energy consumption and FiT installations are readily available at SOA scales. Second, LLSOAs are broadly comparable in terms of population size meaning data can be compared with that from other areas throughout England and

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[10] Four *North Cornwall 009* LLSOA areas (blue) contain Wadebridge town while the 'North Cornwall 007A' LLSOA surrounds the town.

[11] Following the 2001 census, the Office for National Statistics (ONS) developed a set of stable hierarchical geographical building blocks to facilitate the collection and publication of Neighbourhood Statistics. At the midpoint of the scales are the Middle Layer Super Output Areas and Lower Layer Super Output Areas (MLSOAs and LLSOAs) formed by an average population of 7200 and 1500 respectively (ODPM 2005). There are 7193 MLSOAs (plus the Isles of Scilly) in England and Wales, comprising a minimum of 5000 people or 2000 households, and 1235 IGZs in Scotland made up of between 2500 and 6000 people. Within the English MLSOAs are 32,482 LLSOAs containing a minimum of 1000 people.

Wales. Also, blocks are expected to be stable over time, meaning that future surveys could use the same sampling blocks to build up a longitudinal picture of change.

The 'North Cornwall 009A-D' LLSOAs comprises Wadebridge town and the villages of Egloshayle to the South East and Bodieve to the north, while the 'North Cornwall 007A' LLSOA encompasses the area immediately surrounding Wadebridge on all sides, and includes the villages of St Breock, Whitecross, Trevanson, Burlaw, and Sladesbridge (Blue and red areas on Figure 4.4 respectively).

4.3.3 Wider area of interest

Placing a boundary for analysis (i.e. the primary study area as defined in Figure 4.4) is useful for focusing the research on a specific population, and reflects the fact that most of WREN's work focuses on the population of Wadebridge and the surrounding area. However, to ignore all areas beyond these boundaries would be to negate the importance of wider impacts, i.e. those outside of the immediate study area[12]. This is especially important given the rural nature of the area, where populations, and thus stakeholder and impacts to stakeholders are dispersed. Furthermore, some impacts, e.g. local economic impacts may be felt both locally and further afield once multiplier effects are considered. Indeed, from regional and national policy perspectives, local, regional and national economic impacts are potentially of value. A pragmatic approach is therefore taken, with focus on the primary study area complemented by a more general discussion of impacts further afield.

4.3.4 Proxies of energy system change

The use of indicators for analysing system change in general is well established throughout the sustainable development literature e.g. (Ledoux et

[12] Indeed, WREN considers all impacts, rather than only those within a specific boundary of study

al., 2005), and its usefulness in that field informs the adoption of the method here. Indicators are “thriftily selected data assumed to have a causal relationship with a theoretical concept” (Vos et al., 1985). As such, providing that the indicators selected to be representative of local energy system change, they can be valuable as proxies of change. While local energy system change may not be distillable to one or two variables, the purpose is to build an understanding of how individual and meaningful elements of a system change and interact, and what this means for the system as an aggregate of these attributes.

Patlitzianas et al. (2008) notes that much of the existing work on establishing sets of energy indicators has been carried out by international organisations (e.g. EC, UN, OECD, IAEA), and as such focus either on global or economy (i.e. continental or country) -wide scales e.g. (Streimikiene et al., 2007, Streimikiene, 2005, Aslanyan et al., 2005, Taylor et al., 2005) (Vera and Langlois (2007)).

In addition to this, the UK has for several decades employed energy (and climate change)-specific indicators alongside wider sustainability indicators (Defra, 2010, Defra, 2011, HM Government, 2005, DCLG, 2006, HM Government, 2007, DCLG, 2011). By establishing a set of indicators, the Government can prioritise those areas that are deemed most important for meeting policy objectives, and help assess and manage delivery of policies to these ends, either centrally or by local authorities. While these efforts are important from broad sustainable development perspectives, the energy indicators used typically comprise only a small proportion of wider measures

4.3.5 Identification of attributes of community energy

In seeking to understand a local energy system and its evolution though, what attributes should be considered? What can be left out? Fundamentally, indicators must be able to communicate to stakeholders the speed and direction of travel in relation to their objectives. For example, selection of indicators for government objectives depends on which policies are to be monitored (Patlitzianas et al., 2008). Since community energy (and its development) is potentially of interest to a wider set of stakeholders than just policymakers (including but not limited to practitioners and the academic community), it makes sense to consider objectives from that wider set. Building on the literature then (see especially Liverman et al. (1988) and Patlitzianas et al. (2008)), criteria were established in order to guide indicator selection:

- Significance: the indicator should measure something of importance (to the stakeholders involved)
- Availability of data: data should either be readily accessible or obtainable with reasonable time and costs
- Replicable: similar data should be able to be collected both from repeat surveying as well as from comparators
- Unbiased: data collection should be robust and objective

Following these criteria ensures that the data collected here is both robust and of use across a variety of applications, for example, in mapping longitudinal shifts and comparisons between different local energy systems

In light of these considerations, indicators were drawn from a number of sources, including the WREN business plan (WREN, 2011). The indicators have been selected to cover a range of qualitative and quantitative aspects covering resource, economic, and social factors. While these indicators have been identified specifically with consideration to the WREN context, for the purpose of evaluating the progress of WREN against internal and external goals and objectives, they are not site-specific and should be transferable to other similar projects and indeed to energy development projects more generally.

4.3.6 Establishing a baseline

Establishing a baseline is important for a number of reasons. Firstly, existence of a baseline provides a starting point from which change can be monitored and analysed. Longitudinal data analysis, for example, clarifies direction and magnitude of change among and between indicators, and can provide a more complete approach to empirical research than is afforded by cross-sectional observations (Ruspini, 2000). With relevance to the value of this research, Menard (1991) refers to the value of longitudinal data which "allows the analysis of duration; permits the measurement of differences or change in a variable from one period to another…and can be used to locate the causes of social phenomena", the phenomenon in this case being that of energy transitions. Establishing a baseline of Wadebridge's energy economy is thus a vital part in determining the nature and scale of change.

While time constraints of this research do not permit collection of multiple waves of data, establishing a baseline at this stage offers the potential for future analysis of the study area and may provide insights that are otherwise unreachable with cross-sectional analysis.

Secondly, although this research is about understanding change, it is also concerned with understanding *how to measure change*. It this sense then, establishing a baseline is important in that it will help to develop a methodology for repeating the process, either on the same community to build up longitudinal dataset, or on different communities to understand how energy systems differ across different communities.

4.4 Analysis of the impacts of a community energy group

This section sets out the key methods employed in assessing the impact of WREN on the local energy system. It should be noted that because the research boundaries adopted here are different from WREN's internal research on impact, inconsistencies between WREN's assessment of impact, and this assessment, are to be expected. Two significant factors here are the use of a geographical boundary around Wadebridge and the temporal aspect. With respect to geography, as Section 4.3 points out this study focuses on the town of Wadebridge itself, and specifically taking four nationally–derived geographical boundaries to define the primary study area. Analysis of the impacts reported herein are thus analysed within this boundary. While it is accepted that WREN's influence extends beyond this arbitrary boundary, such an approach provides a foundation for objective comparison of CE efforts in other population centres. In terms of timeframes, the data collection period of this thesis necessarily had an end, although WREN continues to keep up-to-date records of impact from the organisation's perspective. Here again then arises the potential for disparities between this, and WREN's datasets.

4.4.1 Contextual data

A wide range of contextual factors define the current energy system in Wadebridge. Furthermore, these factors may play a role in determining the speed and shape of local energy system change. In order to measure 'success', understanding the context in which WREN seeks to enact change is thus important.

Several contextual factors are important when considering energy systems and system change. The literature demonstrates domestic energy requirements are influenced by dwelling type (Druckman and Jackson, 2008, Baker, 2011, Yao and Steemers, 2005), household size (Yohanis et al., 2008, Druckman and Jackson, 2008, McLoughlin et al., 2012, Boardman et al., 2005, Leahy and Lyons, 2009), occupant age (Roberts, 2008, Meier and Rehdanz, 2010, Healy and Clinch, 2002, McLoughlin et al., 2012, Yohanis et al., 2008), income levels/socioeconomic status (e.g. Druckman and Jackson, 2008, Meier and Rehdanz, 2010, Yohanis et al., 2008, Leahy and Lyons, 2009), tenure (Druckman and Jackson, 2008, O'Doherty et al., 2008) and rurality (Druckman and Jackson, 2008). Propensity to adopt *both* domestic energy efficiency measures have been related to tenure (Druckman and Jackson, 2008, Cunningham and Joseph, 1978), whilst microgeneration adoption has been related to age (Sardianou and Genoudi, 2013, Scarpa and Willis, 2010, Balcombe et al., 2013), tenure (Richter, 2013, Gooding et al., 2013) and income/ socioeconomic status (Caird et al., 2008, Roy et al., 2008, Caird and Roy, 2007, Sardianou and Genoudi, 2013). Engagement with issues of sustainability more generally have also been correlated with socioeconomic status (Carter, 2001) and age (Roberts, 2008, Olli et al., 2001), among other variables.

Data contributing to household size, dwelling type, demographics, income, socioeconomic status, tenure and rurality) are taken from 2011 census records for the relevant LLSOAs.

4.4.2 Energy consumption

The scale and form of local energy consumption both sets the baseline for energy system change and influences the opportunities for demand reduction. DECC publishes gas and electricity consumption at the LLSOA scale at annual intervals. Although this includes commercial as well as domestic data, this research focuses on domestic demand. To supplement LLSOA-scale data, finer-grained data at the individual household-level was collected as part of the household energy survey (Section 4.5).

4.4.3 Energy generation

As increasing the adoption of local renewables is a key objective of WREN, it is important to accurately and objectively measure progress against this target. Data is available from two sources. WREN maintains records of renewable installations that have been directly enabled (through installer-referrals, for example) by the group. While self-reporting of non-direct impacts can potentially be open to over-reporting bias, the potential for peer effects is well established (Bale et al., McMichael and Shipworth, 2013, Michelsen and Madlener, 2013), and it is indeed possible that such effects can also be underestimated.

Additionally, through Ofgem's quarterly Feed-in Tariff report ((Ofgem, 2015a), installations by technology can be quantified according to the LLSOA geographical units. A small number (around 6 per cent) of FiT installations have locations registered in terms of Ordnance Survey grid reference rather than postcode, meaning they do not fall within any LLSOA (Long, 2013). While data from sources such as this may be more robust than self-reported data, it is ignorant of influence in ways that the latter is not. For example, WREN hold data on facilitated and influenced installations regardless of location. This thesis therefore considers both WREN and Ofgem data in assessing local RE uptake.

4.4.4 Economic impact

The annual distributional impact of WREN-related microgeneration installation was estimated using self-reported installation data, unit costs and associated savings from onsite use. Average unit costs on a fixed date (Aug 2014) were used (Energy Saving Trust, 2014), to reflect the variability of costs over time. FiT and RHI generation and export revenues were based on tariffs at the time of writing. Energy bill savings were based on average consumption and electricity prices for the study area, assuming 50 per cent of generated electricity is deemed for export, and 25 per cent is used on site (Energy Saving Trust, 2016). The disparity between the two values reflects the mismatch between onsite supply and demand.

Indicative estimations of WREN's direct economic income and expenditure was carried out using financial data made available by WREN (Alexander, 2013). Indirect economic impacts arising from commercial partnerships are not estimated, but self-reported figures from WREN (Hiles, 2014) is used alongside interviews with installers and indicative average industry costs (Parsons Brinckerhoff, 2012) to derive estimations of locally-accruing indirect expenditure.

4.5 Household energy survey

Desk-based data was supplemented by qualitative and quantitative data collected by conducting a postal survey carried out on householders within the study site. The aim here was twofold: a) to understand in finer detail the energy consumption characteristics of the population and b) to investigate local attitudes and perceptions towards energy system change in general, and the use of individual technologies more specifically.

Gillham (2000) outlines several advantages of such an approach: they are relatively low-cost compared to interviews; they are convenient for respondents; they can be quick to analyse (depending on question structure);

and interview bias can be minimised. On the other hand, they can be expensive, and can be open to error design, collection, processing and analysis of data (Biemer, 2010), although these potential pitfalls are characteristic of qualitative methods in general, to a degree.

4.5.1 Questionnaire design

Survey questions were aligned with the research objectives and thus explored both the current energy system in Wadebridge as well as the social barriers and opportunities for local energy system change. The wording of questions focusing on perceptions were in part influenced by surveys previously undertaken by others (e.g. Spence et al. (2010), Demski et al. (2013)).

The questionnaire sought to maximise breadth of data collected whilst minimising the time taken to complete. As such, care was taken to ensure questions and wording was clear, relevant, and brief. Efforts were taken to minimise bias through the use of neutral words, equal weighting of options, and avoiding built-in assumptions, loaded questions, technical jargon or unnecessary complexity. Careful layout and formatting minimised clutter and ensured questions were as easy as possible to follow. Comments and suggestions were sought from WREN on the content and layout of questionnaires.

Careful wording within questions (e.g. “Wind farms” as separate from “individual turbines” sought to control potential variances in respondents’ constructs of simply “wind” (Sturgis and Allum, 2004). Related to this, options sought to respond to contextualist perspectives whereby constructs and attitudes are governed by context-specific facts as well as (abstracted) knowledge (Sturgis and Allum, 2004, Jasanoff, 2000). This was however less possible in some instances, as it was also deemed important to encourage trade-offs to be made between potentially competing technologies. For instance, constructs of local wind farms were likely to be more contextually informed than those of nuclear power in the region, simply because the latter does not exist.

The survey was piloted on a random selection comprising around ten per cent (n=297) of proposed recipients from across the study site to test logistics, return rates, and reveal other deficiencies in survey design. Questionnaires were subsequently modified slightly to remove or reword potentially ambiguous or superfluous questions, or else add additional questions. The return rate from the pilot was 11 per cent (n=34), exceeding the expected lower limit of 10 per cent.

Questionnaires comprised 5 pages including a cover page, which introduced WREN and gave an outline of the research and how data would be used. Assurances were made regarding confidentiality and respondents were assured that opinions were sought (and there were no right or wrong answers). Respondents had the option of returning the survey via a stamped, addressed envelope, handing into the WREN shop, or by filling out an online version. Both then University of Exeter and WREN logos were prominent. Seven sections followed, including:

1. **Household circumstances**, including number of occupants, tenure, and years in property
2. **Domestic energy consumption**, which asked for sources of water and space heating, consumption of electricity and gas (in units or £), presence and rationale of selected microgeneration and efficiency installations, and electricity supplier
3. **Views about the national energy system** relating to attitudes around increased renewable energy investment, demand reduction local energy decision-making and national energy decision-making (5-point Likert scales for each)
4. **Views about the local energy system** relating to the importance of local energy production, local decision-making, local ownership, non-local energy production, personal participation in making local energy decisions, and the degree of confusion around the variety of local energy options (5-point Likert scale for each)

5. **Favourability of local electricity supply options,** including coal/gas, nuclear, wind farms, individual turbines, rooftop PV, solar farms and out-of-county nuclear (5-point Likert scale for each)
6. **Carrying out of 'sustainable' practices**, such as recycling, composting food waste etc
7. **Interest in engaging with WREN** through investing in domestic microgeneration**,** receiving subsidised insulation, and receiving advice about a range of local energy-related services.

The questionnaire was designed carefully with clear instructions for each question to minimise ambiguity. The majority of questions could be answered simply by checking tick boxes, although there was an opportunity to expand on those questions where 'other' was used as an option. Additionally, there was space at the end of the pack in which general comments could be included, allowing respondents to supplement quantitative answers with more nuanced opinions. The full questionnaire is given in Appendix 1.

4.5.2 Sampling strategy

The principle of census sampling as followed to cover the whole of the study area (as defined in Figure 3.1), and a total of 3459 questionnaires were delivered in June 2013. Household addressed were obtained from a database, and included all households in the area apart from those opting out of unsolicited mail (through the Mail Preference Service), those in newly built buildings (less than 6 months old), or who don't have a registered address for other reasons (such as living in an annex with parents/children). All packs were addressed with occupant names to residential properties only.

While census sampling theoretically gives all respondents the same opportunity to participate, it was acknowledged that self-selection bias might have led to nonresponse bias (the responding portion of the population differing from the nonresponding portion) (Groves, 2006). Representativeness was thus calculated by comparing response data with known strata (WREN membership, study site sub-area, and tenure), and improved by post-stratification sampling by these attributes. Resource constraints did not permit pre-notification or reminder stages, though it is acknowledged that response rates could have been improved by these means. Key characteristics of the sampling areas and five sub-areas are given in Table 4.2.

Table 4.2 Wadebridge sampling area characteristics

Sampling area	LLSOA code	Households (no.)	Home ownership (% of total)	WREN Membership (per 100 households)
Area 1	009A	655	78	14
Area 2	009B	917	71	14
Area 3	009C	890	45	10
Area 4	009D	689	65	11
Area 5	007A	577	56	12
Whole area	-	3728	63	12

4.5.3 Response rates

Table 4.3 provides a summary of response rates for the site as well as sub-areas. This includes responses from a draft version of the questionnaire received during the pilot phase, meaning that some questions from the main phase were not answered. A number of reasons (e.g. addressee absent or address inaccessible) resulted in 72 packs being undeliverable, in an overall response rate of around 8.7%. While this is modest, nonresponse does not automatically increase nonresponse bias (Groves, 2006; Peress, 2010), and the post-stratification steps described above act as a check against this possibility. Response rates varied from 6 to 11 per cent across different sub-areas in the study site. Higher response rates are returned from areas with higher social grades (Figure 5.4), a pattern consistent with other surveys (Demski, 2011), and suggests a slight bias towards more educated respondents. Self-selection bias arising from interest in the subject area is also expected to skew results somewhat.

Table 4.3 Response rates for the household energy survey

Sampling area	Distributed	Returned	Response rate	% of completed questionnaires
Area 1	629	64	10	20
Area 2	886	76	9	24
Area 3	1017	65	6	20
Area 4	648	70	11	22
Area 5	578	46	8	14
Whole area	3758	321	9	100

4.5.4 Data analysis

Questionnaire data was entered into Excel and coded where necessary, before being imported into SPSS for analysis. Missing data was coded as such, and all data were screened for anomalies, for example answers that were outside of categories were coded as missing. Parametric t-tests were used to test for significant differences. Not all questions were used in the eventual analysis.

124 respondents included additional comments about both the questionnaire and the issues raised within. These were collated, given identifiers, and coded manually according to broad themes, which were informed by research objectives. More specific themes were then identified as they emerged from the data, for example ‘Identifying specific energy priorities; aesthetics of renewables; understandings of trade-offs). Several of these comments were then used to supplement and explain findings emerging from quantitative data, and are coded in the analysis as *Respondent 1*, for example.

4.6 Semi-structured interviews

16 semi-structured interviews were conducted with stakeholders from throughout the community energy sector, with the purpose of developing insights into the impact and value of WREN and of community energy more generally. With the exception of a few interviews with community energy

groups from outside of the area, the majority of interviews thus focused either specifically on WREN or more generally on the development of community energy in the South West.

The interview as an “interchange of views between two persons conversing around a theme of mutual interest” (Kvale, 1996) is an established mode of qualitative data collection. In particular, interviewing can be used to develop deep insights into individuals’ experiences as well as feelings and interpretations of these experiences (Kvale, 1996, Mack et al., 2005). As concepts and impacts of community energy (and of energy policy more generally) are inherently subjective, the qualitative interview is especially useful here as a method of drawing out meanings and feelings ascribed to phenomena and experiences (Robson, 2002, Kvale, 1996, Rubin and Rubin, 1995).

Semi-structured face-to-face interviews in particular are sympathetic of nuance, complexity and sensitivity characteristic of the present subject area (Bryman, 2008, Robson, 2002, Kvale, 1996), again with relevance to the subject area. As with RE, perceptions of community energy are subject to nuance, so the ability of a method to be enable depth of discussion and enable open expression of perspectives in participants’ own words was key (Hancock). It is also well-suited to the kind of probing for clarification and meaning behind their positions and perceptions, which enhances the validity of data compared to shallower forms of data collection (Schuman, 1966, Øvretveit, 1998). The ability of the chosen method to be sympathetic to sensitive information was important (Bryman, 2008, Robson, 2002), particularly since issues of finance, personal relationships and micropolitics are central to community energy.

With the exception of two phone interviews, all were conducted face-to-face. Such an approach is considered more conducive to developing rapport and empathy with participants, ensures non-verbal communication is not lost, and facilitates conveyance of depth of meaning (Gillham, 2000, Gillham, 2005, Shuy, 2003). Of the face-to-face interviews, one was held via Skype, and while this method has some drawbacks (e.g. potentially obscuring body-language), it offers the potential of maintaining the benefits of face-to-face interactions whilst offering a pragmatic response to time and place limitations (Janghorban et al., 2014).

Semi-structured interviews also permits a balance to be struck between consistency between interviews (within stakeholder groups) and flexibility within interviews, a key consideration when interviewing participants from different groups (Denscombe, 2007, Myers, 1997). Employing similar questions between (similar) stakeholders focused interviews around key areas of interest. Outside of these boundaries however, discussions were allowed to flow around emergent issues raised during the conversation, resulting in a more natural, fluid conversation than would be possible with a survey-type interview technique whilst affording the flexibility to exploring emergent themes (Mathers et al., 2000).

Interviews lasted between 45 and 90 minutes. Initial informal, factual, non-threatening conversations helped to prepare the participant for discussion before moving into heavier issues (Rubin and Rubin, 1995). Interviews concluded when all key issues had been explored or allotted time was up. Switched off the voice recorder both signalled the end of the interview, and while casual chatting usually resumed, this often had the effect of encouraging participants to speak ‘off the record’ (Ibid).

Content varied slightly according to the stakeholder involved. Interviews with community energy practitioners focused on the formation and dynamics of the group, practical issues of project progress and barriers, and the relationship with the policy environment. Discussions with installers focused on the practicalities and benefits of relationships with community energy groups, and interactions with policy. Local authority interviews focused on development of relationships with, and local policies pertaining to local community energy groups. As such, the interviews as a whole aimed to triangulate experiences and values of community energy from a number of stakeholder perspectives (Robson, 2002).

4.6.1 Sampling

A summary of interview participants is given in Table 4.4 (overpage). Stakeholders were purposively selected (Bowling, 2002) on the basis of their individual ability to contribute an informed account of WREN in particular, and/or community energy more generally. The majority of stakeholders can thus be described as representing different actors within the energy system, whereas others (e.g. Charities) may have interacted with WREN as participants in specific programs. While the nature of the energy system means that *everybody* might fall into the category of an interested stakeholder, the intention was to sample a large enough range of stakeholders to reflect a range of perspectives on offer.

Several stakeholders were well placed to report on experiences as representatives of more than one stakeholder group (for example, an NGO representative also had experience of running a community energy group). While the focus of the research was on the activities and impacts of WREN, interviews with a wider (in terms of context and approach) range of community energy practitioners were deemed necessary to build up a picture of the broader community energy sector.

Interviews with several organisations with established relationships with WREN offered insights from beyond the immediate CE space. Contact with representatives from those organisations was made via an intermediary in WREN. All other interviewees were approached directly via email.

Table 4.4 Interviewees

Interview number	Position	Organisation
1	Director	CE group
2	Chair	CE group
3	Director	CE group
4	Chair	CE group
5	CE specialist	Supplier
6	Director	CE group
7	CEO	CE group
8	Project manager	RE installer
9	Managing Director	RE installer
10	Manager	RE installer
11	Strategy Officer	Local Authority
12	Sustainability Lead	Local Authority
13	Policy Officer	Local Authority
14	Chair	Community group
15	Chair	Community group
16	Chair	Community group

4.6.2 Ethics and consent

After initial contact was made with the participants, the purpose and summary of the research was emailed to participants and then discussed again at the start of every interview. Every effort was made to ensure participants of the voluntary nature of their involvement and of their right to withdraw at any time.

In line with the ethical guidelines provided by the University of Exeter's College of Life and Environmental Science, informed consent was requested from each individual. Anonymity was offered to all participants, with the agreement that only the organisation with which they were representing mentioned. In addition, participants were assured that data would be held in accordance with the Data Protection Act 1998, and were offered a copy of their interview transcript to comment on.

4.6.3 Data analysis

The majority of interviews were recorded – with participant's permission – and supplemented by additional notes taken throughout the interviews. Additional notes were also taken immediately after each interview, where key themes and sentiments were reflected upon, and unrecorded comments could be captured. Four interviews were not recorded: three took place over the telephone, making recording difficult, and one occurred more spontaneously, meaning recording equipment was not available. Notes were taken during unrecorded interviews and supplemented by additional notes expanding on key themes immediately afterwards.

Recorded interviews were transcribed verbatim within a couple of days using 'F5 Transcription' software, and uploaded into the NVivo software package for analysis, alongside notes from unrecorded interviews. Coding within NVivo permits sorting and organisation of large amounts of qualitative data into themes, or 'nodes'. Such nodes can be organised linearly, nested within hierarchies, and cross-referenced with other nodes. Following the interviews, notes were identified as recurrent themes from each stakeholder group, and additional nodes added as themes emerged from the data. The structure of nodes and sub-nodes was incrementally refined during the coding process, with principal themes ('parent' nodes) forming the backbone of analysis and more specific topics ('child' nodes) bringing analytical depth and nuance. Verbatim quotes were selected on the strength of their representation of recurring and insightful themes and are presented throughout the analysis to illustrate key points and sentiments.

4.7 Comparison with international exemplars

The insights developed in Chapter three with respect to the experiences of Germany and Denmark provides valuable case studies for comparison with the UK. The chapter summarised the literature around community energy in these countries, with particular focus on the interplay between history, society and politics, as manifested in a suite of industrial and energy policies relevant to the development of more citizen-oriented energy systems. Such countries are often cited by UK community energy proponents as exemplary of the potential scope and impact of the movement in the UK, the rationale being that if others can make progress, so can, and so should, we (Julian, 2014, Nolden, 2013).

Analysis of such literature thus plays an important role in the analysis of the potential of community energy in the UK as it draws attention to issues of political feedback, path dependency, political control, and the interplay between citizens and the state in the formation of direct and indirect energy policy (Pierson, 1993, Pierson, 2000, Lockwood, 2014, Kahneman, 2011).

4.8 Wider observations of community and citizen-led energy

As previously highlighted, the research took place during a period of significant change within energy policy, as well as to both community energy and engaged, citizen-oriented energy more generally. As such, keeping up to date with such developments was key for the case-study-specific findings to be placed in context.

Attendance at meetings, seminars and conferences was thus critical in gaining up-to-date, real-world perspectives of the sector and of wider policy developments, and provided opportunities to engage with key actors, including CE practitioners, intermediaries, and individuals from industry and policy. Through attendance and participation in such events, the research benefits from drawing from experiences and perceptions from throughout the energy world.

Furthermore, the dynamism of the sector throughout the study period was manifested in a stream of policy documents (such as consultation documents and responses) from both government and key actors in the industry. Notes were taken on these releases, as well as during event attendance to provide an additional dimension through which insights could be drawn.

4.9 Summary

This chapter outlined the methodological approach employed in this thesis. It argued that the value of community energy is best understood as both multidimensional and multiscalar, and as such requires a blend of quantitative and qualitative analysis, and an appreciation of impact over multiple timescales. The use of a case study within the context of broader observations of the community energy movement is proposed. A desk based study is complemented by a postal survey of Wadebridge households to build up a picture of the local energy economy, with the latter also eliciting data around local perceptions and attitudes around national and local energy issues. Semi-structured interviews are proposed as a tool for eliciting data around WREN and community energy more generally.

Using the methods described here, the next chapter presents the local context for energy system change in Wadebridge.

5 The local context for energy system change Wadebridge

The context dependency of community energy relates to the degree to which the movement is enabled or constrained by local circumstances (Seyfang et al., 2014). For example, progress against efforts to upgrade domestic energy efficiency will be determined in part by the quality of original housing stock, and medium-scale renewable energy projects may be constrained by availability of capital or other resources, such as suitable sites, or public support. The impact of a community energy project towards goals such as these is highly thus dependent on local opportunities and constraints, and how these are either grasped, or overcome.

Taking a case-study approach, this chapter is concerned with establishing a baseline for a specific energy economy, that of Wadebridge, UK. The chapter continues with a discussion of the drivers, ambitions and approaches favoured by WREN as the principal agent of community energy in the study area. The local context for understanding the impact of WREN on the local energy system is then presented. This includes analysis of the local population and housing stock as the subjects of change, the physical and economic characteristics of local energy supply and demand, and social aspects relating to local perceptions and values with respect to local (and broader) energy system change.

Aside from providing an empirical baseline, in depth study of the energy system in Wadebridge helps us to understand what ‘community energy’ means in terms of the local context. For example, who is the community one seeks to involve? What objectives are targeted, and why? Only by acknowledging the heterogeneity of community energy in this way is it possible to gain a nuanced understanding of the dynamics between CE groups and the systems they are seeking to change. Such nuance, this thesis argues, is central to understanding the value of community energy as not just an economic sector like any other, but a dynamic grassroots movement whose subjective values around what a ‘progressive energy system’ are helping to shape the energy system as we know it.

5.1 WREN's drivers, ambitions and approaches

WREN established itself as an Industrial and Provident Society (IPS) in May 2011, with aims formalised in a business plan later that year. Within, several five-year objectives were established (WREN, 2011):

1. Generate 30% of the town's electricity from renewable sources by 2015
2. Reduce electricity consumption by 5% by 2015
3. Retain economic value of Wadebridge's energy consumption locally
4. Generate £200,000/year profit to be redistributed in a revolving community fund
5. Engage the whole community in all aspects of energy production and consumption, and the wider implications of Wadebridge's energy economy
6. Develop in a way replicable by other communities, and subject the process to rigorous academic evaluation
7. Build wider economic resilience in the form of the Camel Low Carbon Enterprise Zone within the Cornwall Local Enterprise Partnership

The plan demonstrated considerable ambition in both the depth of the targets and the breadth of approaches. Aside from the targets identified above, four key principles were established to inform the initiative:

1. **WREN is an economic programme**. It is of note that from the outset, WREN framed itself as an agent of economic change, and although environmental and social aspects were central to the delivery of this, the principles of economic resilience and independence were central to the approaches taken;
2. **Engagement of the whole community**. In pledging to engage with the whole population of Wadebridge (rather than a self-selecting few), WREN both sought to confront the challenge of inclusion and gain legitimacy within the town's population.
3. **Saving and generating energy at a scale that will have a meaningful impact upon the town's actual consumption**. The

implication here is that changes in consumption will be of a scale tangible to the population, and is related to a fourth principle:

4. **Subject itself to rigorous external evaluation**. Acknowledgement of the value of objective evaluative study is important in developing credibility and trust. This final principle laid the foundation for the current research collaboration on which this thesis is based.

WREN published an updated business plan in November 2012 (WREN, 2012). This document significantly expanded upon the original plan, and while objectives remained broadly similar, it was significantly richer in terms of proposing in detail a 5-year programme of activities to meet these objectives whilst becoming financially self-sustaining.

To meet the stated objectives, WREN has taken a broad approach comprising increasing local renewable capacity and demand reduction programmes, paired more general projects focusing on maximising local social and economic gain. The approach has focused on building capacity and developing rooftop solar, primarily on domestic properties but also on some commercial properties, as well as seeking to develop a community-owned RE installation. Considerable resources have been spent on the latter, a task made difficult by the limited availability of suitable local sites to develop, exacerbated by constraints on the distribution network in Cornwall (Simonds and Hall, 2013).

Of particular interest to WREN at the time of writing (Mid-2015) is in the potential of local energy markets, i.e. local ownership and supply of energy. This has culminated in the development of the Wadebridge Energy Company as a vehicle through which this can be delivered.

5.2 The local political environment

At the county level, the Cornwall County Council White Paper *Economic Ambition* states that supporting the development of low carbon technologies is central to the economic vision of Cornwall County Council (Cornwall Council, 2011). Supporting innovation and investment in low carbon technologies, increasing private sector resource efficiency, and adopting sustainable practices throughout the supply chain are all cited as important stages in addressing growth priorities. These aspirations were further developed through the recently developed *Green Cornwall* programme, through which the council aims to ‘reduce its carbon footprint, facilitate community initiatives and provide the foundations for a low carbon economy’. The strategy, delivery programme and outcomes for doing so are laid out in the Green Cornwall strategy (Council, 2011).

Embedded in this strategy are a series of quantitative and qualitative goals and targets spanning five strategic themes. In addition to these themes (summarised in Table 5.1), the vision states that in the longer term, the aim is for Cornwall to produce the ‘majority of its energy needs from renewable sources’.

Table 5.1 Green Cornwall strategy objectives

Theme	Actions	Programme outcomes and targets
1. Leadership	Council leadership in reaching Cornwall-wide targets and the transformation to a low carbon economy.	Cutting CO_2 emissions of the council by 40% by 2020
2.Green Council	Reducing the Council’s carbon emissions to both meet and exceed its carbon reduction commitment	Contributing towards cutting Cornwall’s green house gas (GHG) emissions above national targets (34%) by 2020 Providing leadership to promote non-transport related energy demand reduction of 10% by 2020
3. Low Carbon Economy	Providing the infrastructure, investment, and requisite skills to create the conditions for a measurable transformation towards a low carbon economy.	A measurable transformation towards a low carbon economy. Specific indicators to be developed to capture the economic impact of low carbon technologies
4.Sustainable communities	Supporting communities to become more resilient, promote	Measurable community benefit (fuel poverty levels, renewable heat

4.Sustainable communities (cont)	demand reduction and increase renewable energy production. Develop community benefit models that tackle fuel poverty and provide local gain through FiT contributions.	incentive (RHI) and FITs utilised for local benefit) A ‘significant’ reduction in fuel poverty levels
5.Renewable energy	Through Council, other public sector, private sector and community organisations activity, promote the use of renewable energy	Supporting the increase in renewable energy production to meet the national 15% target of non-transport related energy by 2020

Source: Cornwall Council (2011)

The aspirations outlined in the Green Cornwall Strategy establish accountable targets generally in line with the council’s sustainability policy that “the goal of sustainable development will be pursued by integrated actions designed to achieve a sustainable, innovative and productive economy that delivers high levels of employment; and a just society that promotes social inclusion, sustainable communities and personal wellbeing.“(Cornwall Council, 2011). In the broadest terms, this policy seeks to communicate a balance of economic, social and environmental objectives.

With particular relevance for community energy, Objective 4 of the Strategy communicates an endeavour to support the development of resilient, low carbon communities. In practice, this has resulted in the establishment of a number of initiatives with partners including:

- Development of a community energy forum for developing capabilities, sharing best practice, and developing better alignment with the local policy agenda;
- Establishment of a revolving loan fund for CE groups seeking capital to developing local RE projects.
- Partnering with local charities and other organisations to tackle fuel poverty in the area.

Consequently, the council has been regarded as relatively progressive in terms of developing local energy initiatives. As with many local authorities however, there are considerable constraints on resources (the Green Cornwall Programme has a staff of one), meaning that support for communities has relied on partnerships with intermediary organisations and political support for grassroots activities. Financial resources are limited, and where available (such as through the revolving loan fund mentioned above) are subject to strict measures of success based on repayment rather than broader social and environmental outcomes (Interview 12).

The introduction of Local Enterprise Partnerships (LEPs) in 2010 meant that the majority of investment for energy projects would eventually be delivered by the private sector (CIoS LEP 2012), and while this does not preclude community projects, investments in such projects would have to be business-driven, i.e. based on a strong business case and proven revenue-generating capacity (Interview 12). It seems clear then that while community energy offers benefits outside of economics, it is politically impossible to rationalise spending without a firm belief that that spending can have a positive and measurable economic impact on the local economy.

5.3 The local population and built environment

In order to fully appreciate how WREN has impacted system-wide dimensions of the energy system, it is necessary to establish a comprehensive cross-sectional baseline of the town's energy system in order for change to be contextualised and so that the speed and direction of change across dimensions can be understood.

5.3.1 Housing stock and access to gas

While the LLSOA[13] classification ensures that the study's sub-areas are broadly comparable, there are some differences in population and household numbers (Table 5.2). Number of people per household, however, is comparable across areas. There is a marked difference in household density (number of households per hectare) between sub-areas of Wadebridge town (Cornwall 009A – Cornwall 009D) and the surrounding rural area (Cornwall 007A).

Table 5.2 Population and household data for study area

LLSOA code	Area	Population[14]	Number of households[15]	Ownership (%)	People per household	Household density
Cornwall 007A	Rural	1,140	467	69	2.44	0.09
Cornwall 009A	Town (South)	1,521	634	80	2.40	7.64
Cornwall 009B	Town (East)	2,015	851	77	2.37	6.35
Cornwall 009C	Town (West)	1,789	832	48	2.15	18.49
Cornwall 009D	Town (North)	1,396	638	71	2.19	6.25
Total		7,861	3,422			

Source: ONS, 2011

[13] As defined in Chapter 4, LLSOA (Lower Level Super Output Area) codes relates to the subareas of the study site. Wadebridge town itself is made up of four areas ('Cornwall 009A','B','C'&'D'), while 'Cornwall 007A' relates to the rural area surrounding the town (Figure 4.4).

[14] All usual residents

[15] Households with at least one usual resident

While access to the mains gas grid in Cornwall is limited in general, gas access in more rural areas is almost non-existent. This is reflected in the variations in numbers of off-gas households for the study site (Figure 5.1), with almost 70 per cent of households off-gas in the rural surrounds (007A) compared to between 14 and 32 per cent in Wadebridge town (009A-D). As gas is considerable cheaper than other forms of heating, this has implications for affordability and the associated policy objective of reducing fuel poverty (Baker, 2011).

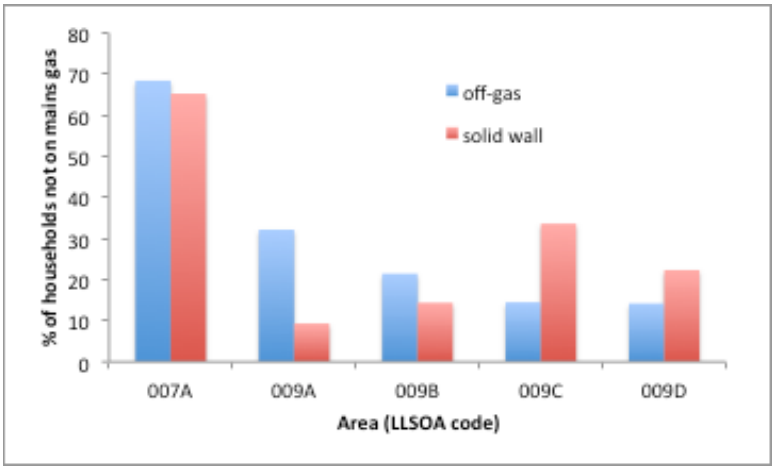

Figure 5.1 Percentages of off-gas and solid wall households in the study area.

Source: CSE (2009)

While sparsely populated rural properties are least likely to be connected to the gas network, they are also more likely to be built with solid walls rather than cavity walls (Baker et al., 2008), making them more costly to heat and difficult to insulate effectively. The combination of having no gas heating and/or a solid wall property means that the property is more likely to be considered 'hard-to-treat' (HTT) with traditional methods of efficiency measures[16], a situation many homes in the study area are likely to find

[16] Defined by the Energy Savings Trust as "Homes that for a variety of reasons cannot accommodate 'staple' energy efficiency measures offered under schemes

themselves in, particularly in more rural areas (e.g. ‘Cornwall 007A’ in Figure 5.1). In Wadebridge town itself, it is the presence of solid walls that contribute most to the efficiency improvement challenges, whereas lack of access to the gas grid is more problematic outside of the town.

The combination of poor housing and expensive heating options in HTT homes means that payback times for remediation can be as high as 30 years (Hoggett, 2008). Additionally, Hoggett notes that since hard to treat properties vary in the problems they present, homeowners may need to invest considerable time to determine the most suitable, cost effective options for treating their home and finding appropriate contractors to carry out the work.

The variation in household density across the study site also has implications for RE options at the community scale. For example, while communal, low carbon heating systems, such as Combined Heat and Power (CHP) units, offer considerable benefits for fuel-poor households, they require a minimum density of heat load and so are ill-suited to rural settings with sparsely sited domestic buildings.

5.3.2 Socioeconomic and demographic considerations

While local building fabric and access to gas determines the technical feasibility of making changes in terms of efficiency and RE measures, such changes are limited by social factors. Even if changes are both technically and economically feasible, whether or not residents engage is dependent on their individual circumstances, their needs, their attitudes and values, and their finances. Such factors can in turn be affected by the socioeconomic and

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such as Warm Front in England [and] include homes that are off the gas network; homes with solid walls; homes with no loft space; homes in a state of disrepair; high-rise blocks; and any other homes where for technical and practical reasons these staple energy efficiency measures cannot be fitted” Energy Saving Trust 2004. Hard to Treat Homes Guide.

demographic construction of the population, and so understanding these parameters is useful.

The socioeconomic situation of the population is of particular interest, as the distribution of educational levels, income and time may influence engagement in low carbon energy transitions in different ways. For example, higher income households consume more energy (Brandon and Lewis, 1999, CSE, 2013), and investment in microrenewables occurs most among higher income households (Fischer and Sauter, 2004, DECC, 2012b).

While income tends to be related to the age of householders, age itself determines energy consumption through a need for higher ambient temperatures through being more sedentary (Collins and Hoinville, 1980, Healy and Clinch, 2002), and the increased likelihood that these owned homes house out-dated heating systems (Hamza and Gilroy, 2011). It is not the case that elderly residents consume more energy through spending more time at home, and it has been found that many such householders heat less of the home (Age Concern and Help the Aged, 2009). These issues are affected and confounded by the fact that elderly households are disproportionately affected by lower incomes, under-occupation, and little scope for home improvements to deal with energy efficiency (Hamza and Gilroy, 2011). In terms of engaging with CE, anecdotal evidence suggests the time-resource intensity of these initiatives mean that it is often retired engineers that drive them, making use of experience and the spare time afforded by retirement (Seyfang et al., 2013, IET, 2013).

With respect to the area of interest, the study population span a range of socioeconomic groups. One measure, the Index of Multiple Deprivation (IMD) ranks deprivation scores across the whole of England (DTLR, 2002). Of the domains captured within the IMD[17], the Income and Living Environment indices are perhaps of most interest for the current research. Both *Income* and *Living Environment* deprivation measures are related to energy issues through correlation with fuel poverty, and indeed has been used as a proxy for such (Baker and Starling 2003), while analysis of deprivation more generally might provide insight into areas where the time and financial resources required for energy engagement are more constrained.

Income Deprivation[18], is confined to small pockets in Cornwall, with around 10% of sub-areas in Cornwall defined as lying within the most deprived 20 per cent in England as a whole (Figure 5.2). While there is some variation within the study area (inset of Figure 5.2), deprivation under this definition is not pronounced.

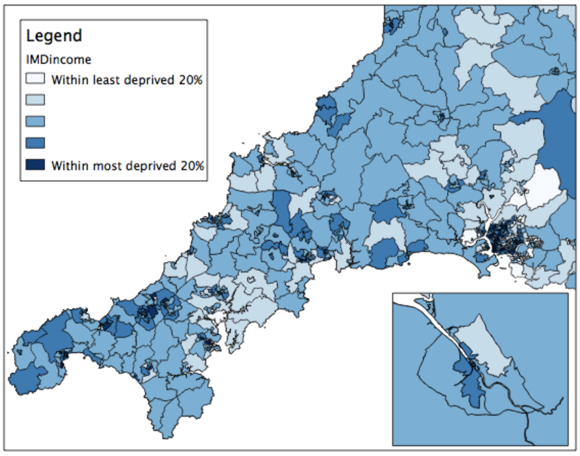

Figure 5.2 Index of multiple deprivation (IMD) 2010, Income Domain Indicators.

Darkest areas indicate LLSOAs with lowest 20% scores in England. Inset map gives detail for Wadebridge and surrounding area

[17] The IMD encompasses a broad range of deprivation domains including Income, Employment, Health and Disability, Education Skills and Training, Barriers to Housing and Services, Crime, and Living Environment.

[18] Income deprivation is measured by summing five indicators relating to numbers of individuals in families claiming various income and family support allowances

Rather more deprivation is evident under the *Living Environment* Index (measuring social and private housing in poor condition, houses without central heating, air quality and road accidents to pedestrians and cyclists) measure (Figure 5.3). This domain classifies central Wadebridge and the outlying area as within the 20% most deprived areas in England (along with 60% of the rest of Cornwall's LSOAs), whilst other areas within the study area score higher.

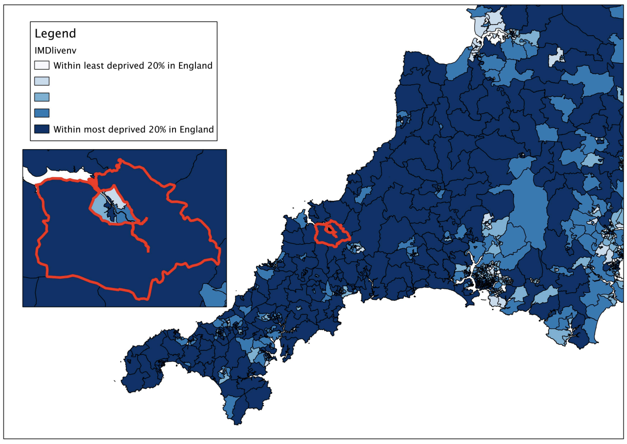

Figure 5.3 Index of multiple deprivation (IMD) 2010, Living Environment Domain Indicators.

Darkest areas indicate LLSOAs with lowest 20% scores in England. Inset map gives detail for Wadebridge and surrounding area

Variation in this second measure is pronounced between urban and rural areas, and while deprivation in the study area is linked more to living conditions than to income, rural income levels in Cornwall are still low by national standards. Relating these indices to fuel poverty depends on which income measure is used. CSE have shown that there is a strong correlation between fuel poverty and the IMD according to 'basic' and 'basic equivilised' income definitions[19], less so with the 'full income' definition (Baker et al.,

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[19] Baker et al (2008) use three definitions of fuel poverty: 'full income' where income includes Housing Benefit and Council Tax Benefit, 'basic income' where income does

2008). Similar variations can be seen relating to social grade based on occupation[20] as opposed to deprivation, as illustrated in Figure 5.4. Of particular note is the higher proportion of individuals in the lowest grade 'E' relative to higher grades in central Wadebridge (coded 009C in Figure 5.4).

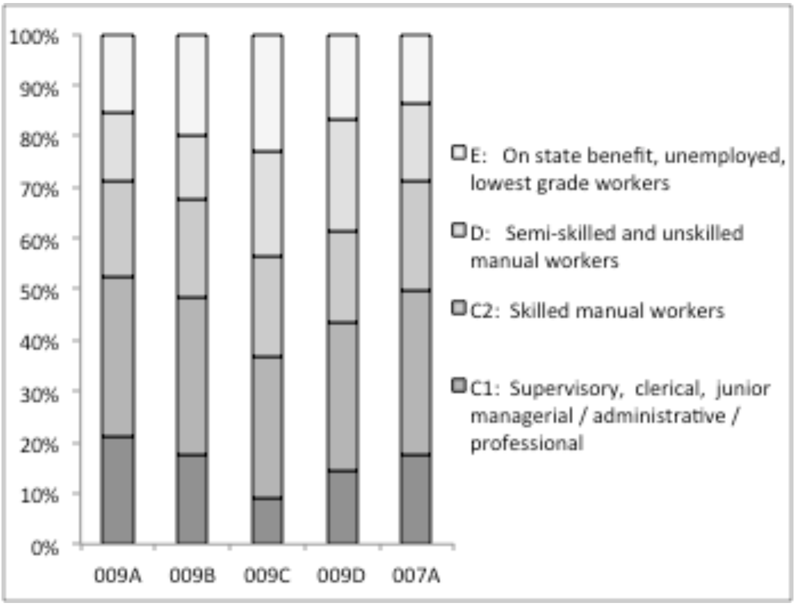

Figure 5.4 Social class stratification across the study site and Great Britain

Source: ONS (2014)

As touched upon above, measures of deprivation and affluence can be useful in helping to understand the potential for engagement with energy issues. For example, DECC analysis suggests that higher densities of household PV is installed in more affluent areas, by those using more electricity, by households in rural more than urban areas, and by those areas with less gas network coverage (DECC, 2012b). While lower income areas also install household PV, this analysis also suggests that these installations are more

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not include Housing Benefit and Council Tax Benefit and 'basic equivalised' income, where income is equivalised to take account of household size and composition

[20] As defined by the National Statistics Socio-economic classification (NS-Sec) grading system

likely to be rented through 'aggregators' via rent-a-roof schemes rather than privately owned by the household itself. This has particular relevance in the study site (and Cornwall more generally), where the socio-economic range is relatively large.

The demographics of the area may also affect engagement with energy issues in different ways. The study area as a whole has a higher proportion of older residents than in Cornwall as a whole, perhaps reflecting the rural nature of the area and associated availability of employment (Figure 5.5). Again there is some variation between sub-units of the study area, with more retirement-age individuals in central Wadebridge and west-Wadebridge (009C and 009B) than other areas.

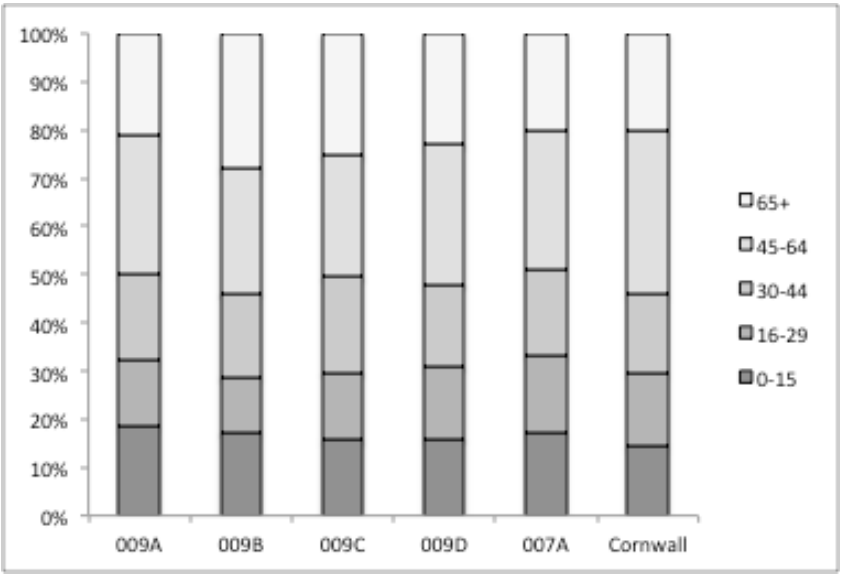

Figure 5.5 Proportions in different age groups throughout study site and in Cornwall as a whole

Source: (ONS, 2013)

While in-depth analysis is not possible without household composition data, DECC analyses find that the prevalence of fuel poverty increases as the oldest member of the household increases (DECC, 2013a). Age (which can be related to income) is another factor determining whether or not households invest in microrenewables, where the greater the average age of the LSOA (up to age 65), the higher the proportion of households with PV installations (DECC, 2012b).

The effect of age has also been explored with relevance to other areas of energy engagement. For example, CE initiatives often rely on voluntary resource base (Seyfang et al., 2012), which may mean that the participants involved most heavily might be those with most time to spare, i.e. in retirement, or in part-time employment rather than those at different stages of their lifecourse. Of course, and as will be seen, the wider organisational and support membership of CE groups means that a more diverse set of volunteers are necessarily involved, albeit in supporting rather than driving roles.

5.4 The local energy economy

CE initiatives, in general, seek to encourage a reconfiguration of local energy systems in terms of changes to supply through developing renewable resources and/or addressing demand issues through behavioural change and efficiency measures. The degree to which transformation in the energy economy is possible will largely depend on the baseline from which change takes place (and can be measured). While the previous section outlined the context in terms of the local population and built environment, this section establishes an energy-specific baseline of the locality with a view to drawing insights into both opportunities and barriers relating to altering the energy economy.

5.4.1 Local energy consumption

Average domestic electricity consumption in the study area largely follows that of Cornwall (‘Wadebridge and surrounding area’ in Figure 5.6), with figures higher relative to nationally derived figures. Higher relative electricity consumption can be explained by the combination of poorly insulated housing stock, and the lack of mains gas connections in rural parts of Cornwall. As highlighted in the previous section, this reiterates the variation within such a large study site encompassing both urban and rural settings, which may have implications for the effectiveness of strategies to engage different sections of the population in different ways. In terms of gas, domestic consumption for the study area again closely matches that of Cornwall more generally, though is considerably less than that for GB as a whole[21].

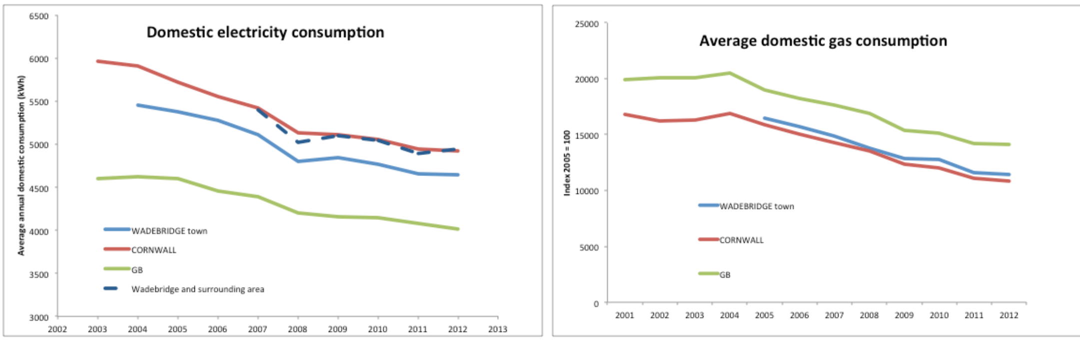

Figure 5.6 Average domestic electricity and gas consumption for Wadebridge and the surrounding area.

Source: DECC 2013

The lack of gas access to much of the study area means that other, more expensive sources of heat energy (petroleum and solid fuels) are used to supplement electricity in many households (Baker, 2011). Data from county level shows that domestic consumption in Cornwall is far less dependent on gas relative to petroleum, coal and electricity compared to GB (Figure 5.7a). These differences are more pronounced in more rural areas; Figure 5.7b illustrates that households in the rural area surrounding Wadebridge (those in Area 007A) rely on a more diverse mix of non-gas heating fuels compared to in Wadebridge town itself.

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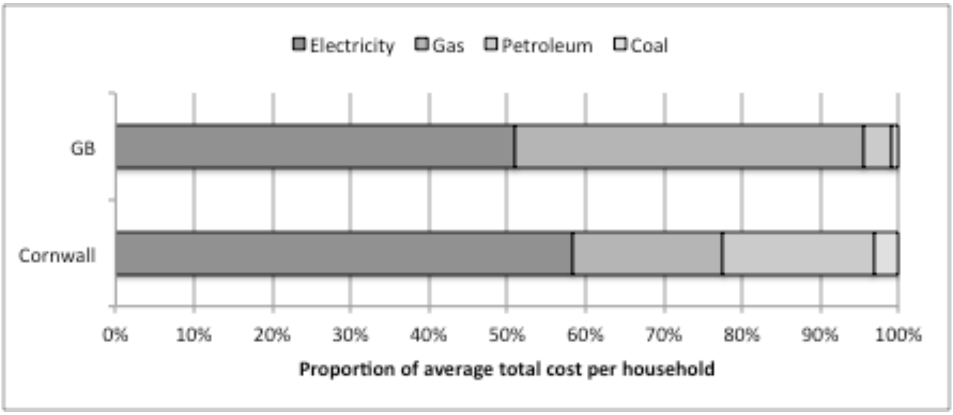
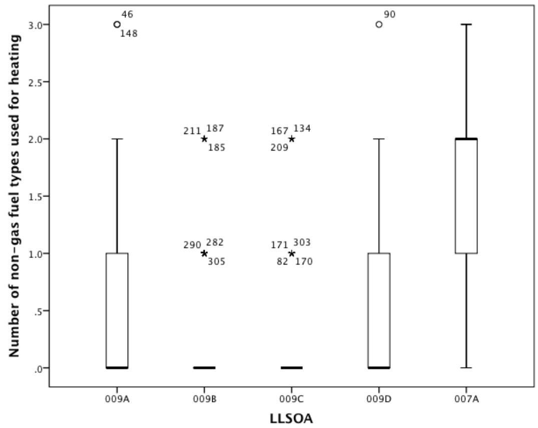
[21] DECC does not supply data for the area surrounding Wadebridge (North Cornwall 007A) as it would be disclosive. Both electricity and gas in Wadebridge and the wider study area have exhibited reductions in electricity (12%) and gas demand (31%) in the seven years from 2005. DECC attributes national reductions in both electricity and gas to improvements relating to more efficient appliances, improved insulation, and more efficient heating systems, in part influenced by expansion of the housing stock with associated improvements in building standards.



(a)



(b)

Figure 5.7 (a) Total domestic energy consumption by fuel type (2011) and (b) reliance on non-gas fuel for heating in different parts of the study site.

Sources: Author's own and DECC (2013d)

5.4.2 Local energy expenditure

The ultimate goal of some CE groups, WREN included, is to develop the concept of local energy markets, and although there are several hurdles to this becoming reality, this is expected to have significant local benefits to the economy. Combining the local fuel mix with costs for Wadebridge households makes it is possible to estimate the extent of energy spending in the local area, and in turn, how much of that remains local to Wadebridge.

The differences in unit cost of different fuel types means that average household energy expenditure in Cornwall vary considerably from that of Great Britain. While energy prices vary across the country, an estimate based on average costs for each fuel type Table 5.3 illustrates the impact of limited gas access on average annual household energy prices (Figure 5.8).

Table 5.3 Cost assumptions for selected fuel types.

Fuel	Cost per unit (pence)	Unit	Energy content (kWh/unit)	Cost per kWh (%)
Electricity	15	kWh	1	15 (100%)
Gas	4.5	kWh	1	0.045 (90%)
Petroleum[22]	55.3	litre	9.8	0.062 (90%)
Coal	40	kg	6.85	0.053 (75%)

Sources: Defra (2009); Bolton (2014)

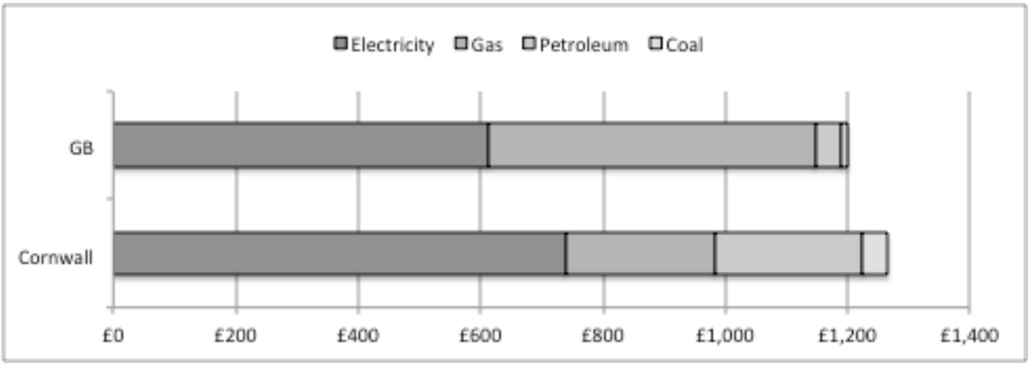


Figure 5.8 Indicative annual average domestic fuel costs (excluding transport)

Source: DECC (2013e)

While data from DECC helps to frame the relative scale of energy spending in Cornwall, localised household data collected through the household survey is more suitable in highlighting spending distributions relevant to the study site. 67 per cent (n=224) of respondents chose to share energy expenditure data as part of the wider survey. Average annual expenditures for both electricity

[22] For the purpose of this analysis, petroleum is assumed to be kerosene, though consumption data include gas oil, LPG, butane and propane along with kerosene, all of which vary in price.

and total energy (£669 and £1272) are comparable with Cornwall averages (£739 and £1266 respectively), though a wide range of both electricity and total energy costs are captured even within this relatively small sample (Figure 5.9).

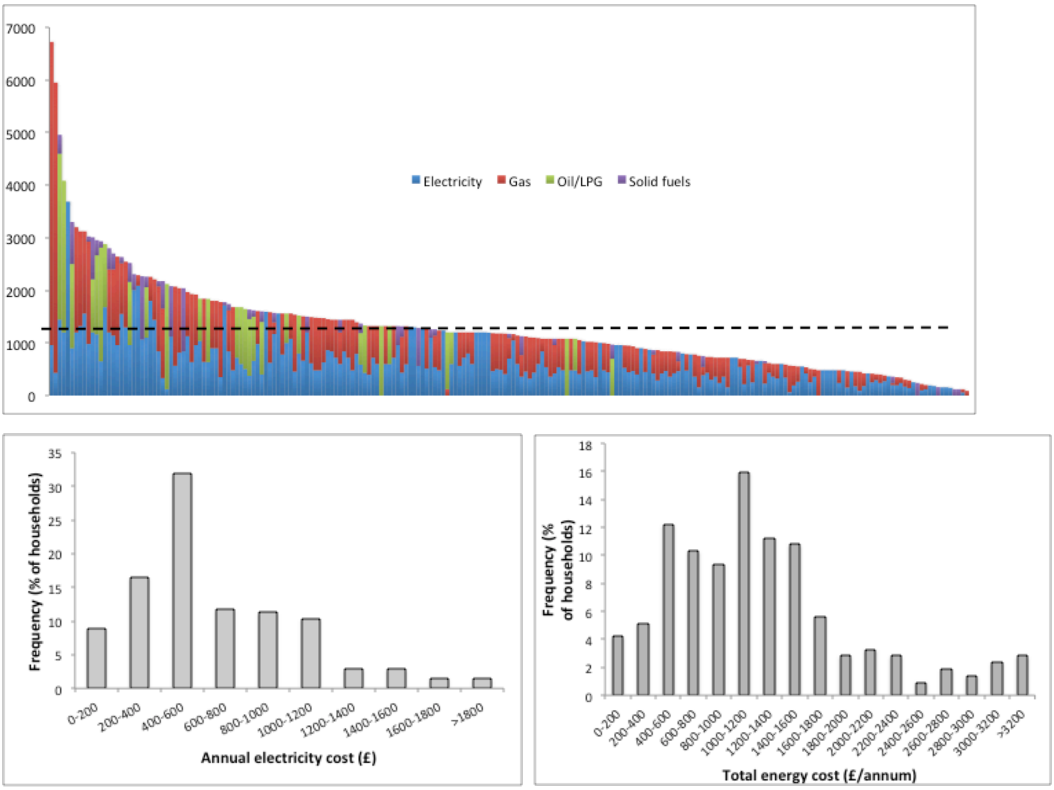


Figure 5.9 a) Breakdown of annual energy costs as reported by 213 residents of Wadebridge, b) Reported annual electricity costs and c) total energy costs for Wadebridge residents

Notes: See [23] and [24]

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[23] Dashed line indicates average annual total fuel cost for the area (£1272)

[24] It should be noted that data is self-reported and as such can be only considered an indication of actual consumption and expense figures. There are some inconsistencies in the data, i.e. several respondents gave data for oil consumption but not electricity. Since it is improbable that some households do not use any electricity, it can be assumed the figure underreports actual energy consumption in the area.

Although comfort levels vary across households, housing quality and access to gas are considered to be significant drivers in determining energy costs. Figure 5.10 further highlights the effect of gas access on overall household energy costs, highlighting that those without access to gas[25] have slightly higher average energy costs (a), and spend more on electricity as a proportion of total costs (b). The relatively high cost of alternative heating fuels means that heating is significantly more expensive for those without gas access. Since one of the study areas lies outside of Wadebridge town where gas access is very low, total energy costs can also be seen to vary geographically, with households in the rural outlying area of Wadebridge paying more (Figure 5.10c).

[25] It is assumed here that those households not reporting any spending on gas do not have access to gas.

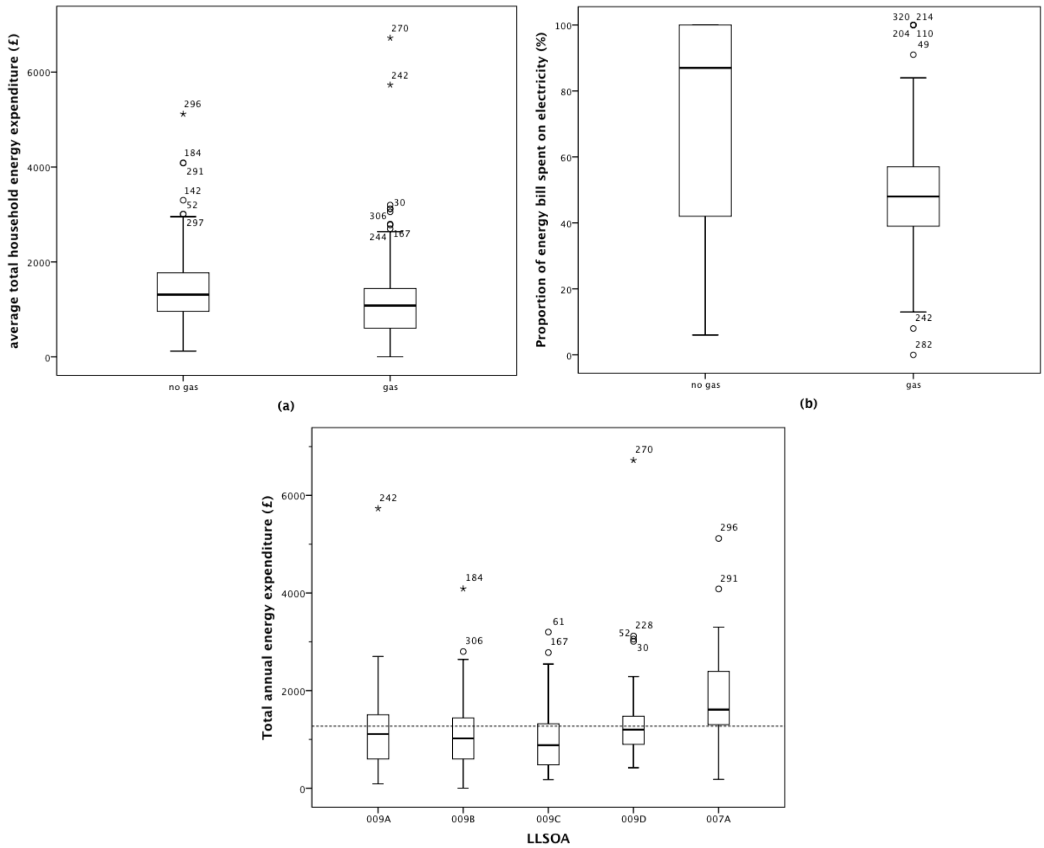

Figure 5.10 a) Effect of gas access on total energy costs, b) proportion of bill spent on electricity, and c) differences in energy costs by study area geography

Source: Author's own

The data presented above can be used to develop a bottom-up model of energy costs in the study area as a whole as well as between LLSOAs within the study area. This can then be used to determine the direct expenditure for domestic energy per household. As Table 5.4 shows, total area expenditures are broadly comparable across sub-areas, ranging from £0.68m to £0.84m. Costs per household exhibit considerable variation, ranging from £868 per annum for households within central Wadebridge to £1776 for those in the rural area surrounding Wadebridge. Adding transport (available at county level only) adds around £1300 to household expenditure.

Table 5.4 Breakdown of household energy costs for study site sub-areas

LLSOA	009A	009B	009C	009D	007A	All areas
Electricity	£615.53	£625.57	£593.26	£763.69	£901.44	£688.45
Gas	£358.03	£327.52	£247.72	£355.68	£140.87	£296.84
Petroleum	£61.89	£12.63	£16.63	£30.69	£575.77	£107.94
Solid fuels	£32.50	£21.05	£10.52	£25.26	£158.61	£41.83
Total per household	£1,067.95	£986.77	£868.13	£1,175.32	£1,776.69	£1,174.97
Number of households	634	851	832	638	467	3422
Total area cost (£m)	0.68	0.84	0.72	0.75	0.83	3.82

Source: Author's own[26]

Of this expenditure, a notable proportion (that of electricity and gas) is spent outside of the locality, and the vast majority (87 per cent) of survey respondents source electricity and gas from one of the big six energy suppliers. It is assumed that the remainder (including petroleum products and solid fuels) are purchased from suppliers based in the South West with local supply chains (relating to storage, logistics and delivery for example). There is the potential for some of the costs spilling out of the area to be retained through local energy markets, a concept being actively explored by WREN and other CE groups.

[26] Recall from the Introduction of Section 4.4 that different research boundaries means that this data may not correlate exactly with that generated by WREN

5.4.3 Fuel poverty

The disparity within the study site in terms of housing stock, gas access and energy expenditure has been highlighted, and previous sections have covered variances in income. Reducing fuel poverty is a key political objective at both local and national policy levels, it is important that it is addressed as an issue in its own right as well as being integrated to other policy objectives, such as the deployment of renewables. Figure 5.11 illustrates that the five sub-areas that make up the study area differ markedly in terms of the proportion of households in fuel poverty Low Income High Costs (LIHC) definition[27].

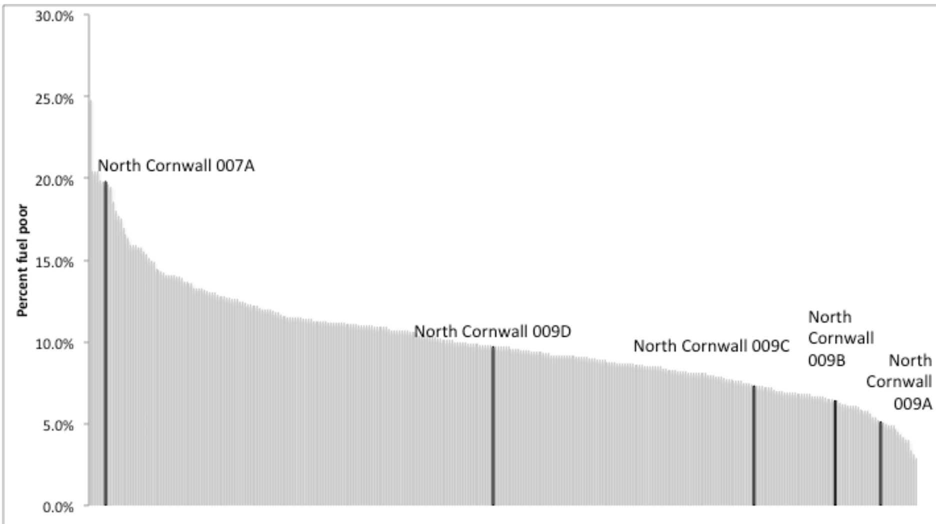

Figure 5.11 Proportion of households in fuel poverty (LIHC indicator) in Cornwall LLSOAs

Sources: DECC (2009a), DECC (2009b), DECC 2013

While the affordability of domestic fuel is clearly of importance in the context of the energy challenges more generally, the intricacies of the issue mean that CE groups may find it difficult to address the problem without significant support. Firstly, the cost of expanding the gas network is to bring cheaper

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[27] Interestingly, using the ‘10 per cent’ measure rather than the ‘low income, high costs’ indicator which replaces places North Cornwall 007A highest in the County for fuel poverty at 37.7%, with the Wadebridge town areas at between 11 and 17%.

heating fuel to households is likely to be beyond the reach of CE groups[28]. Secondly, while groups may be well placed to implement Government-led efficiency programmes, the characteristics of the local housing stock (specifically lack of gas access and solid wall construction as outlined in Section 5.2.1) means that many measures, such as loft and cavity wall insulation may be relatively ineffectual. More recent policy measures to address harder-to-treat properties such as the Energy Company Obligation (ECO) may make some headway, but it is unclear how CE groups can play a role in helping to implement this. Where CE groups do have agency in tackling these issues, they are well placed to be able to target those areas that need most attention in each area, such as the rural area highlighted in the left of Figure 5.11. This is especially important for communities such as Wadebridge, which encompasses a diversity of challenges and opportunities, to be able to maximise impact for the local community.

5.5 Local associations with energy and energy system change

Understanding local attitudes and behaviours is key to identifying opportunities and barriers to changes in energy production and consumption. Societal associations with energy systems and energy system change are considered central in shaping specific energy pathways. For example, public acceptance is required for local deployment of energy infrastructures, (Cowell et al., 2011, Sauter and Watson, 2007, Wüstenhagen et al., 2007), as well as the establishment of new forms of local governance (Walker et al., 2010). With these key themes in mind, this section discusses findings from analysis of postal survey responses.

[28] Cornwall Council announced in March 2014 it will be funding expansion of the gas network to 50 council-owned homes in Wadebridge (Cornwall Council 2014). The scheme, which also includes installation of domestic gas central heating is a good example of a targeted programme to alleviate fuel poverty.

5.5.1 Perceptions of the need for energy system change

In seeking to understand energy-related behaviours, several strands of theory seek to further the understanding of the processes through which individuals become motivated to become part of a changing energy system. Lorenzoni et al. (2007) for example posit that climate change engagement comprises cognitive, affective and behavioural aspects, i.e. "is not enough for people to know about climate change in order to be engaged; they also need to care about it, be motivated and able to take action". The 'knowing' and the 'caring' about climate change are of primary interest in this section: people must understand and be motivated by the costs associated with climate change impacts before they can make individual changes.

While this is clearly important to the current discussion, engaging with CE is about more than engaging with climate change, as Chapter 2 discusses. Thus, knowing and caring about climate change can be extended to specific elements of the energy system, for example, to the structure and governance of the energy system. While stimulating a degree of behavioural change may be possible in isolation, through financial incentives for example (Stern, 2000), cognisance and affection of these energy system dimensions is considered a prerequisite for engaging meaningfully with an energy system transition.

The survey revealed that the majority of Wadebridge residents (84 per cent) agreed (either "strongly agreed" or "agreed") that it is important that Britain as whole invests more in renewable energy technologies (Figure 5.12). This figure is in line with recent nationally-representative figures indicating support for RE technologies in general (61 – 85 per cent depending on specific technology), a belief that RE technologies are needed to meet electricity demand (74 per cent), and that they are a better option to help tackle climate change (71 per cent) than nuclear power (Spence et al., 2010, Demski et al., 2013). Of course, perceptions around the suitability of specific RE technologies, scales and location options are more variable, reflecting the perception of how particular projects align or conflict with individuals' values (explored in Section 6.4.2).

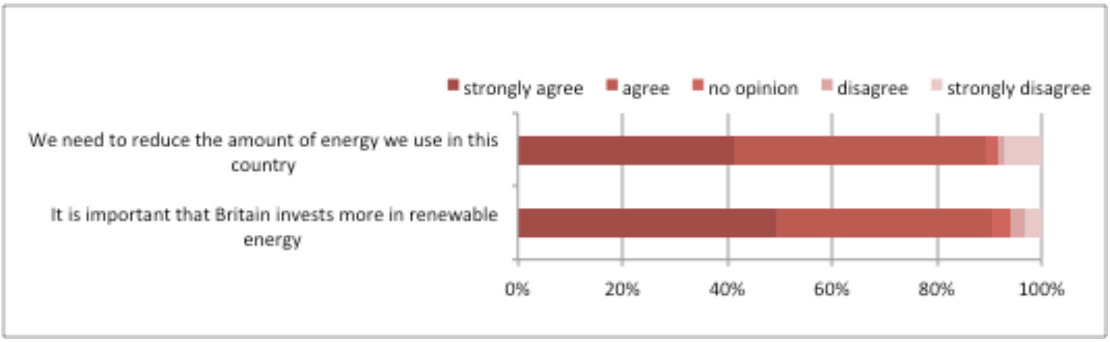

Figure 5.12 Levels of agreement of the need to reduce energy consumption and invest more in renewables

Source: Author's own

The majority of respondents also believed that Britain at present consumes too much energy (83 per cent, Figure 5.12), which again is in line with nationally-representative figure of 73 per cent for the same question (Demski et al., 2013). The overall sentiment was echoed in several survey responses such as the following:

"I think energy issues is one of the greatest facing us. I believe that the whole approach to consumption needs to change" (Respondent 33)

While this type of broad commentary on the energy situation was one of only a few comments given within the survey, there was a large range of responses acknowledging the salience of the issues and the links with society/wellbeing, economics, politics, and governance. Reasons behind the need for demand reduction (at a national scale), given by Demski et al (2012), cover a range of motivations including the need to reduce unnecessary waste, the need to conserve finite energy resources, cost concerns, and environmental concerns. These factors echo some of those expressed by Wadebridge residents, with several reflecting on national energy security concerns and "keeping the lights on". As might be expected, respondents framed these wider issues in terms of more immediate concerns relating to the impact on the household:

"The cost of alternative energy is too high, e.g. the installation costs are expensive and taking into account the interest earned on the capital expenditure (something I have not seen published) it does not seem cost effective" (Respondent 1)

"Energy is too expensive, even more so now that British Gas have nearly doubled the number of units on the higher rate" (Respondent 3)

A focus on cost was a strong theme throughout survey responses, relating both to the current as well as future energy system. This emphasis on cost is not surprising, and reflects current framings of cost as a key energy policy issue in terms of ongoing energy cost increases (and related discussions about the suitability of the UK energy market), and related to this, Prime Minister Cameron's reported framing of environmental and social programmes as "green crap" (Mason, 2013). Cost savings also arose as a common feature in survey respondents' motivations for installing household efficiency measures (section 5.4.3). While electricity consumption in particular then has been considered *doubly invisible* (Burgess and Nye, 2008) in terms of relating consumption to spending, current framings of a suite of energy issues has ensured that perceptions of cost implications of energy to households are not trivial.

Although existing literature has either focused on acceptance or support of specific RE technologies, or on energy transitions more generally (Spence et al., 2010, Demski et al., 2013), little has been done on understanding perceptions and preferences of governance for energy transitions. This is a key element in CE initiatives, not least because such approaches imply a departure from centralised decision-making towards a more inclusive, democratic process of governance. The survey goes some way to exploring these themes from the perspective of Wadebridge residents, and helps to draw some conclusions on the degree of support for potential changes in local energy governance.

5.5.2 Perceptions of local technological change

In terms of the adoption of large and medium-scale renewable energy technologies, getting project proposals through planning is a considerable barrier (Wüstenhagen et al., 2007, Devine-Wright, 2005), and so garnering local acceptance and support at the earliest possible opportunity is seen to be of paramount importance. Furthermore, the emergence of ownership (in part or in totality) of RE installations as a key characteristic of CE in recent years implies the necessity of both legal and financial structures to make this possible, and that local capital can be raised (i.e. that there is sufficient household income and savings, not to mention willingness to invest).

While this study echoes national findings of high levels of backing for renewable technologies *in general*, it is well recognised that levels of support vary significantly when *specific* RE proposals are considered. There is thus both a 'social gap' and an 'individual gap' between supposedly high levels of national support but lower success rates in wind planning applications and individuals' opposition respectively (Bell et al., 2005). Picking apart the reasons behind such gaps is therefore an important part in developing an understanding of the opportunities and barriers for renewable deployment in a given area. The following section explores how the tangibility and concreteness of energy system change at a local scale (as opposed to a national scale) removes discourse from the abstract and places the discussion amid a more realistic set of notions around willingness and ability to change and the public values through which these are manifest.

In order to highlight specific opportunities and barriers to energy system change in the local context, survey participants were asked to gauge support for different generation technologies at different scales and locations. Respondents had seven options to rank: coal or gas power stations in Cornwall; nuclear power stations in Cornwall; wind farms in the Wadebridge area; individual wind turbines in the Wadebridge area; solar PV panels on local buildings; solar farms in the Wadebridge area; nuclear power, but outside Cornwall. While necessarily coarse given the constraints of a postal survey, these options were considered as covering a suitable range across which generalised levels of support could be identified. Clearly, decisions to support or object to specific energy options are more nuanced than simple trade-offs between groups of technologies; where these technologies are sited, their perceived social and environmental impact, cost, and potential benefits all play a part, as does the embedded values and worldview of each individual. While these issues are explored further elsewhere, this section discusses perceptions of technologies in a more generalised sense. It should be noted that some options are necessarily more abstract than others: householders in Wadebridge can presumably relate better to extant wind and solar farms (or those with which they have had prior experience with) than installations with which they have had no relationship. That said, the prevalence of energy issues in the media means that it was assumed that most householders would have some opinion on how different energy infrastructures *might* affect them. It is important to note then that the perceptions discussed here might not be based on the real-world experiences of householders, and instead based on presumptions of experiences.

Figure 5.14 illustrates levels of support for seven different technology options in and around Wadebridge. The data indicates that support levels vary across technologies, with thermal generation options (coal or gas in Cornwall, nuclear inside Cornwall, and nuclear outside Cornwall) attracting least support, and rooftop PV attracting the most support by mode[29]. This also fits broadly with nationally derived figures (e.g. Demski 2013), which similarly indicate more favourable opinions towards renewables than towards conventional energy sources.

[29] Mode relates to the value that appeared most, i.e. the specific level of support expressed by most respondents for each technology

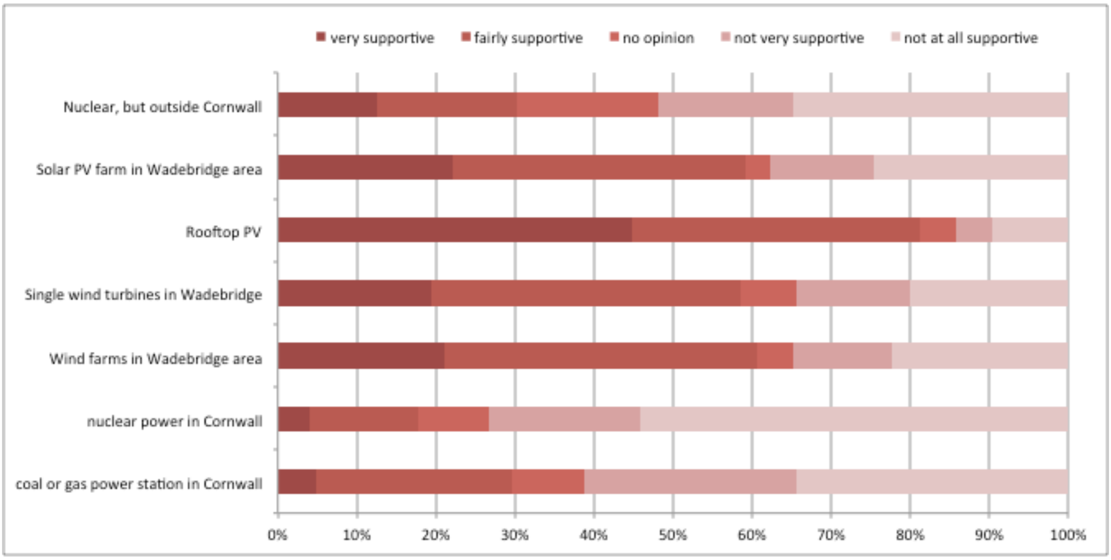

Figure 5.13 Levels of support for various energy technologies in and around Wadebridge

Source: Author's own

For most, rooftop solar PV is the most attractive option for local energy investment. Comments from respondents indicated that that PV is favoured because it has the best 'fit' with the existing environment, and also that it delivers direct benefit to householders by reducing household electricity bills and generate additional revenue. The small-scale nature of solar PV, more that any other technology, lends itself to ownership by individual households, who can often manage the installation process and garner benefits directly. At a larger scale, wind farms in the Wadebridge area seem to be as attractive an option as single wind turbines, suggesting that concentrating multiple turbines in one area does not make a difference to how they are perceived. This is in contrast to solar PV, of which significantly more respondents are "very supportive" of rooftop PV units than of solar farms in the Wadebridge area (and less are not at "all supportive"). This can be explained by the disparity of scale between rooftop PV and solar farms, and the similar scales of wind turbines and wind farms: the former imply a large difference in scale, and perhaps potential for ownership and benefits, whereas the latter are similar in that they are of similar magnitude and often similar in requiring either commercial or collective input.

The notion of Cornish nuclear power is, predictably, the least favoured option for producing Wadebridge's energy. The prospect of nuclear power outside of the county is significantly more appealing than within, suggesting that it is not the idea of nuclear technology *per se* that is opposed, but the perceived negative effects of having a nuclear plant nearby, presumably because of the perceived heath and safety risks. On the whole, those opposing renewables of any form were more likely to demonstrate support for nuclear and coal/gas plants, perhaps demonstrating some acknowledgement of the need for alternative supply options.

The 'localness' of energy production is as relevant to CE projects as its environmental sustainability, and indeed, it is a major driver for WREN's activities. Around a quarter of respondents agreed with the statement "It is important that the energy I use is produced locally in the community" (Figure 5.14a). Also of note here is the large proportion (over one quarter) of undecided respondents reflecting a considerable degree of apathy towards the importance of localness of energy production. It should be noted that efforts were made to ensure that this question was not loaded, i.e. local energy was not communicated as an option that might have financial or local economic benefits; of course however, framing the option in this way may have made a difference. However, the perceptions of local energy infrastructures changes considerably when considering ownership, the majority of respondents believed local ownership was preferable (Figure 5.15b), indicating that acceptance is related to an expectation of the local benefits of ownership. Indeed, only five per cent of respondents disagreed with the notion of local ownership.

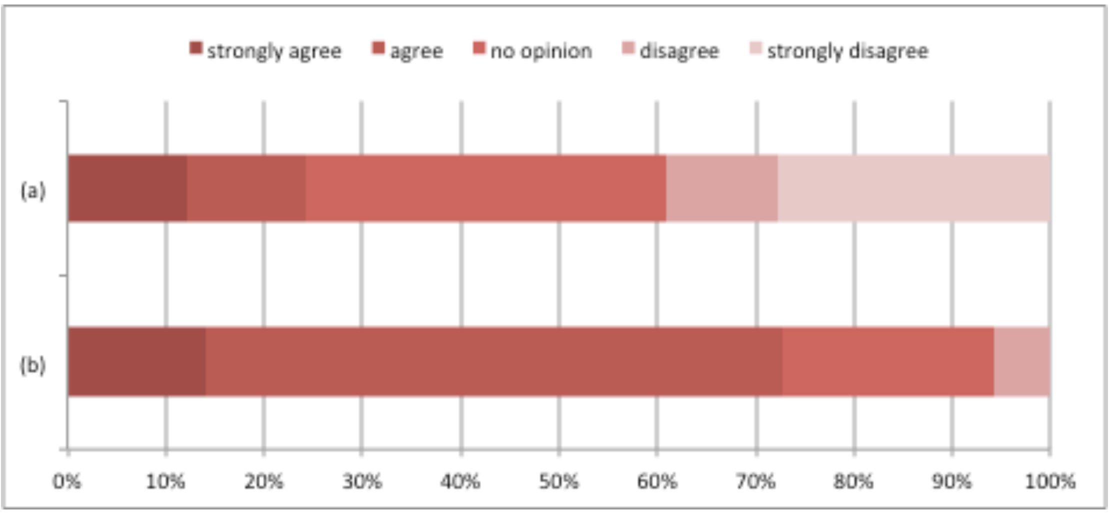

Figure 5.14 a) "It is important that the energy I use is produced locally in the community" and b) "It is better that renewable energy technologies (e.g. wind turbines, solar farms etc.) are owned by the community rather than by an individual or a private company"

Source: Author's own

There was also a significant positive correlation between those in Wadebridge who support more investment in renewables and support for local generation, and similarly, those respondents opposing renewables in general also disagree that energy should be produced locally. This is be expected of course, as opponents of RE often cite reasons of visual impact and other local effects rather than the usefulness of RE in terms of the energy system more generally, for example.

Analysis of these perceptions should be tempered in light of the inherent complexity of the issues and the difficulties in making decisions based on limited knowledge or experience. There may be several ways of meeting the various energy challenges (at a local, regional or national level) and local perceptions are important, especially in terms of determining the paths of least resistance, but also to ensure widespread support of decision-making and deeper engagement in energy issues more generally. However it needs to be noted that it is unlikely that any decision-making at an individual's level (though also perhaps at community or Government levels) is likely to be able to a) distil all relevant information and b) process that information in an objective manner free from bias. Figure 5.15 illustrates that there are a range of uncertainties relating to the various renewable energy options in Wadebridge, and with around two fifths agreeing that the variety of options is confusing. This raises the question of at what level we can reasonable expect civil society to engage in complex decisions relating to changes in energy supply arrangements. As mentioned above, if we are to move to an inclusive and sustainable energy future, consultation and democracy are important to a degree, not least as they help us determine key opportunities and threats to making energy transitions. However, it is clear that the knowledge required to distil complex issues such as energy decisions may be a barrier to such participative democracy, and that a more strategic oversight mode of decision-making might be better suited to this, and wider energy transitions. Chapter 7 will explore how we might start to reconcile these two positions.

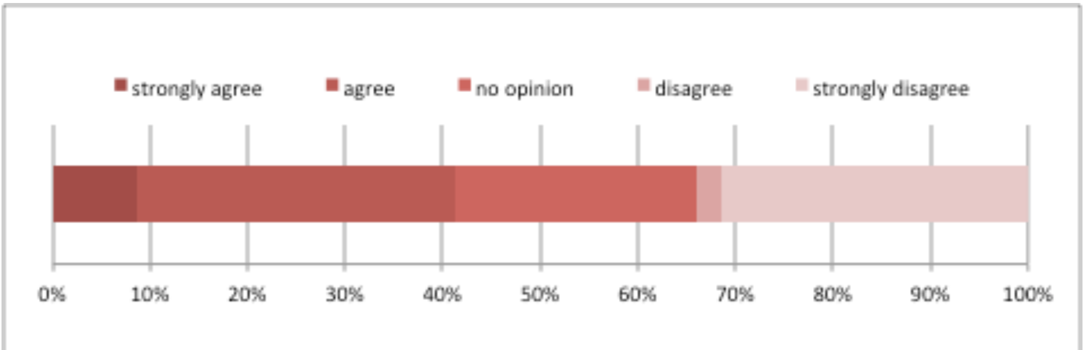

Figure 5.15 "I am confused by the variety of options for renewable energy in Wadebridge"

Source: Author's own

As discussed above, the strong levels of support for rooftop PV compared to other technologies and scales can be explained by the relative harmony the technology has with its surroundings, as exemplified by the comments made about more incongruous solar arrays and wind turbine developments. While wave or tidal power technologies were not offered as an option in the survey, many respondents presented these technologies as a sensible and appropriate alternative:

"Energy should be produced by wave power and use the use of our waters rather than ruin our countryside with wind turbines" (Respondent 82)

"Transfer the River Camel, to electric production. No other wind farms or solar panels needed" (Respondent 180)

"Why are there no observations/comments concerning hydro power, which is less intrusive and far more acceptable than covering good agricultural land with solar panels/wind farms" (Respondent 102)

"Why, when Cornwall has such a long coastline are we not focusing on tidal power - feasible, reliable and virtually invisible; 2) Why, when Cornwall has such a history of mining and research into hot rocks are we not focussing on that, feasible, reliable and virtually invisible (or focused on a few sites). 3) Wind turbines and solar forms are an avoidable visual blight" (Respondent 218)

These comments (of which there were many more) demonstrate a desire for minimising visual impact and are perceived to have fewer trade-offs around the use of agricultural land. With the River Camel (upon which the town of Wadebridge is situated) as well as the coast in close proximity, hydroelectric generation was presenting as something of a panacea by many. This perhaps represents a perception that the energy challenge can be met by using only a single group of technologies and without the need for unnecessary trade-offs between renewable and visual amenities.

In summary, the findings presented in this section have some implications for the deployment of key technologies in Wadebridge. The survey demonstrates a high level of support for rooftop PV, the initial technology of choice for WREN. This support can be demonstrated by the high levels of uptake of the technology, and has likely been bolstered by positive experiences. According to the data collected here, explorations into larger (>5MW solar or wind) technology options in the area is likely to be well received, though is likely to depend on the extent to which local benefits can be communicated and realised to the wider community.

5.5.3 Perceptions of changes to governance arrangements

In terms of making decisions about energy production, Wadebridge residents revealed slightly more support for decision-making at a community level compared to Local Authority or Central Government levels (Figure 5.16).

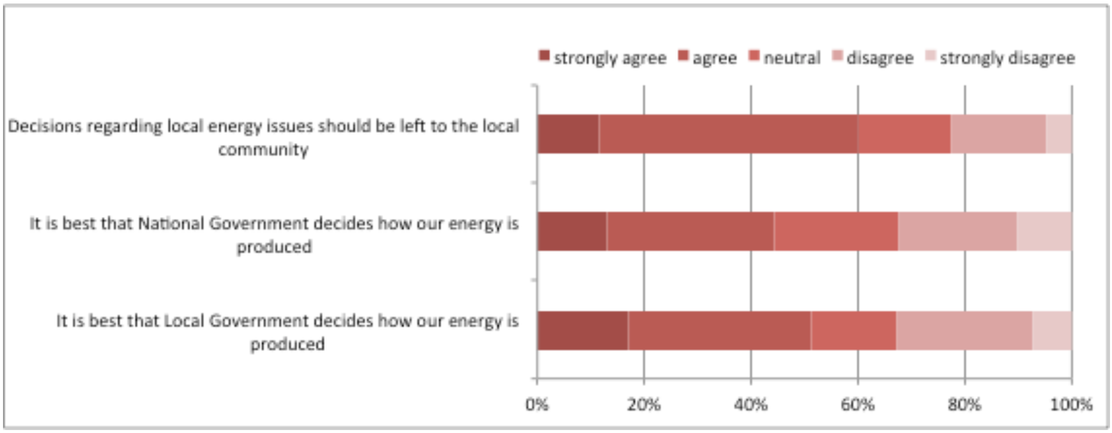

Figure 5.16 Preferences for decision-making around energy issues at national and local scales.

Source: Author's own

This either demonstrates acknowledgement of the need for multiple scales of governance or indeed confusion in what each of these mean for energy decisions. Either way, it raises the questions of what kind of energy decisions are being made at these different scales. For example, some comments from respondents indicated a belief that government is best placed to determine an overall strategy for addressing national energy concerns:

> "Whilst I don't disagree with power being generated locally, it should be a national concern and policy" (Respondent 71)

> "The mix of energy sources (including renewable vs. non renewable) has to have a national overview, otherwise this will lead to disparity and potentially increase fuel poverty (in some regions where renewable resources could not meet demand)" (Respondent 278)

These quotes suggest the opinion that that some energy decisions should be taken strategically, lest more localised decisions lead to inadvertent trade-offs between objectives. That said, when *local* energy decisions are considered, more people than not considered local decision-making more suitable (60 per cent agreeing), suggesting that overall a balance between local and national concerns was felt to be important. Indeed, for some, process seemed less important than progress:

“It doesn't matter who decides…just that it is clean, green, affordable [and] sustainable” (Respondent 35)

While this might appear to highlight a dichotomy of opinion, Butler et al (2013) suggest some rationale for this, stating that it is not necessarily the case that (National) Government *should* lead the way in energy decision-making; rather, they *must* as they are the only actors that hold the requisite powers and are relatively more trusted than other actors, specifically industry: “at the core, publics locate responsibility for delivering transitions with Government, including local, central and wider governing institutions” (Butler et al, 2013). This sentiment was further echoed in the survey, with several respondents judging energy decisions to be of national importance, perhaps because of a perceived fairness in the Government’s allocation of resources:

“leaving all decisions to local use may only encourage an element of selfishness and not keep the broader national picture in mind (Respondent 47)

“Power should be in the National Domain and not local...All power is fed into the national grids anyway” (Respondent 124)

That said, while there is relative trust in central Government as strategists in making energy decisions, this trust may be compromised somewhat with the apparent complicity between Government and utilities, which affects consumers directly (through delivery of key policy mechanisms, such as the Green Deal) and indirectly (through, for example, manipulation of markets to favour large-scale generators and industry), as illustrated by the following quotes:

“In my opinion neither [local nor national decision-making processes] look at the whole picture. [Government] make decisions that are quick fixes, providing them with easy political advantages” (Respondent 33)

“A lot of the statements in this survey are completely impractical. Energy supply is an economic and political driver” (Respondent 87)

That many respondents appear to favour newer, more local versions of energy governance alongside national and local Government perhaps reflects the current salience of energy issues to households (e.g. ongoing electricity bill increases) and an increasing distaste for the status quo, but appears also to signify the public’s awareness of the possibility (and potential impacts) of energy system change. The development of larger and more ubiquitous RE installations, particularly wind and solar farms has perhaps had an effect of embedding the hitherto abstract nature of energy generation in peoples’ consciousnesses. Many of these developments has been the subject of discussion and debate (in the media and beyond) around the siting of such infrastructures, making it more normal for previously disengaged members of society to engage with these debates, particularly if developments have tangible positive impacts.

While much of these debates are centred on visual impacts, particularly in rural areas such as Cornwall, a significant proportion of arguments against renewables installations focus on issues of equity, and the distribution of costs and benefits among those affected. Small and medium-scale renewables in general, as well as the CE initiatives within which they are developed offer alternative economic streams. New forms of ownership often create revenue streams for landowners, for example, providing a focal point for debates to centre on the creation of inequity, the situation of course made worse if installations are perceived to be visually unattractive:

“As previous experience, wind farms only make a lot of money for the land owner on which land they are sited. i.e. rich farmers” (Respondent 160)

“Only those on whose land they are, feel any benefit (financial). A blot on fantastic countryside” (Respondent 162)

While these comments relate to renewable installations in general – rather than CE-led projects specifically, it illustrates the point that small-scale governance approaches are not always more favourable, and the extent to which installations are supported depends on how well the project has engaged with, and benefits the community. It is perhaps telling that these comments were collected before WREN had a stake in any RE development beyond household scale, so it is possible that the views expressed here reflect only those of private sector RE developments. While perceptions being based on such a limited experience of developments does not suggest individuals would be more sympathetic of CE-based projects, it does reinforce the importance of CE-based schemes being *different* in terms of its ability to engage people and better distribute benefits.

As discussed earlier, perceptions relating to energy transitions must of course consider technologies, but also how these technologies are owned and managed by different actors. For example, a wind farm owned and operated by a large-scale developer is fundamentally different from a community conceived, community-owned and managed wind farm, even if there is still involvement by a commercial-scale developer through part-ownership, for example.

The suitability of more local governance arrangements to help deliver more favourable energy systems depends on how these arrangements can be trusted. Traditional modes of energy governance (Parliament, energy utility companies) suffers from significant public mistrust (Ofgem, 2014c, Butler et al., 2013), and so it is vital that newly-formed CE organisations can both gain and maintain trust throughout the communities in which they operate. Analysis of survey responses revealed an apparent dichotomy relating to trust. On one hand, several interviewees identified WREN as a trustworthy alternative in an otherwise irresponsible sphere of utilities and Government:

> "…they have helped translate the possibilities of renewable energy and through the trustworthy conduit of WREN – and they are trustworthy, they believe in what they do – they are a forum for local people, to talk to them to try to understand why they should be doing something, whether its financially or environmentally so they are pretty useful in that respect" (Interview 9)

This perception of trust is explained in this case by the ability to be able to effectively and objectively communicate energy options, a situation far removed from traditional relationships with the energy system. On the other hand, the appearance of a new actor for some seemed to be treated with some suspicion:

“WREN” appears to be run by a cosy clique … and are not representative of the average Wadebridge residents (Respondent 107)

“Whilst some of the objectives of WREN are very well meaning, I also have some concern that the organisation is becoming self-fulfilling in a commercial sense and a more democratic body [is] required to overview” (Respondent 278)

These comments are indicative of some of the difficulties CE face in balancing project development with community engagement. For a segment of the population, blanket opposition to renewables (as indicated by Respondent 107) may mean that any group looking to develop local RE options are seen as untrustworthy. For others, (such as Respondent 278, who favoured the expansion of renewable projects in general) the democratic process offered by CE groups may be limited in its effectiveness. All other things being equal, the governance of local energy decisions by CE groups should certainly be more democratic than the status quo, where (often limited) agency is only available through participating in planning processes. Of course, as in all democracies, while decision-making is participatory, decisions made are unlikely to please every member of that democracy. Moreover, for nascent CE groups, the emergence of a democratic process (where previously there had been none) undoubtedly raises expectations of heightened personal agency and autonomy, which may be unrealistic in retrospect.

Herein lies a balancing act for CE groups in building expectations around the benefits of projects and delivering upon these promises. Such expectations may be as much about specific project outcomes (such as the delivery of a local information scheme) as they are about the processes followed in the pursuit of such outcomes (Walker and Devine-Wright, 2008). A key challenge in the democratisation of energy (discussed at length in Chapter 9) is in widening participation in the development of these expectations, as well as the ownership of outcomes. In addressing these challenges CE groups such as are not only contributing greatly to learning around community-scale RE deployment, but also to the value – and challenges of – the democratic process.

5.5.4 Propensity for change within the community

Although Wadebridge residents communicated slight preference for local decision-making over county or national-level decision-making (as shown above, in Figure 5.16), this was not matched by a personal desire to be more involved in such a process, with only a fifth agreeing that they “would personally like to be more involved in deciding how our local energy is produced” (Figure 5.17). While just over a quarter of respondents disagreed, less than a quarter agreed with this statement, indicating that active involvement in the local decision-making process may depend on what exactly was involved, and perhaps how much of a time commitment it would be. Tellingly, the majority of respondents had no opinion, although the reasons behind such noncommittal it unclear i.e. whether they didn’t want to be involved (but didn’t want to be rude), or didn’t want to commit without having more information about what that engagement involved.

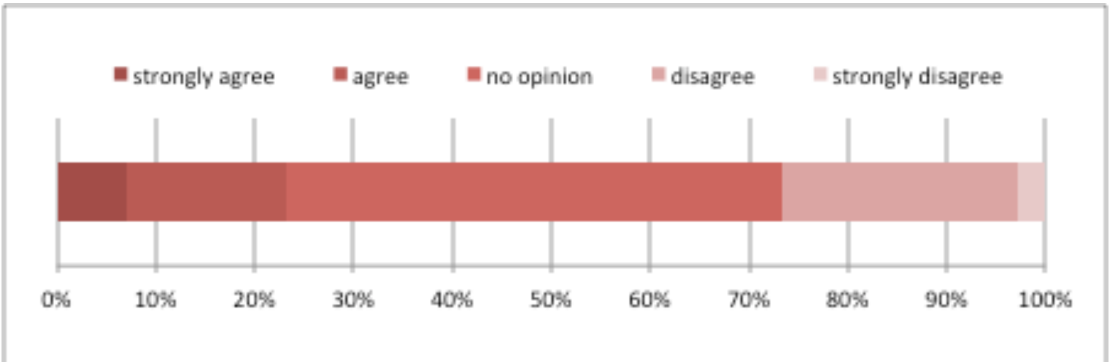

Figure 5.17 “I would personally like to be more involved in deciding how our local energy is produced”

It may be tempting to assume that apathy is the dominant factor here, though that would be overly simplistic. Rather, as Hoffman and High-Pippert (2005) argue, publics do not necessarily want to be involved, but it is still important to "know that they will have the opportunity to participate if they should ever be motivated to do so, and … that the power of their elected representatives could be checked by their own political power" (Hoffman and High-Pippert, 2005: 389). Moreover, the nature of the energy system and particularly the traditional mode of top-down governance by both Government and industry may have fostered civic apathy and helplessness through the absence of positive engagement by these actors. It could then be that the public are demotivated because of the perceived futility in doing so and the paucity of channels through which engagement can be made. This raises interesting questions about society's acknowledgement of the right to reengage (i.e. awareness of ones agency) within these debates. While there has been relative inertia throughout civil society in engaging with something as impenetrable as the energy system, CE (and other grassroots activist organisations) are challenging the status quo and are certainly more visible to society as representing potential alternatives to the current system. Membership of and engagement (of different kinds) through organisations such as WREN are considered integral to this normalisation of alternative modes of governance.

While this may tell us something about the willingness to engage actively in local decision-making, there are however many different ways of engaging with energy issues, as already discussed in previous sections. Additionally, there are multiple opportunities through which citizens of Wadebridge (and beyond) can become involved with WREN, ranging from tacit but latent acceptance of WREN's goals, to membership and support, through to active involvement and investment of time and money. As is the case with most CE initiatives, WREN's board is made primarily up of voluntary posts, meaning that it largely dependent on the goodwill and expertise of a group of committed members and how much time they are willing to invest.

WREN membership[30] can be used as a crude gauge of levels of engagement and support at the most basic level[31]. However, as discussed in Chapter 4, the resource limitations of this study meant that it was not possible to undertake an in-depth survey of WREN members and the extent to which whether membership implies support. Additional work is therefore needed to better understand the drivers behind people joining WREN and other CE groups

Membership growth is illustrated in Figure 5.18(a) and (b). Since its inception in January 2011, WREN membership grew to 1056 individuals in June 2014, around half of whom live in the study area and 95 per cent live within Cornwall. The proportion of membership living in Wadebridge itself has declined somewhat from around three quarters from the early days of WREN. In a population of almost 8000, this is a membership of around 7 per cent, with marginally more support in the suburbs than in central Wadebridge or the surrounding parishes.

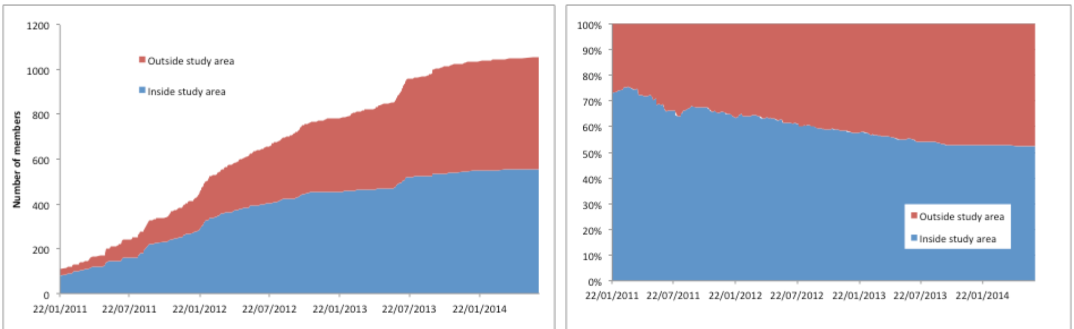

Figure 5.18 a) Growth of WREN membership within and beyond study site and b) change in local membership versus membership from elsewhere

Source: Jerry Clark, pers comm.

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[30] Lifetime membership costs £1 and is open to anyone over 16 years of age.

[31] It is of course possible that opponents to the goals of WREN become members in order to be able to influence its actions and derail efforts, and although WREN does have some known antagonists, there is no evidence to suggest that this is the case.

The change in distribution of WREN members across the county indicates that WREN is increasingly drawing interest and support from an increasingly wide area, most likely through media exposure and engagement in key networks relating to CE as a sector. This suggests a widening social network through which raised awareness of the notion of CE and associated social learning is more likely. While WREN's broad and diverse membership tells us something about its national presence, the degree to which such members influence the workings of the organisation is more nuanced. Certainly, membership status permits voting on WREN's board and direction, though turnouts at board meetings typically number 12 or less, while attendance at early AGMs have been up to 100.

While the democratic structure of WREN means that all members are theoretically able to engage as much one another, levels of engagement varies considerably across the membership. The fact that membership appeared to grow slightly quicker on dates immediately preceding the voting processes for the release of community fund does seem to suggest that people were driven to joining WREN by the prospect of being able to vote, presumably for a particular cause (Figure 5.18). This perhaps indicates that by making the benefits of community energy relevant to the community at large, WREN can perhaps appeal to a larger audience that might be the case otherwise, and is supportive of the importance of framing.

That the local population supports local governance (Figure 5.16) but prefers to be personally detached (Figure 5.17) supports the hierarchy of engagement evident in other CE groups (Seyfang et al., 2013). WREN, like other groups, currently has a core of one or two founding members, a small number of board members and project coordinators, a loose following of supporters and interested members of the community, and a larger network of relatively disengaged supporters, conceptualised in Figure 5.19.

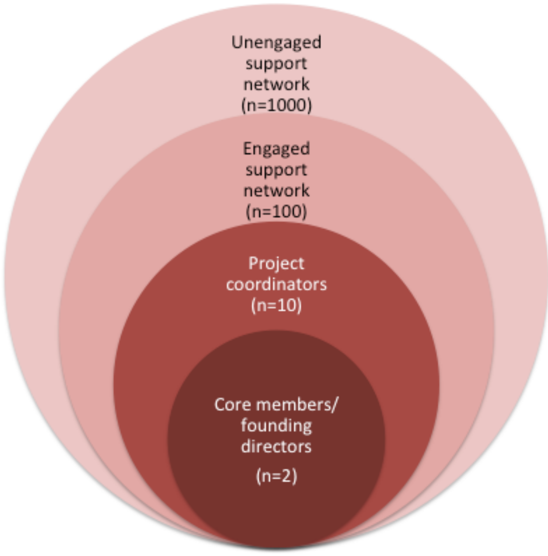


Figure 5.19 Conceptualisation of WREN membership structure

Despite the democratic framework in place, and the strong representation of Wadebridge residents in WREN, there was a concern by some survey respondents (See previous discussion in Section 5.5.3) that the views of WREN is not representative of the local population. As these claims came from non-members, the extent to which key principles of WREN represented the values of both members and non-members was analysed (Figure 5.20) with respect to four survey questions: "It is important that Britain invests more in renewable energy" (*More renewables*); "We need to reduce the amount of energy we use in this country" (*Less consumption*); "It is important that the energy I use is produced locally in the community" (*Local production*); and "Decisions regarding local energy issues should be left to the local community" (*Local governance*).

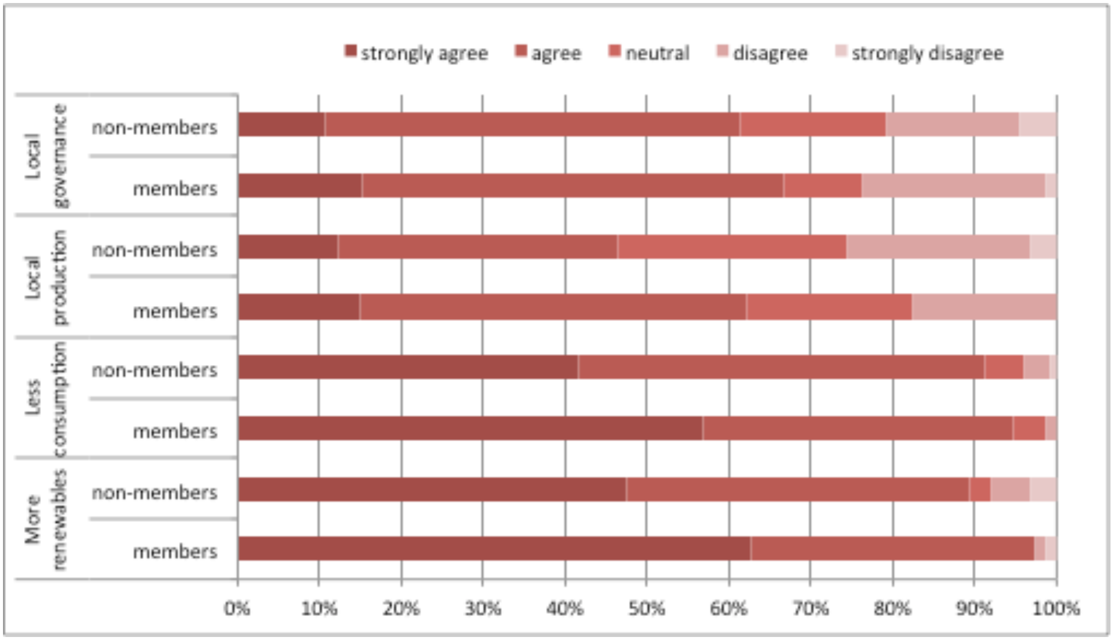


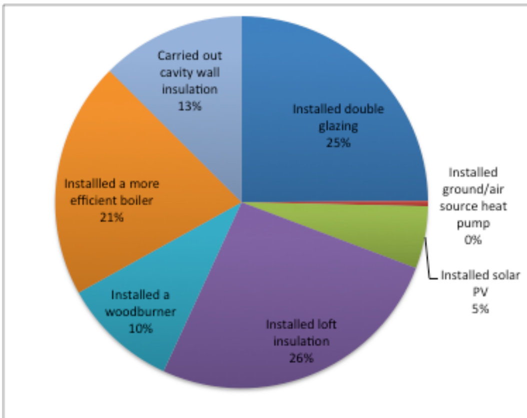
Figure 5.20 Comparisons of responses from WREN members with non-members for key survey questions

This figure illustrates that while there is some difference between the responses members and non-members gave, they are broadly similar with no significant difference between sets. It can be concluded that for these issues there is little difference between the perceptions of members and that of non-members, and that membership is broadly representative of the wider population.

5.5.5 Propensity for change within the household

Exploring householders' relationship with household energy services is also useful in determining opportunities and barriers to behaviour change. In terms of improvements to household energy efficiency, the disruption and expense associated with some improvements means that cost reduction (and other) benefits must outweigh these costs over a reasonable timescale. This means that householders must first accept that improvements would make a difference to the comfort of their home, and be willing and able to make changes. The ability to make changes relates first to whether the householder is authorised to do so (given possible tenure and planning restrictions) as well as whether funding, sourced either personally or through grants/loans, is available.

The household survey illustrates that 78 per cent of respondents had carried out at least one energy service-related installation in their homes, with around a half installing either double glazing or loft insulation since moving in, and one fifth installing more efficient boilers (Figure 5.17a). When interrogated about the reasons for carrying out these changes, more than half of respondents stated that combinations of warmth/comfort and cost savings were key factors, though very few (just over ten per cent) stated that these were the sole factors. Significantly, over a quarter of changes were taken during part of wider home refurbishments/extensions, or are triggered by sudden events, such as a boiler breaking down and needing replaced, or at the same time as home refurbishments.



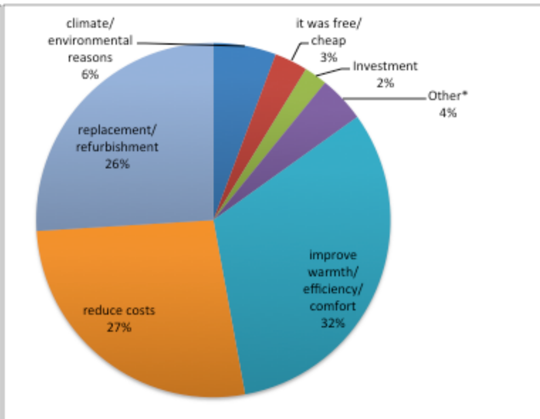


Figure 5.21 a) Types of energy-related household installations in Wadebridge and b) drivers

This resonates with work by Wilson et al. (2013), who in a nationally representative survey found that efficiency measures in the household are rarely carried out unless other "amenity renovations" (major structural changes to kitchens, bathrooms and other living areas) are taking place. Indeed, several respondents to the current survey reported that such renovations were required to deal with ageing and/or poorly constructed buildings, with several commenting on specific issue of damp[32]. It is apparent then that householder decision-making in relation to energy is complex and context-specific, and programmes focusing cost savings alone, for example, may find it difficult to gain traction unless householders are both already unhappy about their living conditions and considering carrying out work to address existing problems

For those households undertaking microgeneration measures (e.g. PV panels, solar water units), cost savings was cited as a key driver. In an area with low levels of access to the gas network, it is clear that cutting electricity consumption is a key priority, and for those able to, investing in microgeneration can be an attractive option. In this sample, 100 per cent of energy generation installations took place on owned, rather than rented properties, indicating that financial security is important (or indeed that there are other barriers for those living in rented properties).

A broader level of engagement with the energy system can be gauged by the diversity of suppliers used by consumers in the study area. According to the household energy survey, 85 per cent of respondents purchased electricity, gas, or both from one of the Big Six energy companies, and while this is lower than the national level of around 96 per cent (Bloomberg New Energy Finance, 2012), it is clear that there is room for more competition. WREN is currently investigating whether local supply arrangements are possible, and local engagement with such a programme would be insightful in terms of engagement and receptiveness to change.

5.6 Summary

This chapter has established the local context of energy system change in Wadebridge, UK. WREN has established itself as an economic programme

[32] Problems with damp are particularly common in Cornwall as a result of the combination of the maritime climate and inefficient and poorly insulated buildings

seeking to engage the whole community in localising energy system value. As such, it is operating within a relatively large and varied population compared to many other CE groups. This, as well as variations also in the type and quality of housing stock offers both challenges and opportunities for local change.

Analysis into consumption and production of electricity and gas in the study area drew attention to unequal distributions of energy-related costs among the population, with implications for targeting specific areas. Social aspects were then explored, first in relation to perceptions of the current energy system, and then relating to the prospect of change to energy system change, specific technologies, and governance arrangements. While small scale solar PV was viewed most favourably among the local population, larger scale, locally sited wind and solar installations were also viewed positively, though this was tempered somewhat with a desire for local tangible benefits.

In terms of governance, respondents displayed support for a range of energy governance scales, from the local to the national, though was slightly skewed towards local decision-making, though again, this data can perhaps only be assessed in the context of local expectations not yet being realised. In terms of personal involvement however, individuals were relatively noncommittal in terms of playing more of a role in local governance processes.

WREN enjoys considerably high levels of local membership, though like other groups, the depth of engagement of these members it highly variable. Nonetheless, membership numbers both imply a tacit approval of the ethos and activities WREN is undertaking and reinforces the importance of linking energy with social objectives, through the community benefit fund, for example.

Overall, this chapter forms the context of, and highlights several potential opportunities and barriers to community energy expanding in Wadebridge. The following chapter builds on this context and examines the degree to which WREN's activities have impacted different dimensions of the energy system.

6 Evidencing the impact of a community energy initiative

"I strongly believe that there is appetite for this grassroots approach and want to see nothing short of a community energy revolution" (Ed Davey, June 2013)

"Any decision to offer additional support for community energy projects needs to ensure value for money, and balance any benefits against costs. That is why it is important to establish robust evidence to underpin the Community Energy Strategy" (DECC (2013b))

The two quotes above, which came out of the same Government department, in the same month, neatly capture the gap between rhetoric and the reality of policymaking in DECC. The benefits of community energy do seem to be acknowledged by government, not least because it is recognised that communities have the potential to "tackle the most challenging issues more effectively than Government alone" (DECC, 2013b). There is however, an apparent reluctance on the part of government to support the growth either of CE in particular, or of inclusive energy policy more generally. Indeed, the government's inaugural Community Energy Strategy was developed within the explicit constraint that it "could not seek to modify policies, except in respect to approaches to community partnerships and community support" (CECG, 2012).

One explanation for this gap in political support for CE may be that there insufficient evidence that CE is worthwhile, or rather there is insufficient evidence 'of the right kind' to demonstrate the value required to provide support. For example, while the purpose of the CE Strategy Call for Evidence (DECC, 2013b) was to fill this gap, the Strategy itself concluded that "quantitative evidence on the social impacts and relative costs and benefits of community energy remains quite limited" and it "will be important to build on this in the future as the sector grows… to inform future policymaking" (DECC, 2014b). As Chapter 3 explains, the paucity of quantitative evidence around CE is partly a consequence of the infancy of the sector. The usefulness of evidence of this type is critiqued in Chapter 8.

This need for evidence for policymaking sets the scene for the current chapter. Specifically, it seeks to address a key issue relevant to understanding the role of CE within the wider energy system: what is the impact of community energy projects? A case-study approach is adopted to understand in depth the evolution of a specific CE project and its coevolution with the wider energy system. As such, the chapter documents the impacts and experiences of WREN as they relate to a wide and evolving range of desired outcomes.

Consideration of multiple dimensions i.e. technological, economic and social are taken to capture the variation in how community energy is valued by different stakeholders. However, it is noted that community energy is unlike other innovations in that the establishment of social networks and their actions define it. As such, the role and impact of social networks and their dynamics for CE is the subject of chapter 7. This chapter then is concerned solely with the technological and economic aspects of WREN's impacts.

This chapter thus introduces the thesis findings with a discussion of impact as it relates to CE, which can be differentiated in terms of dimensional, distributional and temporal aspects. What is meant by impact, and why we should measure it, is central to understanding decisions around energy, in policy circles and among other stakeholders including civil society. The second section then dissects specific impacts arising from WREN's activities, in terms of the impacts of local energy production and consumption and the economics thereof.

6.1 Conceptualising impact in community energy

Before specific impacts can be discussed, it is important to first consider what is meant by impact (i.e. what is being measured, and what is not). Specifically, if CE does affect change, which elements are we most concerned about? How should we treat distributional effects? And over what timescales are impacts important? Addressing such questions will help to conceptualise impact in a way that will be of use for analysing the role of CE. Each question is addressed in turn here.

6.1.1 Dimensions of impact

A whole systems approach to analysing issues in energy requires consideration of technological, business, policy and behaviour components as related to the demand and supply of energy, as well as the interconnections between these components. In order to fully appreciate the impact of community energy (and indeed the impact of *any* approaches or interventions to energy issues) it is thus necessary to analyse the effect of the approach on the whole system, i.e. on all components.

Moreover, the way in which stakeholders understand impact has implications for the immediate and eventual role of CE within the wider energy system. There are a number of approaches to understanding and measuring policy impact relevant to the current research. Principally, the established need for socially and environmentally responsible energy policy-making in the last few decades has been manifested in the incremental development of traditional decision-making frameworks to incorporate non-monetary cost and benefit impacts. For example, the creation of DECC itself was an acknowledgement of the intimacy between energy and climate change challenges, and coincided with a gradual reframing of energy as an multidimensional issue concerning society and the environment, rather than simply technologies and economics. While in practical terms this has been shaped by external pressures (e.g. EU emissions and RE targets), there is evidence to suggest that wider cultural shifts in the need for increased moral responsibility were instrumental[33].

Methodologically, approaches to consider social, economic and environmental impacts simultaneously can crudely be divided into those with foundations in ecological and environmental economic principles (e.g. the Capital Theory Approach (Harper and Kelly, 2003)), or traditional economic development objectives (e.g. Social Cost Benefit Analyses; Policy Impact Assessments).

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[33] Discussions around the moral obligation to address climate change is discussed in relation to society (e.g. Gardiner, 2006) and to Governments (e.g. Stern, 2007).

Despite the differences between approaches, the common thread is the attempt to consider economic alongside social and environmental impacts. This is especially important for energy system decision-making, not least because the energy system is considered central to the healthy functioning of economic as well as social and environmental systems.

While this research does not subscribe to a single specific method of impact assessment, the typological frameworks developed therein are of some use in delineating different dimensions of impact. In particular, the Capital Theory Approach (CTA) establishes several components of capital whose levels should be maintained such that their contribution to wellbeing is non-declining over time, in order to ensure sustainable development (Harper and Price, 2011). These capitals, termed *financial*, *produced* (or human-made), *human*, *social* and *natural*, can be used to produce all goods and services, whose consumption contributes to human wellbeing (Figure 6.1). Although this approach (and other indicator-based methods) has limitations[34], they do provide some useful conceptual starting points for identifying components for mapping impacts.

[34] Limitations include the ethical and methodological difficulties in assigning a common unit of measurement (money) to all forms of capital, the degree of substitutability between capital forms, and the emphasis on the absolute maintenance of capital rather than how it is allocated among the population.

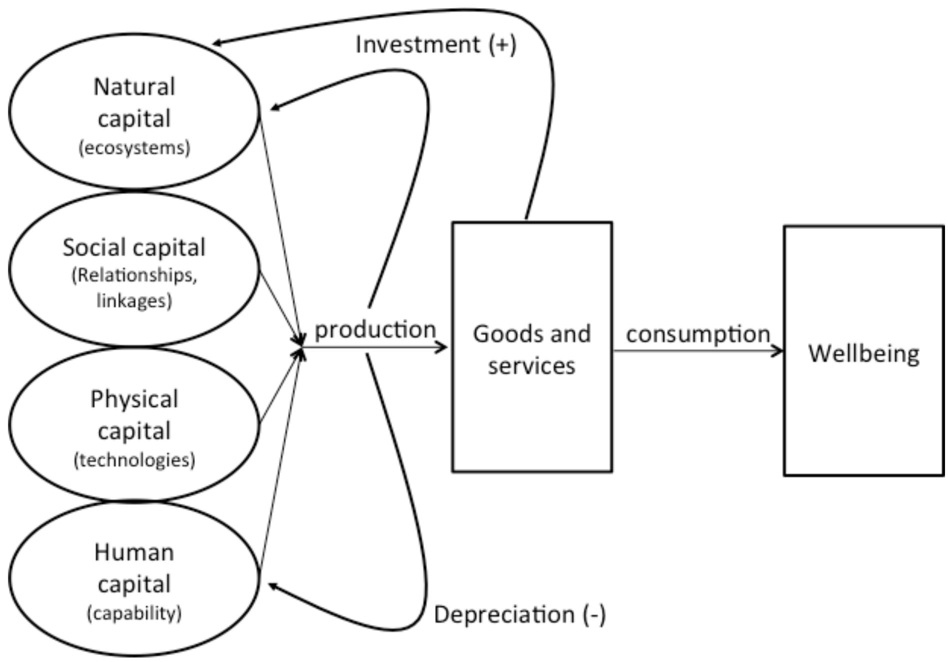

Figure 6.1 A Capitals Theory Approach

Source: Adapted from Harper and Price (2011)

In terms of the current research, a primary purpose of small-scale energy initiatives is to change the quantity, structure, or quality of energy produced and consumed within a given area[35], and while some groups may have more of a focus on emissions reductions (for example) than renewables deployment, every community energy group, by definition, seeks to alter the supply and/or demand of energy resources in a specific area in order to improve the flows of goods and services, and ultimately enhance wellbeing. Broadening out from the CTA, the impact of CE can be categorised into the following broad dimensions:

- **Resource** attributes describe the supply types and quantities produced, transported and consumed in the area of interest, for example, the proportion of electricity delivered by renewable sources in

[35] 'Structure' in this case refers specifically to the fuel type and location of energy generation and consumption, while 'quality' refers to the energetic and environmental qualities of primary energy.

a given area, and the implications for wider energy infrastructure. Embedded within this set of attributes are environmental considerations e.g. carbon intensity of resource, and thus encompass produced and natural capital components;

- **Economic** attributes describe the monetary costs and benefits of supplying and consuming the current energy mix, and may include, for example, capital costs of renewable technologies deployed in a given area. The change in financial capital within the study area is related to the balance of such monetary costs and benefits;
- **Social** attributes may be defined by the ways through which people and groups of people engage directly or indirectly with the energy system. This includes civil society and formal and informal networks (including the community group themselves), but also those actors involved with institutions of technology, governance and markets related to the energy system and energy system change. This broad social framework encompasses both human and social capital[36].

Although these attributes are considered in parallel, how they are weighted depends on the specific goals in question. For example, one community energy group may be focused on generating revenue from RE installations, making economic attributes a central component, while another may be more interested in fostering wider engagement in energy transitions more generally, and might thus weight social attributes as most important. How impacts are perceived by different groups of actors has relevance for how CE is valued by these groups, and in turn, how opportunities and barriers for CE are manifested.

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[36] Two other forms of capital, 'cultural' and 'political' are used elsewhere (e.g. Flora et al., 2004 to define notions of shared identity and engagement with political processes as key elements of sustainable communities and economic development. Both concepts are used here within the overarching notion of social capital, and as such are discussed alongside broader social impacts.

As with many CE groups (Seyfang et al., 2013, Walker and Devine-Wright, 2008, Walker, 2008b), WREN cites local economic resilience as a leading driver for local activities: “WREN is primarily an economic programme of community investment, where environmental and climate issues are implicit” (WREN, 2012). This framing of community energy is interesting: by presenting itself as a key part of the local low carbon economy, with benefits including community income generation, local industry development and high value employment, WREN at once identified and occupied a role as a distributed, community-based deliverer of low carbon policy in Cornwall. The importance of framing, either by groups themselves or by the wider sector has been well documented as a key element of developing niche innovations (Geels and Deuten, 2006, Hargreaves et al., 2013).

Aside from the economic imperative, WREN’s focus on the local suggests that for them, the economics of energy are inseparable from social issues: “WREN seeks to engage the entire population” and “save and generate energy at a scale that will have a meaningful impact upon the population’s actual consumption” (WREN, 2012). Since the principal approach is on RE generation and related savings and income, the ‘social’ side of WREN is thus that of engagement and benefit sharing, and while addressing fuel poverty, for example, does feature in WREN’s business plan, it is perhaps secondary to RE-led projects.

Although energy-related objectives are not necessarily aligned with economic goals (there are many ways to reduce carbon emissions, all varying in cost), changes in patterns of the generation, transmission and consumption of energy all affect economic flows, with implications for the health and sustainability of the local and national economy. Arguably, a key theme within energy policy goals is that they can be more directly related to the concept of wellbeing than ‘purer’ economic goals of growth, measured by GVA and employment. Specifically, the success of any energy policy will depend on its ability to encourage supply to meet demand, but also, the ability to do so within climate change targets while maximising affordability, both of which are more closely linked to wellbeing than to economic growth itself. If we therefore agree that wellbeing is more or at least of equal importance to growth, then taking a whole-systems perspective to energy is crucial. Taking such a whole systems approach, this chapter attempts to consider all dimensions of impact simultaneously to reflect the need for all dimensions to be impacted favourably, if the goals of moving to a sustainable energy system are to be met.

It should be highlighted that these dimensions are interconnected to varying degrees, such that analysis of the economics of community energy, for example, necessarily takes into account distributional aspects of revenue generation, which of course can be considered a social dimension. Similarly, analysis of household energy consumption would inevitably take in all three dimensions by, for example, speaking to household fuel requirements, costs, and related social issues such as fuel poverty.

6.1.2 Distributional aspects

While any analysis of impact would consider the magnitude of change, the issues and challenges associated with energy system change are also related to the distribution of changes among stakeholders. Embedded throughout the dimensions outlined above (resources, economics, and society) are distributional aspects, which this thesis considers as being central to a move to a sustainable energy future. While impacts on any one dimension can be described in terms of the *depth* of impact (e.g. increase in RE capacity), the degree to which this has a societal benefit, say, might be conceptualised as the *breadth* of impact.

In a wider sense, taking the energy policy goals of security, affordability, and low carbon, this thesis argues that it is the distribution of costs and benefits relating to these goals that is key to meeting policy objectives *without sacrificing other objectives* of interpersonal or intergenerational wellbeing and equity. Taken in turn, each goal can be considered. Conventional ideas of energy security relate narrowly to security of supply at a national level. It has been argued however that the property of security is both multidimensional and multiscalar (Mitchell et al., 2013), meaning different things to different actors, over different timescales such that it is the *distribution* of energy accessibility that should provide the focus of analysis. Meanwhile, affordability in the context of energy policy is usually taken to mean the affordability of energy to householders. The distributional aspect of affordability depends on the interplay between fuel prices, income and how easy it is to heat one's home, and thus affects some sections of the population more than others. Finally, from a macro-policy perspective, low carbon is taken as shorthand for emissions and renewable targets at a national scale. Much debates around RE however focus on how such infrastructures are distributed across the landscape, particularly in relation to the proximity to populations. Focusing solely on the amount of RE capacity, rather than its distribution among populations, is misleading.

In terms of community energy then, the dimensions outlined in the previous section can be related by considering the distribution of different types of benefits and costs. Economic analysis of a community energy initiative must include consideration of how costs and benefits are distributed among stakeholders. A social analysis in turn might relate to the extent to which people are engaged with energy decisions, in terms of how decision-making agency is distributed among the population, for example. The geographical distribution of technologies and infrastructure of different scales has different requirements in terms of siting and proximity to the grid, and to consumers, thus affecting distribution of both social and economic costs and benefits.

These distributional aspects are fundamental to understanding CE, not least because notions of justice, democracy and equity are embedded within CE as a whole. Although CE is often concerned with the local deployment of low carbon energy technologies, the type of technologies are often secondary to the economic and social benefits that these technologies can unlock. Indeed, the premise upon which WREN is founded, that "each locality can transform energy from an individual cost to a collective asset" (WREN, 2012) comments both on the economic as well as the social benefits (of redistributed economics) that is possible. It is the *process* rather than the *progress* that is emphasised, and as such, conceptualisations of ‘impact’ must take this into account.

Furthermore, one might consider the redistribution of governance as a key goal of CE. The shift in how people relate to energy has the potential to enable citizens to renegotiate the governance arrangements of the current energy system to a more favourable arrangement, with less volatile energy costs, and less dependence on energy companies with whom transparency and public trust is extremely low (Edelman, 2014). Owning and producing energy for oneself then becomes a way to participate more directly in a system that has hitherto been publicly inaccessible. Of course (and as pointed out by the findings of the household energy survey), it is plausible that the development of another layer of decision-making at the community scale risks disenfranchisement of those who feel excluded by developments. For example, those privately owned RE installations (and with no local benefits redistribution process) are likely to be associated as a retreat from, rather than an advance to, a fairer energy system, as demonstrated by some of the remarks made during the household energy survey.

6.1.3 Temporal aspects

An extension of the distributional aspects described above, temporality describes how the energy system dimensions (resources, economics, and society) are distributed over time. As discussed previously in Chapter 4, temporal aspects have enormous implications for how impact is measured, and how their effects are perceived. Different actors may be addressing issues through the lens of different timeframes, and thus have conflicting perceptions about the value of specific changes to the energy system. In terms of CE, some impacts (e.g. increasing local RE capacity, deploying household efficiency measures) may be expected to take months or years, whereas more profound impacts in low carbon innovation, political engagement, or cultural shifts, for example, can be expected to take years or decades.

WREN's initial business plan was explicit in setting a 5-year timeline over which objectives would be measured (WREN, 2011, WREN, 2012), a timeframe which was deemed ambitious, though achievable. Business plans are typically short-termist, focusing on 3-5 year horizons during which meaningful steps toward progress can be made, not least because investors typically look for appropriate returns within that timeframe. While the formation of business plan helps to establish objectives, budgets and approaches, for some practitioners becoming more business-like runs counter to the ethos of the CE sector as a grassroots movement (Seyfang et al., 2014).

In dissecting the impact of a specific CE project, this analysis explores the impacts brought about by WREN over a relatively short timeframe of a few years, as constrained by the research resources of this particular study. It is acknowledged that two or three years is unlikely to be enough to measure profound changes to an energy system, even at a local scale, taking in all dimensions. It takes time for objectives to be set and resources to be found. Energy generation resources (particularly at medium to large-scales) can take several years in planning and to access finance. It can therefore take considerable time for impacts arising from these new resources to become measurable. In presenting the impacts of WREN then, it is important to consider pipeline as well as completed projects, as well as to reflect on those activities that do not have any tangible output but contribute to the group's goals at a deeper, more strategic level.

Additionally, and as has been discussed, WREN (and the CE sector more generally) has not evolved in a vacuum, and so cannot be analysed as such. Rather, WREN has developed within the context of CE growth more generally, as well as within the context of developments in technology, policy, economics and society, with timescales of years, decades or generations.

While the overarching focus of this thesis is situated at the junction between real-time impact and longer-term structural change in the energy system, the remainder of this chapter provides a snapshot of the evolution a specific CE project and its impacts over just a few years.

6.1.4 Energy production

WREN has sought to affect local energy production through a number of channels. To date, the focus has been on providing advice to householders and businesses interested in installing, or finding out more about, renewables (but specifically domestic PV and heat). This has in many instances led to WREN recommending specific businesses to carry out installations, implying that for many, WREN occupies an informed and trusted position within the community.

Figure 6.3a illustrates the growth in solar PV in and beyond the immediate study area as directly supported by WREN through referrals and facilitating the rent a roof scheme, amounting to 328kW[37]. WREN-influenced installations comprised around a fifth of the total for the study site (Figure 6.3b)

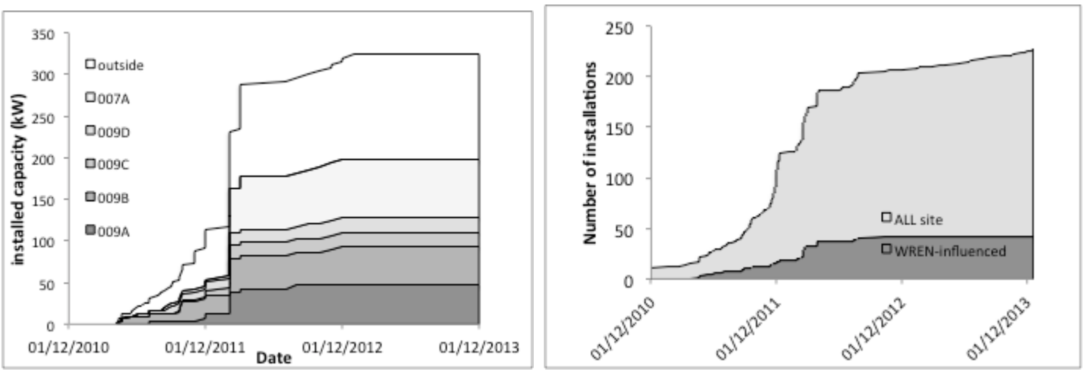

Figure 6.2 a) WREN-influenced Solar PV installations including those outside of study area and b) WREN-influenced PV in the Wadebridge area only, as compared with total installed over the same timeframe.
Sources: WREN (2013, pers comm), Ofgem 2014 (2014b)

As highlighted previously, it is difficult to ascertain the extent to which influence takes place. It is true that some households may have installed PV anyway (i.e. without WREN's assistance), although offering information,

[37] Recall from the Introduction of Section 4.4 that different research boundaries means that this data may not correlate exactly with that generated by WREN

guidance and access to a trusted local supplier is likely to support uptake. Furthermore, peer influence has been found to play a role in influencing RE adoption (Bale et al., McMichael and Shipworth, 2013, Michelsen and Madlener, 2013), suggesting that it is plausible that those supported by WREN are likely to have influenced others, both to use the same referral service, but also to have PV installed without WREN's assistance. One might reasonably suggest then that WREN has influenced more than that represented by the dark-grey area in Figure 6.2b through the aggregative and peer-dynamic effects of PV adoption.

As well as those installations directly supported by WREN, several other installations in the study area and beyond have connections to the group. Installers of a 242kW solar array at Chapel Amble, north of the study area, are members of WREN and contribute to the WREN community fund. Cornwall Council has also installed several (around 200kW capacity) installations in and around the area on social housing and council-owned buildings (e.g. library, leisure centre), and was directly influenced by WREN's activities in making these decisions (Clark 2013, pers comm).

WREN has also focused significant resources in encouraging the adoption of renewable heat installations in the area, resulted in 55 installations[38] totalling 850kW, made possible through administering one-off grants available through the Renewable Heat Premium Payment Communities (RHPP2) scheme. In addition to these, the group also helped to facilitate several more commercial installations, totalling around 510kW. As with small-scale solar, it is possible that these installations, through social networks have further influenced energy-oriented decisions in other households and businesses, though this is not quantified here.

Based on these figures it is possible to roughly quantify the change in financial flows resulting from WREN's programme of activities relating to

[38] Around half of which were in the immediate study area

renewables. Table 6.1 summarises estimated spending and revenue both within and beyond the study area for small-scale renewable installations.

Table 6.1 Estimated financial flows resulting from WREN-supported domestic solar and heat installations to Dec 2013

Intervention	Solar PV	ASHP	GSHP	S. therm	Biomass	Total
Number of installations	144	4	1	26	21	
Unit cost (£)	8,000	15,000	15,000	6,000	6,000	
Annual bill savings (£)	140	700	700	90	400	
Ann FiT/RHI revenue (£)	1,500	1,000	1,000	330	750	
Ann export revenue (£)	75					
Total expenditure (£)	1,256,000	60,000	15,000	156,000	126,000	1,613,000
Year 1 revenue (£)	247,275	2,800	700	8,580	15,750	275,105
Year 1 savings (£)	21,931	4,000	1,000	2,340	8,400	37,671
Year 1 rev & savings (£)	269,206	6,800	1,700	10,920	24,150	312,776

Source: Author's own. See [39] and [40] for notes

At the small-scale end of the renewables market, this suggests that WREN is directly and indirectly responsible for supporting over £1.6M of investment within the study area alone, mainly for household rooftop PV, and has facilitated savings and revenues of over £300,000/year[41]. This excludes local

[39] Includes an estimated 75 installations influenced by WREN; south-facing homes consuming 4800kWh electricity/annum; average unit costs based on Energy Saving Trust data (http://www.energysavingtrust.org.uk); FiT and RHI rates based on average for period of study (40p/kWh, 7.3p/kWh, 18.8p/kWh,19.2p/kWh and 12.2p/kWh for PV, ASHPs, GSHPs, solar thermal and biomass units respectively); PV export rate of 4p/kWh

[40] Recall from the Introduction of Section 4.4 that different research boundaries means that this data may not correlate exactly with that generated by WREN

[41] This correlates well with WREN's figure of £1.5m of local installer sales as stated by Hiles (2014)

expenditure and revenue from non-domestic schemes, some of which are large-scale.

Understanding the distribution of these costs and benefits is a little more complex. In general, higher income households are more likely to invest in microrenewables (Fischer and Sauter, 2004, DECC, 2012b), suggesting that the direct benefits of reduced fuel costs and revenue generation accrue to those households least in need. Some commentators have suggested that the current FiT regime amounts to a socially regressive tax, in that only those who can afford to invest in panels can benefit, while bill-payers of all means pay the costs. (e.g. Monbiot, 2010). Whether this is the case clearly depends on how the panels are financed, for example, purely by householders, by taking out loans, or through so-called rent-a-roof schemes, whereby third party organisations effectively lease panels in return for FiT and export revenues. For the majority of WREN-influenced PV installations in Wadebridge, panels were financed by householders themselves or through loans.

The constituent costs of renewable installations vary across technologies and scales, and thus affect the impact of this spending on the local economy. For solar PV, small-scale installations (under 10kW), module and inverter (which are typically sourced from overseas) costs make up less than half of total installed costs, with the remainder being made up of fixings and other components, labour, scaffolding, transport and other overheads (Parsons Brinckerhoff, 2012) which can accrue locally. Therefore, since the favoured installers are local to Wadebridge it is likely that a significant proportion of local solar expenditure remained local to Wadebridge, and certainly within Cornwall. For those local installers focusing on small-scale PV installations, staff costs were identified as the single largest cost to operations (Interviews 8 & 10). Similarly, for renewable heat technologies, labour costs average between 22 and 42 per cent of total installed costs depending on technology type (SWEETT, 2013), meaning that the majority of sales income for the 62 WREN-led installations accrued local to Wadebridge.

The majority of domestic heat installations took place under the Renewable Heat Premium Payments Community (RHPP2) scheme, whose purpose was to encourage community-led deployment of renewable heat systems, specifically targeting middle to low income households and those off the gas network. While the scheme was relatively well taken-up by WREN, it was felt that the scheme did not work as well as it could in engaging lower income households (Clark 2013, pers comm).

In addition to the above, WREN has also engaged with larger commercial-scale installations both inside and outside of the study area. For example, the group facilitated, through garnering support, the repowering of a wind farm (replacement of eleven 450kW turbines with five 2MW turbines) in the west of the primary study area in St Breock, with the developers in turn identifying WREN as independent administrators of a community benefit fund worth £50,000/annum. As of Autumn 2015, WREN had also been appointed to administer funds from two other commercial projects in the area, highlighting the role of CE beyond influencing deployment.

WREN is also currently working on plans to develop a medium-scale (>5MW) project to be funded through a local share offer. That there is a considerable membership suggests that there would be significant local interest in investing in such a project and it is likely that the requisite finance will be raised. The economic impact resulting from such an intervention would be substantial.

6.1.5 Energy consumption

Although it was not possible to determine significant changes in average household energy consumption resulting from WREN's activities within the boundaries of this research, several observations can be made. Firstly, DECC estimates electricity and gas consumption data at LLSOA level (DECC, 2014e), which, if analysed over a longer timeframe, may be useful in tracking accelerated changes in average consumption. The household-specific consumption data presented here provides a baseline against which longitudinal analysis could determine changes at a finer scale, although longer timescales would likely be required to be able to ascertain significant changes.

Outside of this study, WREN has begun to make steps to gather household-scale data, both to help understand local energy consumption levels, and to explore the possibilities for demand reduction through behavioural change. Activities have included trialling smart meters in 100 households in the town, with a view to observing electricity consumption changes in real time, and collaborating with Cornwall Council to trial a localised smart grid through the Smart Cornwall programme and understand potential impacts.

In terms of affecting change, WREN has sought to reduce household energy consumption through a variety of activities (a non-exhaustive summary is given in Table 6.2). These have generally focused on facilitating and supporting Government-funded efficiency installations, as well as information and efficiency awareness schemes.

WREN has also sought to reduce household energy consumption through encouraging and supporting uptake of the CERT (Carbon Emissions Reduction Target) programme, which wound up in Dec 2012. WREN partnered with an intermediary, CEP to publicise subsidised loft and cavity wall insulation. Of the 98 completed household installations, almost three quarters were in the immediate study area. Table 6.3 estimates household and total cost savings for the study area resulting from this programme.

Table 6.2 Financial impact of WREN-led CERT deployment in the study area

	cavity wall	loft insulation	both	total
Number of installations	7	36	29	72
Reduction of gas consumption (%)[42]	7.8	1.7	9.4	
Saving per household[43]	£23.17	£5.05	£27.92	
Total annual savings	£162.16	£181.76	£809.62	£1,153.55

Source: Installation rates courtesy of Jerry Clark (2013, pers comm); Also DECC (2013c)

As with FiT uptake, it should be pointed out that some households signing up to CERT through WREN may have done so without their instigation, though this is difficult to quantify. It is likely however that WREN would have had the effect of accelerating uptake by administering it locally, and through raising awareness and communicating potential financial savings to householders.

WREN has also sought to encourage adoption of electric vehicles by negotiating a £200 cash-back deal from local dealership, payable in the WREN local currency (see below). Ten such purchases have been made through this scheme.

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[42] Based on weighted savings for all UK house types (rather than the actual house types). This table uses DECC (2013c) estimates of savings based on matched pairs of intervention and comparator properties of five house types for interventions undertaken in 2010, and differs markedly from other estimates from, for example the Energy Saving Trust

[43] Based on an average household gas expenditure of £297 as estimated in Chapter 5. Using the average total heating costs (including oil, solid fuel etc) of £446 increases the estimated total annual savings to £1732.

6.1.6 Other economic impacts

The direct economic impact of WREN refers to forms of local financial capital spent, and created by WREN on employment and expenditure. Financial resources flow into WREN through grants, donations, finders' fees and membership fees, and are spent either on procuring goods and services, or the creation of a community benefit fund[44]. Indirect economic impact can be defined as the impact on firms that (directly and indirectly) supply the activity identified as direct impacts (discussed above). For conventional commercial businesses this would typically include the spending on employees and the impact on local businesses arising from the firm's expenditure. For CE, however, the focus is on distributing impacts rather than accumulating profits, so additional impacts should be considered, and in WREN's case, the impact of business partnerships and community fund spending is of particular interest.

At present a large proportion of the group's income is in the form of grants from central Government, with smaller contributions from the Local Authority and the EU. Of externally sourced funds (those from outside of Cornwall), grants made up the vast majority in the year 2012-13 (Figure 6.3a) These have primarily been energy focused (administered through DECC), though several have been from rural support agencies (e.g EU Rural Development Fund; Defra), or indeed a combination of energy and rural-focused funds. The surplus, from donations, finder's fees (commission from business referrals) and income from the use of the WREN currency[45] is mostly sourced locally (from within Cornwall).

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[44] Re-spending of the community benefit fund is considered an indirect impact

[45] 10 per cent of each 'WREN' (the local currency) spent in the town comes accrues to WREN

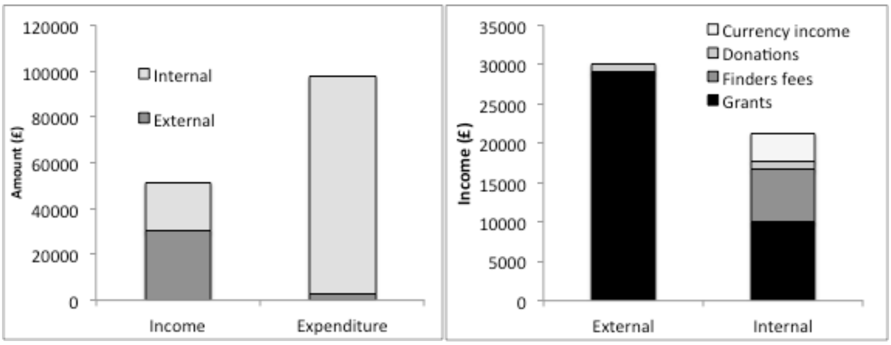

Figure 6.3 a) WREN's external and internally-sourced income and b) sources: 2012-13

Source: Alexander (2013)

While there is almost an even split between local and non-local income, the bulk of expenditure occurs locally (Figure 6.3b), with most being spent on rent, wages, subcontracting and professional fees. Minimal expenditure accrues outside of the locality, primarily on utilities and insurance. While WREN employs very few staff (two in 2012/13), subcontracting of individuals and businesses to undertake technical work relating to programme delivery and carrying out professional services (accountancy, auditing etc.) occurs local to Wadebridge, and is significant. It is perhaps expected that an organisation of this size would employ local rather than non-local individuals and services, though the ethos behind WREN as a driver of local economic resilience however makes this more certain. Indeed, since most human resources are contributed voluntarily, it is the presence of local skills and experience that ensure initiatives such as WREN are viable. CE is initially dependent on tapping into local skills, though can also have impact in terms of supporting the local economy via employment and augmenting the local skills base.

While the contribution of volunteer time is clearly integral to the progress of CE group, it is difficult to quantify precisely this contribution. WREN estimates that in 2012/13 it benefitted from something in the region of 5000 hours. Valuing this voluntary time is similarly complex, not least because the skills contributed by different volunteers is highly varied. It should be noted however that many CE volunteers have considerable past experience and expertise from which to draw from careers in technical, professional and management positions.

Another way in which the group supports the local economy is through passing on leads to ‘preferred’ RE installers, procured and vetted by WREN. As noted previously, it is difficult to ascertain fully the impact of WREN in accelerating local RE deployment in total, as it is likely that many installations would have gone ahead without WREN’s interventions. What is likely is that RE deployment in the area has been catalysed, through for example facilitating knowledge about RE options and making introductions to favoured installers. One installer, while suggesting that WREN might not have had a huge impact on business, highlighted that the value of WREN as a trustworthy ‘brand’ should not be underplayed:

> “[WREN was not] massively influential for what we did, but they were useful…if there were WRENs about everywhere there’d be a lot more renewable energy business” (Interview 9)

Regardless of the scale of the impact, it seems likely that the customer leads helped to favour local installers over national competitors and thus concentrate overall spending on local rather than national goods and services. Due to strong competition between installers, particularly in the domestic solar market, customer acquisition is ever more important and can contribute considerably to overall installation costs:

> “…there is a difference between being busy and making money. We have a lot of people shouting at us to look at things, but its not like fitting gas boilers. People have wonderful ideas of holiday complexes and they want us to quote for this and that and in the end the groundwork cost 100 grand more than it should have been. In the end there’s quite a lot of renewables businesses for the money…You know, we win jobs off other people, but its very easy to lose work, very easy. We have to be very competitive. There’s a lot to look at but translating that into work is a challenge” (Interview 8)

For several businesses, WREN acts as a useful trusted point of contact for prospective customers, removed from often-aggressive sales techniques seen elsewhere in the microrenewables sector (Interviews 8,9 & 10). Indeed, it is likely that acting through intermediaries such as WREN can ease the labour and costs associated with customer acquisition, even when finders' commission fees are taken into account.

Aside from WREN's energy-related activities, several parallel strands seek to retain the economic and social value of energy-related projects within the local community. One such strand is community benefit funds, which redistribute money towards a range of social, environmental, cultural and sporting projects in the local area. Several funds have been released to date, including WREN project-specific funds (arising directly from WREN's projects) as well as local commercial-led projects that have used WREN to administrate annual community benefit funds locally. Up to late 2015, the former had released £10,000, and the latter £40,000. Additions of new commercial-sourced funds means from 2015, annual payments of £70,000 will be made from three developments to local community groups.

Funding has been used by recipients in a variety of ways, from covering the cost of project premises to supporting general running costs, most of which are sourced locally. One youth project used the fund to match another funding application to purchase a minibus, again sourced from a business in Cornwall. Although the sums involved for each beneficiary can be relatively small, they are well-received charities and other small organisations who are often reliant on such funds, particularly if they can be used to leverage additional funds from other sources.

Another such strand is the WREN currency, the 'Wren' (Wr), which WREN issues for use as an alternative local currency. Wrens are printed by WREN, and distributed to the community as incentives for engaging in one of several WREN-based activities, including using WREN to act as intermediaries for Green Deal or RHI schemes, or switching electricity suppliers to a favoured energy supplier. As of August 2015, around 50 independent businesses in Wadebridge accept the currency, in return donating 10 per cent of all Wrens received back to the WREN community fund.

Such a scheme is likely to have several benefits across multiple dimensions, as discussed by Seyfang and Longhurst (2013). For example, social networks are strengthened, and civic participation rewarded; shorter supply chains are favoured, reducing transport emissions and better linking local consumption with local supply; and local trade is enhanced, resulting in both local multiplier effects and income for WREN to be reallocated in the community benefit fund. Further work would be needed to ascertain the actual value of this scheme to the local economy, although a positive net impact on the local economy is certain.

Of course, as with all of WREN's projects, while the local currency has a monetary focus, it is directed towards maximising social as well as economic benefits. As such, WREN (and most other CE groups) hold clear value in terms of being driven by progressive agendas, and providing the processes in place are fair and robust, are likely to garner local support in ways that commercial enterprises cannot. However, working from limited resources does mean that commercial firms can often facilitate some functions (such as RE deployment) more effectively, which raises questions around how energy policy can better value a broader and more progressive set of objectives.

6.2 Conceptualising WREN's impact

Figure 6.4 conceptualises the range of potential local and immediate impacts on resources, economics, and society influenced by WREN's activities. Building on the capitals approach outlined in Figure 6.1, this outlines the direct and indirect use of internal and external resources to create a set of goods and services. Such a framework emphasises a) the multiple dimensions of value stemming from WREN, and by extension other CE initiatives, b) the importance of the distinction (but inclusion) of direct and indirect impacts, and c) the duel importance of local value retention alongside wider societal value.

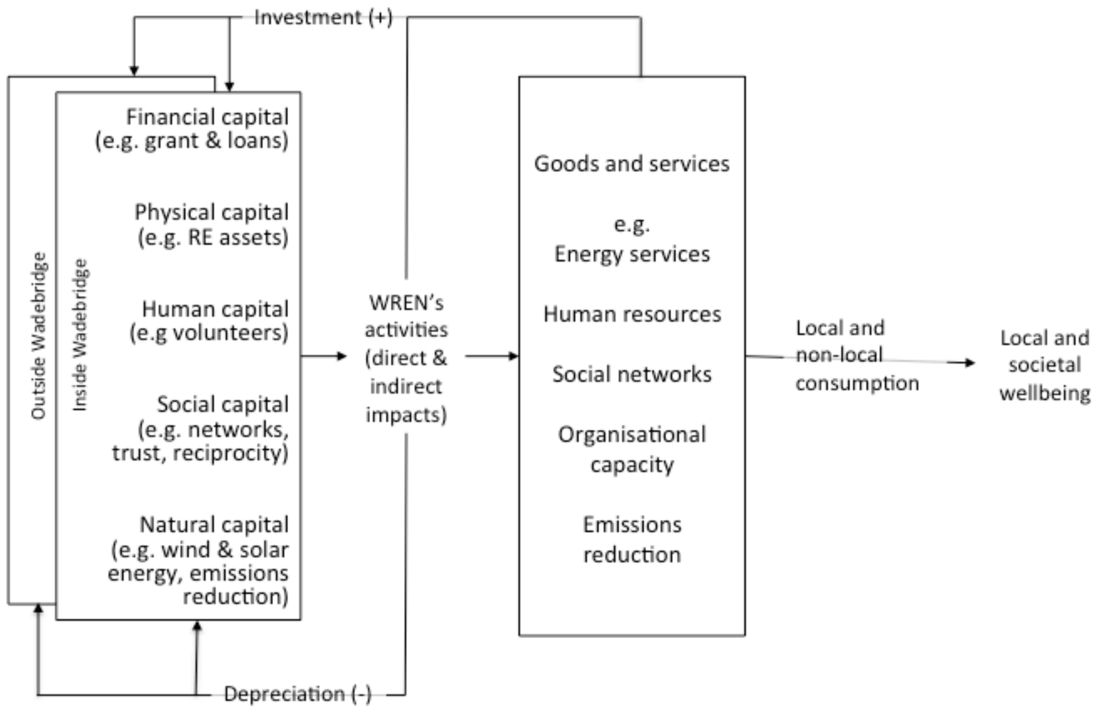

Figure 6.4 Framework of impacts

In terms of the emphasis of multiple dimensions, this framework rejects the notion that community energy can be boiled down to crude metrics around *only* economics, or *only* renewables deployment. The strength of community energy is not just in the ability to deploy renewables, and do so with favourable economics, but to do so in a way that is sensitive to local contexts, and within local populations. Commercially deploying renewables is likely to be quicker and easier without engaging communities, although doing so would be far less likely to be valuable to local communities. In the context of the need for transformational change in the energy system, consideration of the social and political aspects of community energy – explored in the following two chapters – is at least as important as economic arguments.

The inclusion of indirect impacts is central to the argument that CE initiatives and practices cannot be meaningfully separated from the populations within which they are embedded. These include effects that are likely to have taken place without WREN's input, but which were catalysed by the existence, encouragement, or support of WREN and its activities, such as through peer influencing of innovation adoption and contributions to wider cultural shifts towards a low carbon economy (Bale et al., McMichael and Shipworth, 2013, Michelsen and Madlener, 2013, Brohmann et al., 2007).

The dual emphasis of the framework on local value retention alongside societal value is a departure from existing analyses of community energy, which tend to focus either on single projects or the whole sector. Considering both simultaneously captures the located, grassroots nature of community energy practice although recognises that this exists within the context of networking and learning with other groups and with the sector as a whole. This dimension also captures the importance of CE from a policy perspective in that sectoral impact arises not only from the aggregated impacts of groups, but also from the implications of the synergy between them, i.e. the value of CE as a dynamic, responsive, and innovative movement.

This framework does not seek to offer simple answers, for example by presenting the monetary benefits of WREN, and indeed, it is argued that such analyses would be flawed in their understanding of the value of community energy. Rather, it seeks to provide an overview of the varied ways of assessing value, and provides a template for a wide range of stakeholders to consider a broad range of impacts and values from different perspectives.

6.3 Summary

This chapter has conceptualised and analysed the impacts of WREN's programme of activities. The first section set out a discussion around the concepts of impact as related to the dimensions, distribution and temporal nature of impact in community energy in general, and the WREN initiative more specifically, providing the framework onto which impact can be understood. It was established that the nature and complexity of CE and energy systems more generally requires a whole systems approach, taking into account multiple dimensions (physical, economic and social) simultaneously. Understanding how such impacts are distributed is considered key to providing a meaningful presentation of impact, not least because CE is often based on notions of equity and justice. The distribution of impacts across time was also discussed, with particular reference to potential struggles between short term-objective-based analyses and longer-term observations of energy system evolution.

The second section documented specific impacts resulting from WREN's programme of activities. The group's drivers, ambitions and approaches provided context and goes some way to explaining the trajectory of the group's approaches as ways of addressing their objectives. WREN is having demonstrable impact on stimulating the deployment of small-scale PV and renewable heating the locality both directly as trusted intermediaries and indirectly through influencing and supporting deployment more widely. Some progress has also been made in addressing demand reduction, particularly as intermediaries between households and national programmes, though this is difficult to quantify. Although WREN does not yet own any RE infrastructure, the group has shown that even without ownership, there are considerable opportunities to tweak parts of the energy system so as to maximise local economic impact and improve the distribution of economic flows throughout the locality.

This chapter discussed how WREN's activities have altered the physical and economic aspects of the local energy system. The following chapter continues the discussion around impact by looking at social impacts, and in particular how WREN has impacted on, and been impacted by local human and social capital.

7 Social capitals and wellbeing within community energy

The distribution of financial capital in WREN's locality is a key objective to the group. However, the processes and outcomes taken by WREN (and CE more widely) are predicated on the availability and deployment of other forms of capital, rather than just financial. Human and social capitals are of particular importance in this regard, and indeed are defining characteristics of the 'community' part of community energy.

Some of the social impacts of community energy were explored in Chapter 6, and can be related to wellbeing directly, e.g. employment, or more efficient energy use in households. The collective nature of CE however implies intrinsic value in the collective nature of CE, i.e. that societal interaction is valuable in some sense. Indeed, as this chapter shows, CE is a product and a function of societal interaction in a number of different ways. So, while *produced* and *financial* capital resources were the focus of the last chapter, this chapter focuses on the value of people, i.e. *human* and *social* capital in community energy.

Specifically, this chapter presents findings related to the importance of people-oriented capitals to WREN. It begins by introducing human and social capitals as useful terms for understanding the social element of CE. The role of human capital and bonding social capitals are then discussed in relation to the establishment and early development of WREN. The role of bridging capital is then explored with reference to WREN's relationship with the broader community. Finally, the ways through which WREN has employed linking capital to establish and utilise links with influential individuals and organisations is related to the development of legitimacy and political agency.

7.1 Conceptualising people-oriented capitals

While the local creation and accumulation of physical and financial capital is of clear importance to the development of CE, progress towards CE goals on an individual as well as a sectoral level influences and is influenced by the establishment and growth of both human and social capital. To help understand this, it is first necessary to conceptualise *human* and *social* capital in this regard.

7.1.1 Human capital

In an economic sense, human capital relates to “any stock of knowledge or characteristics a worker has (either innate or acquired) that contributes to his or her “productivity” (Acemoglu and Autor, 2011). In a broader sense, human capital is defined by the OECD as “the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic wellbeing” (OECD, 2001: 18). Since the focus of this chapter is on the social, rather than just the economic impacts of CE, this distinction is relevant.

For example, the human element of CE is more than just as a factor of production. If a firm’s employees are merely resources from which profits can be derived, social enterprises in general seek to use human resources to leverage further human and social resources, and focus on wellbeing rather than economic productivity. In the specific case of WREN then, individual members make up a key resource with which CE projects can be imagined and carried out, as well as the beneficiaries of their actions. In the sense that most CE groups seek to create wealth in the form of self-sufficiency and wider wellbing of their communities, CE practitioners might be termed social ‘entrepreneurs’ (Chell, 2007).

Although human capital is usually taken to represent the stock of knowledge or skills of an individual acquired through education or experience, other personal characteristics such as confidence, optimism and resilience (often considered as psychological capital (Luthans et al., 2004)) are also of relevance here.

7.1.2 Social capital

Much has also been written about the concept, measurement and application of social capital. While the vast literature around social capital has explored a variety of definitions, the political scientist Robert Putnam described it as “features of social organisation, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions.” (Putnam, 2000). Kay (2003) further summarised six key components of social capital as *trust*; *reciprocity and mutuality*; *shared norms of behaviour*; *shared commitment and belonging*; *formal and informal social networks*; and *effective information channels*. As with financial or physical capital, social capital can be thought of as productive, existing as a ‘stock’ or ‘resource’ that can be drawn upon to meet certain goals. In the context of the current research, the broad goal of interest is that of the move to a sustainable energy system.

Since the development of CE operates across scales from the micro to the macro, it is perhaps most appropriate to explore social capital issues across a commensurate range of scales. Gittel and Videl (1998) proposed two dimensions of social capital, *bonding* and *bridging*, which in turn relate networking within and between social networks. Bonding strengthens the connections between people who already know one another, while bridging connects strangers. Bonding social capital is useful for reinforcing existing ties and sharing internal resources, for example to help less fortunate members of a group, thus further promoting solidarity and reciprocity (Putnam, 2000). Bridging, on the other hand is most useful when external resources (including information) are useful, such as when seeking employment. In this case, weak social ties are more valuable as they provide channels to other individuals, particularly because these individuals move in different circles (Granovetter, 1973).

Further nuance can also be found within *bridging capital* to differentiate between the type of actors involved. The term *linking capital* has been used to describe relationships with those individuals and organisations not on equal footing, particularly if they hold power and/or influence (e.g. Putnam, 2000, Narayan-Parker, 1999, Woolcock, 1998, Harper and Kelly, 2003). In terms of community energy then, bonding capital is that present *within* CE groups, bridging capital is that *between* CE groups and others, such as the local community, while linking capital may be that between CE groups and policymakers, for example (Figure 7.1).

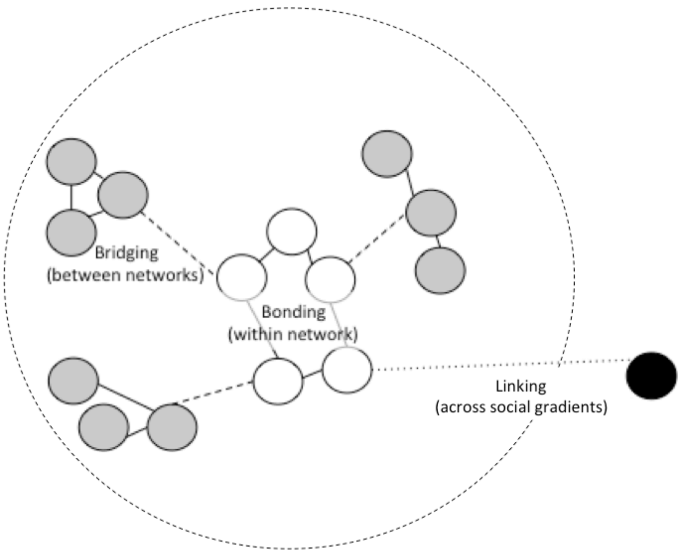

Figure 7.1 Bonding, bridging and linking social capital

As many of the impacts of WREN's activities relate either directly or indirectly to the development and maintenance of human and social capital across these three dimensions, this section uses these dimensions as a framework on which to hang analyses of the social impacts of WREN. Understanding the roles of these dimensions is a key part in determining how better decision-making (in policy as well as among CE practitioners) might better maximise the potential of the sector.

7.2 Bonding social capital: setting a course

Much of the literature on CE has emphasised the need for local knowledge, skills and leadership for the initial creation of groups, the development of agendas and putting ideas into action (Haggett et al., 2013, DECC, 2014b, Houghton, 2010, Martiskainen and Watson, 2009). This need for capacity within individuals is echoed in Government calls for, and the literature on, Big Society as a form of decentralising power. The entrance of the 2010 coalition Government and the advent of an era of austerity stimulated both short-term public sector cuts and widespread reform, as enshrined in the Localism Bill. Principles of reform included localising power and funding, increasing diversity of provision in public services, and supporting communities, individuals and volunteers to determine and participate in service provision (Treasury, 2010).

Despite criticisms around its delivery (Jones, 2011, Lowndes and Pratchett, 2011), many agree that the underlying principle of rebalancing power is not unappealing, particularly as it concerns energy policy. Roberts (2011) asserts that such principles are central to meeting the energy challenges as it requires engagement of individuals, communities, business and all levels of Government. What is clear is that decentralisation of process implies the use and development of local skills and expertise, and a renewed capacity to work together. One of the main selling points of Big Society is thus that it helps to create and foster capacity within and among individuals, and that such enhanced capacity is self-reinforcing (King et al., 2010). Local groups thus both require human and social capital to come into being, and can maintain and nurture both forms of capital as they develop.

7.2.1 Development of shared interests

The importance of social capital to the evolution of WREN is evident from analysis of the history of the group. Like the majority of CE groups (Seyfang et al., 2013), WREN was formed by individuals, rather than being business or local authority-led, for example, in this case a handful of local business owners to oppose proposals for a fourth supermarket in Wadebridge early in 2010. Bonding through a shared interest in retaining local economic resilience, two opponents to the supermarket established the 'Love Wadebridge' campaign, arguing that an additional supermarket would be detrimental to the local economy. While the founders of this campaign (who would later become WREN cofounders) had had little prior contact (let alone bonding), a set of shared interests was considered instrumental in bringing them closer together:

"we only met a few days before we got into [the Love Wadebridge Campaign]. Weirdly, we met through my son, who's a musician. He bumped into him at the folk festival because [the Chair] had been quite prominent at some things he had been playing at…and we got together through that really. We found we had lots of other shared interests (like green building) and so it went on from there, and sort of a mutual understanding of each other's capabilities" (Interview 1)

This importance of shared interests, as a form of social capital, has been found to be the common thread among other successful social enterprises. Indeed, Evans (2003) document the influence of social capital on eight social enterprise case studies, and note that shared interests and values are a key determinant in helping groups to cohere and initiate social enterprises. While such shared interests were seen as highly influential in bringing core members together, it is worth highlighting that this was made possible through the connections made through informal social networks, in this case the local folk music scene.

Cornwall Council eventually approved the supermarket plans in early 2011[46]. By then, however, the common interests and values held by the group had been strengthened through pursuing a common goal, and the group had been successful in strengthening the core group and building a wider network of supporters. When DECC rolled out the small-scale FiT in April 2010 the core group's momentum helped it to reconfigure the focus from local food to local energy. While the goods and services demanded from food and energy systems are clearly different, the parallels (e.g. centralised incumbent infrastructures, few market leaders, vertical integration) meant that the interests held by Love Wadebridge were already aligned with that of its successor, WREN, with the focus being on local economic resilience through sustainable consumption.

The shared interests, and later, the shared experiences gained during the Love Wadebridge campaign provided a valuable prototype through which the foundations of trust and reciprocity could be built and tested. Putnam proposed that this kind of sustained contact is needed, in order to build the

[46] The supermarket subsequently pulled out of the development and as of August 2014 no further plans were in place.

relationships, but importantly, to be able to experience first hand the benefits of social capital. (Putnam, 2000, Gittell and Vidal, 1998). That the supermarket campaign itself was not a success was irrelevant; by then the core group of WREN had a shared satisfaction from simply working together and strengthening relationships.

7.2.2 Expanding membership

As already noted, CE groups are most likely to succeed if they are able to tap into local human capital, specifically in terms of the particular sets of knowledge, skills and experience relevant to setting up social enterprises in general and engaging with energy issues more specifically. Of the 14 directors, and particularly the fewer core members, the range and complementarity of knowledge, skills, competencies and attributes was seen as instrumental to the functioning of WREN as a coherent and coordinated enterprise, as highlighted in these two quotes from a board member

> "My role is more along the lines of making the things that do come to fruition actually work, and it's not just the two of us… John is brilliant on how cooperatives work and all the fuel poverty elements…then we've got Pete on board who's good at drawing all the strands together and making sure we're not doubling up on work. We've got 14 directors all together." [47]
>
> (Interview 1)

Of importance here is the perceived value in the *range* of human capital WREN draws upon, and in particular the balance between the capacity to set the agenda and overarching vision, facilitating often quite technical activities, and organising a diverse programme of CE-related activities. Of course, such a range of capabilities and experience would be common to any well-functioning (for-profit) business, the lack of resources and specialist nature of CE might suggest that drawing such a range from a potentially small

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[47] Names have been changed

geographical area would be challenging (Harris and Kor, 2013). However, there is evidence to suggest that since social enterprises are typically more resource scarce and have weaker institutional structures, human resources therein often demonstrate quicker knowledge and skill acquisition, increased flexibility, creativity, entrepreneurial drive and strong intrinsic motivation (Miller et al., 2012). Additionally, the absence of monetary incentives for staff (the majority of WREN directors are volunteers rather than employees) suggests that social incentives such as shared norms and belonging, trust and reciprocity are more important in acquiring and maintaining human resources in CE[48].

So, while individual human capitals are both required for and developed by effective CE groups (or indeed any organisation), social capitals, and particularly bonding social capital, are key to ensuring that these components work well together by reinforcing relationships and sharing resources. Importantly, Putnam (2000) notes that such a process is self-reinforcing, in that simply working together towards a common goal serves to bind the group further: even if the group is comprised of people from different backgrounds, shared norms, the trust and reciprocity fostered simply by working together help to strengthen ties.

For several reasons bonding social capital is likely to be especially important within CE organisations. Firstly, the time and expertise offered by group members is more often than not voluntary, meaning that members presumably trust others to pull their weight and offer reciprocal resources in kind. Labour may be free, but is not necessarily worthwhile if it is counterproductive in terms of meeting the objectives of the group as a whole. Secondly, most CE groups also require (initially at least) financial backing as

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[48] Of course, such rewards are also needed for one to be satisfied in an employed position, but are perhaps more likely to influence behavior where conventional salary rewards are not present, as in social enterprises.

well as time resources from members to help with buying essential resources and ensure projects get to a point where they are self sustaining. Again trust and reciprocity are considered central in ensuring these initial investments are not unduly at risk from freeloading, irresponsible, or members who otherwise risk that investment. In WREN's case, six directors were directly and substantially financially invested in the organisation. Finally, as discussed previously, the range of possible directions a given CE group can take is as varied as the possible approaches to meet such challenges, so agreement on specific missions and agendas can be valuable. Thus, shared commitment to a particular set of causes, and effective communication in addressing objectives is important.

Within the sociotechnical transition literature, trust and the localness that supports it, has found to be of importance for experimentation in niche projects. Coenen et al (2010) in particular notes that geographical proximity (or physical closeness of actors) is most likely to encourage social networking and help to foster trust through mutuality and reciprocity. This trust (or social proximity) built through mutual experiences and kinship is vital in articulating expectations among niche experimenters (WREN members, in this case): developing promises of future benefits helps to attract interest and mobilise resources, and sets the agenda and writes the script that positions and influences others. Importantly, Coenen et al. (2010) find that such expectations have been found to be most powerful when they describe tangible rather than abstract outcomes (e.g. such as reduced household energy costs), and when they are specific rather than general (e.g. describing a process of energy-related activities rather than a utopian vision). Additionally, a variety of studies have demonstrated that niche expectations are most powerful when shared by an increasing number and variety of actors (Coenen et al., 2010, Borup et al., 2006, Brown, 2003, Smith et al., 2005). In the case of WREN, shared expectation can be considered as key to the strength of group: key decisions are unlikely to be made without mutual understanding of the potential benefits and vision of the outcomes. Additionally, the increasing levels of membership within WREN are considered testament to the local legitimacy of the group. While it may not be explicit, becoming a WREN member implies support for, and a sharing of the group's overall vision and specific agenda.

7.3 Bridging capital: Broadening the appeal of community energy

The importance of human and social capital within community energy groups extends outside of the boundaries of the group and into the wider communities in which they seek to encourage change. As already stressed, the ways in which the local community *values* a local energy approach will be in part down to the impacts of economic and energy resource changes affect people, but will also be affected how social impacts are felt. Indeed, these impacts will be especially important if more tangible impacts (such as locally reduced electricity costs, employment etc.) are not immediate. If bonding capital can be recognised as a key component in the development of WREN as a niche actor, 'bridging' capital is arguably equally as important in helping to legitimise the niche within the wider population.

Niche innovations are "carried and developed by small networks of dedicated actors, often outsiders or fringe actors" (Geels and Schot, 2007). The growth of these networks in terms of increased local support is thus critical to niche development. In the case of the CE niche, bridging capital can be understood as those links between those inside, and those outside, of the core body of CE group members, through which resources external to the original group can be secured.

Furthermore, while the 14 directors of WREN can be considered as bonded (through trust, reciprocity etc.), it is bridging capital that brought them together in the first place. WREN's initial vision can be traced back to two members, and it was their ability to attract and bring into the fold other, previously unconnected individuals that formed what is now known as WREN, especially those whose skills and expertise could augment WREN's existing human resources. Indeed, while local skills are important for setting up CE projects in the first place, the absence of local skills may not limit the potential for success. For example, Haggett et al (2013) found that while local skills do provide confidence and a can-do attitude to get things off the ground, in-house knowledge does not guarantee success and many other factors come into play not least being able to identify gaps in expertise and making the necessary links to external human resources.

7.3.1 Developing local legitimacy

Secondly, as stated in the original WREN business plan, a key objective of the group is to engage the whole population of Wadebridge in energy issues. Forging meaningful links with members of the community is thus considered by the group to be a measure of success. This is important in itself: making progress towards the energy challenges in general necessarily requires widespread engagement of publics, and so engaging whole communities such as Wadebridge may be an important step. The importance of engagement to WREN is also in part a practical consideration, since support and buy-in from the wider community suggests a degree of legitimacy. Indeed, some of the findings that came out of the household energy survey suggested that some local residents remained unconvinced about the potential benefits of local decision-making, citing fears about not being representative of the community at large.

There is a balance then to be struck between bonding and bridging social capital. If too much resource is spent on building bonding capital (by simply running projects without expanding membership), there is a risk of becoming too insular and neglecting the outside community (Putnam, 2000). Spending time developing bridging capital would ensure inclusivity and representativeness, but may limit the resources available for actually carrying out projects.

Again, trust is an important factor in making links with members of the community. As highlighted in the Chapter 5, some household energy survey respondents were automatically sceptical of WREN's intentions because of the perceived potential for WREN's activities to bear winners as well as losers. While it is perhaps inevitable that we will have winners and losers in efforts to change the energy system, this only makes it more important that the group demonstrates adherence to certain principles such as fairness and transparency in the ways it pursues goals. In this sense then, process may in some sense be more important than progress, i.e. building legitimacy through membership and trust is a necessary prerequisite to actually making changes on the ground, with large-scale RE installations for example.

7.3.2 Broadening the appeal

While much of WREN's investment in bridging capital is focused around developing knowledge, support and activity around energy projects, it is also possible for bridging capital to be developed without directly engaging people with energy issues. This is especially valuable since doing so offers alternative routes into bringing the community together. One such approach (common in many CE initiatives) is through WREN's community benefit fund, which seeks to channel profits into a variety of community-related projects. The fund is open to any community project that can demonstrate how additional funds would help the local community, meaning that financial benefits accrued through energy projects are disseminated across the local community. While a proportion of the population indicated wilful disengagement from participating directly in CE (Section 5.5), it could be argued that the fund enhances the relevance of CE to those individuals, i.e. by making clear that WREN is concerned with community as much as it is about energy. Certainly it provides the community with a real and near-immediate stream of benefits resulting from CE, itself an important factor in developing trust in WREN's activities as already discussed.

Additionally, depending on where the fund is awarded it has the potential to bridge the divide between energy issues and wellbeing, as all beneficiaries are directly or indirectly involved in addressing local social issues, although this was not a prerequisite of obtaining funds. However, several interviewees from beneficiary groups highlighted that their organisation's activities extended past their formal remit, meaning that incoming funds have the potential to have multiple, and often socially-directed impacts. These include formal and informal support roles. For example, the local food bank also provides a “free hot drink, a listening ear and additional support where needed to break the cycle of poverty” (Interview 16). An interviewee from the marine conservation group meanwhile stated how important participating (in the group) was for some volunteers, particularly for elderly individuals who were dealing with ill health and bereavement (Interview 14). For other organisations funds had spillover impacts to other groups: the youth group minibus whose purchase was supported by WREN funds was also to be used by the local Age Concern organisation, as a potential lifeline to isolated rural households (Interview 15).

That social organisations have the propensity and capacity to support other social organisations is important in itself. All of the groups contacted emphasised that funding in general was extremely difficult to come by and required considerable resources to seek funding sources and fill out applications. One saw attracting funds as a “full-time job”, meaning that receiving the WREN fund allowed the group to breathe and stop fundraising for a while (Interview 14). Another group highlighted that the fund was vital in helping to attract and snowball additional match funding. With one key goal of most groups being to become self-sustaining to help focus on key goals, this peer-to-peer support of social organisations is extremely important, and the role of WREN and other CE groups in this regard cannot be disregarded.

Aside from through the community benefit fund, WREN has sought to engage with a wide range of community members from children, through talking to school classes to the business community through being active in the town’s chamber of commerce. Additionally, the group’s premises (the “Energy Shop”) in Wadebridge’s town centre serves as a visible and accessible manifestation of the group’s readiness to bridge the group-community divide. Indeed, the shop is somewhat unique in that it provides a place for energy issues, which can be both complicated as well as sensitive, to be discussed in confidence. Some use the shop as a first point of contact in enquiring about domestic RE installations, and is valued as a neutral provider of information amid a potentially otherwise confusing landscape. Others are able to discuss concerns about energy costs and indeed, more general issues related to inadequate, poorly insulated housing and their effects on wellbeing:

> "This particular chap it was more to do with the state of the house. There was mould growing up all the walls, and I could see looking at the photographs what some of the problems were. There was clearly an issue with the gutter that was probably blocked or overflowing, and that was causing damp on the inside, and some serious condensation issues. It was probably 70s built social housing…not ancient. Definitely got a cavity, probably not cavity insulation. If we have to embarrass the council into getting it done, then that's a shame" (Interview 1)

While the issues described here of general housing quality, the links to heating and home comfort are clear, and for this person the Energy Shop was seen as a sensible source of advice and providing a service that others had not seemed to be able to. The accessibility of the shop is likely influential in facilitating bridging interaction with Wadebridge residents. Indeed, it means that WREN has the capacity to develop bridging capital passively whilst still actively engaging the community through other means. Trust, as already mentioned, is extremely important in building bridging capital: the individual referred to in the passage above exhibited trust in WREN to help address issues with his home, for example. Additionally, the shop itself provides both a hub for social networks and a conduit for effective information channels, and both, along with trust seen as vital components of social capital.

7.4 Linking capital: reforging local energy governance

WREN and its impacts do not exist in isolation. Rather, it is part of a wider network of grassroots CE initiatives operating in the context of both support and hindrance on the part of political institutions at local, regional and national levels including Government departments (notably DECC), Ofgem as energy regulators, the DNO (Western Power Distribution) and Cornwall Council departments (primarily economic development and planning). The ability of WREN (and other CE groups) to relate to and negotiate with these kinds of institutions is vital if CE is to have any future.

Linking capital in the current context then refers to the relationships WREN forms and develops with those institutions that hold influence over WREN, and indeed the wider CE sector. If bonding and bridging capital are about ‘getting by’, and ‘getting ahead’ in life, linking capital is concerned with making things happen by *creating* rather than merely taking opportunities. This is especially important in the context of the energy system, as incumbents actively oppose and constrain the actions of new entrants and new business models.

Sector learning is understood to develop through the networking (linking) of niche actors with sector intermediaries, in terms of the abstraction of local lessons towards more general principles (Kemp et al., 1998, Schot and Geels, 2008). Furthermore, direct networking can also take place between practitioners and incumbents, such as policymakers, creating opportunities for aligning practices with policy, and vice versa. In this context, linking capital and the opportunities it affords are important factors in initiating whole system change.

7.4.1 Building supportive niche networks

With reference to sociotechnical transition theory, the strength of actor networks is an important factor in determining the form, direction and rapidity of transition (Schot and Geels, 2008). For example, an increased number of engaged participants both from within the niche and in supporting organisations contribute to the *articulation of pressures* which challenge incumbent actors to support burgeoning movements (Smith et al., 2005). Furthermore, the interaction between niche actors and incumbents is important in terms of guiding and shaping transitions, particularly by aligning expectations and sharing of resources between stakeholders, including information (Rotmans et al., 2001, Kemp et al., 1998)

Niche-regime interactions can play out as direct or indirect processes. In documenting the emergence of CE intermediaries, Hargreaves and fellow authors chart three distinct ‘waves’ responding to a shifting funding and policy landscape (Hargreaves et al., 2013):

- A first wave of pre-1990s organisations (e.g. Centre for Alternative Technologies, Centre for Sustainable Energy) focused on encouraging alternative (or ‘appropriate’) technologies and the ‘soft energy paths’ they can facilitate;
- A second wave comprising organisations (e.g. the Energy Savings Trust and Community Renewables Initiative-supported regional initiatives) to manage spending of public funds;
- A third wave of independent organisations and wider interest from think tanks and NGOs to provide support and advice to the burgeoning CE sector, largely stimulated by the emergence of FiTs and RHIs for small-scale developers

The current structure of CE intermediaries comprise all three layers, each supporting CE within the context of their own contexts (Ibid). While the first wave, which were driven largely by the appetite for self sufficiency and different approaches to technologies, the next two waves were supported by central Government, first under New Labour’s new-localism and latterly through the Conservative-Liberal Democrat Coalition’s Big Society agenda, and it is in these waves that CE has gained mainstream momentum. This suggests that while CE is viewed as ‘grassroots’, the development of the sector has both been helped by and acted as a catalyst for the growth of a supportive network of intermediaries[49].

Such a network of intermediaries is considered central to the development of CE as a niche, not least because it establishes what Geels and Deuten (2006) term the ‘creation of institutional infrastructure’, which enables the “gathering and interaction of actors, the exchange of experiences and the organisation of collective action” (Ibid). Hargreaves et al (2013) also highlight the role of

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[49] While it is true that most CE groups can be described as grassroots, i.e. self starting, most would agree that external support (particularly financial opportunities afforded by the FiT) have been critical in their development

intermediaries as extending to brokering and managing interactions with other actors, including energy companies, developers and policymakers. This role is seen as an important step towards mainstreaming CE, either through drawing interest and finance from private developers or by lobbying Government for changes to CE-related policy or wider energy policy reform. Either way, the creation and development of these networks both contribute towards a form of directional coherence through an articulation of selection pressures (Smith et al., 2005) in such a way as to negotiate with and challenge the incumbent regime.

The relationships between CE and outside actors are developed over local as well as national scales. Locally, WREN formed alliances with a number of key organisations (and the human capital therein) that helped to strategize, plan and implement activities. These included Green Trust Wind/Communities for Renewables (a CE-focused social enterprise who has provided assistance with technical and financial aspects of projects), Community Energy Plus (a local energy-focused charity with experience in administering efficiency measures). Existing links with the town council and the Chamber of Commerce were instrumental in attracting support from local decision-makers and the business community.

7.4.2 Niche-policy advocacy

For some groups, including WREN, affecting the politics of energy is as important as affecting local energy systems and indeed, evidence suggests that such work is important part of niche development (Smith et al., 2015, Smith et al., 2014).

For example, WREN's presence and relationship with individuals and institutions from outside of the network have been important in moving forward the CE conversation as a whole. Of primary significance is WREN's representation on the Community Energy Contact Group (CECG), a practitioner focus group established by Greg Barker to identify and address the needs of CE groups across the country in the context of Localism and exploring the opportunities for communities to play a "significant role in the transformation of the UK energy systems" (DECC, 2014a). The group set the agenda and significantly fed into the Government's first Community Energy Strategy (DECC, 2014b). For DECC, the contact group established a single, manageable point of contact for the sector, though there is evidence that for some CE groups, the reduction of CE to a single voice was seen as relenting again to a minority-led top-down agenda (Hargreaves et al., 2013).

It is not incidental that all of the founding members of the CECG representing CE groups occupied (or had previously occupied) executive or senior positions in their fields, only some of which were energy or sustainability-related. Additionally, several held positions either in or well aligned with policy, including the WREN representative, who held a senior position in the NHS. Such experience and competence was felt to be of considerable value in being able to speak at an appropriate level:

> "He's very good at picking up on new angles and very good at tapping into the right people, partly because of the positions he's been in in the past, dealing with Government ministers." (Interview 1)

While it is not clear that the ability to network was a prerequisite for joining the CECG, it doubtlessly helped, not least in having the capacity to converse around complex issues. This high level of competence and ability to engage at a high level is undoubtedly related to human capital, not least educational attainment. There does appear to be a correlation between human capital and (the ability to nurture) social capital: CE leaders are often well educated and often have many years of experience in a professional capacity, making them well disposed to the importance of directed and purposive social networking. While this relationship makes sense in terms of building linking capital, it is less clear that this extends to all forms of social capital, particularly when class stratification is considered. For example, Gamernikow (2003) documents disagreement in the literature around whether social capital is an inevitable outcome of education itself, or if it is a sign of social and educational advantage, i.e. whether social capital is embedded in, and contributes to the reproduction of, social stratification.

WREN has also been active within local policy circles, with the group's progress lauded by Cornwall Council as something of a regional exemplar. While such a relationship has proved mutually beneficial, some interviewees indicated concern that this meant that the Council was neglecting the needs of other CE groups, who also may have been making progress but who didn't have the presence of WREN. On one hand, this use of linking capital was thus seen as a potential threat (to other groups), but on the other placing WREN on a pedestal meant that that it was in danger of becoming "too big to fail", i.e. that as long as WREN - as something of a flagship scheme - was supported, CE in the region more generally more generally would be safe.

It is in issues such as these that the micro-political aspects of CE come to the fore. Several interviewees stated that despite the intricacies of technologies, planning, and economics, the success or failure of CE all hinges on personal relationships (Interviews 2 & 11). Such relationships are necessarily both strategic and political in nature, and require a strong set of leadership and personality competencies. Bridging and linking social capital is then key to navigating the politics (at both national and local scales) of energy system change, not least because of the importance of local support and acceptance of technologies, managing stakeholder expectations, and the balancing of democratic participation and autocratic action. It is no surprise then that community energy in any given region is likely to be made up of a handful of key stakeholders who lead local CE efforts and act as stalwarts for energy system change. While CE is often considered to be about *people power*, it is powerful people, i.e. a small number of leaders, who appear to be instrumental in shaping and driving change.

Aside from engaging with political processes, interacting with the Distribution Network Operators (DNOs) is seen by some commentators to be of fundamental importance in addressing the challenges associated with the installation of medium-large scale RE (Simonds and Hall, 2013). This is particularly important where there are grid constraints (such as in Cornwall) especially as commercial developers have the resources to be able to move quickly and saturate available grid capacity, either by themselves or through consortia building to fund grid upgrades (Communities for Renewables, 2013). The relative infancy of CE in the UK means that such technical and institutional barriers are commonplace, and that dialogue between CE practitioners and intermediaries and incumbents, such as DNOs, the regulator and the Government are required to identify and overcome these issues. WREN has made important steps in this regard by initiating collaborative links with the DNO as well as other organisations with interest in strengthening the local energy system.

However, it is not only engagement with those in levels of authority and influence that is important. Indeed, the importance of engagement within multiple actor networks is a key theme across the CE sector, meaning that linking capital is a necessity rather than an ancillary attribute for CE practitioners. For example Seyfang et al. (2012) survey of 354 groups highlights that the opportunities afforded by outside organisation networking was seen as the second most success factor only to the group's own qualities[50].

Networking in this context referred to a broad set of relationships with Local Authorities, other CE groups, businesses, schools, NGOs/charities, and National Government Departments, and making links with a range of organisations is likely to require a breadth of skillsets. In WREN's case, there was a clear division of labour among directors between networking tasks: for example, a director who had existing contacts within the local business enterprise community was charged with managing relationships with local businesses, while another director with a background in finance could liaise directly with finance-oriented intermediaries.

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7.5 Leadership

Although social capital is clearly central to the processes and outcomes of community energy, the creation and momentum of CE is fundamentally underpinned by human capital. Indeed, given the multiple layers of barriers CE groups face, the importance of human capital for CE in general has been highlighted elsewhere (e.g. see (Haggett et al., 2013, DECC, 2014b, Houghton, 2010, Martiskainen and Watson, 2009), and leadership itself has been identified as an important factor in successful CE projects (Seyfang et al., 2012, van der Horst, 2008).

The range of competencies required of CE groups is vast, and depending on the context can require expertise in community engagement, website development and social media, technical issues, finance and accounting, project management, business planning, planning and legal issues, and project evaluation (DECC, 2014b). However, it is the manifestation of personal qualities in the leadership of CE groups that influences the speed and direction of CE efforts, and consequently the movement as a whole. Three key roles of CE leadership can be identified in relation to human and social capital: group formation, maintenance of momentum and niche policy advocacy.

7.5.1 Group formation

While community energy groups may ostensibly be run by the 'community', the role of influential leadership in these groups, and in the sector as a whole cannot be understated. As with WREN, around 60 per cent of groups are set up by individuals (Seyfang et al., 2013) meaning that the majority of groups were reliant on the one or two individuals to act on perceived failings and opportunities within the energy system and be both willing and able to draw in form a group to draw other members to the cause. This suggests the need for considerable human capital in terms of the knowledge needed to be able to identify problems and potential solutions in the form of a local vision, the ability to encourage and mobilise others, and the will, determination and tenacity to drive ideas towards tangible outcomes.

Vision creation is particularly important here, as it helps to create a salient narrative around local issues, enlightening others to problems, and establishes expectations around the benefits to be gained from acting, both of which are considered important processes in niche development (Hargreaves et al., 2013, Coenen et al., 2010, Kemp et al., 1998). While a group's vision can be shaped by process of negotiation, for some groups, the vision of key individuals (as discussed in Section 7.2.2) was instrumental in guiding the rest of the group

7.5.2 Maintenance of momentum

In such a challenging, resource-scarce environment, the need for optimism and determination was considered vital in taking projects from inception to delivery, as highlighted here:

> "You need to believe that you'll find a way through anything…sooner or later. People might say "what's your business plan?. You shouldn't be doing this if there's not a business plan."…And we say…we will find a way through it." (Interviewee 3)

For this participant in a burgeoning CE group, faith, determination and vision was considered more important than other forms of capital, the sentiment being that without such traits, other key pieces of organisational or financial capital that would be needed to take their project to the next level could never be attracted. Where benefits can be social rather than financial, value must be believed in and promised by creating a 'market of expectations' (Kemp et al., 1998) before it can be realised.

Previous portrayals of CE practitioners as 'retired engineers' sought to communicate the importance of time-rich, technically minded tinkerers in driving the sector (IET, 2013). However, while understanding and overcoming technical challenges might be important, they are likely to be secondary to more fundamental attributes such as determination and belief, and the ability to form and communicate a vision, attributes which may be more difficult to 'buy in' than technical expertise.

In WREN, several directors made clear that the group Chair was instrumental in identifying opportunities and holding the Group's overall vision, and that there was a process of the rest of the board "catching up" with the next big idea:

> He (the Chair) doesn't necessarily set the agenda, but he does have the vision to see the agenda in the first place. Sometimes I think "what's this one about?"…a couple of days later I get it, and off we go. (Interview 1)

This suggests that considerable faith was placed in the Chair in identifying opportunities and appropriate pathways for moving forward, a position. The relationship between the Chair and the other board members was clearly then one of trust: Trust by the board (and indeed the wider community) in the various strategies and approaches presented, and trust by the Chair in the board to be capable of being able to deliver this vision.

7.6 Summary

This chapter explored the concepts of human and social capital, and discussed their importance in relation to the development of WREN. In summary, the chapter suggested that human capital, along with three types of social capital: bonding, bridging and linking have all played significant roles in WREN's evolution.

Bonding around common interests and goals around energy can be related to previous learning and relationship building around a previous project. The appeal of these interests and values were also instrumental in bringing in a core membership with a range of valuable experience and expertise. Legitimacy within the community is shown to have been dependent on the availability and deployment of bridging capital, which for WREN has been achieved by broadening the appeal of the programme, by, for example making energy relevant to wider needs and aspirations of the community. WREN's ability to gain political legitimacy within both local and national government is related to linking capital and associated human capital attributes. Finally, leadership is discussed in relation to the importance of specific personal qualities in forming and maintaining momentum in CE’s evolution.

8 The growth and diversification of community energy in the UK

Of course, over the course of this research, WREN has not developed in a vacuum; it has evolved in parallel with a multitude of other CE groups across the UK, with the growth of citizen-led energy more generally, and within the context of (and in response to) considerable changes to the energy system and to energy policy in general. Moreover, the impacts of the sector are not only local, but have national consequences in terms of both the aggregation of local impacts, and the broader evolution of the sector to comprise an increasing diversity of actors, approaches and impacts.

While no sector-wide quantification of impacts has been carried out, impacts of the kinds discussed here, and of similar magnitudes have been experienced in hundreds if not thousands of other localities. Moreover, the growth in the number, size and impact of CE during the course of this research has influenced and has been influenced by growing support from a range of actors, including civil society, intermediaries, business communities, local authorities. Recognition of the sector by national government has come in the form of the development of the UK's first Community Energy Strategy

This chapter thus moves on from analysis of a single project to consider the impacts of the community energy sector, as well as of citizen-oriented energy as more broadly defined. It first offers a critique into the importance and of expectations, networks and learning as three elements considered in the transition literature as critical to the development of niche innovations. Recognising that CE does not develop in a vacuum, it then discusses how ongoing change in the broader context of the energy system is opening up opportunities for both CE, particularly through the process of the democratisation of energy. The chapter concludes with reflections on how other actors beyond the traditional CE niche are adapting to these opportunities, particularly as a response to pioneering approaches taken by CE actors.

8.1 Consolidating approaches, aggregating impact

In seeking to understand the aggregative impact of local projects on wider sociotechnical change, Strategic Niche Management (SNM) offers one analytical perspective. This approach emphasises the role of networking and social learning in reinforcing positive expectations around an innovation (Hoogma et al., 2001, Kemp et al., 1998, Schot and Geels, 2008). Community energy thus represents an innovation whereby aggregation of impacts and learning from local experiments contributes to a ‘global’ level of shared rules, which are then abstracted and disseminated back down to niche actors via intermediaries (Seyfang et al., 2014, Hargreaves et al., 2013), culminating in the standardisation and institutionalisation towards a more efficient innovation trajectory (Kemp et al., 1998, Geels and Raven, 2006, Geels and Deuten, 2006).

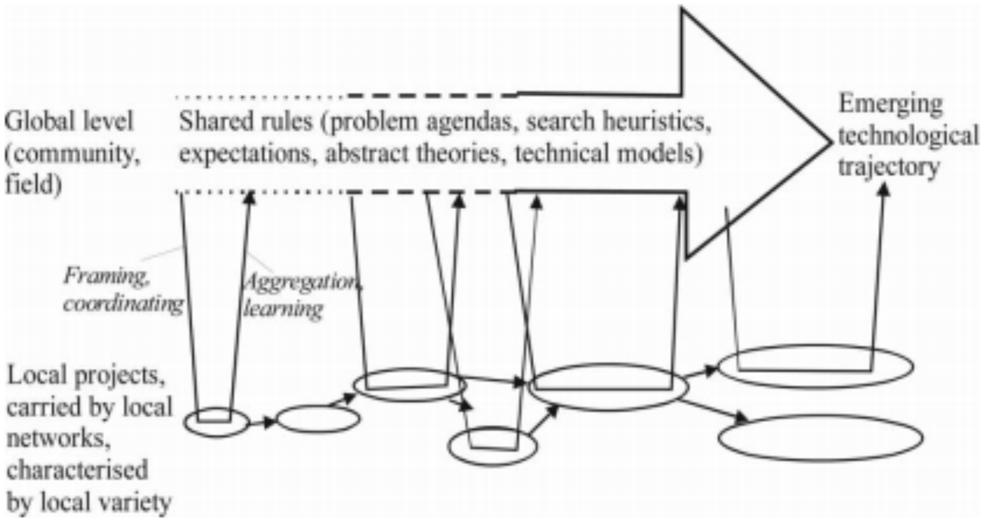

Figure 8.1 Local projects, global rules, and an emerging innovation trajectory

Previous work, notably Seyfang et al (2014) has sought to understand the growth CE with respect to SNM. Specifically, these authors considered three factors identified by the transition literature as influencing the direction and outcome of niche development: expectations, networks and learning. This section reflects on these findings and critically examines the use of SNM as an appropriate analytical framework for understanding CE

8.1.1 Developing expectations around community energy

In order for community energy to progress from isolated projects to a coherent niche, they must first demonstrate value to those stakeholders able to influence its evolution. However, since niche innovations are, by definition not market ready, they do not have current market value and must instead rely on promises that future performance is valuable (Kemp et al., 1998). As such, niche formation and development is dependent on the ability of stakeholders to understand and realise expectations around the benefits of an innovation. Niche formation in other words is reliant on the development of a 'market of expectations' (Ibid) around an innovation, thus making the evolution of which a self-fulfilling prophecy (Geels and Deuten, 2006).

The stakeholders within CE of course spans a wide range of actors capable of influencing the trajectory of the movement, including CE practitioners themselves, but also the business community, intermediaries, policymakers, and civil society. Such actors can either exert influence positively or negatively, i.e. a local population supporting or opposing a CE development, or a Government department enabling or constraining local ownership of energy assets. Furthermore, influence can be imposed both directly, through the deployment by DECC of a CE-directed policy mechanism for example, or indirectly, through increased support for large-scale generation with opportunity costs relevant to small-scale technology deployment.

However, while UK energy policy has so far been supportive of RE deployment in general, CE has developed *in spite of* rather than *because of* directed support for the movement. This has been explained by the inability of the Government to recognise value in the non-market goals of community energy in ways that civil society can, perhaps because of the dominant market paradigm that defines current Government. For policymakers to support community energy, it must simply be able to demonstrate cost-effective delivery of energy policy goals, which clearly ignores the wider benefits it can offer, for example to social innovation or transformational change.

Professionalization of parts of the movement go some way to satisfying the expectations of policymakers. Under such professionalization, robust business plans are central to identifying and communicating visions and deliverables; stakeholder confidence is central to local legitimacy; and financial sustainability is the endgame. However, policy support only for CE groups of this mould does naïvely assume that all CE groups are similar in terms of drivers, values, objectives, and approaches, which clearly is not the case.

Expectations around community energy are thus shaped by perceptions and actions of a large set of actors, whose agency and interests vary widely. Though linked, a distinction can be made between local expectations, which develop around specific CE experiments searching for viable local solutions, and 'global' expectations around functionality, which arises in part from aggregation of local lessons, but more strongly from external circumstances (Figure 8.2), such as the availability of RE support. For community energy to flourish then, it must prove capable of marketing expectations around the technological and social innovations that comprise it, and simultaneously to local and 'global' actors.

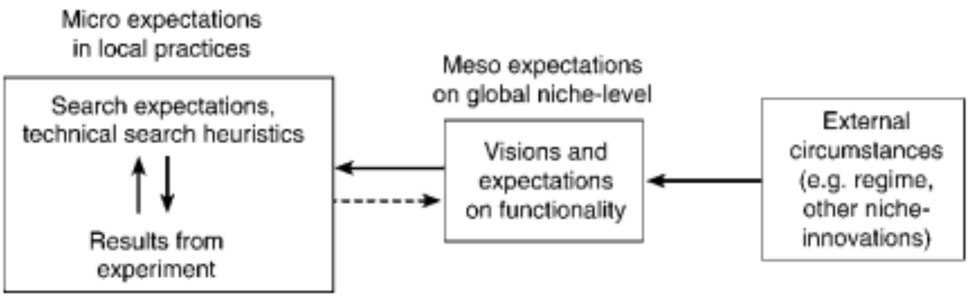

Figure 8.2 Relationships between levels of expectations

Source: Raven (2005)

The literature suggests that expectations are most powerful if they are shared by many actors, credible, specific and coupled with societal problems (Kemp et al., 1998, Coenen et al., 2010, Borup et al., 2006, Brown, 2003, Smith et al., 2005). To what extent do these criteria hold when considering community energy as a niche?

8.1.1.1 Shared versus diverse expectations

As Geels (2006) suggests, shared, positive expectations help to align actions towards promoting the development of niches, particularly where cognitive rules (such as goals, problem agendas, problem-solving strategies, current theories, tacit knowledge, design methods and criteria) are also shared. In terms of the development of a shared vision *within* the community energy sector, Seyfang et al argues that plurality in both rationales and vision within CE results in an overarching niche that does not yet communicate any coherent vision (Seyfang et al., 2013).

This does not suggest that CE is unable to develop without coherence, only that the framing of CE as a niche, and the use of SNM as an analytical tool may well be inappropriate. CE comprises a multitude of technological and social innovations in different configurations, such that expectations of CE at both local and global scales may be affected by expectations and perceptions around specific technologies. For example, if one’s only experience with RE has been negatively affected by commercial ventures (with minimal community engagement or community benefits), it may be difficult for the promises around fair processes and outcomes of community energy to find traction.

Furthermore, a niche understanding of CE supposes that cognitive rules are shared between stakeholders, which is unlikely given that the grassroots nature of CE is synonymous with subaltern goals and objectives. For example, the radical drivers behind many CE practitioners can contradict both commercial and policy priorities through pluralism of social, environmental and economic objectives. As a result, policies that encourage ‘professionalization’ of CE may be frustrated, as many groups wish to remain niche and eschew professional norms of commercialisation and competition (Seyfang et al., 2014).

The credibility and specificity of expectations relates to the ease in which they refer to measurable outcomes, and although this is possible for most aspects of community energy, it is more difficult for others. For example, while the financial outcomes of community wind ownership might be easily understood and communicated, the benefits of other projects focusing on community participation and democracy may be more nebulous, indirect and subjective, and are thus more difficult to convey. However, the apparent failure of the CE sector to produce specific and credible expectations is a consequence of its diversity, which is only an issue when viewed under an SNM spotlight.

In light of the diverse and pluralistic nature of CE, it seems inappropriate to pigeonhole CE into a tightly-defined niche, if only that it risks closing down innovation around different approaches, with different resources and towards different objectives (Stirling, 2014a, Stirling, 2015, Seyfang et al., 2014). Rather, diversity resulting from the movement's grounding in civil society, grassroots innovations and sustainability (understandings of which are also pluralistic) brings inherent strength to the sector, not least because it opens the door to being able to address multiple objectives at once (Seyfang et al., 2014).

8.1.1.2 Linking energy with societal issues

Aside from expectations being shared, credible and specific, it is also suggested that expectations around innovations can be powerful if they help address a range of societal problems (Kemp et al., 1998). This thesis suggests that this aspect of expectations is particularly relevant because of both the plurality within community energy and because the scale in which it operates is relevant to people and communities. From a pragmatic perspective, social framings can also help to legitimise local energy governance. It is from here that sensitive framing of CE emerges as a lynchpin in maximising stakeholder support, both for the sector and for individual community groups (Hargreaves et al., 2013, Geels and Deuten, 2006)[51].

As chapter 5 discussed with reference to WREN, many CE initiatives frame energy objectives only as incidental to social objectives. For example, while drivers may include helping to meet national renewable targets or emissions reductions, they are often more fundamentally interested in the social impacts of change (such as the redistribution of wealth) and indeed are often bound as social enterprises to act towards such goals.

Focusing on community-specific objectives is possible because CE groups are usually embedded within communities, and become more so as (particularly bridging) social capital grows. Additionally, energy often intersects with other issues more directly relevant to households, such as poor quality housing, health, employment and inclusion, providing opportunities to address individuals' wellbeing more directly than broader policy measures. The ability of CE groups to understand and help address such a wide range of issues means that CE becomes both appealing to a broader audience than would be possible by focusing purely on energy, and legitimises CE groups as new actors within local energy systems. CE organisations thus have the potential to inhabit a valuable position of trust previously absent from the energy system.

Expectations around redistributing wealth is especially persuasive in the context of both increasing energy bills and decreasing trust in energy companies, and the framing of CE has developed to reflect this. As the

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[51] Of course, it is the diversity and plurality within CE that enables it to be sensitively framed to satisfy the needs of a range of stakeholders. This suggests that while CE may not currently be coherent enough for some stakeholders (specifically those looking to professionalise CE), plurality and diversity within the movement lends itself to co-option by other stakeholders.

proportion of CE-led RE increases, the ability to extract and retain value in the form of ownership and management of energy assets, including generation but also networks also increases. The development of both technological and social capital within CE initiatives is paving the way for a shift in dominant framings and aspirations away from 'local economic resilience' towards 'local energy supply'. While the latter does imply the former, it also importantly contains more direct connotations around wresting control from the Big Six and implies a new form of energy democracy.

In terms of alignment with wider societal goals, expectations around local energy markets goes some way to capturing the transformative nature of the movement. Paradoxically, this may mean emphasising not only its contribution towards current energy objectives, such as decarbonisation, but also its role in more progressive terms through addressing wider social issues such as inclusion, democracy, justice and equity. The notion of the democratisation of energy in this sense includes not only the distribution of wealth-creating potential among society, but the distribution of power and agency in having more prominent roles within energy system governance.

8.1.2 Networking with civil society

Past discussions of networking have focused on the development of links either between niche innovators, i.e. between CE groups, or between groups and intermediary organisations (Seyfang et al., 2014, Hargreaves et al., 2013). To this end, the growth in the number of CE groups over the last few years has created increasing opportunities for between-group networking, particularly as more and more groups are created in proximity to existing groups. This growth has stimulated the development of administration-wide representative bodies in the form of Community Energy Scotland, Wales and England (in 2008, 2012 and 2014 respectively), all of which have further enhanced opportunities for networking both horizontally and vertically.

However as previous chapter also highlighted, networking with civil society is at least as important, particularly as the resources these stakeholders hold has consequence for the success or failure of individual groups. These resources include physical assets (such as rooftops and land for siting RE), financial capital (by way of investment in efficiency and RE technologies), and social (such as the trust and support which legitimises the actions of groups). As Chapter 7 discussed, building social capital by way of membership and support was an important outcome for WREN, and indeed is seen as an important strategy for many CE groups.

The importance of civil society to CE as a grassroots innovation distinguishes it from conventional sociotechnical innovations somewhat. While the latter does acknowledge the role of social networks, including civil society, in shaping niche development, their role tends to be limited to adopters of innovations (Verbong and Geels, 2007). Grassroots innovations by contrast are activities *of* rather than *for* civil society: the innovators are members of civil society, and the innovations often comprise social innovations around new ways of social organisation (Seyfang and Smith, 2007).

As such, community energy cannot be considered in isolation from the communities in which they are embedded, and from which they have grown. The groups that carry out CE may be formalised, legal entities with a small core of active members, but their vision and actions are shaped by the needs and constraints of the wider community. As such, policies that seek to develop CE must have at their heart acknowledgement the inseparability of CE groups from their civil society foundations, for example by providing directed support for building social networks.

8.1.3 Learning within community energy

Strategic Niche Management (SNM) theory posits that the development of local, context specific projects coalesce into progressively coherent networks of learning through the growth of networks and intermediary organisations (Geels and Deuten, 2006). Figure 8.1 illustrates this linear progression, from a set of isolated *local* projects (with no networking or knowledge sharing); an *inter-local* phase of increased knowledge-sharing within networks (which initiates formation of a coherent niche); a *trans-local* phase of systematic sharing of knowledge as a more abstracted level; and a *global phase*, whereupon institutionalisation and standardisation establishes dominant cognitive rules, with profoundly frame and influence the further development of local practices (Geels and Deuten, 2006).

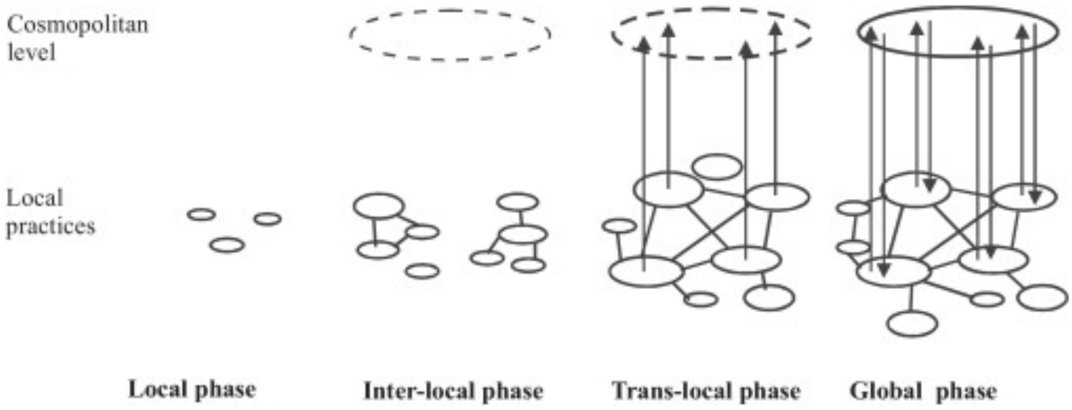

Figure 8.3 Phases in the development of shared knowledge and niche coherence

Source: Geels and Deuten (2006)

Seyfang et al's analysis of community energy as a grassroots innovation found that the sector in 2013 displayed some knowledge sharing, but that this mostly took place between groups, i.e. at the inter-local phase. While learning was found to be of particular importance for individual group development, the authors did not consider learning structures to offer prospects of challenging the regime, at least under the framework of learning set out by the SNM (Seyfang et al., 2014).

While this thesis broadly supports Seyfang et al's findings, CE has continued to expand significantly over the last few years, both in terms of the number of active groups, as well as associated intermediaries. The formation of representative bodies (as discussed above) represents progress towards a better-developed institutional infrastructure, facilitated by more networking by way of conferences and workshops, and informal networking through the increased proximity and contact between practitioners.

Several pieces of nuance can also be added to current understanding of learning in CE. First, not only is the configuration of resources important for

CE groups (as discussed in the previous chapter), different forms of information appear to have different value according to the needs of groups at a given time. The generalised knowledge available obtainable through training and advice from intermediaries for example is of general use at a group's beginnings, but the availability of ad-hoc advice from peers is valuable in terms of being able to tackle problems as they arise. The value in these mentoring relationships was in turns both practical and pragmatic: Other groups had 'been there' and might have the answer to a particular problem, or they were 'at the coal face' and encountering similar issues, so the groups could thus provide moral support to one another. In such a challenging, resource-scarce environment, the need for such moral support and optimism, between as well as within groups came up time and time again.

Second, while in some senses the communitarian ethos of the CE sector encourages a sharing economy, resource scarcities paired with competition between groups may mean that sharing is not automatic. Whether or not groups are willing to share learning depends on perceived losses of doing so, i.e. the chances that other community groups can use such learning to get ahead. This suggests that to get ahead, there is pressure on groups to tend more towards the 'enterprise' end of the social-enterprise spectrum.

8.2 Articulation of selection pressures: a shifting context

Community energy is not emerging into a vacuum; rather, its development can be understood in relation to momentous shifts in context in terms of science and technology, politics, and culture. Such broad shifts present new opportunities and constraints on the current energy system, and are thus instrumental in affecting the shape of decision-making, and its ultimate direction. This section considers these broad pressures and discusses how they are likely to impact on the development of community energy in the UK.

The literature on sociotechnical transitions suggests that for innovations to have transformative impact on systems, having coherent niches is only part of the picture (Kemp et al., 1998). Policymaking can of course be influenced by the emergence of new innovations, but only insofar as power and politics allow (Smith et al., 2005, Meadowcroft, 2005). In other words, whether or not niches break into the mainstream is also dependent on whether the pressure on regimes is such that niche innovations start to appear attractive to regime actors (Smith et al., 2005). As Smith et al (2005) state, “without at least some form of internal or external pressure…it is unlikely that substantive change to the developmental trajectory of the regime will result”(Smith et al., 2005).

Selection pressures of course include the emergence of innovative niches themselves, but can also be exerted by ‘landscape’-level pressures affecting the technological, economic, political, and cultural context (See Figure 4.2). This section thus discusses several key pressures relating to the emergence of community energy as an appealing prospect for actors within the current UK energy system.

8.2.1 Democratising effect of small-scale technologies

A large part of CE is about gaining control over the way energy is produced and consumed in a locality. Such control may be important by itself (especially if subsidiarity in energy issues is considered important), but importantly facilitates the empowerment of communities by way of localising both assets and their value. By virtue of their size, safety, cost, and ease of deployment, the technologies in use by CE groups today are far more amenable to distributed ownership than large-scale fossil fuel technologies. In short, small-scale technologies are in effect democratising the energy system.

The democratising potential of small-scale energy was a key driver of their early development of RE technologies. The first electricity from wind power was produced in the late 1800s, bringing together recent advances in electrical engineering with turbines originally developed to provide mechanical power for milling and pumping (Rivkin and Silk, 2013). Over the next few decades, technology was driven variously at small-scale by their use in rural farms unconnected to supply networks, and later at grid-connected utility scales as their use in avoiding fossil fuel shortages (Vestergaard et al., 2004). Incremental improvements in the price/performance ratio at a range of scales means that generation from wind is now efficient enough to be economically feasible for a range of users at utility, down to community and domestic scales.

Solar electricity's beginnings can too be traced to the late 1800s, though early experiments with selenium were vastly improved by the use of silicon in the 1950s (Perlin, 2013). Advances in electronic engineering enabled their use on space applications through the 1960s and paved the way for further improvements, and experiments with terrestrial applications in the 1970s (Ibid). These were initially limited to remote locations with no grid connectivity, particularly in marine settings, but became increasingly relevant in grid-connected settings to reduce domestic electricity costs, the growing employment of which has driven rapid improvements in price/performance ratios in recent decades (Fraunhofer ISE, 2015).

While CE may of course employ other technologies, the stories of wind and solar illustrate how RE has evolved in large part to meet the needs of society at a scale relevant to the user. The scale and modular nature of solar PV means that it is particularly suited to domestic settings, bringing significant benefits in terms of avoided electricity costs, and for a level of investment in line with household finances. The physics of wind technology means that unit efficiencies increase dramatically with increased size, meaning that wind power is most feasibly deployed at community or utility scales.

While centralised technologies may have for the most part satisfied societal needs up of the past, emerging energy technologies have coevolved with society's need to have cleaner, more affordable, and more secure energy. To that end, increasing deployment of RE by an increasing numbers and diversity of owners is democratising the energy system in ways that would not be possible with traditional technologies. As of September 2015, 770,000 PV units had been deployed in the UK (97 per cent of which are under 50kW in capacity), enabling a huge number of households to gain some control over the UK's energy assets, as well as their own energy expenditure.

8.2.2 Embedding consensus around climate change

The environmental pressures of climate change are associated with political, economic and social pressures on the incumbent energy regime to mitigate impacts. These issues have become more widely understood over the last few decades, and society is transitioning from a point of ignorance to progressively broader scientific, political and societal consensus of the mechanics and impacts of climate change.

Isolated theories in the early to mid-1900s were substantiated with increased scientific efforts in the 1970s and 80s to understand the impact of GHG emissions on the climate. This culminated in the establishment of the IPCC in 1988 as the first in a series of attempts to summarise knowledge, and subsequent reports of which communicate overwhelming scientific consensus around climate warming and its anthropogenic drivers (IPCC, 2013). The IPCC and others also makes clear the consensus around the environmental and economic risks associated with climate change (IPCC, 2014, Stern, 2006), and provides the backdrop for global efforts to limit both GHG emissions and associated temperature increases. Despite global variations in both awareness, and perceptions of threats, political rhetoric in the UK appears to reflect global consensus.

This political support is part and parcel of widespread associated societal and corporate acknowledgement of climate change and its implications. There are significant global variations, but the majority of the UK public both believe in climate change, accept that anthropogenic impact is a factor, accept there are risks to people in Britain, and that individually they can and should do something to help reduce climate change (Spence et al., 2010, Parkhill et al., 2013).

Such growing consensus theoretically legitimises governments to mitigate, for example by supporting the development of domestic RE technologies, whilst limiting the use of fossil fuels for energy production. The role of renewable and small-scale energy technologies in reducing emissions is well understood, and again, theoretically provides an opportunity for CE as a body through which RE can be deployed.

8.2.3 Individualistic means for collectivist ends?

Another example of landscape change with relevance for community energy is the creep towards a more individualistic society, away from communitarianism. While CE might ostensibly appear to be driven by a selfless empathy towards enhancing wellbeing of wider communities, it is also possible to relate the drivers and processes within CE to more individualistic notions of autonomy, trust, and reciprocity.

Various studies have documented societal trends towards individualism, particularly in the west. Drivers including increasing complexity and stratification of society, increased secularism, and the growth of capitalism have been attributed to the growth of individualism over collectivism as the dominant doctrine in western society (Allik and Realo, 2004, Durant, 2010, Dumont, 1992).

The protection and encouragement of individual interests over those of the state or wider society forms an important part of capitalism and the basis of Western market-led ideologies previously discussed (Lukes, 2004). This is in part related to political individualism, whereby opposition of interference or obligations by the State or other social institutions. The individual's perception of, and relationship with the state however can play out in very distinct ways, liberalism and anarchism being two sides of the same coin (Brown, 1993). While both moral stances share the emphasis on individual freedom, the former is centred on negative liberty (absence of coercion or restraint), while the latter focuses on 'positive liberty' in terms of the right to agency via self management and equal access to develop personal capacities (Berlin, 1969).

At first glance, these societal and political trends seem to be at odds with the emergence of community energy – and indeed the growth of other communitarian movements beyond energy. One response to this might be that the heightening dominance of individualism provides both the context and a driver for anarchistic struggles by radical subsets of society to create and support niche alternatives, and to resist and encourage radical change.

Both negative and positive liberty dimensions of individualism are relevant here, in the rejection of incumbents as *de jure* holders of power, as well as in the expression of personal agency. In terms of the former, the democratisation of energy technologies provides the means for individuals to challenge norms around energy governance. Indeed, that individuals initiate the majority of CE groups suggests that individual autonomy is an important foundation on which collective autonomy can be built. However, while the absence of restraint is universal, the right to agency is not; it is in examining positive liberty that CE can be more critically examined. For example, it has already been suggested that the unequal distribution of capital within and between communities has the potential to contribute to unequal concentrations of power, and thus liberty.

Individualism can also be examined with respect to autonomy and independence, particularly as they relate to social capital, and the cooperation and social solidarity that define it (Allik and Realo, 2004). For example, divisions of labour, functions and roles in modern society (and indeed in community energy) means that autonomy and independence serves to unite, rather than separate individuals (Durkheim, 1884, Allik and Realo, 2004). As Putnam attests, social capital serves to “improve the efficiency of society by facilitating coordinated actions”, and that individual benefits cannot be attained without collective pursuit of goals, whether collective or not (see Putnam, 2000, p. 124).

This becomes somewhat clearer when key elements of social capital, particularly, trust, reciprocity and shared norms, are examined in relation to individualism. For example, while Chapter 7 highlighted the importance of social capital to the formation and growth of social enterprises, trust, reciprocity and shared norms evidently form the basis of neoclassical assumptions of self-interest: participants must have trust in each other and in the market; reciprocity is central to exchange; and exchanges take place within the agreed conventions of the market. Furthermore, the importance of individualism and self-interest is of course pertinent to society as a whole, as conceptualised by the mutual societal benefits of Smith's invisible hand (Smith, 1776).

This all suggests that the continued rise in individualism does indeed open the door to the emergence of communitarian niches, including community energy. Even though social enterprises may have social (rather than profit-based) objectives, these are paradoxically, but most effectively pursued by those with individualistic morals in terms of expectations of autonomy, responsibility, trust and reciprocity.

8.2.4 Niche development

Last, but certainly not least, niche development itself can be considered an important contributor of selection pressure on the regime. As with other selection pressures, the emergence of promising niche innovations helps to highlight the need for change, but they also present real opportunities for responding to that change.

While expectations, networks and learning developing around CE can be understood as contributing to pressure for regime change, as discussed above it has been argued that the CE sector is currently too incoherent to challenge the established energy regime in any meaningful way, at least according to SNM theory. However, it seems clear that the CE movement is displaying considerable momentum, in itself as well as in its influence across the wider regime. This is observable in the expanding ownership of small-medium scale renewables by individuals and communities, the steady growth of communities of businesses and intermediaries, and the establishment of the UK's first community energy strategy in 2014.

More importantly perhaps, CE practitioners can in retrospect be considered pioneers, in that the approaches and innovations they employ are being increasingly adopted by other actors. It is to this onward evolution of community energy that the final section of this chapter turns.

8.3 Emulation of community energy pioneers

The focus of this chapter so far has been on the groundswell of pressures supporting community energy, and broadly reflects the emphasis on the niche within sociotechnical change literature. However it has been argued that such emphases neglect the importance of politics and power that underpin policymaking, while incorrectly assuming that incumbent regimes are monolithic barriers to be overcome (Smith et al., 2005, Meadowcroft, 2005, Geels, 2014). This section thus considers the role of politics and power in resisting, but also positively responding to pressures to adopt community energy approaches. While many regime actors are clearly resistant of change, it is also evident that some are actively and positively adapting to by way of appropriation of the principles and approaches CE has pioneered.

8.3.1 Material, institutional and discursive regime resistance

In the face of prevailing pressures to adopt niche innovations, Geels (2014) describes three key forms of resistance: material, institutional, instrumental and discursive, all of which contribute to stabilising incumbency and defy pressure to change. The effect of each of these forces can be discussed in terms of the barriers community energy is facing.

Material forms of power relate to the employment of technical capabilities and financial resources to maintain the status quo of incumbents (Ibid). Such power can be seen in recurring promises about the potential of new large-scale infrastructures to deliver upon energy goals. To incumbents, Carbon Capture and Storage (CCS) and new nuclear both represent innovation step changes, but importantly favour established scales of infrastructure and ownership, and a particular form of governance. As such, their familiarity is as potent as that of the silver bullet symbolism they seek to represent. Conversely, small-scale energy is underestimated as contributing only marginally, and understood as incompatible with sunk capital, such as existing centralised generation and distribution networks.

Related to this, *institutional* resistance relates to the effect of dominant political cultures, ideologies and governance structures in strengthening incumbents while actively resisting change (Ibid). For example, the liberal market economic framework through which energy policy are implemented de facto privileges large utilities with greater capabilities and resources than both smaller companies and new entrants (which are small by nature).

Depoliticised governance structures favour techno- economic analysis rather than democratic scrutiny (Kuzemko, 2014, Hay, 2007, Mügge, 2011). Such processes are clearly unsympathetic to community energy, whose non-monetary and distributive benefits are difficult to fit into existing analytical frameworks, such as cost benefit analysis. The inadequacies of established methods of appraisal means that despite DECC's acknowledgement that CE can help address areas of energy policy that traditional approaches cannot (DECC, 2014b), the absence, in the eyes of incumbent decision-making frameworks, of 'robust' ways to capture this provides a rationale for limiting policy support.

Institutional resistance can also be seen in terms of the limited agency the state has in steering change resulting in the energy system from market-led ideology driving depoliticisation (Kuzemko, 2014). It is as a result of such drivers that large-scale energy options continue to be pushed through by regime incumbents, despite being uneconomic, undemocratic, or otherwise unsuitable, as the case for the proposed nuclear renaissance in the UK. This of course has the added effect of shutting out competing technologies, including small-scale technologies. This is reflected also in the wielding of *instrumental* forms of power, referring to the relative wealth of resources (e.g. positions of authority, media access, finances etc) available to incumbents to help meet objectives.

Finally, *discursive* strategies can be employed to shape dominant discourses in terms of both what is discussed, and how these things are discussed (Ibid). Particularly relevant to community energy for example is the degree to which incumbent interests are represented in Government, which extends beyond lobbying, to holding positions within DECC for example, through industry secondments. Subaltern interests in CE can of course seek control over dominant discourses around both prognostic (defining problems) and diagnostic (defining solutions) framings of energy problems (Ibid). This might involve, for example, highlighting climate change as a social rather than techno-economic problem, and thus requiring consideration of social approaches. However, discourse remains to be shaped by a 'discourse coalition' (Hajer, 1995) of policymakers and incumbent firms, who exert far greater power, not least through control of media (Lindblom, 2002).

The importance of discursive strategies was particularly evident in the framing of a raft of changes to energy policy in summer 2015, including reduction of support for onshore wind and solar, and scrapping of several energy efficiency mechanisms. Faced with the challenge of reconciling the perceived need for a continued deepening of austerity measures with climate and energy challenges, Energy Secretary Amber Rudd stated that "climate action is about security, plain and simple - economic security" (Rudd, 2015). Such a statement not only demonstrates an extremely narrow view of energy security, but appeared to look to foreclose any discussion about other objectives, such as sustainability or affordability in the pursuit of austerity-driven short-term cost savings over long-term societal benefits.

8.3.2 Increased market share of independent suppliers

While it is true that many incumbents within the energy regime are resisting change, some key actors are actively adapting to the new energy reality of alternative technologies and engaged communities. In many ways the development of new business models within energy supply are adopting principles and approaches pioneered by the CE sector.

One key group is the utilities themselves, either as innovative business models within established businesses or as new entrants. Many of these new suppliers eschew traditional business models of the Big Six, instead focusing on customer service, and by offering a small number of competitive tariffs, with electricity sourced either wholly or mostly from renewable sources.

Growth in the market share (up to 12.6 per cent in June 2015 (Utility Week, 2015)) of these smaller suppliers has been attributed to a number of factors, including the fact that they benefit from exemption from social and environmental obligations such as the Energy Company Obligation (Ofgem, 2014c). Price rises by the Big Six also stimulated switching to non-incumbents, some of whom were actually able to reduce prices at the same time (Ibid). Although market growth of non-incumbents is not directly related to community energy, it does reflect wider societal dissatisfaction in the ways in which traditional business models deliver homogeneous energy products with opaque pricing and tariff structures. Instead, increased competition means that greater attention is being paid towards gaining and retaining customers, which is creating room for business models seeking to gain customers' trust through offering transparency and better customer service experiences.

8.3.3 Experimentation in local supply

Alongside the new utility entrants described above is an emerging set of entities seeking to develop local energy supply models. Being able to generate energy for local consumption is perhaps a natural progression from conventional CE models, most of which centre around generation and localisation of the value associated with generation. Indeed, while local supply arrangements are not solely being explored by CE entities, they are grounded in, and seek to further develop the main principles, values and goals of civil society movements, including local economic development, socioeconomic equity, environmental protection and self-governance (Hall and Roelich, 2015). Furthermore, as with community energy, local supply arrangements by definition have geographical foci.

Although the past few chapters have shown how community energy in a broad sense can help address energy policy objectives, Hall et al (2015) highlight that local energy supply specifically can offer four key opportunities that incumbent business models are unable or unwilling to pursue:

- Better routes to market for local generation than Electricity Market Reform currently permits, thus supporting community and small scale generators;

- Better fulfilment of the potential for demand side response, particularly by way of geographically-specific supply markets and better customer engagement, and with associated behavioural, economic and technical benefits;
- Better gains in energy efficiency through better engagement with consumers, and roll-out of energy service company (ESCo) business models;
- Relocalising energy value by retaining local energy expenditures.

The eight local supply archetypes identified by the authors offer each of these aspirations to a greater or lesser degree, whereas the current archetype (the traditional non-local utility business model) is wholly negligent of these broader system benefits at the expense of maximisation of throughput and profit (Table 8.2).

Table 8.1 Local supply archetypes and opportunities.

Archetypes	Enabling Mechanisms	Opportunities of local supply: Better routes to market for local generation	Fulfilling the potential of the demand side	Real energy efficiency gains	Re-localising energy value
Current Archetype	Full Supply License	--	-	--	---
Local White Labelling	Third Party Licensed Supplier Partnership (TPLSP)	+	-	-	-/+
Local Aggregator	TPLSP	++	+++	+	+
Local 'Pool and Sleeve'	License Lite with TPLSP	+	-/+	-	+
Municipal Utility	Full Supply License	+++	+	---	++
Municipal ESCo	Full Supply License	+++	++	+++	+++
MUSCo	Full Supply License	+++	++	+++	+
Peer to Peer	TPLSP	+++	-/+	-/+	+
Peer to Peer with Local Balancing Unit	TPLSP With local settlement unit	++	++	-/+	++

Key ---strongly negative effect, --moderately negative, -weak negative, -/+ neutral or ambiguous effect, + weak positive, ++ moderately positive, +++ strongly positive effect.

Source: Hall and Roelich (2015)

This experimentation with local supply is hindered somewhat by a regulatory and institutional system that has traditionally served, and indeed favours large-scale suppliers (Mitchell, 2014a, Mitchell et al., 2014). However, some efforts are being made by Ofgem as the UK energy regulator to better understand the opportunities afforded by so-called non-traditional business models (NTBMs) in order to understand the regulatory changes needed to support their development (Ofgem, 2015b). This can be contrasted with some overseas examples where local supply is already the norm, such as Germany (Julian, 2014), or in New York State, where energy regulation is undergoing reform to enable local supply (New York State PSC, 2014).

8.3.4 Emulation of CE by Local Authorities

Local supply arrangements of the forms outlined above are being investigated by a number of actors, including community groups and social enterprises, but also local authorities. The involvement of the latter group in particular is of particular interest here, as it represents a reconfiguration of an existing set of regime actors towards the opportunities created by community energy.

Although LAs might not be considered as central to the energy system as industry or central Government, they can nonetheless be considered as key regime actors. Up until recently, the role of LAs in the energy system has largely been to transpose national policy down to the local level, through, for example facilitating complex planning processes (DTI, 2006b, CCC, 2012) and coordinating local responses to national policy initiatives (Walker and Devine-Wright, 2008). Wider potential roles around acting as efficiency champions and as agenda-setters in setting local targets have been discussed elsewhere (DTI, 2006a, DTI, 2006b, CCC, 2012, Burton and Hubacek, 2007), although rarely have such approaches proved especially innovative.

The inexorable growth of community energy is presenting both new challenges and opportunities for Local Authorities. For example, CE groups are increasingly addressing energy issues that may have previously been deemed the responsibility of LAs, such as driving local energy efficiency programmes, identifying vulnerable households, and shaping local RE deployment. In many ways the objectives of CE groups are well-aligned with that of LAs in terms of emphases on deployment of renewables (and associated carbon reductions) local economic resilience, and development of local economies in terms of increased employment and skills development. However, in terms of fuel poverty, while CE groups are well placed to identify vulnerable households and inadequate properties, resource constraints mean that they are rarely able to make meaningful headway into the issue.

The closeness of objectives between CE and LAs is further helped by complementarity in resource availability; CE groups often have local legitimacy and specific local expertise and enthusiasm, while LAs can often offer organisational and financial support for local projects. CE and LAs often have symbiotic relationships, which are often informal, but which offer significant opportunities for mutual working.

Such symbiosis, Geels (2007) states, can provide the basis for adoption by regime actors of innovations, the development and embedding of which can ultimately contribute to major reconfigurations of regimes. For example, it is conceivable that development of a LA-backed RE portfolio can provide the basis for local revenue generation, which can then be used to make progress into addressing fuel poverty. Each of these strands may represent a single innovation (crowd-funding through local share offers, RE technologies etc), but combined they offer potential to change dramatically the remit, resources and reach of local authorities as actors in the energy system.

Indeed, several local authorities – namely Plymouth and Swansea City Councils - are in the early stages of experimenting with models of this kind. With these exemplars, the LA has been instrumental in the formation of standalone CE entities to help deliver local RE projects on behalf of the LA. Although technically autonomous, such closeness enables significant efficiencies to be made through sharing of organisational and human resources (which may help overcome legal and financial barriers for instance) and cutting down on bureaucratic barriers such as those involved with siting RE infrastructures. The relative wealth of resources means that projects can be brought to completion at a speed more closely resembling that of corporate entities than of social enterprises.

For Local Authorities with responsibility as public service providers, engaging in community energy offers the potential for greater engagement with local populations with implications for wellbeing. For example, such partnerships can act as vehicles for delivering services traditionally falling under LA remits, such as coordinating local responses to national efficiency measures, coordinating fuel switching campaigns, and addressing local fuel poverty concerns by building relationships between local housing, health, employment and other wellbeing service providers under one roof. In a sense the adoption by LAs of CE objectives and approaches brings together many of the services already in their remit, but is enhanced by adding key dimensions of cost savings and revenue generation enabled through RE ownership.

These models are demonstrative of the innovations tested by CE being adopted, and no doubt improved by regime members. The reason the model appears to work is fourfold. First, it combines a blend of tried and tested social and technological innovations that compliment and reinforce one another. Second, the objectives of LAs are already closely aligned with those of many CE groups. Third, they control many of the resources required to implement CE projects, such as financial and organisational capital, as well as access to natural capital in the form of potential RE sites. And fourth, they bridge the divide between local populations, community groups and national government, all of whom play key roles in the energy system. Taken together, this suggests that the emergent role of local authorities as deliverers of community energy is only the beginning.

8.4 Summary

Moving on from the previous chapters, which focused primarily on WREN, this chapter takes a broader perspective of the evolution of the CE movement as a whole. In doing so it considered the aggregative effects of the development of multiple CE projects on both the direction of the movement as a whole, as well as on key actors within the broader energy system.

The conceptualisation of CE as a niche innovation was critically examined with respect to the development of expectations, networks and learning within the movement. Although coherence of vision and expectations can be considered an important part of niche development, it is argued here that more value lies in maintaining a diversity of visions, not least because it is more supportive of grassroots interests. Additionally, the critical role of civil society within CE means that aligning and fulfilling expectations around societal issues is a particular strength of the movement. This also has bearing for the importance in networking and building relationships with local communities. In terms of learning, it is suggested that the value of networking and learning varies not only between CE groups, but also between according to the specific needs of groups at particular times.

Ongoing shifts in the context within which energy policy exists is also of consequence to the development of community energy. Four specific pressures are described as articulating towards the wider adoption of CE. These are a) the continued development of small-scale RE technologies driving the democratisation of energy; b) deepening consensus around both climate change impacts and the need for mitigation; c) societal trends towards individualism and its relationship to communitarianism; and c) the momentum of the CE movement itself. These all contribute to a wide scale shift in the rules and preferences of people towards small-scale energy.

Finally, while it is clear that some regime actors are exerting resistance to these pressures, others are actively and positively adapting by way of appropriation of the principles and approaches CE practitioners have pioneered. This last point suggests that the momentum behind community energy has started to instigate structural changes in the energy system. The following chapter continues in this vein to explore more fully the transformational potential of community energy.

9 The transformational effect of democratisation

Chapter 8 placed findings from a single community energy case study within the context of the broader evolution of community energy. It demonstrated how aggregated impact of local expectations, networks and learning is contributing to sector-wide change, and how the formal community energy sector has influenced adoption of key principles and approaches by other regime actors. As well as describing energy system in transition however, the evolution of citizen-oriented energy more widely (and encompassing community energy) can also be described as transformative in that it is affecting the fundamental structure of the energy system, including technologies, actors, and the relationship between them.

A discussion of the democratising effect of small-scale energy follows, in which the emergence of distributed technologies creates value throughout energy networks, as opposed to a conventional system whose value is more centralised. The changes to the energy system afforded by such democratisation, it is argued, are transformative in that they change fundamentally the structure of the system, the actors within that system, and their agency.

A discussion of the democratising effect of small-scale energy is followed by a summary of the key elements of transformative change arising from small-scale energy. The chapter concludes with a discussion around the relative role of different scales of governance in shaping energy system transformation.

9.1 The redistribution of power

As the previous chapter introduced, the emergence of a new scale of technologies is having a democratising effect on the energy system. This is valuable not only from a position of the distribution and devolution of power to a wider diversity of actors, but also in terms of a systems resilience perspective. Furthermore, it is argued here that the distribution of both assets and agency in the energy system is self-reinforcing because of network effects.

makes economic sense in the sense of the optimisation of modern energy networks.

9.1.1 New technologies, new actors

Fossil-fuel-based energy production exhibits economies of scale that favour centralisation of geography as well as concentrations of capital that necessitate centralised ownership. These economies of scale are far less relevant to emergent small-scale renewable energy technologies: the value of the latter increases less in line with the scale of individual plant than with the distribution of (smaller) plant across energy networks.

Importantly, the scale of these new energy technologies means that they are relatively affordable to people and communities, opening up ownership to a diversity of actors. This in turn has profound implications for the distribution of capital, with implications for both system and societal objectives. First, it opens up the potential for growth in renewables by enabling an entirely new set of investors to release financial capital (previously destined for pension funds or other savings schemes, for example) and participate in the development of energy infrastructures. Importantly, the development of new business models employing a variety of funding platforms means that individuals can invest at a variety of levels in projects across the country (through online platforms such as Abundance Generation and Trillion Fund, whose £5 minimum investment seeks to enshrine the concept of ‘democratic investment’) as well as in their communities and own households. The shareholders of the energy system are thus becoming more numerous, more dispersed, and more diverse than had been made possible under a wholly centralised system. Additionally, such shareholders are also becoming stakeholders insofar as they represent an increasingly powerful segment of civil society with interest and influence in shaping energy markets, and thus the energy system more generally.

It would be naïve to suggest that it has been RE technologies alone that are democratising the energy system, though they can be considered central to the process. Ownership of energy production technologies offers the potential to extract value in terms of both reducing the need to buy energy from suppliers, and becoming a supplier oneself. However, the emergence of complimentary technological innovations are both playing a part in the democratisation process and allowing additional value to be extracted by prosumers. These include material innovations such as domestic energy efficiency products and technologies, which reduce the overall need for energy; ICT, which enables ‘smart’ systems of domestic and grid optimisation; and affordable storage solutions, which also help to manage local demand and supply. Domestic energy aside, electric vehicles offer further opportunities to reduce petroleum consumption and offers potential for integration into electricity networks. As such an ecosystem of technologies develops, so too does the network economies they enable, which further reinforces the nascent system.

Social innovations though are also playing a key role in democratisation: crowdfunding and similar business models, many supported by ICT and social media, is becoming a standard model of raising equity for citizen-scale energy projects (including community energy projects, but also commercial enterprises funded in whole or in part by individuals). Social innovation in terms of collective action in ‘traditional’ community energy networks both orient themselves toward, and benefit from information diffusion. Taken together, technological and social innovations are profoundly changing the rules of the game in terms of distributing value across energy networks and among society.

9.1.2 From economies of scale to network economies

If the centralisation of electricity production at the start of the 20^{th} century was driven by economies of scale, decentralisation can be understood as being driven by network economies. Economies of scale are of course relevant to network economies, although they stem from the size of the *network* rather than the size of individual infrastructures or the enterprises that own and operate them. Furthermore, since value is created and distributed among all network members, rather than concentrated in a small number of profit/maximising firms, the drive towards network economies is on the part of individuals and communities (Kelly, 1998, Rifkin, 2011). Incrementally increasing deployment and integration then can be expected to result in increasing distribution of value among an increasing number of stakeholders.

As well as being beneficial from a wealth-distribution perspective, the creation of value throughout increasingly large networks is also of value from a system, and policy-perspective. For example, the problems of intermittency and need for redundancy that may be caused by RE deployment at a small scale may be helped in part by further increases in deployment, particularly when multiple, diverse and geographically distributed technologies are employed in association with the integration of efficiency and demand management and demand response measures (Mitchell, 2015b, Mitchell, 2015a, Jansen, 2015). More generally, the slow but steady replacement of fossil-fuel based technologies with RE technologies offers a step change in system efficiency in terms of the reduction in conversion losses from the former (Mathiesen et al., 2015).

While emerging technologies are slowly but inexorably changing the game, the UK has been slow to capitalise on the opportunities network economies afford. Rather than supporting those technologies that facilitate this type of change, energy policy under the Tory government has recently taken a deliberative shift back to the recentralisation of technology assets, for example by continuing backing for a nuclear renaissance, a move that is manifestly undemocratic.

Despite disregard for the opportunities of network economies in this country, other Governments are actively seeking to understand and shape these developments to meet policy objectives. For example, in setting out in its Reforming the Energy Vision (New York State PSC, 2014), the New York State Public Service Commission communicate to ensure that energy system transformation is customer-centred by encouraging both deeper penetration of renewable sources, and promoting markets through which energy management such as efficiency demand response measures can be facilitated. In doing so, the State is demonstrating rare leadership in holding consumers as central to energy system transformation, both intrinsically and as a necessary element of achieving energy policy objectives.

9.1.3 Path dependency and lock-in to democratisation

Since the democratisation of energy system describes the devolution of power (and wealth) from centralised incumbents, it is worth reflecting on how the emergence of distributed power might evolve. To what extent, for example, can the democratisation of energy be expected to continue in terms of both the depth and breadth of emancipation?

At the most basic level, the processes behind democratisation lend themselves to a degree of path dependency in that they would act to reinforce the process by positive feedback. In the same way that network economies helped to lock in fossil fuel based generation, the development of distributed generation and complimentary network infrastructure will be instrumental in locking in distributed technologies. For example, the economics of installing domestic renewables are likely to improve once prosumers can take advantage of storage and electric vehicle innovations. Of course, under a distributed, democratised system, these returns do not accrue to only a few actors, they benefit a network of individuals and communities, who are becoming increasingly keen to participate as benefits become realised.

As pointed out above, increased participation as a network of prosumers contributes to network effects arising from the mutual interconnectedness of different technologies and networks. So, as centralised fossil fuel generation both necessitated and was reinforced by centralised radial networks, the move to more decentralised technologies is necessitating more distributed, responsive networks, which then paves the way for more complete deployment and integration of RE, opportunities for energy efficiency improvements, as well as creates demand for symbiotic innovations such as storage and electric vehicles.

Furthermore, network effects extend to actors and institutions, for example by increased within-industry cooperation around more distributed system, including the development of technological, institutional and financing standards. For example, established RE sectors such as wind has developed to favour established technology forms, such as the 'Danish concept' turbine; regional, domestic and international industrial networks and lobbies have grown to support burgeoning RE sectors; and small-scale loans and crowd-funding have become established as accepted and effective forms of financing for domestic and community-scale projects seeking to own their own physical energy assets. In turn, specific skills and knowledge around RE ownership helps to consolidate learning and spread expectations, illustrated for example in the increasing expectation that commercial projects should offer either community benefits or joint ownership to local populations.

In sum, and to reiterate, just as fossil fuel technologies resulted in the lock-in to centralised technologies and concentrations of wealth and agency, a new, relatively distributed landscape of technologies and actors can also be expected to self-perpetuate and become locked-in. It should be emphasised that just as carbon lock-in was a consequence of the need to manage standards and concentrate capital for large-scale fossil-fuel generation, trends towards increased decentralisation is less a consequence of strategic design than of the resultant combination of small-scale energy technologies suiting contemporary societal needs.

9.2 The transformational nature of small-scale energy

The emergence of new technologies, actors and values combined with the path dependent tendencies of democratisation suggests that small-scale energy has the potential to be transformational in terms of creating structural change in the energy system. Indeed, in light of the inadequacies of the established energy system (as discussed in Chapter 2), this thesis argues that it is becoming apparent that it is *only* small-scale energy that can overcome energy system inertia. This section briefly highlights the conceptual difference between *transition* and *transformation* before discussing how key elements of small-scale energy can be considered as contributing to transformational change.

Sociotechnical *transitions*, as discussed in chapter 7 are conceptually divergent from the concept of *transformations*, and in order to appreciate the full impact of small-scale energy the distinction is important. The sociotechnical transition literature has primarily developed around the desire to understand and steer technological innovation pathways through environments controlled by incumbent interests, towards a known end of innovation breakthrough. Societal transformation studies, on the other hand, typically comprise technological as well as social innovations, driven by "incommensurable, tacit and embodied knowledges, involving more diverse, emergent and unruly political re-alignments that challenge incumbent structures pursuing contending (even unknown) ends" (Stirling, 2014a)[52].

As such, both transitions, and transformations recognise the role of society, although while agency in the former is limited to niche-regime contestation, in the latter it is more often associated with how subaltern interests within civil society, as manifested in social movements direct change (Seyfang and Smith, 2007, Stirling, 2014a). That said, while actors may be value-led, the concept of transformation itself is purely descriptive, simply defining the

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[52] It should be noted that the use of *transition*, rather than *transformation*, as a key concept throughout this thesis is borne out of the employment of the sociotechnical transition literature (specifically the MLP) rather than any intentional emphasis on technological innovation. In any case, while the terms are not interchangeable, the use of one often implies the other, i.e. transformational change of some kind may require sociotechnological transformation, and vice versa (Stirling, 2014).

processes agreed to be required to move to a structurally distinct energy system (Mersmann et al., 2014).

9.2.1 Realignment with societal needs

Path dependency can be used to explain how society has been locked into a suboptimal pathway characterised by technologies, institutions and behaviours that cost more, financially, environmentally and socially, than alternatives. In order to escape lock in, we as society first need to be aware of the relative unsuitability of large-scale technologies, and secondly, have an alternative pathway to turn to (Unruh, 2002). On both counts small-scale energy is realigning system characteristics with societal needs.

Our understanding of what society needs in relation to energy has changed somewhat over the last few decades, such that the inadequacies of the current energy system in addressing these needs has become apparent. Energy policy has previously focused solely on making sure supply met consumer demand and that costs were kept reasonable. Now, however, there are expectations by householders and society not only that energy is (and remains to be) affordable, but also that demand should be uninterrupted. Furthermore, society more generally should expect the processes through which energy is obtained are safe, and do are not damaging either to humans or the wider environment.

In the absence however of critical reflection of these issues, either by policymakers or the media (with whom self-interest, rather than societal interest tends to prevail), it is left to society itself to come to their own conclusions, and thus create a “countervailing critical mass or social consensus for policy action” (Unruh, 2002). This thesis suggests that it is community energy pioneers - including both formal CE groups and the wider group of actors employing small-scale energy approaches – that form the vanguard of this critical mass.

First, the CE movement in particular has largely been driven by grassroots subaltern interests, which are by their nature dissenting towards assumptions around the ‘correct’ way to structure an energy system, and emphasising dramatically different sets of values. For example, many CE groups cite the relocalisation of energy value as a central driver, and actively oppose the exertion of power by incumbents. In doing so, CE and citizen-oriented energy more widely has in many ways has raised questions around the inevitability of a specific variant of capitalism (i.e. that which concentrates value and wealth) whilst highlighting the existence of an alternative.

It has been argued elsewhere that the fallibility of capitalism as we know it is being demonstrated more widely. In particular, the advent of ICT and the consequence of increasing abundance and availability of information and the rise of collaborative consumption is giving rise to embryonic innovations that challenge the assumptions of modern day capitalism, i.e. the efficacy of markets or the importance of property rights (Mason, 2015). Additionally, just as the institutions of capitalism are socially constructed, new modes of 'postcapitalism' can be formulated to reflect conscious and collective deliberation about its failings and around alternatives.

Community energy might certainly be considered an embryonic innovation in some regards, for example in the blurring of social with market-based values and the blending of private with public and community-based goods and services. The strong foundation of social capital (networks, trust and reciprocity, as highlighted in Chapter 7) means that community energy is by definition collaborative, and as such it actively promotes the sharing of information and expertise, rather than marketization of such resources. Of course, it should be pointed out that as with other embryos, such new modes of capitalism have been facilitated by enabling technologies, which includes ICT, but also small-scale technologies.

9.2.2 Increasing levels of engagement

While the established energy system has come to be one that is disengaging of society, the emergence of both CE and citizen-oriented energy is demonstrating that a) people and communities want to be more engaged and b) will need to be more engaged in order to meet our energy challenges.

First, the uptake of domestic renewables alone (and solar PV in particular) is testament to the fact that people are far more engaged i.e. that people are willing to become more than just consumers of energy, than forecasts had suggested. The growth in both community energy and the entrance of local authorities into the niche space is evidence of significant willingness to engage in collective energy efforts, and while this comprises engagement by civil society citizens as ‘prosumers’, it includes other forms of both active and passive engagement such as investment, participation in CE groups, and support for local RE schemes. At a broader level, increases in supplier switching rates over recent years has been driven by the arrival of new entrants, and marks a potential shift in consumers’ attitudes with respect to how energy is perceived as a good.

As distributed energy networks expand, so too do the opportunities for citizen engagement. This will be relevant in terms of ongoing decentralisation of energy in and near populations (including electricity generation, but also renewable heat and electric transport), but particularly in terms of the increasing focus on integration of such technologies into networks. For example, the ability of smart grids to facilitate more flexible, responsive networks is based on assumptions about the propensity of consumers to engage with energy in different ways than they have previously.

One particular benefit of increased citizen engagement may be increased opportunities around addressing energy efficiency (Hall and Roelich, 2015). The deepening of RE and the emergence of smart infrastructure both create channels through which citizens are linked more explicitly to the energy system, and manifested through new relationships with energy providers and other actors (e.g. within district heating networks). Such new and changed relationships, backed up by new business models, offer novel opportunities for more holistic energy services, such as ensuring homes are well insulated before renewable heat technologies are installed, for instance. The emergence of real-time information and feedback enabled by smart meters (which offer a degree of passive engagement) may also encourage uptake of energy efficiency measures (Darby, 2006).

All of this goes some way to refuting the assumption that energy policy objectives can be carried through without people noticing. Rather, by giving people a stake in the energy system, we can evidently give people a reason to care about its future.

9.2.3 Challenging institutional and cognitive norms

One important consequence of increasing the proportion of small-scale energy is that it is challenging institutional and cognitive norms of the energy system. Institutional and cognitive norms encompass the rules by which individuals, businesses, and governance institutions abide, for example attitudes, values, and worldviews, shaping how energy is governed (Geels and Deuten, 2006, Verbong and Geels, 2007, Kuzemko, 2014). Small-scale energy brings with it a new set of rules and assumptions about how the energy system could be governed.

It has been argued that energy has undergone a process of non-deliberative depoliticisation whereby the creation of institutions has narrowed debate around energy issues by assuming norms around how energy should be governed (Kuzemko, 2014). This places value on specific forms of expertise and information (i.e. technical and economic) particularly as this is held as more credible than others (i.e. social and behavioural) (Hay and Wincott, 1998, Adler and Haas, 1992). This supports dominant framing of energy as a supply issue, and the maintenance of dominant centralised supply-focused technologies. Such norms around accepted principles and assumptions contributes to lock-in by presenting decisions as agreed or non-negotiable, and as such renders decisions them untouchable to debate and deliberation by outside actors (Kuzemko, 2014).

While it is fair to say that the UK energy system is still very much centred on both technocratic and non-deliberative forms of governance, development of knowledges around energy systems is slowly challenging this as a system norm. Most important of these is the acknowledgement of system-wide approach to addressing the energy challenges, and related to this, the increasing contribution of social sciences to understanding and enabling energy system change. The increasing contribution of social science (relative to technical disciplines) in energy research has coevolved alongside the growing role for people and communities in shaping the energy system, and marks a shift in demand for more appropriate forms of knowledge (Sovacool, 2014, Stirling, 2014b). As the role of individuals and communities in the energy system intensifies, a deeper understanding of the social and behavioural dimensions of energy will be needed in order to engage these actors.

9.2.4 Overcoming presumed normativity

The deepening of the relationship between society and energy assets and issues suggests that energy governance is slowly but inexorably becoming more plural and polycentric governance (Ostrom, 2014, Goldthau, 2014). Marking a significant departure from centralised control, polycentrism is considered more likely to address issues relating to equity, inclusivity, information, accountability, organisational multiplicity and adaptability, all of which are predisposed to more effective energy and climate governance (Ostrom, 2007, Ostrom, 2014). The emerging polycentrism in energy governance, involving households, communities, business communities, local authorities and central government also less prone to regulatory capture, are more legitimate and participative than has ever been the case under centralised governance, and the momentum towards more polycentrism seems likely to continue.

For incumbents, the emergence of polycentrism poses a challenge to their agency and ultimately to their existence. Energy system incumbents value inertia as a check against instability: the security and familiarity inherent in incremental change (i.e. slight tweaking, but continuation of support for centralised technology policies) is much preferable to radical changes, which may involve more risk, but also usually different actors. It is thus that RE and energy efficiency technologies are unfavourably framed by incumbents as unreliable, inefficient, and immature, and new value propositions framed as illegitimate.

For businesses, though, sunk assets and cognitive norms is also symptomatic of complacency, which contributes to the tendency for established companies to consistently ‘miss the wave’ of disruptive innovations, the new attributes they introduce, and the new markets they create and then dominate (Bower and Christensen, 1996). The reluctance of the Big Six to invest more heavily in renewable infrastructure is in part due to the assumption (by policymakers as well as themselves) that centralised, thermal plant will always have a role to play in the UK energy system because of the perceived necessity for reliable base load. The expansion and integration of RE technologies however is challenging this assumption (Holliday, 2015). Institutional and cognitive norms provide further barriers to thinking outside the box.

More fundamentally, the mere state of incumbency (i.e. being in power, and being among the majority) may encourage in incumbents a state of ‘presumed normativity’, meaning that worldviews, values and methods are assumed to be the ‘correct’ ones (Stirling, 2015). Incumbent trajectories are thus held as “paradigmatic of progress”, and are deemed as necessary and inevitable as they are positive (Ibid). Such *Panglossian judgements* have been recently vindicated by the election of a majority Conservative government, thereby providing a mandate both for severe increases in austerity measures alongside massive reductions in support for sustainable energy.

However, in light of ongoing polycentrism, presumed normativity is unlikely to be politically sustainable. There is a huge disconnect between the move to devolved power at the local government / city scale, and the command-and-control style of governance favoured by the Cameron/Osborne partnership, but it is clear which is the more legitimate.

9.3 Managing the unmanageable?

It is clear then that small-scale energy offers potential for transformational change in the energy system. It is thus worth reflecting on the role of policymakers as well as other actors in affecting such change.

9.3.1 A fallacy of control?

Taking domestic renewables as an example, the small-scale FiT can be understood as having a democratising effect, and while this was a key driver for proponents of the policy, subsequent policy design was more aligned with deployment objectives.

Government intervention in the UK (particularly creation of the FiT) was a central factor to the development of small-scale energy over the last few years. The underestimation of deployment rates under the FiT however is striking, and suggests limits to the degree of control government policy has on the development of the sector. Installed capacity of solar PV in 2014 was around 10 times that thought plausible under the highest rate of annual deployment (DECC, 2011c, DECC, 2015b). The cost of installing large-scale solar in 2013 was less than the lowest projected estimate in 2011 for 2015. Wind capacity also exceeded the highest expected deployment rates, though to a lesser degree than with solar, and lower associated cost reductions. Such underestimations of both deployment rates and cost reductions are in part explained by assumptions by DECC that sector growth in the UK would mirror that already taken place in Germany (Grubb, 2014).

In terms too of social innovation, while community approaches to addressing energy challenges were mentioned in early DECC White Papers, the emphasis was on energy saving rather than also the potential for generation, and while growth of the sector has been relatively modest, the interest in citizen, community and Local Authority-led forms of energy production could not have been predicted at the outset of the FiT. Nor could the impact of diversification of ownership be predicted, such as how pioneering work of CE practitioners is paving the way for a suite of new business models across different actors. As with technological innovation, the globalisation of information facilitates the transfer of social learning from such exemplars around potential benefits, as well as new ways of doing things. Moreover, social innovation is overwhelmingly driven by grassroots social interests, which is by definition beyond the control of policy, not least because the drivers and benefits of social innovation are social – rather than monetary - in nature.

To suggest that the UK government has driven transformational change would be to fall foul of the *fallacy of control*, whereby greater roles are assigned to intention - and thus to the traits of political actors - than to serendipity. It is not that policymakers have been impotent in influencing change, but only that it can be difficult to ascertain the influence of government in shaping change. This of course has implications in limiting expectations about what we think government could do to enact change, not least because the transformational changes underway in the energy system (more affordable technologies, diverse ownership etc.) are acting to further dilute top-down agency.

9.3.2 Management or murmuration?

The fallacy of top-down control is especially evident when considered opposite the dispersed and unpredictable dynamics of individuals. Driven by autonomous agency and underpinned by social collectivity around specific values, virtues and visions, transformational movements such as those within small scale energy are by definition resilient to the imposition and reframing of values from above. For example, while incumbent interests might favour the professionalization and standardised 'scaling up' of community energy, the value of community energy and transformative movements in a wider sense is in the alternative, social, even antagonistic questioning of what is valuable, and how to get there, rather than conformation to the norms of incumbent interests.

It is thus by these definitional qualities of autonomous agency and social collectivity that Stirling relates the dynamics of transformations to 'murmurations', steered relationally by the spontaneous realignment of myriad subjective orientations (Stirling, 2015). Such a term seeks to convey the dynamism and agility of the underlying bases of transformative movements, through radical and rapid realignment through "emergent latent coordination between autonomous subjects" (Ibid). The ability of grassroots movements such as community energy to shape-shift to continually align with societal interests is only possible because they are driven, and expressions of, societal interests.

This also explains the inappropriateness of the containment and management of such movements, particularly as embracing their organic, unruly and unpredictable nature is perhaps the only way to permit progressive innovations to mature.

9.3.3 Lessons from international exemplars

What is there to be learnt then from the international exemplars discussed in Chapter 3? The chapter summarised a range of circumstances from both Denmark and Germany that could be used to explain strong community energy sectors. In particular path dependency in these cases can be used to explain how current energy system features have evolved from historic circumstances[53]. For example, traditions of cooperative movements and regional and plural governance arrangements paved the way for distributed ownership and control of RE and related grid assets, which in turn explain a strong societal ownership of both the challenges and solutions of the energy systems. Also, reliance on wind power for agriculture in Denmark supported the development of knowledge, expertise, and supply chains around wind for domestic electricity generation, which was reinforced as Denmark became the global leader in wind technology.

Such path dependency towards small-scale distributed energy systems can also be attributed to the move away from large-scale energy as an alternative. For example, strong support for locally derived renewable energy was

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[53] It should be acknowledged that lessons from past experiences are often (if not always) affected by the *narrative fallacy*, which arise inevitably from our eagerness to make sense of the world, and the ease at which specific salient events can be seized as causal narrative elements (Taleb, 2007; Kahneman, 2011).

complimented by strong opposition for nuclear power as a sustainable option in both countries, making nuclear moratoria attractive propositions for both. In sum, historic circumstances has made meant that it has perhaps been easier, politically and technically for these countries to follow a path towards more decentralised energy systems than the UK. Moreover, path dependency in these countries is reinforcing rather than resistant of local energy: political choice is constrained by societal pressure to maintain local control and ownership over energy assets, rather than gain it in the first place, as in the UK.

However, as this chapter has shown, the context within which energy systems can be understood is changing, in terms of the necessities of climate change mitigation, the availability of new technologies and the evolution of societal preferences, such that new pathways are presenting themselves to policymakers. It is possible to presume that since the UK has not been endowed with the same attributes as Denmark or Germany, it is less able, or even unable to make any progress towards a sustainable energy system. However, this stance would be defeatist. Having a different historic path to Germany and Denmark does not mean that the UK has missed the boat, but it does mean that RE and citizen oriented energy finds it more challenging to demonstrate value to policymakers, both in economic and political terms. However, the technological and societal transformation underway, this thesis argues, means that there is increasing pressure to catch up with pioneering countries.

Indeed, such transformative changes present real opportunities to become as much of a leader in some emerging fields as Denmark and Germany have become in both supporting RE industries and diverse ownership thereof. To maximise the benefits offered by energy system transformation, the UK must both acknowledge their existence, and develop a coherent strategy to develop opportunities before it is too late. The rest of this section summarises five ways through which lessons learnt from Denmark and Germany's experiences could help to secure such opportunities.

First, in the same way that Denmark sought domination of wind power supply chains, there is an emergent opportunity to lead the way internationally in terms of expertise and innovation around smart grid solutions. By reframing the challenges posed by increasing RE deployment as an opportunity, the UK is in an extremely good position to pioneer novel smart grid applications, data and system management and novel business models (Strbac et al., 2016), all of which will become increasingly valued in a world with increasingly distributed energy systems.

Secondly, history shows us that while the context of energy systems is continually evolving (not least in terms of technological development, global climate policy and societal preferences), some countries (e.g. Germany and Denmark) are evidently more deft than others (e.g. the UK) in responding to change. In making future decisions then, the UK must recognise the ever-changing context of the energy system means that building flexibility into the energy system is a must. The ability to flex in response to new conditions will avoid lock in to unsustainable pathways, minimise the sunk costs associated with supporting out-dated policies, infrastructures and institutions, and regain direction should perverse outcomes to policies present themselves (Schuppe, 2015b). Flexible, reflexive and adaptable governance arrangements then are a must, and the UK can learn much from the kind of inclusive (and therefore stable) policymaking environment exhibited in Denmark (Lockwood, 2015).

Third, the counterpoint to flexibility however is having an overarching vision, and therein lies another key lesson from the cases explored in Chapter 3. Both Denmark and Germany, while admittedly playing to path dependent strengths, have both demonstrated the importance of vision and determination in setting long-term objectives and designing policy around these objectives. Amid the bleakness of energy policy under the conservative government, some glints of sense have emerged in the form of the establishment of the National Infrastructure Commission, which has been charged with providing oversight in terms of the best direction for the UK energy system (National Infrastructure Commission, 2016a). Such a development has the potential to provide the Government with a much-needed, impartial but trusted steer on the infrastructural needs of the future energy system.

Fourth, the UK should acknowledge both the need and the desire for energy system infrastructures to be integrated sensitively within communities. The strong supportive constituency behind the governance of energy in Germany demonstrates the importance of legitimacy in making energy decisions (Lockwood, 2014). In the same vein, the UK can do much better in capitalising on strong public support for renewable energy options relative to large-scale fossil-fuel options (DECC, 2016) rather than pursuing the development of the latter, such as shale gas.

And lastly, integrating RE has been helped in part by interconnectedness of Denmark and Germany's grids with its neighbours. While this is clearly more challenging for the UK as an island nation, the forthcoming interconnection programme (National Infrastructure Commission, 2016b) is testament to the UK's ability to identify and react to opportunities of an emerging global energy system.

9.3.4 Key policy lessons

Several key lessons can be drawn from this. First, the UK needs to create a vision of an energy future that aligns energy policy objectives with ongoing transformation within the energy system. This would necessarily require policy to more meaningfully engage with individuals, households, and society more generally in terms of shaping the future energy system around the needs of people, rather than business interests. Importantly, this would necessitate an urgent rethinking of current policy, which favours revisiting both centralised, but undemocratic forms of energy such as nuclear, and repurposing fossil fuel exploitation for unconventional gas. Continuing with either proposition would represent a backward step away from a sustainable energy future. As a check against this, *all* energy policy decisions should be appraised on their ability to engage society proactively, rather than exist as a side effect.

Second, energy policy should as far as possible nurture those parts of the energy system that offer potential. This includes supporting the development of a diversity of renewables in general, but with a focus on augmenting the democratising impact of such technologies in particular. Community energy is a necessary component of energy policy strategy, though it should certainly not be considered sufficient in terms of engaging the whole of society. Rather, diversity within community energy should be supported, particularly because space to innovate in response to changing circumstances and adapt to local contexts is vital if we are to maximise the potential benefits of the democratisation of energy. For example, local energy markets represent significant progress in terms of introducing justice, equity and participation, as well as more conventional forms of value into local populations, and their development should be supported. There is a clear role for, and precedent of, devolved administrations such as Local Authorities and cities to provide more progressive leadership in supporting citizen-oriented and community energy: such bodies can employ latent resources (including physical, financial, human, and organisational capital) in ways that most CE groups cannot, whilst maintaining a position of proximity and trust with local communities.

Lastly, in the absence of preferential treatment of community energy, or of citizen-oriented engagement more generally, better-resourced commercial actors will always outcompete them. Commercial and social enterprises offer entirely different value propositions, such that policy decisions to level the playing field must take into account differences in resource availability, but also the ability to deliver value. For wholly private projects, projects may be developed quickly, but they will be disengaged from local populations and offer relatively little value to society as revenues will be internalised. For projects wholly or partly owned by social enterprises, deployment may take considerably longer, but will offer considerably higher value to local communities. This raises questions around whether policy should be embracing commercial, rather than social needs, and indeed what this means for the legitimacy of policy actors.

On the face of it, citizen-oriented energy might at one point resemble an *unstoppable force* challenging the *immovable object* of centralised energy system incumbents. On closer inspection however, the paradox falls down: as the proliferation and interconnection of emergent social and technological innovations continues, ‘community energy’ is revealed as an increasingly broad set of actors, values and business models, some of which will struggle and perish, some of which will learn, adapt and thrive, but all of which are valuable. System incumbents are similarly diverse in their ability to adapt and respond to prevailing pressures and opportunities. Additionally, learning around technological and social innovation from other countries undergoing transformation means that the UK energy system is continually exposed to pressures from outside. It is in this wider context that citizen-oriented energy as a transformational movement appears unstoppable.

9.4 Summary

This chapter progresses from a sociotechnical transition-perspective of community energy to considering the transformational potential of the movement. In summary, the chapter discusses how new technologies and new actors are changing the rules of the energy system from one which relies on economies of scale to one in which network economies are more important. This implies a shift of assets, wealth and thus value from a small number of private actors to a large, distributed and diverse network of actors including citizens from civil society, but also encompassing businesses and local authorities.

Further, it was suggested that community energy is inherently aligned with transformational processes in terms of responding to societal needs, engaging new actors, challenging institutional and cognitive norms, and overcoming presumptions around the ‘right’ way to govern the energy system. This raises questions about the relative roles and responsibilities in shaping energy system transformation.

10 Conclusions

This thesis set out to explore the value of community energy in the UK. In light of the multiple challenges of climate change and concerns around energy insecurity, cost and quality, analyses of approaches have hitherto ignored the overarching issue of scale, that is, whether small-scale energy technologies and dispersed ownership offer particular benefits to addressing these challenges. The expansion of both formal and informal community energy in the UK is characterised by a dramatically different set of technologies, ownership arrangements and governance structures than is conventional, and thus provides an entry point for understanding the role of small-scale energy.

A review of the literature identified three overarching themes that provided the rationale for the perspectives taken in this thesis. Firstly, incumbency and innovation in energy systems are often studied as isolated phenomena, which neglects the complex dynamic between the two. Secondly, that technical and economic perspectives typically shape our academic and political understanding of energy issues is fundamentally ignorant of the importance of social dimensions. And lastly, the general tendency of studies around community energy to focus on *either* specific experiences or sector-wide evolution masks the importance of the scaling up of expectations and experiences from projects on-the-ground towards insights around system evolution and transformational change.

To address these emergent themes, the original research question, *What is the value of community energy in the UK*?, was established. From that broad, overarching question, three more specific lines of inquiry were identified. These were:

a) What impact can community and citizen-oriented energy have on local energy systems?
b) How do social dimensions of community energy relate to its value?
c) In what ways does the community energy movement, and citizen-oriented energy more widely impact upon the wider UK energy system?

While this thesis took ‘community energy’ to mean formalised groups and adopted DECC’s definition of “collective action to purchase, manage and generate energy” (DECC, 2014b), the foundations and embeddedness of such groups within civil society called for broader consideration of the role of individuals and communities to encompass *citizen-oriented* energy. Community energy provided the primary focus for this research, but this is considered within the context of citizen-oriented energy activities more broadly, which considers the role of individuals as consumers, prosumers, activists, investors and voters (Figure 4.1).

10.1 Summary of results and discussion

The findings of this thesis can be distilled down to eight key points, which capture the essence of the main arguments. These are as follows:

1. **Today’s energy system is considerably different in terms of both the ‘rules of the game’, and the game itself**. We no longer expect the energy system to just provide us with energy; it also needs to be clean, secure and sustainable. Technological and social innovations have created new means through which objectives can be met.
2. **Overcoming inertia within the energy system can be considered a key challenge**. Ignoring inertia and focusing only on the energy ‘trilemma’ risks making only marginal adjustments to the system, rather than the structural change that is required.
3. **Only small-scale energy can overcome inertia**. Large-scale infrastructure and ownership models are fundamentally inconsistent with change, particularly as they represent considerable-sized sunk assets controlled by a small number of stakeholders.
4. **There is a trend towards more small-scale energy**. The development of renewable energy technologies in particular is rescaling energy technologies towards scales more appropriate with the demand requirements of consumers.
5. **Social capital has become an increasingly important resource for the energy system**. As the energy system involves an increasing

number of stakeholders from civil society, the importance of networks, trust and reciprocity is increasing.

6. **Community energy has been influential in spawning a broad range of business models**. The principles and approaches developed by learning in the community energy sector are being used by other actors, such as local authorities, beyond the community energy niche space.
7. **The development of small-scale technologies in particular is having the effect of democratising UK energy system**. This represents a significant shift from concentrated value and power within the established energy system to greater distribution of value and power in the emergent system.
8. **There is a key role for policy in engaging society in the energy system**. Policies can be more or less democratic in the ways that they engage and distribute value differently. Given the direction of energy system change, policymakers should consider the strategic importance of democratisation.

10.2 Summary of chapters

This section provides a brief summary of the empirical and discussion chapters of the thesis.

10.2.1 Establishing a baseline for community energy impacts

The literature review highlighted the paucity of robust, objective evidence around the impact of community energy. This is in part related to the inherent subjectivities around deciding *what to measure*, as well as *how to measure it*. Moreover, approaches taken by community energy practitioners are often ad-hoc, and focus on absolute project successes rather than relating to robust baseline measurements. The overall premise of this chapter was that the local focus of community energy means that the impact of a group's activities are heavily influenced by the specific local context regarding the resources, opportunities and constraints present in each locality.

In developing an understanding of Wadebridge's energy system, Chapter five establishes the context upon which change can be understood. This presented the findings from a large-scale household energy survey. The relatively broad geographical focus of WREN means that relatively large local variations exist in terms of the local housing stock, access to the gas network, and socioeconomic and demographic spread compared to smaller community energy groups. Such variety as suggests that the case study, Wadebridge might be considered a microcosm of larger geographical areas, where multiple challenges relevant to energy policy present themselves (such as fuel poverty and opportunities and appetite for increased deployment of renewables), although trade-offs between goals are perhaps inevitable. Similarly, the local energy economy is characterised by considerable variations in domestic energy consumption profiles and expenditures across the study area, in large part due uneven connectivity to the gas network.

The household energy survey also showed that local public support for the need to both reduce overall energy consumption and increase investment in renewables, with a preference for smaller scale technologies in the form of rooftop PV (although local wind and larger scale solar were also held favourably). In terms of governance, the population supported community-scale decision-making, although it was acknowledged that local issues had to be balanced with strategic oversight. Trust and participation emerged as key themes here: there were some limits to their willingness to become more involved personally (at least without knowing more), and while some individuals questioned the authority of WREN in shaping Wadebridge's energy future, it is suggested that these perceptions will be shaped by attention to process as projects progress, i.e. by creating, nurturing and delivering upon expectations. The large membership of WREN suggests at least tacit support approval of the ethos and activities WREN represent, both locally and further afield.

10.2.2 Measuring success

Employing WREN as a case study, Chapter six set out to develop a comprehensive understanding of the impacts of WREN's programme of activities, and in doing so directly addressed the first research question. In summary, the chapter highlighted a broad range of impacts resulting from WREN's activities. Particular progress has been made in the last few years around developing local renewable energy capacity, particularly in the deployment of small-scale PV and renewable heat. In both instances, WREN has demonstrated that community groups can act as important centres of expertise, providing initial information about technologies and government support schemes, assisting with project appraisal, and as a signposting service to trusted local installers. A valuable element of community energy groups such as WREN is as trusted local intermediaries in the delivery of both information as well as support for domestic renewable deployment.

In addition to support for small-scale renewables, WREN had acted as a key point of contact for larger schemes. For example, support of local larger-scale wind and solar installations ensures provides channels for public engagement for privately-owned installations. This helps to foster local legitimacy for such schemes while providing democratic means through which monetary community benefits can be distributed. Furthermore, WREN has been involved in a wide range of activities, including acting as intermediaries for government demand reduction schemes, providing education and training for schools and businesses, and negotiating preferential prices through the bulk-buying of energy-related products.

The impact of WREN on the local energy system has been exceptionally broad, and demonstrates the ability of community energy groups to operate holistically in facilitating a wide range of energy-related goods and services. Proposals to develop local electricity supply will likely build on significant networks of local support, and can be expected to take local benefits to the next level.

On a more fundamental level, the chapter highlighted the importance of multidimensional, distributional and temporal considerations when assessing impact in community energy, and in doing so contributes to ongoing discussions around standardising assessment methodologies.

10.2.3 Social capital and community energy

The literature review highlighted the potential for community energy to engage with society in way that has not been possible under a regime dominated by centralised technologies and governance frameworks. As an investigation of the interplay between WREN's evolution and social capital, Chapter seven addresses the second research question: *How do social dimensions of community energy relate to its value*?

In summary, the chapter suggested that human capital, along with three types of social capital: bonding, bridging and linking have all played significant roles in WREN's evolution. For WREN, who like the majority of community energy groups was formed by individuals, human capital is a critical component in terms of the development a local vision, and the existence of requisite knowledge, experience and determination needed to develop that vision. Bonding capital is then developed through the coalescing of other likeminded individuals to gather around such nuclei, and the collective negotiation of common objectives and values. Legitimacy within the community is dependent on the availability and deployment of bridging capital, which for WREN has been achieved by broadening the appeal of the programme, by, for example making energy relevant to wider needs and aspirations of the community. Lastly, linking capital, as the relationship with those outside of the network holding power and influence has in WREN's case has been deployed to great effect, such as through representation within DECC's Community Energy Contact Group. In order for community energy to move from visions, to practice, to becoming agents of the energy system, the availability and use of all forms of social capital is thus considered of utmost importance.

In a broader sense, with regard to ongoing academic bias towards technical and economic perspectives on energy pathways, this chapter sought to readdress the balance towards the social dimensions. The social dimension of community energy is shown to have local impacts in terms of facilitating the growth of populations' capabilities, and sector-wide impacts through the employment of linking capital towards progressive ends.

10.2.4 The growth and diversification of community energy

Chapter 8 moves on from analysis of a single project to consider the impacts of the wider community energy sector, as well as of 'community energy' more broadly. First, it offered a critique into the importance of expectations, networks and learning as three elements considered in the transition literature as critical to the development of niche innovations.

Second, recognising that CE does not develop in a vacuum, it then discusses how ongoing forces in the broader context of the energy system, for example the democratising effect of alternative energy technologies, the widening societal consensus around climate change, and the strengthening role of individualistic tendencies in society.

While the CE sector has clearly developed in itself, there is also evidence to suggest that other actors beyond the traditional CE niche are adapting to the opportunities small-scale energy affords, particularly as a response to pioneering approaches taken by CE actors. This is being manifested in the growing diversity of business models being adopted by both businesses and other regime actors, such as local authorities.

10.2.5 The transformational effect of democratisation

The literature review suggests that overcoming inertia can be considered a key challenge alongside the energy trilemma. Chapter nine thus focuses on the role of small-scale energy in affecting system *transformation*, rather than just sociotechnical *transition*. In addressing the contribution of community energy to such transformational shifts this chapter completes the response to the third research question: '*In what ways does community energy impact upon the wider UK energy system?'*

Specifically, the chapter picks apart how emergent technologies are democratising the energy system, and how this, and other factors are contributing to transformational change in the energy system. Democratisation of energy the energy system implies a shift of assets, wealth and thus value from a small number of private actors to a large, distributed and diverse network of actors including civil society, but also encompassing businesses and local authorities.

As Chapter 2 discussed, the 'rules of the game' have changed in terms of what we require the energy system to do, i.e. address climate mitigation and offer energy security, rather than just provide consumers with unending supplies of energy. By offering the prospect for devolved power and wealth, energy system democratisation contributes to these changing rules by creating a new set of values around engaging with the energy system, whilst providing the means through which more meaningful engagement can occur.

The close alignment of small-scale energy with societal needs, the greater need to engage with individuals, and the emergence of a new set of institutional and cognitive norms are identified as key elements of enabling transformative change. As such, small-scale energy is considered vital to overcoming inertia. This however raises questions about the role of policymakers in determining the 'right' way to govern the energy system, as well as put in place the policies to enable this.

10.3 Contributions, limitations and future avenues for research

This final section reflects on the contribution of the thesis to audiences in practice, academia and policy, on the limitations of the research, and on the potential contribution of future avenues of research in addressing these, and other opportunities for knowledge creation.

10.3.1 Contribution of knowledge

As a thesis focusing on the value of community energy, this research contributes to the growing body of evidence around community energy. In so far as is possible, this research seeks a more rounded understanding of community energy impacts, which is currently reliant on more anecdotal and ad-hoc accounts of the sector. Furthermore, the methodologies employed in this thesis to understand the multi-dimensional aspects of community energy will be of value to ongoing attempts to standardise appraisal of efforts within community energy.

Related to this is the contribution this thesis makes to the philosophy of understanding impact in community energy. While it is natural for practitioners and policymakers alike to wish for standardised appraisal methods, the creation of such a tool would risk being ignorant of the diversity of contexts, resources, drivers and approaches characteristic of the community energy sector. From a policy perspective, such considerations are important if community energy is to be seen as anything more than another economic sector.

This thesis has engaged with literatures on innovations and governance, and is of particular value in bringing together understanding of incumbency and inertia with that of innovation and dynamism. To this end, the MLP in particular offered a key framework of analysis, and this research contributes to ongoing developments in our understanding of this interface.

Of value for the MLP literature is the mapping of real-world observations on to the theoretical heuristics the MLP offers, particularly concerning micro-dynamics of social interactions, public perceptions, and micropolitics of community energy. While the MLP is considered valuable as an academic tool, such observations enriches and brings life to assumptions of agency in theoretical frameworks and operationalizes such abstractions for the understanding of a more diverse set of audiences, for example in civil society and policy.

This thesis also seeks to further understandings of community energy for policymakers (at both central and local government levels), through an objective description of the evolution of the sector within the context of broader landscape-level processes. Highlighting the social value of the movement seeks to encourage a reassessment of the frameworks through which energy decisions are made. While the subjectivities of sustainable energy progress remain open to debate, this thesis seeks to highlight that transformational processes are underway, and there are potential gains to be made by capitalising on the opportunities transformation brings.

10.3.2 Limitations and future research avenues

As with all pieces of research, several limitations can be identified that may constrain the contribution of this research to policy, practice or academia.

Firstly, a conscious decision was made to employ a case study approach to provide an in-depth account of a single community energy project. As Chapter four showed, there are potential limitations to this approach in terms of the extent to which such observations can be considered representative of the wider movement. As chapter four discusses, representativeness was not considered vital in this case, largely because community energy is so context specific. However, it is conceded that in-depth analysis of other groups would further increase the richness in understanding that case-studies can bring. Analysis of similar groups, carrying out similar projects in comparable contexts might be useful in highlighting how subtle differences in available resources influence project outcome, for example. Observations of other groups would be similarly valuable in terms of building insights around the delivery of different projects, such as securing community ownership of local infrastructures.

In the same vein, observing the effect of geographical context on the success of community energy initiatives would be valuable in building an understanding of the resource requirements of disparate groups. Such work would also be important in bringing to light the issue of path dependency in community energy, that is the risk that it is those communities already relatively rich in resources (including social capital) that are best placed to identify and address local energy issues, meaning that other communities, which may be in greater need of assistance, may be left behind. This would have clear implications for policy in terms of identifying how best to prioritise support for community energy, and would contribute to the emergent literature on the geography of energy transition.

Another limitation potentially arises from the focus on success, rather than failure. In part this stems from our natural attraction to success and the tendency to attach causal meanings or overly simple narratives to such success. Furthermore, successful groups are of course easier to find, and are perhaps more willing to success than past groups would be to give a post-mortem on failed groups. This however means that our understanding of the community energy movement is biased towards lessons gleaned from successful groups, whereas unsuccessful groups may well provide as much, or greater insight into the determinants of success. For example, failure to survive as an entity may stem from any one of a number of factors, whose avoidance might be ignored by focusing only on narratives of success

As with many projects of this kind, another limitation of this thesis is the conflict between a desire to understand change, and the limited time in which to do so. It was carried out during a period of remarkable flux. The four-year period of research was marked by both dramatic and incremental changes in the subject area, including the rapid reduction of the cost of solar installations, continuous change in energy policy with both direct (e.g. publication of the government's first Community Energy Strategy) and indirect (e.g. removal of subsidies for onshore wind) consequences for community energy, and huge expansion of the community energy sector. It can, however profess to offer no more than a relative snapshot, and predictions of how the UK energy system will proceed are as speculative as any other. However, as a snapshot this thesis does provide a starting point from which longitudinal observations can be made, in terms of what is happening in Wadebridge, as well as how the wider sector is evolving.

10.4 Concluding remarks

This thesis addresses the research question: *What is the value of community energy in the UK?* It is argued that the value for energy system stakeholders is multi-scalar (i.e. experienced at local, regional and national scales), multidimensional (i.e. takes account of economic, social and environmental impacts) and temporal (i.e experienced over different timescales, from the immediate, to the generational). Furthermore, community energy initiatives are closely aligned and overlap with the increasing role of individuals (rather than collectives) as users, prosumers, investors and decision-makers in the energy system within which they reside. By bringing together evidence from local as well as sectoral-level impacts this thesis provides a holistic, rounded perspective of the impact of community energy over the last four years and the value of that impact for society.

Community energy can have significant impacts locally, particularly relating to stimulating local investment in renewable energy technologies, retaining the revenues associated with such investment, and an associated reduction in energy costs. For individuals and communities, such economic benefits are not trivial particularly as they represent the desire and the ability to retain value locally. Chapter 7 also demonstrated that community energy has the ability to affect social organisation relating to addressing energy objectives by stimulating the creation of networks around common interests relating both to energy issues, and self-determination more generally.

In terms of wider impact, the UK community energy sector has developed considerably over the last four years and is demonstrating widespread impacts to local energy systems as well as broader synergistic shifts relating to the momentum of the movement as a whole. The diversity inherent in the movement is particularly valuable in terms of the opportunity to respond to local needs. Furthermore, the diverse learning within community energy projects is encouraging new actors, such as local authorities to experiment with similar approaches.

Outside of the immediate community energy space, efforts to better reduce, manage and produce energy by individuals has coevolved with the CE movement. Such is the momentum of both community and citizen-led energy efforts that a tipping point is surely approaching, representing a long-term shift in the scale and distribution of technologies, economics and actors within the energy system.

While community energy encompasses a multitude of drivers and values, the democratising potential of technological and social innovations within community energy is seductive as it represents a step change in rebalancing power towards individuals and communities. It is argued that although policy has been relatively negligent of small-scale energy, there is considerable momentum behind drives towards more societal engagement in the energy system, increasing the need for policy to support this. This suggests an urgent need for policymakers and other incumbents to reflect on the realities of the emergent energy system, and embrace, rather than resist, small-scale energy.

11 References

Acemoglu, D. & Autor, D. 2011. Lectures in Labor Economics. MIT.

Ackerman, F. & Stanton, E. 2006. Climate Change: the Costs of Inaction. Report to Friends of the Earth England, Wales and Northern Ireland. Global Development and Environment Institute, Tufts University.

Ackermann, T., Andersson, G. & Söder, L. 2001. Distributed generation: a definition. *Electric Power Systems Research,* 57**,** 195-204.

Adams, S. & Berry, S. 2008. Low carbon communities: A study of community energy projects in the UK. Warwickshire: Ruralnet UK.

Adler, E. & Haas, P. M. 1992. Conclusion: epistemic communities, world order, and the creation of a reflective research program. *International organization,* 46**,** 367-390.

Age Concern & Help the Aged 2009. One voice: shaping our ageing society. London: Age Concern and Help the Aged.

Agora Energiewende 2015. Understanding the Energiewende: FAQ on the ongoing transition of the German power system

Aldridge, J. 2013. The role of the small-scale feed-in tariff in electricity system transition in the UK. PhD Thesis, University of Exeter.

Alexander, R. 2013. Report of the directors and financial statements for the year ended 31 March 2013 for WREN.

Allik, J. & Realo, A. 2004. Individualism-collectivism and social capital. *Journal of cross-cultural psychology,* 35**,** 29-49.

Andersen, P. D. 1998. Wind power in Denmark: Technology, Policy and Results. 51171/97-0008. Roskilde, Denmark: Danish Energy Agency.

Arrow, K. 1962. The economic implications of learning by doing. *The Review of Economic Studies,* 29**,** 155–173.

Arthur, W. 1988. Self-Reinforcing Mechanisms in Economics, PW Anderson, K. Arrow and D. Pines (eds.), The Economy as an Evolving Complex System. Reading, MA: Addison-Wesley.

Aslanyan, G., Molodtsov, S. & Iakobtchouk, V. 2005. Monitoring the sustainability of Russia's energy development. *Natural Resources Forum,* 29**,** 334-342.

Bahaj, A. S. & James, P. a. B. 2007. Urban energy generation: the added value of photovoltaics in social housing. *Renewable and Sustainable Energy Reviews,* 11**,** 2121-2136.

Baker, W. 2011. Off-gas consumers: Information on households without mains gas heating. Consumer Focus.

Baker, W., White, V. & Preston, I. 2008. Quantifying Rural Fuel Poverty. Centre for Sustainable Energy.

Balcombe, P., Rigby, D. & Azapagic, A. 2013. Motivations and barriers associated with adopting microgeneration energy technologies in the UK. *Renewable and Sustainable Energy Reviews,* 22**,** 655-666.

Bale, C. S. E., Mccullen, N. J., Foxon, T. J., Rucklidge, A. M. & Gale, W. F. Harnessing social networks for promoting adoption of energy technologies in the domestic sector. *Energy Policy*.

Bardsley, N., Buchs, M., James, P. A., Papafragrou, A., Rushby, T., Saunders, C., Smith, G., Wallbridge, R. & Woodman, N. 2013. Initial

effects of a community-based initiative for energy saving: an experimental analysis. *University of Southampton, 18pp.*
Barker, G. 2013. Green conservatism: Move over Big Six, we need the Big 60,000. Blog for Green Alliance, 13 September 2013.
Battle, J. 1997. Speech to the Institute for Economic Affairs, London 4th June 1997.
Bayod-Rújula, A. A. 2009. Future development of the electricity systems with distributed generation. *Energy,* 34**,** 377-383.
Bcg 1972. Perspectives on Experience. Boston: The Boston Consulting Group.
Bell, D., Gray, T. & Haggett, C. 2005. The 'Social Gap' in Wind Farm Siting Decisions: Explanations and Policy Responses. *Environmental Politics,* 14**,** 460-477.
Benhabib, S. 1990. Hannah Arendt and the redemptive power of narrative. *Social Research,* 57**,** 167-196.
Bergman, N. & Eyre, N. 2011. What role for microgeneration in a shift to a low carbon domestic energy sector in the UK? *Energy Efficiency,* 4**,** 335-353.
Berlin, I. 1969. Two Concepts of Liberty. *In:* BERLIN, I. (ed.) *Four Essays on Liberty.* London: Oxford University Press.
Berr 2007. Meeting the Energy Challenge. A White Paper on Energy. *In:* DEPARTMENT OF TRADE AND INDUSTRY & DECC (eds.). Norwich.
Berr 2008. UK Renewable Energy Strategy: Consultation. *In:* DEPARTMENT FOR BUSINESS ENTERPRISE AND REGULATORY REFORM (ed.). London: DECC.
Biemer, P. P. 2010. Total survey error: Design, implementation, and evaluation. *Public Opinion Quarterly,* 74**,** 817-848.
Bijker, W. E. 1995. *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change*, The MIT Press.
Bijman, J., Iliopoulos, C., Poppe, K. J., Gijselinckx, C., Hagedorn, K., Hanisch, M., Hendrikse, G. W. J., Kühl, R., Ollila, P., Pyykkönen, P. & Sangen, G. V. D. 2012. Support for farmers' cooperatives: Final report. European Commission.
Bloomberg New Energy Finance 2012. UK Big 6 Utility Investment Trends: A report for Greenpeace UK on the generation investments of the Big 6 utilities.
Bluestein, J. 2000. Environmental benefits of Distributed Generation.
Boardman, B. 1991. *Fuel Poverty: From Cold Homes to Affordable Warmth*, John Wiley & Sons Ltd.
Boardman, B., Darby, S., Killip, G., Mark Hinnells, Jardine, C. N., Palmer, J. & Sinden, G. 2005. 40% House. Oxford: Environmental Change Institute, University of Oxford.
Boehmer-Christiansen, S. & Skea, J. 1991. *Acid Politics: Environmental and Energy Policies in Briatin and Germany,* London, Belhaven Press.
Bolinger, M. 2001. Community wind power ownership schemes in Europe and their relevance to the United States. *Lawrence Berkeley National Laboratory*.
Bolton, P. 2014. Energy Prices. House of Commons Library.

Borges, C. L. T. & Falcão, D. M. 2006. Optimal distributed generation allocation for reliability, losses, and voltage improvement. *International Journal of Electrical Power & Energy Systems,* 28**,** 413-420.
Borup, M., Brown, N., Konrad, K. & Van Lente, H. 2006. The sociology of expectations in science and technology. *Technology Analysis & Strategic Management,* 18**,** 285-298.
Bower, J. L. & Christensen, C. M. 1996. Disruptive technologies: Catching the wave. *The Journal of Product Innovation Management,* 1**,** 75-76 %@ 0737-6782.
Bowling, A. 2002. *Research methods in health: Investigating health and health services. Second Edition,* Oxford, Open University Press.
Brandon, G. & Lewis, A. 1999. Reducing houshold energy consumption: a qualitative and quantitative field study. *Journal of Environmental Psychology,* 19**,** 75-85.
Brohmann, B., Feenstra, Y., Heiskanen, E., Hodson, M., Mourik, R., Prasad, G. & Raven, R. 2007. Factors influencing the societal acceptance of new, renewable and energy efficiency technologies: Meta-analysis of recent European projects. *Paper presented at European Roundtable for Sustainable Consumption and Production,*

Basel, June 20-22 2007
Brophy Haney, A. & Pollitt, M. 2010. New models of public ownership in energy. EPRG Working Paper 1030.
Brown, L. S. 1993. *The politics of individualism: Liberalism, liberal feminism and anarchism*, Cambridge Univ Press.
Brown, N. 2003. *A Sociology of Expectations: Retrospecting Prospects and Prospecting Retrospects*.
Bruns, E. & Ohlhorst, D. 2011. Wind power generation in Germany: A transdisciplinary view on the innovation biography. *The Journal of Transdisciplinary Environmental Studies,* 10.
Bruns, E., Ohlhorst, D. & Wenzel, B. 2010. *Renewable energies in Germany's electricity market: A biography of the innovation process*, Springer.
Bryman, A. 2008. *Social Research Methods,* Oxford, Oxford University Press.
Buchan, D. 2012. The Energiewende: Germany's gamble. Oxford Institute of Energy Studies.
Büchs, M., Edwards, R. & Smith, G. 2012. Third sector organisations’ role in pro-environmental behaviour change – a review of the literature and evidence. Third Sector Research Centre.
Burgess, J. & Nye, M. 2008. Re-materialising energy use through transparent monitoring systems. *Energy Policy,* 36**,** 4454-4459.
Burton, J. & Hubacek, K. 2007. Is small beautiful? A multicriteria assessment of small-scale energy technology applications in local governments. *Energy Policy,* 35**,** 6402-6412.
Butler, C., Parkhill, K. & Pidgeon, N. 2013. Deliberating energy system transitions in the UK – Transforming the UK Energy System: Public Values, Attitudes and Acceptability. London: UKERC.
Caird, S. & Roy, R. 2007. Consumer Adoption and Use of Household Renewable Energy Technologies. Milton Keynes: Design Innovation Group, Open University.

Caird, S., Roy, R. & Herring, H. 2008. Improving the energy performance of UK households: Results from surveys of consumer adoption and use of low- and zero-carbon technologies. *Energy Efficiency,* 1**,** 149-166.
Campbell, J. L. & Hall, J. A. 2006. The State of Denmark. *In:* CAMPBELL, J. L., HALL, J. A. & PEDERSEN, O. K. (eds.) *National identity and the varieties of capitalism: The Danish experience.* Montreal: McGill-Queens University Press.
Carter, N. 2001. *The Politics of the Environment: Ideas, Activism, Policy,* Cambridge, Cambridge University Press.
Ccc 2011. Household energy bills - Impacts of meeting carbon budgets. December 2011. Committee on Climate Change
Ccc 2012. How local authorities can reduce emissions and manage climate risk. London: Committee on Climate Change.
Ccc 2014. Meeting Carbon Budgets – 2014 Progress Report to Parliament.
Ccc 2015. Reducing emissions and preparing for climate change: 2015 Progress Report to Parliament

Summary and recommendations.
Cecg 2012. Minutes of 4th Meeting of Community Energy Contact Group. DECC.
Ces 2009. Community Renewable Energy Toolkit. Available at http://www.communityenergyscotland.org.uk/search?q=toolkit. Community Energy Scotland.
Chambers, A. 2001. *Distributed generation: a nontechnical guide,* Tulsa, OK, PennWell.
Chell, E. 2007. Social enterprise and entrepreneurship towards a convergent theory of the entrepreneurial process. *International small business journal,* 25**,** 5-26.
Cired 1999. Dispersed generation. Preliminary Report of CIRED Working Group WG04.
Cise 2011. Measuring community energy impacts: How do we decide what really counts? *In:* COMMUNITY INNOVATION FOR SUSTAINABLE ENERGY (CISE) (ed.) *Grassroots Innovations.*
Cma 2015. Energy market investigation: Summary of provisional findings report. Competition and Markets Authority.
Coenen, L., Raven, R. & Verbong, G. 2010. Local niche experimentation in energy transitions: A theoretical and empirical exploration of proximity advantages and disadvantages. *Technology in Society,* 32**,** 295-302.
Collins, K. & Hoinville, E. 1980. Temperature requirements in old age. *Building Services Engineering Research and Technology,* 1**,** 165-172.
Communities for Renewables 2013. DECC Community energy strategy consultation: Response from Communities for Renewables CIC
Cooper, A. 2013. Putting the people into energy and climate policy: Social sciences at DECC. Public lecture, 13 March 2013, UCL Energy Institute.
Cornwall Council 2011. Economic ambition: A Cornwall Council White Paper. Truro, Cornwall.
Cornwall Energy 2014. Independent suppliers reach record 7.5% share of domestic market. September 2014.

Council, C. 2011. Green Cornwall: Working towards a greener, sustainable, low carbon cornwall. *In:* CHIEF EXECUTIVES DEPARTMENT (ed.).

Cowell, R., Bristow, G. & Munday, M. 2011. Acceptance, acceptability and environmental justice: the role of community benefits in wind energy development. *Journal of Environmental Planning and Management,* 54**,** 539-557.

Cse 2009. Hard to Treat Dataset. *In:* CENTRE FOR SUSTAINABLE ENERGY (ed.).

Cse 2013. CSE Dimpsa Data. *In:* CENTRE FOR SUSTAINABLE ENERGY (ed.).

Cse & Cdx 2007. Mobilising individual behavioural change through community initiatives: Lessons for Climate Change. *In:* CENTRE FOR SUSTAINABLE ENERGY (ed.) *Report by the Centre for Sustainable Energy (CSE) and Community Development Xchange (CDX).* Bristol: Defra.

Cumbers, A. 2013. Making Space for Economic Democracy: The Danish Wind Power Revolution. *UNRISD Think Piece. Accessed March,* 20.

Cunningham, W. H. & Joseph, B. 1978. Energy conservation, price increase and payback periods. *Advances in Consumer Research,* 5**,** 201–205.

Danish Energy Authority 1990. Energy 2000. [Denmark]. Energi 2000; Handlingsplan for en baeredygtig udvikling.

Danish Ministry of Climate, E. a. B. 2013. Smart Grid Strategy: The intelligent energy system of the future.

Darby, S. 2006. The effectiveness of feedback on energy consumption. *A Review for DEFRA of the Literature on Metering, Billing and direct Displays,* 486**,** 2006.

Databuild & Energy Saving Trust 2013. Community energy in the UK: A review of the evidence. London: Department for Energy and Climate Change.

Databuild & Energy Saving Trust 2014. Community energy in the UK: Part 2. DECC.

David, P. 1985. Clio and the economics of QWERTY. *American Economic Review,* 75**,** 332-337.

Dclg 2006. Strong and prosperous communities: The Local Government White Paper. *In:* DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT (ed.). London.

Dclg 2011. The single data list. *In:* DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT (ed.). London.

Dea 2012. New Danish energy agreement: 50% of electricity consumption from wind power in 2020.

Decc 2009a. 2009 Sub-regional fuel poverty methodology and documentation. *In:* DEPARTMENT OF ENERGY AND CLIMATE CHANGE (ed.). London: DECC.

Decc. 2009b. *Fuel poverty sub-regional statistics* [Online]. Available: http://www.decc.gov.uk/en/content/cms/statistics/fuelpov_stats/regional/regional.aspx [Accessed 10/04/12.

Decc 2010a. Feed-in tariffs: Government's response to the summer 2009 consultation. London: Department of Energy and Climate Change.

Decc 2010b. Renewables Obligation Banding Review Process. *In:* DEPARTMENT OF ENERGY AND CLIMATE CHANGE (ed.). London.
Decc 2011a. Low Carbon Communities Challenge: Interim Report 2010/11. *In:* DEPARTMENT OF ENERGY AND CLIMATE CHANGE (ed.). London.
Decc 2011b. Planning our electric future: a White Paper for secure, affordable and low-carbon electricity. Department of Energy and Climate Change.
Decc 2011c. Review of the generation costs and deployment potential of renewable electricity technologies in the UK. Study Report REP001. Department of Energy and Climate Change.
Decc 2011d. UK Renewable energy roadmap. *In:* DEPARTMENT OF ENERGY AND CLIMATE CHANGE (ed.).
Decc 2012a. Energy Security Strategy. Department of Energy and Climate Change.
Decc 2012b. Identifying trends in the deployment of domestic solar PV under the Feed-in Tariff scheme Department of Energy and Climate Change.
Decc 2012c. UK greenhouse gas emissions quarterly statistics: Methodological summary. Department of Energy and Climate Change.
Decc 2013a. Annual Report on Fuel Poverty: Statistics 2013. Department of Energy and Climate Change.
Decc 2013b. Community Energy Call for Evidence. Department for Energy and Climate Change.
Decc 2013c. National energy efficiency data framework: Part II. Impact of energy efficiency measures in homes.
Decc 2013d. Total final energy consumption at regional and local authority level.
Decc 2013e. Total household expenditure on energy in the UK (QEP 2.6.1). *In:* DECC (ed.).
Decc 2014a. Community energy contact group: Remit of the Community Energy Contact Group.
Decc 2014b. Community Energy Strategy: Full Report. Department for Energy and Climate Change.
Decc 2014c. Digest of United Kingdom Energy Statistics. Chapter 6: Renewable sources of energy.
Decc 2014d. Government response to consultation on changes to financial support for solar PV.
Decc 2014e. MLSOA and LLSOA electricity and gas estimates.
Decc 2015a. Cutting the cost of keeping warm: A fuel poverty strategy for England
Decc 2015b. Digest of UK Energy Statistics (DUKES).
Decc 2015c. Guidance on community ownership models under the Feed-in Tariffs scheme. Department of Energy and Climate Change.
Decc 2015d. Solar photovoltaics deployment.
Decc 2016. DECC Public Attitudes Tracker - Wave 17.
Defeuilley, C. & Furtado, A. T. 2000. Impacts de l'ouverture à la concurrence sur la R&D dans le secteur électrique. *Annals of Public and Cooperative Economics,* 71**,** 5-27.

Defra 2006. Climate Change: The UK Programme 2006. London: TSO: Department for Environment, Food and Rural Affairs.
Defra 2009. Guidance on how to measure and report your greenhouse gas emissions.
Defra 2010. Measuring progress: Sustainable development indicators 2010. Defra.
Defra 2011. Mainstreaming sustainable development: The Government's vision and what this means in practice. Defra.
Demski, C., Spence, A. & Pidgeon, N. 2013. Transforming the UK Energy System: Public Values, Attitudes and Acceptability: Summary findings from a survey conducted August 2012. UKERC.
Demski, C. C. 2011. *Public perceptions of renewable energy technologies–challenging the notion of widespread support.* Cardiff University.
Denscombe, M. 2007. *The good research guide: For small-scale social research projects. Third Edition,* Berkshire, Open University Press.
Department of Commerce 2012. Commerce preliminary finds dumping of chrystalline silicon photovoltaic cells, whether or not assembled into modules from the People's Republic of China.
Devine-Wright, P. 2005. Local aspects of UK renewable energy development: exploring public beliefs and policy implications. *Local Environment,* 10**,** 57-69.
Devine-Wright, P. 2007. Energy citizenship: Psychological aspects of evolution in sustainable energy technologies. *In:* MURPHY, J. (ed.) *Governing Technology for Sustainability.* London: Earthscan.
Dgrv. 2014. *Cooperatives in Germany: History of cooperatives* [Online]. Available: http://www.dgrv.de/en/cooperatives/historyofcooperatives.html.
Diamond, J. 1997. *Guns, Germs, and Steel: A short history of everybody for the last 13,000 years,* London, Vintage.
Dobbyn, J. & Thomas, G. 2005. Seeing the light: the impact of micro-generation on our use of energy. London: Sustainable Consumption Roundtable.
Dogan, M. & Pelassy, D. 1990. *How to compare nations: Strategies in comparative politics (2nd ed.).* , Chatham House.
Dondi, P., Bayoumi, D., Haederli, C., Julian, D. & Suter, M. 2002. Network integration of distributed power generation. *Journal of Power Sources,* 106**,** 1-9.
Droege, P. 2009. *100 Per Cent Renewable: Energy Autonomy in Action,* London, Earthscan.
Druckman, A. & Jackson, T. 2008. Household energy consumption in the UK: A highly geographically and socio-economically disaggregated model. *Energy Policy,* 36**,** 3177-3192.
Dti 2003. Our energy future: Creating a low carbon economy. *In:* DEPARTMENT OF TRADE AND INDUSTRY (ed.). London: TSO.
Dti 2006a. The Energy Challenge. Energy Review Report 2006. *In:* DEPARTMENT OF TRADE AND INDUSTRY (ed.). London.

Dti 2006b. Our Energy Challenge: Power from the People. Microgeneration Strategy. *In:* DEPARTMENT OF TRADE AND INDUSTRY (ed.). London: TSO.
Dumont, L. 1992. *Essays on individualism: Modern ideology in anthropological perspective*, University of Chicago Press.
Durant, W. 2010. Lessons of history.
Durkheim, E. 1884. The division of labor in society. *Journal des Economistes***,** 211.
Ec 2009. Directive 2009/28/EC on the promotion of the use of energy from renewable sources. *In:* EUROPEAN PARIAMENT (ed.).
Eccc 2013. Energy and Climate Change Committee. Oral Evidence on energy prices, 29 October 2013.
Edelman 2014. 2014 Edelman Trust Barometer: Global Energy Findings.
Eia 2011. Annual Energy Review. U.S. Energy Information Administration (EIA).
Energinet.Dk 2009. Green thinking in Denmark: Wind power to combat climate change. Energinet.
Energy Saving Trust 2004. Hard to Treat Homes Guide.
Energy Saving Trust. 2014. *Energy Saving Trust* [Online]. Available: http://www.energysavingtrust.org.uk/.
Energy Saving Trust. 2016. *Solar Energy Calculator - Assumptions* [Online]. Available: http://www.pvfitcalculator.energysavingtrust.org.uk/.
Erge, T., Hoffmann, V. U. & Kiefer, K. 2001. The German experience with grid-connected PV-systems. *Solar Energy,* 70**,** 479-487.
European Commission 2011. Communication from the Commission to the European Parliament and the Council, the European Economic and Social Committee and the Committee of the Regions, Energy Roadmap 2050', COM(2011) 885 Final.
European Commission 2015. Renewable Energy Progress Report.
Evans, A., Strezov, V. & Evans, T. J. 2009. Assessment of sustainability indicators for renewable energy technologies. *Renewable and Sustainable Energy Reviews,* 13**,** 1082-1088.
Evans, B. Energising Communalities – UKERC Meeting Place Workshop Report , . UKERC Meeting Place Workshop, 12th June 2006 2006. UKERC.
Evans, M. D. 2003. The contribution of social capital in the social economy to local economic development in Western Europe (CONCISE). Brussels: European Commission.
Fell, H.-J. 2009. Feed-in tariff for renewable energies: An effective stimulus package without new public borrowing.
Fenno Jr, R. F. 1986. Observation, context, and sequence in the study of politics. *The American Political Science Review***,** 3-15.
Financial Times. 2015. UK should think again about Hinkley Point nuclear power station. *Financial Times. 9th September 2015*.
Fischer, C. & Sauter, R. Users as pioneers: Transformation in the electricity system, microCHP and the role of the users. Proceedings Berlin Conference on Human Dimensions of Global Environmental Change, 2004. 319-337.

Flora, C., Flora, J. & Fey, S. 2004. *Rural communities: legacy and change (2nd edition),* Boulder, CO, Westview Press.
Florini, A. & Sovacool, B. K. 2009. Who governs energy? The challenges facing global energy governance. *Energy Policy,* 37**,** 5239-5248.
Flyvbjerg, B. 2006. Five misunderstandings about case-study research. *Qualitative inquiry,* 12**,** 219-245.
Fouquet, R. & Pearson, P. J. G. 2012. Past and prospective energy transitions: Insights from history. *Energy Policy,* 50**,** 1-7.
Foxon, T. J. 2002. Technological and institutional 'lock-in' as a barrier to sustainable

innovation. *ICCEPT Working Paper.* Imperial College Centre for Energy Policy and Technology (ICCEPT).
Foxon, T. J., Gross, R., Chase, A., Howes, J., Arnall, A. & Anderson, D. 2005. UK innovation systems for new and renewable energy technologies: drivers, barriers and systems failures. *Energy Policy,* 33**,** 2123-2137.
Foxon, T. J., Reed, M. S. & Stringer, L. C. 2009. Governing long-term social–ecological change: what can the adaptive management and transition management approaches learn from each other? *Environmental Policy and Governance,* 19**,** 3-20.
Fpag 2009. Eighth Annual Report. Fuel Poverty Advisory Group.
Fraunhofer Ise 2015. Photovoltaics report. Fraunhofer Institute for Solar Energy Systems ISE.
Gale, J. 2015. CO2 capture storage, use or recycle.
Gamernikow, E. 2003. Social capital and human capital. *Encyclopedia of community.* SAGE Publications.
Gardiner, S. M. 2006. A Perfect Moral Storm: Climate Change, Intergenerational Ethics and the Problem of Moral Corruption. *Environmental Values,* 15**,** 397-413.
Geels, F. & Deuten, J. J. 2006. Local and global dynamics in technological development: a socio-cognitive perspective on knowledge flows and lessons from reinforced concrete. *Science and Public Policy,* 33**,** 265-275.
Geels, F. & Raven, R. 2006. Non-linearity and expectations in niche-development trajectories: ups and downs in Dutch biogas development (1973–2003). *Technology Analysis & Strategic Management,* 18**,** 375-392 %@ 0953-7325.
Geels, F. W. 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy,* 31**,** 1257-1274.
Geels, F. W. 2005. *Technological transitions and system innovations: a co-evolutionary and socio-technical analysis*, Edward Elgar.
Geels, F. W. 2014. Regime resistance against low-carbon transitions: Introducing politics and power into the multi-level perspective. *Theory, Culture & Society***,** 263-276.
Geels, F. W. & Schot, J. 2007. Typology of sociotechnical transition pathways. *Research Policy,* 36**,** 399-417.
Giddens, A. 1984. *The Constitution of Society: Outline of the Theory of Structuration,* Cambridge, Polity Press.

Gillham, B. 2000. *Developing a Questionnaire,* London, Continuum.
Gillham, B. 2005. *Research Interviewing: the range of techniques,* Berkshire, Open University Press.
Gittell, R. & Vidal, A. 1998. *Community organizing: Building social capital as a development strategy*, Sage.
Goldthau, A. 2014. Rethinking the governance of energy infrastructure: Scale, decentralization and polycentrism. *Energy Research & Social Science,* 1**,** 134-140.
Gooding, J., Edwards, H., Giesekam, J. & Crook, R. 2013. Solar City Indicator: A methodology to predict city level PV installed capacity by combining physical capacity and socio-economic factors. *Solar Energy,* 95**,** 325-335.
Granovetter, M. 1973. The strength of weak ties. *American journal of sociology,* 78**,** l.
Gray, D. E. 2004. *Doing Research in the Real World,* London, Sage Publications.
Gronow, J. & Warde., A. 2001. *Ordinary consumption,* London, Routledge.
Gross, R. & Heptonstall, P. 2010. Time to stop experimenting with UK renewable energy policy. ICEPT Working Paper. October 2010.
Gross, R., Leach, M. & Bauen, A. 2003. Progress in renewable energy. *Environment International,* 29**,** 105-122.
Groves, R. M. 2006. Nonresponse Rates and Nonresponse Bias in Household Surveys. *Public Opinion Quarterly,* 70**,** 646-675.
Grubb, M. 2014. *Planetary Economics: Energy, climate change and the three domains of sustainable development*, Routledge.
Grubb, M., Butler, L. & Twomey, P. 2006. Diversity and security in UK electricity generation: The influence of low-carbon objectives. *Energy Policy,* 34**,** 4050-4062.
Grubb, M. J. 1991. The integration of renewable electricity sources. *Energy Policy,* 19**,** 670-688.
Haas, R., Ornetzeder, M., Hametner, K., Wroblewski, A. & Hübner, M. 1999. SOCIO-ECONOMIC ASPECTS OF THE AUSTRIAN 200 kWp-PHOTOVOLTAIC-ROOFTOP PROGRAMME. *Solar Energy,* 66**,** 183-191.
Hadjilambrinos, C. 2000. Understanding technology choice in electricity industries: a comparative study of France and Denmark. *Energy Policy,* 28**,** 1111-1126 %@ 0301-4215.
Haggett, C., Creamer, E., Harnmeijer, J., Parsons, M. & Bomberg, E. 2013. Community Energy in Scotland: the Social Factors for Success.
Hain, J. J., Ault, G. W., Galloway, S. J., Cruden, A. & Mcdonald, J. R. 2005. Additional renewable energy growth through small-scale community orientated energy policies. *Energy Policy,* 33**,** 1199-1212.
Hajer, M. a. U. 1995. *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process*, Clarendon Press.
Hall, S. & Roelich, K. 2015. Local Electricity Supply: Opportunities, archetypes and outcomes.

Hamza, N. & Gilroy, R. 2011. The challenge to UK energy policy: An ageing population perspective on energy saving measures and consumption. *Energy Policy,* 39**,** 782-789.
Hargreaves, T. 2012. Community Energy: Taking stock, moving forwards? Grassroots Innovations Research Briefing 12. Grassroots Innovations.
Hargreaves, T., Hielscher, S., Seyfang, G. & Smith, A. 2013. Grassroots innovations in community energy: The role of intermediaries in niche development. *Global environmental change,* 23**,** 868-880.
Hargreaves, T., Nye, M. & Burgess, J. 2008. Social experiments in sustainable consumption: an evidence-based approach with potential for engaging low-income communities. *Local Environment,* 13**,** 743-758.
Harnmeijer, A., Harnmeijer, J., Mcewan, N. & Bhopal, V. 2012. Report on Community Renewable Energy in Scotland. Edinburgh Centre for Carbon Innovation; Sustainable Community Energy Network; UK Energy Research Centre.
Harper, G. & Price, R. 2011. A framework for understanding the social impacts of policy and their effect on wellbeing: A paper by the Social Impacts Taskforce. Defra.
Harper, R. & Kelly, M. 2003. Measuring social capital in the United Kingdom. Office for National Statistics.
Harris, D. & Kor, Y. 2013. The Role of Human Capital in Scaling Social Entrepreneurship. *Journal of Management for Global Sustainability,* 1**,** 163-172.
Hay, C. 2007. *Why We Hate Politics,* Cambridge Malden SA, Polity Press.
Hay, C. & Wincott, D. 1998. Structure, agency and historical institutionalism. *Political studies,* 46**,** 951-957.
Healy, J. D. & Clinch, J. P. 2002. Fuel poverty, thermal comfort and occupancy: results of a national household-survey in Ireland. *Applied Energy,* 73**,** 329-343.
Heinrich Böll Stiftung 2015. The Energiewende Story.
Heiskanen, E., Johnson, M., Robinson, S., Vadovics, E. & Saastamoinen, M. 2010. Low-carbon communities as a context for individual behavioural change. *Energy Policy,* 38**,** 7586-7595.
Hielscher, S. 2011. Community energy in the UK: A review of the research literature. *In:* SPRU (ed.) *Grassroots Innovations.* University of Sussex.
Hielscher, S., Seyfang, G. & Smith, A. 2011. Community innovation for sustainable energy. *CSERGE Working Paper 2011-03.* Centre for Social and Economic Research on the Global Environment.
Hiles, C. 2014. Developer and community partnerships. RegenSW.
Hills, J. 2012. Getting the measure of fuel poverty. *In:* DEPARTMENT OF ENERGY AND CLIMATE CHANGE (ed.). London: DECC.
Hm Government 2005. Securing the future: Delivering UK Sustainable Development Strategy. *In:* DEPARTMENT OF ENVIRONMENT FOOD AND RURAL AFFAIRS (ed.). London.
Hm Government 2007. The new performance framework for Local Authorities & Local Authority Partnerships: Single set of National indicators. *In:*

DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT (ed.). London.
Hm Government 2008. Climate Change Act (chapter 27). *In:* HMG (ed.) *November 2008.* London: The Stationery Office.
Hm Government 2009a. The UK Low Carbon Transition Plan: National strategy for climate and energy. *In:* DEPARTMENT OF ENERGY AND CLIMATE CHANGE (ed.). London.
Hm Government 2009b. The UK Renewable Energy Strategy. *In:* DEPARTMENT OF ENERGY AND CLIMATE CHANGE (ed.). London: Crown.
Hm Treasury & Decc 2010. Energy market assessment. *In:* HM TREASURY & DEPARTMENT OF ENERGY & CLIMATE CHANGE (ed.). Surrey.
Hoffman, S. M. & High-Pippert, A. 2005. Community Energy: A Social Architecture for an Alternative Energy Future. *Bulletin of Science, Technology & Society,* 25**,** 387-401.
Hoggett, R. 2008. Hard to Treat Housing Case Study. Community Energy Plus.
Hoggett, R. 2010. *The opportunities and barriers for communities to secure at-risk finance for the development of revenue-generating renewable energy projects.* MSc Energy Policy, University of Exeter.
Hoggett, R. 2013. Supply Chains and Energy Security. *In:* MITCHELL, C. & WATSON, J. (eds.) *New Challenges in Energy Security: The UK in a Multipolar World.* Basingstoke, UK: Palgrave Macmillan.
Hoggett, R. 2014. Technology scale and supply chains in a secure, affordable and low carbon energy transition. *Applied Energy,* 123**,** 296-306.
Holliday, S. 2015. The idea of large power stations for baseload is outdated. Energy Post website,September 11th 2015.
Hoogma, R., Weber, M. & Elzen, B. 2001. Integrated long-term strategies to induce regime shifts to sustsinability: the approach of strategic niche management. Paper presented at the Towards Environmental Innovation Systems Conference, 27-29 September, Eibsee, Germany.
Houghton, T. 2009. Delivering local sustainable energy: learning from success - Literature Review for the Ashden Awards. Houghton Research.
Houghton, T. 2010. Galvanising Community-led Responses to Climate Change. NESTA.
Hughes, T. 1983. *Networks of Power,* Baltimore, Johns Hopkins University Press.
Iea 2008. Empowering variable renewables: Options for flexible electricity systems. International Energy Agency/OECD.
Iea & Oecd 2002. Distributed generation in liberalised electricity markets. *In:* INTERNATIONAL ENERGY AGENCY (IEA) (ed.). Paris: IEA; OECD.
Iet 2013. IET Evidence to the ECC Committee cal for evidence on Local Energy. Institute of Engineering and Technology.
Ipcc 2013. Climate Change 2013: The Physical Science Basis. Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change *In:* IPCC (ed.). Intergovernmental Panel on Climate Change.

Ipcc 2014. Climate Change 2014: Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

Irena 2012. 30 years of policies for wind energy: Lessons from 12 wind energy markets. International Renewable Energy Agency.

Jackson, T. 2009. *Prosperity without Growth: Economics for a Finite Planet*, Routledge.

Jackson, T. & Michaelis, L. 2003. Policies for sustainable consumption: A report to the Sustainable Development Commission. 17th September 2003.

Jacobsson, S. & Bergek, A. 2004. Transforming the energy sector: the evolution of technological systems in renewable energy technology. *Industrial and Corporate Change,* 13**,** 815-849.

Jacobsson, S. & Lauber, V. 2006. The politics and policy of energy system transformation—explaining the German diffusion of renewable energy technology. *Energy Policy,* 34**,** 256-276.

Jahn, D. 1992. Nuclear power, energy policy and new politics in Sweden and Germany. *Environmental Politics,* 1**,** 383-417.

Jamasb, T. & Pollitt, M. G. 2008. Liberalisation and R&D in network industries: The case of the electricity industry. *Research Policy,* 37**,** 995-1008.

Janghorban, R., Roudsari, R. L. & Taghipour, A. 2014. Skype interviewing: The new generation of online synchronous interview in qualitative research. *International Journal of Qualitative Studies on Health and Well-being,* 9.

Jansen, M. 2015. UK is perfectly placed to use 100 per cent renewable power. *New Scientist*.

Jasanoff, S. 2000. The "science wars" and American politics. *In:* B, M. D. & GROTE, C. V. (eds.) *Between understanding and trust: the public, science and technology.* Amsterdam: Harwood.

Jenny, A., López, J. R. D. & Mosler, H. J. 2006. Household energy use patterns and social organisation for optimal energy management in a multi-user solar energy system. *Progress in Photovoltaics: Research and Applications,* 14**,** 353-362.

Jones, G. 2011. Localism and the Big Society: What is the Government Up To? CNN Speech Outline.

Jørgensen, U. & Karnøe, P. 1995. The Danish wind turbine story: technical solutions to political visions? *In:* RIP, A., MISA, T. J. & SCHOT, J. (eds.) *Managing Technology in Society: The Approach of Constructive Technology Assessment.* London: Pinter Publishers.

Julian, C. 2014. Creating Local Energy Economies: Lessons from Germany. ResPublica.

Kahneman, D. 2011. *Thinking, fast and slow*, Macmillan.

Kay, A. 2003. Social capital in building the social economy. *In:* PEARCE, R. (ed.) *Social enterprise in Anytown.* London: Calouste Gulbenkian Foundation.

Kay, A. 2015. Subsidy-free solar in the UK? *Renewable Energy Focus,* 16**,** 38-40.

Keiler, J. & Häuser, H. 2014. Betreiberdatenbasis. IWET Datenbank.
Keirstead, J. 2007. Behavioural responses to photovoltaic systems in the UK domestic sector. *Energy Policy,* 35**,** 4128-4141.
Kelly, K. 1998. *New Rules for the New Economy,* New York, Penguin.
Kemp, R., Schot, J. & Hoogma, R. 1998. Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis & Strategic Management,* 10**,** 175-198.
Kern, F., Kuzemko, C. & Mitchell, C. 2014. Measuring and explaining policy paradigm change: the case of UK energy policy. *Policy and Politics*.
Ki-Moon, B. 2014. Opening remarks at the 2014 UN Climate Summit, New York, 23 September 2014. United Nations.
King, E., Roberts, L., Toynbee, M., Scakville, T. & Bruce, G. 2010. The new 'neighbourhood army': The role of community organising in the Big Society.
Klein, N. 1918. Proceedings of the Biennial Convention of the Amalgamated Clothing Workers of America.
Kpmg 2011. Rekommunalisierung der Energieversorgung ist in jeder dritten Kommune ein Thema.
Krohn, S. 2000. The wind turbine market in Denmark. Danish Wind Power Association.
Kuzemko, C. 2013. *The Energy Security-Climate Nexus: Institutional Change in the UK and Beyond*, Palgrave Macmillan.
Kuzemko, C. 2014. Depoliticisation, Institutions and Political Capacity: Explaining Sedate Energy Transition in the UK. EPG Working Paper 1405.
Kuzemko, C. & Bradshaw, M. 2013. Energy security: geopolitics, governance and multipolarity. *New Challenges in Energy Security: The UK in a Multipolar World.* Palgrave MacMillan Basingstoke.
Kvale, S. 1996. *InterViews: An Introduction to Qualitative Research Interviewing,* Thousand Oaks, Sage Publications.
Lasseter, R. H. Control of distributed resources. *In:* FINK, L. H. & VOURNAS, C. D., eds. Bulk Power Systems Dynamics and Control IV, Restructuring. Organised by IREP and National Technical University of Athens, August 23–28, 1998 1998 Santorini, Greece. 323–329.
Lauber, V. 2005. *Switching to renewable power: A framework for the 21st century,* Bath, Bath Press.
Leahy, E. & Lyons, S. 2009. Energy use and appliance ownership in Ireland. ESRI, Working Paper No. 277.
Ledoux, L., Mertens, R. & Wolff, P. 2005. EU sustainable development indicators: An overview. *Natural Resources Forum,* 29**,** 392-403.
Liddell, C. 2008. Cost-benefit analysis of tackling fuel poverty. Department of Social Development.
Liebreich, M. 2011. First They Ignore You….
Liebreich, M. 2015. An energy sector tansformed must be an energy sector reformed. BNEF blog: 18th August 2015

Lijphart, A. 1984. *Democracies: Patterns of Majoritarian and Consensus Government in Twenty-One Countries,* New Haven, Yale University Press.
Lindblom, C. E. 2002. *The market system: What it is, how it works, and what to make of it*, Yale University Press.
Liverman, D. M., Hanson, M. E., Brown, B. J. & Merideth, R. W. 1988. Global sustainability: Toward measurement. *Environmental Management,* 12**,** 133-143.
Lockwood, M. 2013. Governance, Innovation and the Transition to a Sustainable Energy System: Perspectives from Economic Theory. *IGov Working Paper Series.* University of Exeter.
Lockwood, M. 2014. Learning from Merkel's approach to energy politics. IGov blog, 10th March 2014.
Lockwood, M. 2015. The Danish system of electricity policy-making and regulation: EPG Working Paper: 1504.
Long, N. 2013. *RE: Email correspondence from Ofgem representative received on Monday, 29 July 2013.*
Lopes, J. a. P., Hatziargyriou, N., Mutale, J., Djapic, P. & Jenkins, N. 2007. Integrating distributed generation into electric power systems: A review of drivers, challenges and opportunities. *Electric Power Systems Research,* 77**,** 1189-1203.
Lorenzoni, I., Nicholson-Cole, S. & Whitmarsh, L. 2007. Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global environmental change,* 17**,** 445-459.
Lovins, A. B. 1976. Energy Strategy: The road not taken. *Foreign Affairs*.
Lovins, A. B. 1977. *Soft Energy Paths: Towards a durable peace*, Harper Collins.
Lowndes, V. & Pratchett, L. 2011. Local Governance under the Coalition Government: Austerity, Localism and the 'Big Society'. *Local Government Studies,* 38**,** 21-40.
Lucas, N. J. D. 1985. *Western European Energy Policies: A Comparative Study of the Influence of Institutional Structure on Technical Change,* Oxford, Oxford University Press.
Lukes, S. 2004. INVASIONS OF THE MARKET. *In:* DWORKIN, R. (ed.) *From Liberal Values to Democratic Transition. Essays in Honor of Janos Kis.* Budapest: Central University Press.
Luthans, F., Luthans, K. W. & Luthans, B. C. 2004. Positive psychological capital: beyond human and social capital. *Business Horizons,* 47**,** 45-50.
Mack, N., Woodsong, C., Macqueen, K. M., Guest, G. & Namey, E. 2005. Qualitative research methods: a data collectors field guide.
Maegaard, P., Krenz, A. & Palz, W. 2013. *Wind power for the world,* Boca Raton, Florida, CRC Press.
Marechal, K. & Lazaric, N. 2010. Overcoming inertia: insights from evolutionary economics into improved energy and climate policies. *Climate Policy,* 10**,** 103-119.
Margolis, R. M. & Kammen, D. M. 1999. Underinvestment: The Energy Technology and R&D Policy Challenge. *Science,* 285**,** 690-692.

Martiskainen, M. & Watson, J. 2009. Energy and the Citizen. *In:* SCARSE, I. & MACKERRON, G. (eds.) *Energy for the Future – A New Agenda.* Hampshire: Palgrave Macmillan.
Mason, P. 2015. *Post Capitalism: A Guide to Our Future*, Allen Lane.
Mason, R. 2013. David Cameron at centre of 'get rid of all the green crap' storm. *The Guardian*.
Mathers, N., Fox, N. & Hunn, A. 2000. Using interviews in a research project. *In:* WILSON, A., WILLIAMS, M. & HANCOCK, B. (eds.) *Research Approaches in Primary Care.* Oxon: Radcliffe Medical Press Ltd.
Mathiesen, B. V., Lund, H., Connolly, D., Wenzel, H., Østergaard, P. A., Möller, B., Nielsen, S., Ridjan, I., Karnøe, P. & Sperling, K. 2015. Smart Energy Systems for coherent 100% renewable energy and transport solutions. *Applied Energy,* 145**,** 139-154 %@ 0306-2619.
Mcloughlin, F., Duffy, A. & Conlon, M. 2012. Characterising domestic electricity consumption patterns by dwelling and occupant socio-economic variables: An Irish case study. *Energy and Buildings,* 48**,** 240-248.
Mcmichael, M. & Shipworth, D. 2013. The value of social networks in the diffusion of energy-efficiency innovations in UK households. *Energy Policy,* 53**,** 159-168.
Meadowcroft, J. 2005. Environmental political economy, technological transitions and the state. *New Political Economy,* 10**,** 479-498.
Meier, H. & Rehdanz, K. 2010. Determinants of residential space heating expenditures in Great Britain. *Energy Economics,* 32**,** 949-959.
Menard, S. 1991. *Longitudinal Research,* Newbury Park, Sage Publications.
Mersmann, F., Wehnert, T., Göpel, M., Arens, S. & Ujj, O. 2014. *Shifting Paradigms: Unpacking Transformation for Climate Action. a Guidebook for climate Finance & Development practitioners. ,* Berlin, Wuppertal institute for climate, environment and energy.
Meyer, N. I. 2007. Learning from wind energy policy in the EU: lessons from Denmark, Sweden and Spain. *European Environment,* 17**,** 347-362 %@ 1099-0976.
Michelsen, C. C. & Madlener, R. 2013. Motivational factors influencing the homeowners' decisions between residential heating systems: An empirical analysis for Germany. *Energy Policy,* 57**,** 221-233.
Middlemiss, L. & Parrish, B. D. 2010. Building capacity for low-carbon communities: The role of grassroots initiatives. *Energy Policy,* 38**,** 7559-7566.
Miller, T. L., Grimes, M. G., Mcmullen, J. S. & Vogus, T. J. 2012. Venturing for others with heart and head: How compassion encourages social entrepreneurship. *Academy of management review,* 37**,** 616-640.
Mitchell, C. 1994. *The Renewable Non-Fossil Fuel Obligation: A Case Study of the Barriers to Energy Technology Development. DPhil.*
Mitchell, C. 1995. The renewables NFFO: A review. *Energy Policy,* 23**,** 1077-1091.
Mitchell, C. 2008. *The political economy of sustainable energy*, Palgrave Macmillan.

Mitchell, C. 2013. How to change the balance of power. *New Statesman. 5th May 2015*.
Mitchell, C. 2014a. Change and Inertia in the UK Energy System – getting our institutions and governance right. IGov Working Paper: 1402. University of Exeter.
Mitchell, C. 2014b. Future energy markets and networks in the UK and European Union. *In:* EKINS, P. & WATSON, J. (eds.) *UK Energy in a Global Context. UKERC Synthesis Report.* UKERC.
Mitchell, C. 2014c. Lessons from America: New York State's Reforming the Energy Vision. IGov blog: 2nd Jult 2014.
Mitchell, C. 2015a. No resource is 100% reliable: a 100% renewable energy system operation on no wind, no sun days. IGov blog: 31 July 2015.
Mitchell, C. 2015b. No resource is 100% reliable: A No-Regret Energy Policy-reduce, flatten and flex. IGov blog: 28th July 2015.
Mitchell, C., Bauknecht, D. & Connor, P. M. 2006. Effectiveness through risk reduction: a comparison of the renewable obligation in England and Wales and the feed-in system in Germany. *Energy Policy,* 34**,** 297-305.
Mitchell, C. & Connor, P. 2004. Renewable energy policy in the UK 1990–2003. *Energy Policy,* 32**,** 1935-1947.
Mitchell, C., Froggatt, A. & Hoggett, R. 2014. Governance and disruptive energy system change.
Mitchell, C., Watson, J. & Whiting, J. 2012. *Energy Security in a Multipolar World,* Basingstoke, UK, Palgrave Macmillan.
Mitchell, C., Watson, J. & Whiting, J. 2013. *New Challenges in Energy Security: The UK in a Multipolar World*, Palgrave Macmillan.
Mitchell, C., Woodman, B., Kuzemko, C. & Hoggett, R. 2015. Public Value Energy Governance: establishing an institutional framework which better fits a sustainable, secure and affordable energy system. EPG Working Paper: 1502.
Mitchell, C. E. A. 2011. Expert Report on Connection and Charging Arrangements for Transmission Networks to input to Project TransmiT.
Monbiot, G. 2010. *A Great Green Rip-Off* [Online]. Available: http://www.monbiot.com/archives/2010/03/01/a-great-green-rip-off [Accessed 26 April 2012.
Morris, D. 2001. *Seeing the light: regaining control of our electricity system. Institute for Local Self-Reliance,* Minneapolis, MN.
Mtp. 2005. *BNDL01: Assumptions for energy scenarios in the domestic lighting sector* [Online]. Defra. Available: efficient-products.defra.gov.uk/spm/download/document/id/567 [Accessed 10/04/12.
Mügge, D. 2011. From pragmatism to dogmatism: European Union governance, policy paradigms and financial meltdown. *New Political Economy,* 16**,** 185-206 %@ 1356-3467.
Müller, S., Brown, A. & Ölz, S. 2011. Renewable energy: policy considerations for deploying renewables

http://www.iea.org/publications/freepublications/publication/Renew_Policies.pdf.

Myers, M. D. 1997. Qualitative research in information systems. *Management Information Systems Quarterly,* 21**,** 241-242.
Nao 1994. The renewable energy research, development and demonstration programme. HMSO.
Narayan-Parker, D. 1999. *Bonds and bridges: social capital and poverty*, World Bank Publications.
National Infrastructure Commission. 2016a. *National Infrastructure Commission website* [Online]. [Accessed 29th April 2016.
National Infrastructure Commission 2016b. Smart power. National Infrastructure Commission report. March 2016.
Neslen, A. 2015. Carbon capture battle stirs hopes, dreams and grim realities. *The Guardian. 23rd March 2015*.
New York State Psc 2014. REV: Reforming the Energy Vision New York State Public Service Commission.
Nolden, C. 2013. Governing community energy—Feed-in tariffs and the development of community wind energy schemes in the United Kingdom and Germany. *Energy Policy,* 63**,** 543-552.
Nye, M. 1990. *Electrifying America,* Cambridge, MA, MIT Press.
O'doherty, J., Lyons, S. & Tol, R. S. J. 2008. Energy-using appliances and energy-saving features: Determinants of ownership in Ireland. *Applied Energy,* 85**,** 650-662.
Obama, B. 2014. Speech to the 2014 UN Climate Summit, 23 September 2014.
Odpm. 2005. *Neighbourhood Statistics Geography Policy* [Online]. Available: http://www.neighbourhood.statistics.gov.uk/HTMLDocs/downloads/GeographyPolicy.pdf [Accessed 10/04/12.
Oecd 2008. Costs of Inaction on Environmental Policy Challenges: Summary Report. *Meeting of the Environment Policy Committee (EPOC) at Ministerial Level.*
Office for National Statistics 2011. 2011 Census: Aggregate data (England and Wales)
Ofgem 2008. Energy Supply Probe. Final Report.
Ofgem 2010. Project Discovery: Options for delivering secure and sustainable energy supplies Ofgem.
Ofgem 2012. Gas Security of Supply Report. Ofgem report to Government.
Ofgem 2014a. Consultation on a proposal to make a market investigation reference in respect of the supply and acquisition of energy in Great Britain. Ofgem.
Ofgem 2014b. Feed in Tariff Installation Report March 2014.
Ofgem 2014c. State of the Market Assessment.
Ofgem. 2015a. *Feed in Tariff Quarterly Report* [Online]. Available: https://http://www.ofgem.gov.uk/environmental-programmes/feed-tariff-fit-scheme/feed-tariff-reports/feed-tariff-quarterly-report.
Ofgem 2015b. Non-traditional business models: Supporting transformative change in the energy market. Discussion paper.
Ofgem & Berr 2008. Distributed Energy—Further Proposals for More Flexible Market and Licensing Arrangements. *In:* OFGEM (ed.). London.

Olesen, G. B., Maegaard, P. & Kruse, J. 2004. Danish Experience in Wind Energy - Local Financing: Working report for the WELFI project. Comité de Liaison Energies Renouvelables. .
Olli, E., Grendstad, G. & Wollebaek, D. 2001. Correlates of environmental behaviors bringing back social context. *Environment and behavior,* 33**,** 181-208.
Ons 2013. 2011 Census, Detailed Characteristics for 2011 Census Merged Wards and Middle Layer Super Output Areas in England and Wales.
Ons 2014. 2011 Census, Detailed Characteristics on Approximated Social Grade for Middle Layer Super Output Areas and 2011 Census Merged Wards in England and Wales.
Ostrom, E. 2007. The governance challenge: matching institutions to the structure of social-ecological systems. *Princeton University Press, Forthcoming*.
Ostrom, E. 2014. A polycentric approach for coping with climate change. *Ann. Econ. Finance,* 15**,** 71-108.
Øvretveit, J. 1998. *Evaluating health interventions,* Buckingham, Open University Press.
Parag, Y. & Darby, S. 2009. Consumer–supplier–government triangular relations: Rethinking the UK policy path for carbon emissions reduction from the UK residential sector. *Energy Policy,* 37**,** 3984-3992.
Parkhill, K., Demski, C., Butler, C., Spence, A. & Pidgeon, N. 2013. Transforming the UK Energy System: Public Values, Attitudes and Acceptability –

Synthesis Report. London: UKERC.
Parsons Brinckerhoff 2012. Solar PV costs update. Department of Energy and Climate Change.
Patlitzianas, K. D., Doukas, H., Kagiannas, A. G. & Psarras, J. 2008. Sustainable energy policy indicators: Review and recommendations. *Renewable Energy,* 33**,** 966-973.
Pb Power 1999. Distributed network review. New and renewable energy programme.
Pearson, P. & Watson, J. 2012. UK Energy Policy 1980-2010: A history and lessons to be learnt
Pepermans, G., Driesen, J., Haeseldonckx, D., Belmans, R. & D’haeseleer, W. 2005. Distributed generation: definition, benefits and issues. *Energy Policy,* 33**,** 787-798.
Perez, C. 1985. Microelectronics, long waves and world structural change: new perspectives for developing countries. *World development,* 13**,** 441-463 %@ 0305-750X.
Perlin, J. 2013. *Let it Shine: The 6,000-year Story of Solar Energy*, New World Library.
Pierson, P. 1993. When Effect Becomes Cause: Policy Feedback and Political Change. *World Politics,* 45**,** 595-628.
Pierson, P. 2000. Increasing returns, path dependence, and the study of politics. *American political science review***,** 251-267.
Piu 2001. Working paper on penalties for intermittent sources of energy by David Milborrow. UK Cabinet Office.

Platt, R. 2014. The real cost of 'green crap'. *New Scientist,* 221.
Pollitt, M. 2008. The arguments for and against ownership unbundling of energy transmission networks. *Energy Policy,* 36**,** 704-713.
Pollitt, M. G. 2010. UK renewable energy policy since privatisation. *In:* MOSELLE, B., PADILLA, J. & SCHMALENSEE, R. (eds.) *Harnessing Renewable Energy in Electric Power Systems: Theory, Practice, Policy.* London: RFF Press.
Putnam, R. D. 2000. *Bowling alone: The collapse and revival of American community*, Simon and Schuster.
Ragwitz, M., Held, A., Resch, G., Faber, T., Haas, R. & Huber, C. 2007. OPTRES. Assessment and Optimisation of Renewable Energy Support Schemes in the European Electricity Market. Fraunhofer IRB Verl., Stuttgart.
Raven, R. P. J. M. 2005. Strategic niche management for biomass. PhD thesis. Eindhoven University of Technology.
Raven, R. P. J. M. & Geels, F. W. 2010. Socio-cognitive evolution in niche development: Comparativeanalysis of biogas development in Denmark and the Netherlands. *Technovation,* 30**,** 87-99.
Raven, R. P. J. M., Heiskanen, E., Lovio, R., Hodson, M. & Brohmann, B. 2008. The contribution of local experiments and negotiation processes to field-level learning in emerging (niche) technologies meta-analysis of 27 new energy projects in Europe. *Bulletin of Science, Technology & Society,* 28**,** 464-477.
Ray, S., Munksgaard, J., Morthorst, P. E. & Sinner, A.-F. 2010. Wind energy and electricity prices: Exploring the 'merit order effect'.
Reed, E. 2013. The GB Gas and Electricity Markets. Cornwall Energy.
Richter, L.-L. 2013. Social Effects in the Diffusion of Solar Photovoltaic Technology in the UK. EPRG Working Paper 1332.
Rifkin, J. 2011. *The third industrial revolution: how lateral power is transforming energy, the economy, and the world*, Macmillan.
Rip, A. & Kemp, R. 1998. Technological change. *In:* RAYNER, S. & MALONE, E. L. (eds.) *Human Choice and Climate Change.* Columbus, OH: Battelle Press.
Rivkin, D. A. & Silk, L. 2013. *Wind Energy*, Jones & Bartlett Publishers.
Robert, C. & Zeckhauser, R. 2011. The methodology of normative policy analysis. *Journal of Policy Analysis and Management,* 30.
Roberts, S. 2008. Demographics, energy and our homes. *Energy Policy,* 36**,** 4630-4632.
Roberts, S. 2009. Securing community engagement with renewable energy. Bristol: Centre for Sustainable Energy.
Roberts, S. 2011. *Does my society look big in this? How is the government's 'big' idea for energy policy shape up?* [Online]. Available: http://www.cse.org.uk/news/view/1513 [Accessed 02 May 2012.
Robson, C. 2002. *Real World Research,* Oxford, Blackwell Publishing.
Rosenow, J. 2012. Energy savings obligations in the UK—A history of change. *Energy Policy,* 49**,** 373-382.
Roth, P. A. 1989. How narratives explain. *Social Research Update,* 56**,** 449-478.

Rotmans, J., Kemp, R. & Asselt, M. V. 2001. More evolution than revolution: transition management in public policy. *foresight,* 3**,** 15-31 %U http://www.emeraldinsight.com/journals.htm?articleid=874125.
Roy, R., Caird, S. & Abelman, J. 2008. YIMBY Generation – yes in my back yard! UK householders pioneering microgeneration heat. London, UK: The Energy Saving Trust.
Rubin, H. J. & Rubin, I. S. 1995. *Qualitative Interviewing – The Art of Hearing,* London, Sage.
Rudd, A. 2015. Secretary of State Amber Rudd's speech to the Aviva conference, ‘Climate Change: The Financial Implications'. London: 24th July 2015.
Runci, P. 2005. Renewable Energy Policy in Germany: Pacific Northwest National Laboratory Technical Lab
Report PNWD-3526. Maryland: Joint Global Change Research Institute, University of Maryland.
Ruspini, E. 2000. Longitudinal Research in the Social Sciences. *Social Research Update,* Spring 2000.
Sardianou, E. & Genoudi, P. 2013. Which factors affect the willingness of consumers to adopt renewable energies? *Renewable Energy,* 57**,** 1-4.
Sauter, R. & Watson, J. 2007. Strategies for the deployment of micro-generation: Implications for social acceptance. *Energy Policy,* 35**,** 2770-2779.
Scarpa, R. & Willis, K. 2010. Willingness-to-pay for renewable energy: Primary and discretionary choice of British households' for micro-generation technologies. *Energy Economics,* 32**,** 129-136.
Schmidt, S. & Buehler, R. 2011. The planning process in the US and Germany: A comparative analysis.
Schot, J. & Geels, F. W. 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technology Analysis & Strategic Management,* 20**,** 537-554.
Schröder, M., Ekins, P., Power, A., Zulauf, M. & Lowe, R. 2011. The KfW experience in the treduction of energy use in and CO2 emissions from buildings: Operation, impacts and lessons for the UK. UCL.
Schumacher, E. F. 1973. *Small is beautiful: A study of economics as if people mattered*, Vintage.
Schuman, H. 1966. The Random Probe: A Technique for Evaluating the Validity of Closed Questions. *American Sociological Review,* 31**,** 218-222.
Schuppe, T. E. 2013. Brown clouds looming on the green energy horizon in Germany. 08 October 2013.
Schuppe, T. E. 2015a. The German Energiewende turns around Industry's Business Models (Part IIIa).
Schuppe, T. E. 2015b. The German Energiewende turns around Policy Framework (Part II).
Schweizer-Reis, P., Schulz, M., Vallvé, X., Vosseler, I., Ramírez, E. & Serrano, J. 2000. Successful user schemes for photovoltaic stand-alone systems: solar energy for rural electrification—lessons learned.

Technical Report. Fraunhofer-Institut für Solar Energiesysteme ISE, Freiburg.
Scoones, I., Leach, M., Smith, A., Stagl, S., Stirling, A. & Thompson, J. 2007. Dynamic Systems and the Challenge of Sustainability. STEPS Working Paper 1. STEPS Centre, Brighton.
Scrase, I. & Mackerron, G. 2009. *Energy for the Future,* Basingstoke, Hampshire, Palgrave Macmillan.
Setis 2014. Strategic Energy Technology (SET) Plan: Towards an Integrated Roadmap: Research and Innovation Challenges and Needs of the EU Energy System.
Seyfang, G., Haxeltine, A., Hargreaves, T. & Longhurst, N. 2010. Energy and communities in transition: Towards a new research agenda on agency and civil

society in sustainability transitions, CSERGE working paper EDM, No. 10-13.
Seyfang, G., Hielscher, S., Hargreaves, T., Martiskainen, M. & Smith, A. 2014. A grassroots sustainable energy niche? Reflections on community energy in the UK. *Environmental Innovation and Societal Transitions*.
Seyfang, G. & Longhurst, N. 2013. Growing green money? Mapping community currencies for sustainable development. *Ecological Economics,* 86**,** 65-77.
Seyfang, G., Park, J. J. & Smith, A. 2012. Community Energy in the UK. 3S Working Paper 2012-11. Norwich: Science, Society and Sustainability Research Group.
Seyfang, G., Park, J. J. & Smith, A. 2013. A thousand flowers blooming? An examination of community energy in the UK. *Energy Policy*.
Seyfang, G. & Smith, A. 2007. Grassroots innovations for sustainable development: Towards a new research and policy agenda. *Environmental Politics,* 16**,** 584-603.
Shove, E. 2003. *Comfort, cleanliness and convenience; The social organisation of normality. ,* Oxford, UK.
Shove, E. & Warde, A. 1997. Noticing inconspicuous consumption. Paper presented at the European Science Foundation TERM Programme Workshop on Consumption, Everyday Life and Sustainability. Lancaster, UK; University of Lancaster.
Shuy, R. W. 2003. In-person versus Telephone Interviewing' in. *In:* HOLSTEIN, J. A. & GUBRIUM, J. F. (eds.) *Inside Interviewing: New Lenses, New Concerns.* Thousand Oaks: Sage Publications.
Sijm, J. P. M. 2002. The performance of Feed-in-Tariffs to promote renewable electricity in European countries. Energy Research Centre of the Netherlands.
Simonds, V. & Hall, B. 2013. Overcoming grid connection issues for community energy projects. Cooperatives UK; The Co-operative Group.
Smith, A. 1776. *Wealth of nations*, University of Chicago Bookstore.
Smith, A. 2012a. Civil society in sustainable energy transitions. *In:* LOORBACH, D. & VERBONG, G. P. J. (eds.) *Governing the energy transition.* New York: Routledge.

Smith, A., Hargreaves, T., Hielscher, S., Martiskainen, M. & Seyfang, G. 2015. Making the most of community energies: Three perspectives on grassroots innovation. *Environment and Planning A*.
Smith, A., Kern, F., Raven, R. & Verhees, B. 2014. Spaces for sustainable innovation: Solar photovoltaic electricity in the UK. *Technological Forecasting and Social Change,* 81**,** 115-130.
Smith, A., Stirling, A. & Berkhout, F. 2005. The governance of sustainable socio-technical transitions. *Research Policy,* 34**,** 1491-1510.
Smith, A., Voß, J.-P. & Grin, J. 2010. Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research Policy,* 39**,** 435-448 %@ 0048-7333.
Smith, K. 2012b. The Danish wind industry 1980-2010: Lessons for the British marine energy industry. *Underwater Technology-Journal of the Societyfor Underwater Technology,* 30**,** 27 %@ 0141-0814.
Sørensen, B. 1995. History of, and recent progress in, wind energy utilization. *Annual Review of Energy and the Environment,* 20**,** 387-424.
Soutar, I. 2015. Overcoming inertia is the key to unlocking a sustainable energy future. New Thinking Blog, Jan 12th, 2015. Igov, University of Exeter.
Sovacool, B. K. 2010. *The Routledge handbook of energy security*, Routledge.
Sovacool, B. K. 2014. What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda. *Energy Research & Social Science,* 1**,** 1-29.
Spence, A., Venables, D., Pidgeon, N., Poortinga, W. & Demski, C. 2010. Public perceptions of climate change and energy futures in Britain. Cardiff University.
Spliid, I. 2014. Stamdataregister for vindmøller. Danish Energy Agency.
Spratt, S., Simms, A., Neitzert, E. & Ryan-Collins, R. 2009. The Great Transition. London: New Economics Foundation.
Stern, N. 2006. *The Economics of Climate Change: The Stern Review*, Cambridge University Press.
Stern, P. C. 2000. New Environmental Theories: Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues,* 56**,** 407-424.
Stirling, A. 2014a. Emancipating Transformations: From controlling 'the transition' to culturing plural radical progress. Steps Centre.
Stirling, A. 2014b. Transforming power: Social science and the politics of energy choices. *Energy Research & Social Science,* 1**,** 83-95.
Stirling, A. 2015. Knowing Doing Governing: realising heterodyne democracies. *In:* VOSS, J.-P. & FREEMAN, R. (eds.) *Knowing Governance: making models, making methods, shaping political reality.*
Strbac, G. 2008. Demand side management: Benefits and challenges. *Energy Policy,* 36**,** 4419-4426.
Strbac, G., Konstantelos, I., Aunedi, M., Pollitt, M. & Green, R. 2016. Delivering future-proof energy infrastructure. Report for the National Infrastructure Commission. February 2016.

Streimikiene, D. 2005. Indicators for sustainable energy development in Lithuania. *Natural Resources Forum,* 29**,** 322-333.
Streimikiene, D., Ciegis, R. & Grundney, D. 2007. Energy indicators for sustainable development in Baltic States. *Renewable and Sustainable Energy Reviews,* 11**,** 877-893.
Sturgis, P. & Allum, N. 2004. Science in Society: Re-Evaluating the Deficit Model of Public Attitudes. *Public Understanding of Science,* 13**,** 55-74.
Sweett 2013. Research on the costs and performance of heating and cooling technologies. Department of Energy and Climate Change.
Taylor, P. G., Wiesenthal, T. & Mourelatou, A. 2005. Energy and environment in the European Union: An indicator-based analysis. *Natural Resources Forum,* 29**,** 360-376.
Tlt 2007. Bankable Models which Enable Local Community Wind Farm Ownership – A report for the Renewable Energy Advisory Board & DTI.
Toke, D., Breukers, S. & Wolsink, M. 2008. Wind power deployment outcomes: How can we account for the differences? *Renewable and Sustainable Energy Reviews,* 12**,** 1129-1147 %@ 1364-0321.
Treasury, H. 2010. Spending Review 2010.
Ukerc 2009. Making the Transition to a Secure and LowCarbon Energy System: Synthesis Report. London: UK Energy Research Centre.
Unfccc 1992. The United Nations Framework Convention on Climate Change.
Unruh, G. C. 2000. Understanding carbon lock-in. *Energy Policy,* 28**,** 817-830.
Unruh, G. C. 2002. Escaping carbon lock-in. *Energy Policy,* 30**,** 317-325.
Utility Week 2015. New entrants energy market share climbs to 12.6 percent.
Van Der Horst, D. 2008. Social enterprise and renewable energy: emerging initiatives and communities of practice. *Social Enterprise Journal,* 4**,** 171-185.
Vera, I. & Langlois, L. 2007. Energy indicators for sustainable development. *Energy,* 32**,** 875-882.
Verbong, G. & Geels, F. 2007. The ongoing energy transition: Lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960-2004). *Energy Policy,* 35**,** 1025-1037.
Vestergaard, J., Brandstrup, L. & Goddard, R. D. A brief history of the wind turbine industries in Denmark and the United States. 2004. 322-327.
Vos, J. B., Feenstra, J. F., De Boer, J. & Van Baalen, J. 1985. Indicators for the state of the environment. Free University, Amsterdam: Institute for Environmental Studies.
Walker, G. 2008a. Decentralised systems and fuel poverty: Are there any links or risks? *Energy Policy,* 36**,** 4514-4517.
Walker, G. 2008b. What are the barriers and incentives for community-owned means of energy production and use? *Energy Policy,* 36**,** 4401-4405.
Walker, G. & Devine-Wright, P. 2008. Community renewable energy: What should it mean? *Energy Policy,* 36**,** 497-500.
Walker, G., Devine-Wright, P., Hunter, S., High, H. & Evans, B. 2010. Trust and community: Exploring the meanings, contexts and dynamics of community renewable energy. *Energy Policy,* 38**,** 2655-2663.
Walker, G., Hunter, S., Devine-Wright, P., Evans, B. & Fay, H. 2007. Harnessing Community Energies: Explaining and Evaluating

Community-Based Localism in Renewable Energy Policy in the UK. *Global Environmental Politics,* 7**,** 64-82.
Warren, C. R. & Mcfadyen, M. 2010. Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland. *Land Use Policy,* 27**,** 204-213.
Watson, J. 2004. Co-provision in sustainable energy systems: the case of micro-generation. *Energy Policy,* 32**,** 1981-1990.
Watson, J. 2008. Setting priorities in energy innovation policy: Lessons for the UK. Discussion Paper 2008-08. *Energy Technology Innovation Policy (ETIP) Discussion Paper Series.* Cambridge, Mass.: Belfer Center for Science and International Affairs.
White, H. 2009. *The content of the form: Narrative discourse and historical representation*, JHU Press.
Wicks, M. 2009. Energy Security: A national challenge in a changing world.
Wilson, C., Chryssochoidis, G. & Pettifor, H. 2013. Understanding homeowners' renovation decisions: Findings of the VERD Project. London: UKERC.
Wiser, R. & Bolinger, M. 2011. Wind technologies market report. Department of Energy Energy Information Administration.
Woodman, B. & Baker, P. 2008. Regulatory frameworks for decentralised energy. *Energy Policy,* 36**,** 4527-4531.
Woodman, B. & Mitchell, C. 2011. Learning from experience? The development of the Renewables Obligation in England and Wales 2002–2010. *Energy Policy,* 39**,** 3914-3921.
Woolcock, M. 1998. Social capital and economic development: Toward a theoretical synthesis and policy framework. *Theory and society,* 27**,** 151-208.
Wren 2011. A Community Powered Town: WREN Business Plan. Wadebridge Renewable Energy Network.
Wren 2012. Wadebridge Renewable Energy Network Business Plan. Wadebridge Renewable Energy Network.
Wren 2013, pers comm. WREN-assisted PV installations.
Wüstenhagen, R., Wolsink, M. & Bürer, M. J. 2007. Social acceptance of renewable energy innovation: An introduction to the concept. *Energy Policy,* 35**,** 2683-2691.
Wwf 2006. The Balance of Power: Reducing CO2 Emissions from the UK Power Sector. London: ILEX Energy Consulting.
Yao, R. & Steemers, K. 2005. A method of formulating energy load profile for domestic buildings in the UK. *Energy and Buildings,* 37**,** 663-671.
Yin, R. K. 1994. *Case study research: Design and Methods,* Thousand Oaks, CA, Sage Publications.
Yohanis, Y. G., Mondol, J. D., Wright, A. & Norton, B. 2008. Real-life energy use in the UK: How occupancy and dwelling characteristics affect domestic electricity use. *Energy and Buildings,* 40**,** 1053-1059.

12 Appendices

Appendix 1 Wadebridge Home Energy Survey

You may be aware of the work the Wadebridge Renewable Energy Network (WREN) is doing to tackle the challenges of rising energy costs and help attract low carbon development to the area.

WREN is a not-for-profit cooperative, Membership costs £1, and runs on a one-member-one-vote basis. WREN's goal is to generate 30% of Wadebridge's electricity from renewable sources by 2015, and 100% by 2020, in a way that maximises local benefits through community ownership and local energy supply arrangements, and generates income to be re-invested in the community. WREN also aims to help reduce heating bills by making local homes more energy efficient. Together, it is hoped that these efforts will bring local economic benefits, such as employment, to Wadebridge.

This survey is being carried out by PFA Research Ltd on behalf of the University of Exeter and WREN to help us learn what householders in your local area think about energy issues, and to understand how the area uses energy and how this might change in the future. We are looking for your opinions, and there are no right or wrong answers.

Please rest assured that your confidentiality is maintained to the highest possible standards. This survey is undertaken following the Data Protection Act (1998) and the Market Research Society Code of Conduct. In short, your personal details and any other information you provide will not be sold or passed on to any third party and, following the survey, we will only make contact with you on your request.

Completed questionnaires can either be posted using the enclosed freepost envelope, or handed into the WREN Energy Shop on the Platt in Wadebridge. Alternatively, you could fill out the questionnaire online at

http://www.pfa-research.com/e-surveys/wren/wren1.htm. If you have any questions, please call into the Energy Shop or contact Iain Soutar, Peter Lanyon Building, Tremough Campus, University of Exeter, TR10 9EZ, or by email at i.soutar@exeter.ac.uk.

Many thanks for taking the time to give us your views.

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WADEBRIDGE RENEWABLE ENERGY NETWORK

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Your Home

Q1 How many people live at this property? Adults [ ]

Children (Under 16 years of age) [ ]

Q2 Is your home...

Owned q Rented q

Q3 Approximately how old is the property? [ ] Years

Q4 Is your property…?

Detached q Bungalow q Flat q

Semi-Detached q Terraced q Other: [ ]

Q5 Do you work from home?

No, this is purely a residential property q

Yes, work from home sometimes q

Yes, work from home all the time q

Yes, the home is the business (i.e. B&B) q

Q6 How many people in your household are members of WREN? [ ]

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«ID_Marker»

Energy in your home

Q7 How do you heat your home? (Please tick all that apply for each column)

	Water heating	Room heating
Mains gas	q	q
Electricity	q	q
LPG tank	q	q
LPG bottle	q	q
Wood	q	q
Oil	q	q
Coal or smokeless fuel	q	q
Other - Please specify	q	q

Q8 If other for water heating, please specify:

Q9 If other for room heating, please specify:

Q10 Approximately how much energy does your household use per month OR quarter?

	Monthly	Quarterly	Not applicable	Don't know
Electricity - Usage in **kWh units**				
OR... Electricity - Cost in **£**				
Gas or LPG - Usage in **kWh units**				
OR... Gas or LPG - Cost in **£**				
Oil - **Litres**				
OR... Oil - Cost in **£**				
Wood or solid fuels - Cost in **£**				

Q11 Since moving into your current property, which of the following have you carried out?

(Please tick all that apply)

Installed double glazing	q	Installed a more efficient boiler	q
Installed loft insulation	q	Carried out cavity wall insulation	q
Installed solar PV	q	Installed ground/Air source heat pump	q
Installed a woodburner	q		

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Wadebridge Renewable Energy Network

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Q12 What were you three main reasons for making the changes in Q11?

Q13 Did you access any funding for you energy related home improvements?

Yes q No q

Q14 Is your electricity or gas supplied by any of the following suppliers?

British Gas	q	EDF	q
Eon	q	Npower	q
Scottish Power	q	Scottish and Southern (SSE)	q
Good Energy	q	Ecotricity	q
GreenEnergy	q	None of these	q

Q15 Would you be interested in any of the following?

(Please tick all that apply)

Investing in local renewable energy generation	q
Hosting 'free' PC and biomass heating from the WREN Energy Company	q
Receiving subsidised home insulation	q
Receiving advice on renewable technologies	q
Finding out about car-sharing in Wadebridge	q
Local energy supply arrangements	q
Monitoring your own home energy use	q
Receiving advice on reducing your energy use	q

Q16 Would you like WREN to contact you regarding any of the points in Q15?

Yes q No q

Energy in Britain

Q17 To what extent do you agree or disagree with the following statements relating to electricity production and consumption in Britain?

	Strongly Agree	Agree	Disagree	Strongly disagree	No opinion
It is important that Britain invests more in renewable energy	q	q	q	q	q
We need to reduce the amount of energy we use in this country	q	q	q	q	q

It is best that Local Government decides how our energy is produced	q	q	q	q
It is best that National Government decides how our energy is produced	q	q	q	q

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Energy in your Community

Q18 To what extent do you agree with the following statements relating to electricity production and consumption in Wadebridge?

	Strongly agree	Agree	Disagree	Strongly disagree	No opinion
It is important that the energy I use is produced locally in the community	q	q	q	q	q
Decisions regarding local energy issues should be left to the local community	q	q	q	q	q
I would personally like to be more involved in deciding how our local energy is produced	q	q	q	q	q
It is better that renewable energy technologies (e.g. wind turbines, solar farms etc.) are owned by the community rather than by an individual or a private company	q	q	q	q	q
I would rather renewable energy technologies were not situated in or around Wadebridge	q	q	q	q	q
I am confused by the variety of options for energy in Wadebridge	q	q	q	q	q

Q19 How supportive would you be of the following sources for producing Wadebridge's electricity?

	Very supportive	Fairly supportive	Not very supportive	Not at all supportive	No opinion
Coal/gas power stations in Cornwall	q	q	q	q	q
Nuclear power stations in Cornwall	q	q	q	q	q
Wind farms in the Wadebridge area	q	q	q	q	q
Individual wind turbines in the Wadebridge area	q	q	q	q	q
Solar PV panels on local buildings	q	q	q	q	q
Solar 'farms' in the Wadebridge area	q	q	q	q	q
Nuclear power stations, but not in Cornwall	q	q	q	q	q

Thank You

Q20 Our research is continuing, would you be interested in discussing any of the issues raised in this survey further?

Yes q No q

Q21 Please leave your contact details here if you said 'Yes' to question 16 and/or question 20:

Title:	
First name:	
Surname:	

Address 1:	
Address 2:	
Town:	
Postcode:	

Email:	

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Q22 Are there any additional comments you would like to make?

Thank you very much for completing the survey. Please return the questionnaire to PFA Research Ltd using the included freepost envelope or hand it into the WREN Energy Shop on the Platt in Wadebridge by

17 July 2013

Should you be unable to locate the freepost envelope please address the return to

Freepost RSXH-GRAB-JRJR

PFA Research Ltd

Tremough Innovation Centre

Tremough Campus

Penryn, Cornwall, TR10 9TA

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